AER/AGS Special Report 118

Alberta Energy Regulator

# In Situ Stresses Adjacent to Salt Formations of the Elk Point Group, Eastern Alberta and Western Saskatchewan

AGS ALBERTA GEOLOGICAL SURVEY

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Advanced Geotechnology Inc.[1]

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## Foreword

This Special Report is the public release of a consultant report by Advanced Geotechnology Inc. submitted to the Alberta Geological Survey in 2001. The report describes a three-phase investigation of in situ stresses in and adjacent to salt formations of the Devonian Elk Point Group in eastern Alberta and western Saskatchewan carried out in 2000 and 2001, with a focus on salt cavern design considerations for the potential storage of greenhouse gases.

The report contains a comprehensive literature review of salt rock mechanics, with a particular focus on storage caverns, provides an analysis of relevant data in the study area to determine the orientation and magnitudes of in situ stresses in and adjacent to the Lotsberg, Cold Lake, and Prairie Evaporite formations, and includes recommendations for further studies to quantify in situ stress and rock mechanical properties in salt formations, which could potentially host greenhouse gas storage caverns.

ADVANCED GEOTECHNOLOGY

# IN-SITU STRESSES ADJACENT TO SALT FORMATIONS OF THE ELK POINT GROUP

## ALBERTA GEOLOGICAL SURVEY

## ALBERTA ENERGY AND UTILITIES BOARD

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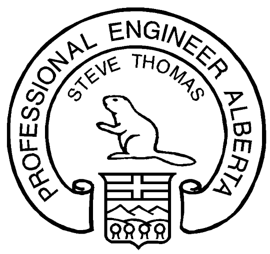



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The Association of Professional Engineers,
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(Original Version of the Report Signed, August 2001



ADVANCED GEOTECHNOLOGY

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**EXECUTIVE SUMMARY**

This report describes a three-phase investigation of in-situ stresses in and adjacent to salt formations of the Elk Point Group in eastern Alberta and western Saskatchewan. In-situ stresses will be required to design underground caverns in salt strata for the potential storage of greenhouse gases.

Phase 1 was conducted for an original study area in the Fort McMurray – Lloydminster corridor in Alberta. Published literature and public domain data on in-situ stresses in and adjacent to salt formations of the Elk Point Group were identified, reviewed, and analyzed. The assumption of isotropic stresses in the salt formations may be adequate for future preliminary cavern design studies, but the possibility of anisotropic stresses in these salts cannot be ruled out. Relevant rock mechanical properties were identified for similar salts from other basins, but no such data for the Elk Point Group salts were located. A comprehensive literature review of salt rock mechanics, particularly as applied to storage caverns was also conducted in Phase 1 and is included as part of this report

Phases 2 and 3 identified and analyzed stress magnitude and orientation data within a wider study area including the part of Alberta and a limited part of western Saskatchewan underlain by the Prairie Evaporite Formation. Bulk density logs were used to produce vertical stress and vertical stress gradient contour maps of the entire study area. Analysis of stress-induced borehole breakouts recorded on dipmeter logs determined that the average minimum horizontal stress in the Paleozoic-age formations above the Basal Red Beds, including strata in the Elk Point and Beaverhill Lake Groups, was 129° with a 95% confidence interval of 13°.

There were no horizontal in-situ stress magnitude data identified in the public domain for strata of the Elk Point Group over the expanded study area. It may be possible to invert in-situ stress magnitude data by back-analyzing borehole breakouts. An example of this stress prediction technique is provided, demonstrating the existence of horizontal stress anisotropy in the Elk Point Group for one well.

Recommendations are given for further studies to quantify in-situ stress and rock mechanical properties in salt formations which could potentially host greenhouse gas storage caverns.

## SUMMARY

### Literature Review on Salt Geomechanics

1. The geomechanical behaviour of salt is dominated by creep deformation, which is affected by stress and temperature conditions, and the physical properties of salt.
2. Deformation responses around underground openings can vary widely depending upon in-situ conditions and salt properties, therefore creep testing of samples from the location of interest is required to assess the expected response of a particular salt formation.
3. Elastic mechanical deformation properties of salt are relatively consistent for salts of similar composition, but strength properties can vary considerably. These elastic deformation and strength properties are required along with creep parameters for the design of stable caverns in salt.
4. No published data on the relevant mechanical properties of the Elk Point Group salts were identified in the literature review conducted for this study.
5. The in-situ stress state in salt formations is generally assumed to be isotropic in its virgin condition prior to the introduction of an underground opening.
6. Stress measurements in salt formations are difficult to perform, but, in some parts of the world, in-situ tests have shown that anisotropic stress conditions can exist.
7. Proprietary site-specific engineering reports for oilfield waste disposal or hydrocarbon storage caverns in salt may provide a source of measured or calculated in-situ stresses within the study area. Salt cavern development in Alberta is concentrated in the Fort Saskatchewan area within the Lotsberg Formation.
8. No publicly-available data from which to confidently estimate the magnitude of the minimum horizontal stress were identified. The assumption of isotropic stresses in the salt formations is considered a reasonable first approximation in the absence of hard data from hydraulic fracture tests or similar in-situ tests.

**In-Situ Stress Data**

1. In the original Phase 1 study area, 65 wells were used to determine the vertical stress at the top of the Prairie Evaporite Formation and 49 wells were used to determine the vertical stress at the top of the Basal Red Beds Formation. In the expanded study area, an additional 112 wells were used to determine the vertical stress at the top of the Prairie Evaporite Formation (90 from the expanded Alberta study area and 22 from the expanded Saskatchewan study area).
2. In total, there were 24 minimum horizontal stress orientations available in the entire study area for Paleozoic-age formations (8 from the Geological Atlas of the Western Canadian Sedimentary Basin and 16 from breakout analyses described in this report). This includes minimum horizontal stress orientations determined in: 9 wells in formations above the Beaverhill Lake Group, 10 wells within the Beaverhill Lake Group, and 9 wells within the Elk Point Group.
3. Numerous cores have been taken in and adjacent to the salt formations of the Elk Point Group in the study area. Stress relief petal or disking fractures may be present in stiff carbonate and evaporite rocks in these cores, and could be oriented with paleomagnetics to provide additional estimates of horizontal stress orientations.
4. Colour contour maps were prepared for displaying vertical stress magnitudes and gradients at the top of the Basal Red Beds Formation in the original study area. The vertical stress ranges from 13.5 to 39.1 MPa at the top of the Basal Red Beds in the original study area. The vertical stress gradient at the top of the Basal Red Beds in the original study area ranges from 21.3 to 23.6 kPa/m. A region in the central part of the original study area possesses vertical stress gradients less than 22 kPa/m. This anomaly is associated with thicker occurrences of the relatively low-density Lotsberg and Cold Lake salt formations.
5. Contour plots show that the vertical stress at the top of the Prairie Evaporite Formation ranges from 7.4 to 31.7 MPa in the original study area and from 10.2 to 54.0 MPa in the expanded area. The vertical stress gradient at the top of the Prairie Evaporite Formation ranges from 21.3 to 23.9 kPa/m in the original study area, decreasing towards the eastern boundary of the Prairie Evaporite Formation. The vertical stress gradient at the top of the Prairie Evaporite Formation in the expanded

study area ranges from 21.5 to 24.7 kPa/m, with the lower vertical stress gradients being in the northeast and the higher vertical stress gradients being in the southwest. This trend is likely a result of northeastward-thickening Quaternary or Cretaceous deposits of relatively low density and the increase in density of formations above the Prairie Evaporite towards the southwest. Despite sparse data coverage in some parts of the study area such as Wood Buffalo National Park, the contour plots for the vertical stress and the vertical stress gradient are considered representative of in-situ conditions.

6. The dataset of 8 wells from the Geological Atlas of the Western Canadian Sedimentary Basin has an average minimum horizontal stress orientation of 137° with a 95% confidence interval of 16°, and a range from 118° to 148°. The average minimum horizontal stress orientation determined from the 16 wells analyzed in this report (weighted by breakout length) is 120°, with a 95% confidence interval of 16°, and a range from 101° to 152°, similar to the atlas measurements in the Paleozoic-age formations. It is important to note that the dataset from the atlas was from Paleozoic-age formations above the Beaverhill Lake Group whereas 15 of the 16 wells analyzed in this report had breakouts from the Beaverhill Lake Group and/or Elk Point Groups. The average minimum horizontal stress orientation (not weighted by breakout length) for all 24 wells is 129°, with a 95% confidence interval of 13°.

7. The occurrence of breakouts adjacent to salt formations of the Elk Point Group indicates that the horizontal stresses are likely slightly anisotropic in the salt strata. An example of inverse modelling based on a borehole breakout analysis in the Elk Point Group demonstrated that it is possible to estimate the ratio of maximum to minimum horizontal stress. A horizontal stress ratio of 1.24 to 1.37 was calculated using AGI's STABView borehole stability software and rock strengths estimated from log data.

## CONCLUSIONS

1. No published data on minimum horizontal stress magnitudes or rock mechanical properties of the Elk Point Group salts were identified in the literature review conducted for this study.
2. Vertical stress magnitudes ranged from 13.5 to 39.1 MPa at the top of the Basal Red Beds in the original study area. Vertical stress gradients ranged from 21.3 to 23.6 kPa/m in this same area.
3. The vertical stress magnitude ranged from 7.4 to 54.0 MPa at the top of the Prairie Evaporite Formation in the entire study area. Vertical stress gradients ranged from 21.3 to 24.7 kPa/m in this area, increasing from the northeast to the southwest.
4. There was no significant difference between the vertical stress gradient at the top of the Prairie Evaporite Formation and the top of the Basal Reds Beds in the original study area. Therefore, it is reasonable to assume that the vertical stress at the bottom of the Lotsberg Formation within the expanded study area can be estimated using the vertical stress gradient determined at the top of the Prairie Evaporite Formation.
5. The average minimum horizontal stress orientation for all 24 wells examined in the entire study area is 129° with a 95% confidence interval of 13°.
6. A slight rotation of the minimum horizontal stress to a more NNW - SSE orientation in the upper Paleozoic-age strata could be seen in the dataset. The average minimum horizontal stress orientation was 116° in the Elk Point Group, 124° in the Beaverhill Lake Group, and 139° above the Beaverhill Lake Group.

## RECOMMENDATIONS

1. Rock creep, deformability and permeability properties should be determined from laboratory tests on good quality salt core. These properties are required to assess the expected response of the salt surrounding potential underground storage caverns. (High priority)
2. Micro-frac tests should also be conducted as part of any salt cavern development program to determine site-specific values of the maximum and minimum horizontal stress magnitudes. Although expensive, micro-frac tests are the only reliable means to determine whether the in-situ stresses are anisotropic. (Medium priority)
3. There are cores available from the original and expanded study areas that could provide additional information on horizontal stress orientations and magnitudes. Examination of a select group of cores would indicate whether or not stress relief fractures occur in strata adjacent to, or perhaps within, salt formations of the Elk Point Group. These stress relief fractures would provide a complementary method of determining horizontal stress orientations and help verify the hypothesis that horizontal stresses are anisotropic. (Medium-low priority)
4. Hydraulic fracturing data, which can be used to estimate the minimum horizontal stress magnitude, could be obtained or perhaps purchased from operators and/or service companies. Considerable effort would be required to collect, review and analyze such data because of the low data quality expected. Furthermore, it is not expected that any data will be available for the salt formations of primary interest. (Low priority)

# 1. INTRODUCTION

## 1.1 Background

The Alberta Geological Survey (AGS) is involved in studies related to carbon dioxide ($CO_2$) sequestration in Alberta. The options being considered for $CO_2$ disposal are:

- injection into coal beds,
- injection into depleted reservoirs,
- injection into saline aquifers, and
- injection into salt caverns.

There are several major $CO_2$ producers in the Ft. McMurray-Lloydminster area in northeastern Alberta. In this area, the Western Canada Sedimentary Basin thins, and there are very few coal beds, saline aquifers or depleted aquifers suitable for $CO_2$ sequestration. Therefore, salt[1] beds are considered a potentially viable target for disposal in this area.

Within the Western Canadian Sedimentary Basin, there are several salt-bearing units within the Elk Point Group. To assess the viability of disposal of $CO_2$ into caverns in one or more of these salt units, an understanding of the magnitudes and orientations of the in-situ stresses is required.

A multi-phase investigation has been undertaken to examine in-situ stresses in and adjacent to salt formations. Three study areas were identified by AGS for investigation: Phase 1 – the original study area bounded by latitude 53 - 58° N and longitude 110 - 112° W, which includes Ft. McMurray and Lloydminster, Phase 2 - an expanded Alberta study area covering the areal extent of the Prairie Evaporite Formation within Alberta, and Phase 3 - an expanded Saskatchewan study area bounded by latitude 49.5 - 56° N and longitude 109 - 110° W (Figure 1.1). Phase 1 of the study also included a literature review on rock salt behaviour and in-situ stress measurements in salt, and a review of data availability within the original study area. Phase 2 involved detailed analyses and interpretation of the data in the original study area and the preparation of a report for the

[1] Note on Nomenclature: For the purpose of this report "salt" or "salt formation" refers to halite salt, not other evaporite salts such as sylvite or carnallite.

original study area. In addition, data availability in the expanded Alberta study area was assessed. Phase 3 involved compiling additional data for a portion of western Saskatchewan. In this final phase the data in both the expanded Alberta and Saskatchewan study areas were analyzed and combined with the data from the original Phase 1 study area. This final report covers the study Phases 1 to 3.

### 1.2 Objectives

The main objectives of the investigation were to:

1. Review literature pertaining to the geomechanical response of salt to applied differential stress, salt mechanical properties and their variability within the Elk Point Group in the Western Canada Sedimentary Basin, in-situ stress measurements in and adjacent to salt and other evaporite formations (particularly as applied in Western Canada), and other regional in-situ stress studies for bedded salt and other evaporite rocks.
2. Identify well data and other publicly-available information relevant to the study area such as regional stress data, 4-arm dipmeter logs suitable for borehole breakout analysis and bulk density logs. Also, cored intervals and formation pressure measurements were reviewed in the original study area.
3. Analyze relevant data in the study area to determine the orientation and magnitudes of in-situ stresses in and adjacent to the salt formations of interest.

### 1.3 Scope of this Final Report

This report incorporates the findings from:

1. An interim report on Phase 1 which was delivered to the AGS in December, 2000,
2. A report on Phase 2 delivered to AGS in March, 2001, and
3. The data analysis and interpretation from Phase 3, ending August, 2001.

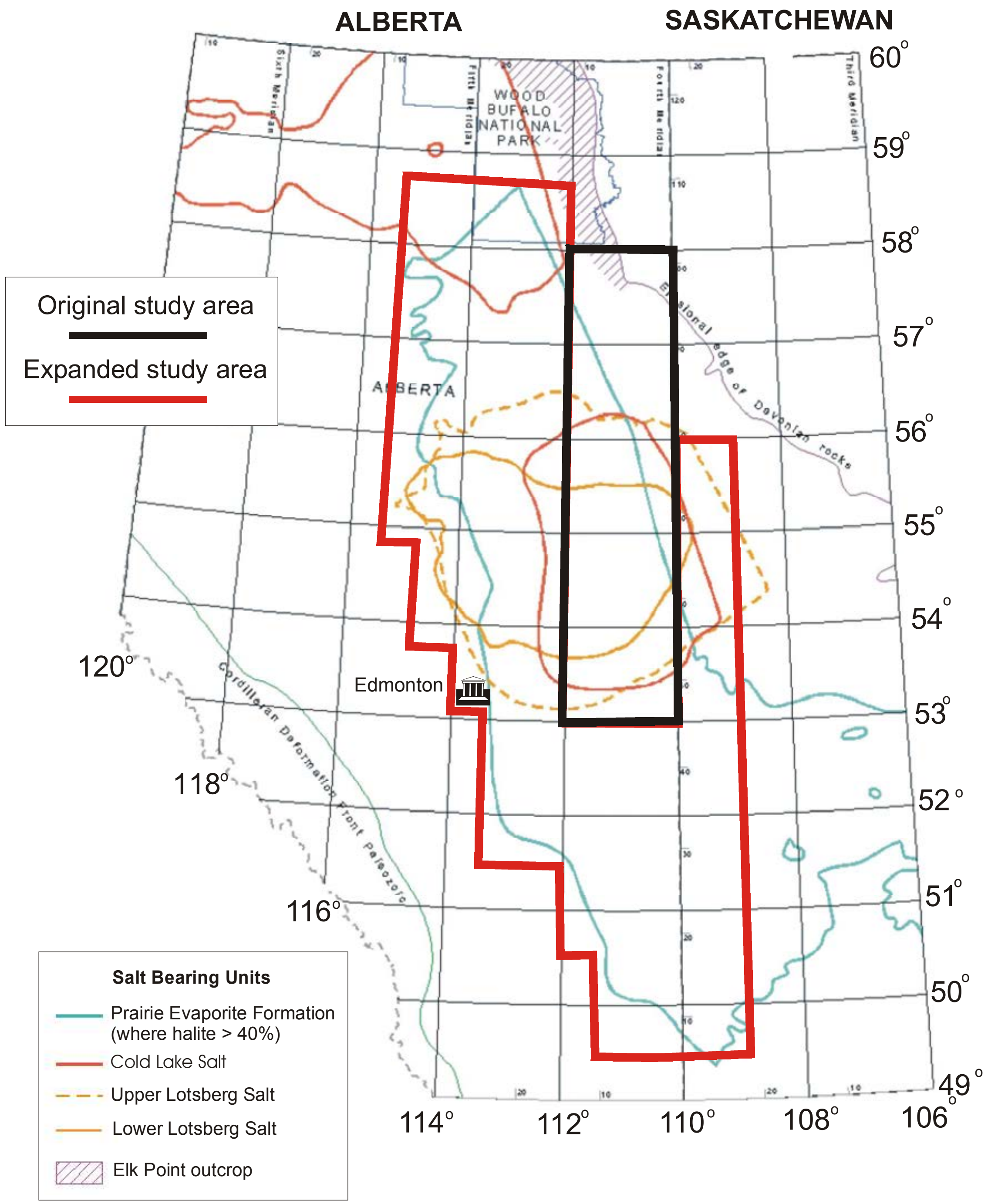


**Figure 1.1: Map showing location of the original study area bounded by 53° to 58° latitude N and 110° to 112° longitude W outlined in black. The expanded study area is outlined in red including the Saskatchewan study area bounded by 49.5° to 56° latitude N and 109° to 110° longitude W. The areal extent of the salt bearing units as provided by the Alberta Geological Survey are also shown on the map.**

## 1.4 Authorization and Chronology

Background information and a request for a proposal were received from Dr. Stefan Bachu of the AGS at a meeting with Advanced Geotechnology Inc. (AGI) on June 22, 2000. Preliminary maps showing the areal extent, depths and thicknesses of the various salt-bearing units in the study area were provided to AGI at that meeting. AGI proposal 20-175, dated August 1, 2000, was accepted by AGS, and a contract to conduct Phase 1 of the proposal was signed on August 3, 2000. Dr. Matt Grobe of the AGS acted as a resource to the project to access well information available from the AEUB. A draft version of an interim report for Phase 1 of the study was reviewed at a meeting between AGS and AGI in Calgary on December 1, 2000. A copy of the interim report for Phase 1 was sent to AGS on December 7, 2000 and further revisions were discussed at a meeting between AGI and AGS on December 20, 2000. Two copies of the revised interim report for Phase 1 were sent to AGS on January 5, 2001.

A proposal to conduct Phase 2 of the study was submitted to AGS on December 18, 2000. The proposal was discussed with Dr. Stephan Bachu at a meeting on December 20, 2000. A contract covering Phase 2 of the study was signed at that meeting. A draft report on Phases 1 and 2 of the study was discussed at a meeting with Dr. Stephan Bachu on February 14, 2001. The final report for Phases 1 and 2 was submitted to AGS on March 7, 2001.

A proposal to conduct Phase 3 of the study was submitted to AGS on March 28, 2001. The proposal was accepted and a contract was signed on April 10, 2001. On May 10, 2001, at the request of Dr. Bachu the Phase 3 study area was further expanded into western Saskatchewan and a contract amendment was agreed to by AGI on June 8, 2001. A draft version of the final report for Phases 1, 2, and 3 was reviewed with Dr. Bachu on August 30, 2001. Two copies of the final report and data were delivered to the AGS in September, 2001.

## 1.5 Sources of Information

The sources of information on in-situ stresses that were evaluated for this study included the following:

- AEUB well database and library,

- University of Calgary library,
- AGI library, rock mechanics journals and published paper collection
- personal contact with University and industry representatives including:
  - Prof. Doug Milne (University of Saskatchewan),
  - Prof. Emery Lajtai (University of Manitoba),
  - Prof. Brian Stimpson (University of Manitoba),
  - Prof. Robert Corthesy (Ecole Polytechnique),
  - Dr. Neil Chandler (AECL),
  - Dr. Frank Hansen (Sandia National Laboratories),
  - Dr. Alan Coode (IMC Colonsay),
  - Dr. Douglas Bingham (Alberta Environment),
  - Dr. J.C. Roegiers (University of Oklahoma),
  - Mr. Edward Dancsok (Saskatchewan Energy and Mines), and
  - Mr. Myron Sereda (Saskatchewan Energy and Mines).

Relevant well data were reviewed by AGI staff using the publicly available Alberta and Saskatwchewan well data purchased from CDPubco and viewed in AGI's GEOVISTA software. Maps of the study area showing the various salt formations of the Elk Point Group were provided to AGI by AGS as hardcopies, and in digital form in CANVAS format. AGI acquired the CANVAS software to view and manipulate these maps for Phases 2 and 3 of the study.

## 2. SALT FORMATIONS OF THE ELK POINT GROUP

The Elk Point Group in the Western Canada Sedimentary Basin includes the following three evaporite formations:

- Prairie Evaporite Formation,
- Cold Lake Formation, and
- Lotsberg Formation (Upper and Lower).

These Middle Devonian formations are shown in the stratigraphic table of formations Figure 2.1. The Lotsberg is near the base of the Devonian sequence of the Elk Point Group. The Cold Lake Formation is slightly higher in the section, and the Prairie Evaporite lies close to the top of the group. The Elk Point Group is overlain by the Beaverhill Lake Group, also of Middle Devonian age. The type localities and lithologic descriptions which follow are abstracted from the Lexicon of Canadian Stratigraphy (CSPG, 1997).

### 2.1 Prairie Evaporite Formation

**Type Locality**: Imperial Davidson No. 1, in 16-8-27-1W3M, Saskatchewan, between 1326.5 and 1524m (4352 and 5000 ft). Typical development of the Prairie Evaporite occurs in the White Rose et al. Drake 4-29-32-22 well (LSD. 4-29-32-22W2) between 993.3 and 1186.9 m (3259 and 3894 ft).

**Lithology**: Halite, carnallite ($KMgCl_3•6H_2O$) and sylvite (KCl) of various hues and degrees of crystallinity, but predominantly red and moderately coarsely crystalline. Locally blue halite is present. Seams of red or grey dolomitic mudstone and some anhydrite beds are present.

**Thickness and Distribution**: Maximum of 218 m (715 ft), with the thickest part occupying a belt from west of Saskatoon east to Melville and south to North Dakota. Extensive solutioning of salts has given rise to an irregular thickness to the formation and local absence of salt. Areas of major salt solutioning occur in south-central Saskatchewan. The Prairie Evaporite extends from north-central Alberta southeastward into Manitoba, and southward into North Dakota and Montana.

**Relationship to Other Units**: The basal contact is conformable with carbonates or anhydrite of the Winnipegosis Formation. The Prairie Evaporite is correlated with the Muskeg and Presqu'ile Formations in northern Alberta.

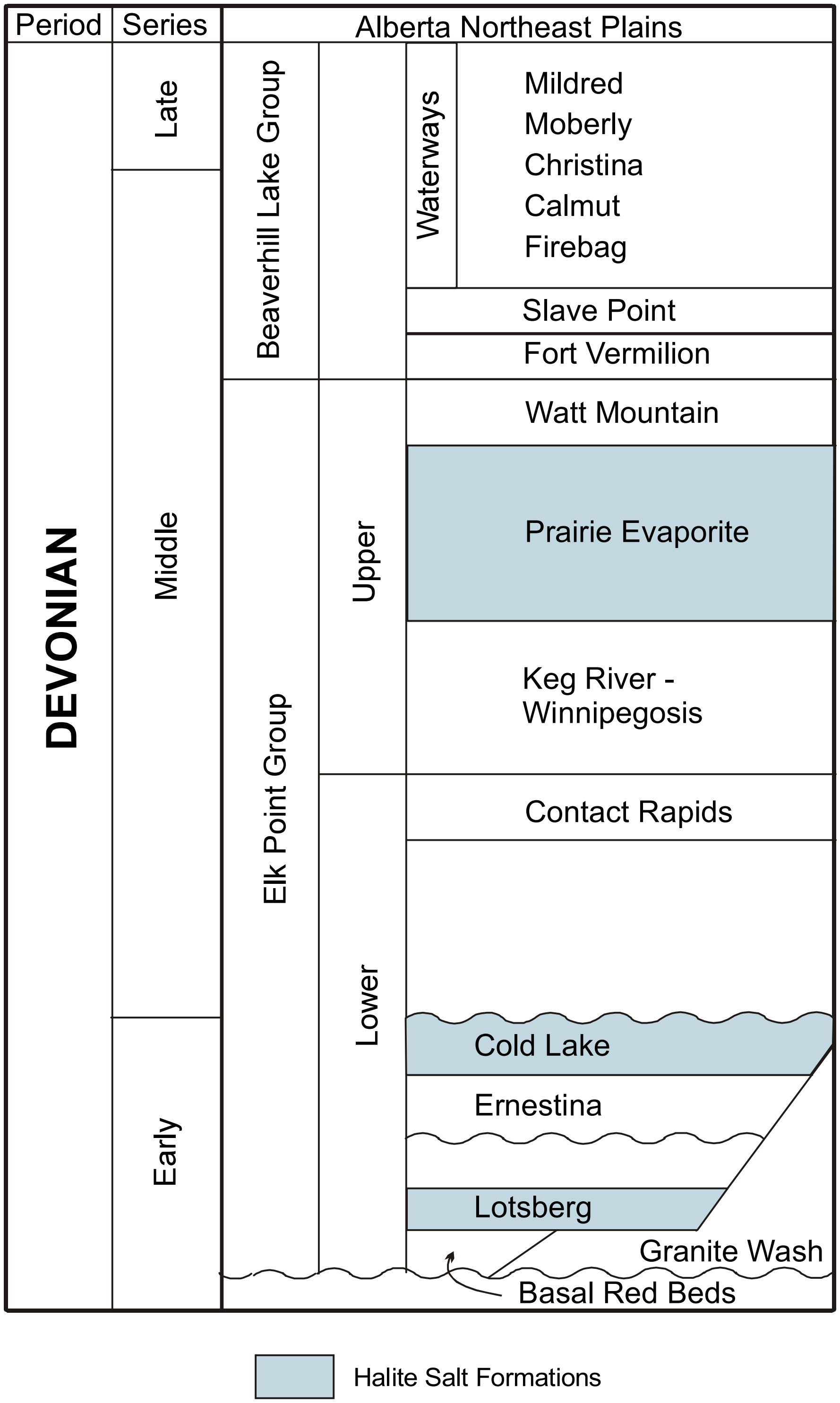


**Figure 2.1: Stratigraphic cross section showing the halite salt formations of the Elk Point Group in the study area.**

The Prairie Evaporite contains three main potash members: Esterhazy (17 m), Belle Plaine (14 m) and Patience Lake (18 m) members (Fuzesy, 1983). The White Bear member is 4 m thick. In Saskatchewan, these members consist primarily of variable proportions of halite, sylvite, and carnallite, and occur within the upper 70 m of the Prairie Evaporite Formation. It is inferred that most of the sylvite and a small proportion of the halite have been altered to carnallite by fluids rich in magnesium.

## 2.2 Cold Lake Formation

**Type Locality**: Canadian Seaboard 10-13-60-4W4M, in Alberta, between 982.1 and 1037.8 m (3222 and 3405 ft). Name derived from White Rose C & E Cold Lake 7-22-66-1W4M, between 811.7 and 863.2 m (2663 and 2832 ft).
**Lithology**: Halite, with thin basal red calcareous to dolomitic shale, 6 m (20 ft) thick in type well.
**Thickness and Distribution**: The Cold Lake Formation extends from the vicinity of the Meadow Lake escarpment (approx. 54°31'N. 105°40'W) through northwestern Saskatchewan and eastern Alberta to the south flank of the Peace River-Athabasca arch. It is present north of the arch, where it extends across northern Alberta into northeastern British Columbia east of the Fort Nelson arch, and into southern District of Mackenzie, east and north of the Tathlina Arch. In the District of Mackenzie it is considered a member of the Mirage Point Formation. It is up to 56 m (184 ft) thick in the eastern Alberta Basin, 79 m (259 ft) in northern Alberta, and 117 m (389 ft) in southern District of Mackenzie.
**Relationship to Other Units**: The Cold Lake Formation overlies the Ernestina Lake Formation and is overlain by the Contact Rapids Formation in western Saskatchewan and eastern Alberta, and by the Chinchaga Formation in northern Alberta, northeastern British Columbia and the southern District of Mackenzie. In general, the unit grades into Basal Red Beds of the Elk Point Group around the margins of the basin and across the Peace River-Athabasca arch. It grades into coarse clastics on the flank of the Peace River and Tathlina arches that are referred to as Elk Point Sands or Granite Wash. In central Alberta it grades westward into red, dolomitic shales overlying the Ernestina Lake Formation which are included in the Contact Rapids Formation.

## 2.3 Lotsberg Formation

**Type Locality**: Canadian Seaboard Ernestina Lake 10-13-60-4W4M, in Alberta, between 1057.7 m (3470 ft) and 1225.8 m (4020 ft).

**Lithology**: The type section is almost pure halite. More commonly thin beds of red and green calcareous shale occur and, in the centre of the basin, a red shale unit ranging from 30 to 60 m (100 to 200 ft) separates the salt sequence into two units.

**Thickness and Distribution**: The Lotsberg Formation ranges up to 229 m (750 ft) thick. It extends from the Meadow Lake Escarpment from approximately 53° to 53°45'N and 109°30' to 112°W northwards through western Saskatchewan and eastern Alberta to approximately 56°15'N.

**Relationship to Other Units**: In western Saskatchewan and eastern Alberta, the Lotsberg Formation rests on red sandstones and dolomites at the base of the Devonian. Where salt is not present, the Lotsberg Formation becomes part of the basal Devonian red bed unit in northern Alberta and southern District of Mackenzie, the Meadow Lake Formation of Saskatchewan and the La Loche Formation of the outcrop area in northeastern Alberta. The unit is overlain by the Ernestina Lake Formation.

# 3. LITERATURE REVIEW

## 3.1 Geomechanical Behaviour of Salt

The geomechanical behaviour of salt is complex. Under applied deviatoric stress conditions, salt deformation is typically dominated by creep (i.e., time-dependent deformation). The creep behaviour of salt under load is known to be affected by the deviatoric stress magnitude (stress difference), temperature, mean stress, degree of fluid saturation, mineralogical composition, and microstructure (including pore and crack porosity, grain size, and stress history). Rapid loading or unloading can also result in semi-brittle behaviour and the development of fractures near an underground opening or free surface (Jeremic 1994).

Following the application of a deviatoric stress to a test sample, the axial strain increases rapidly from the initial elastic strain during a primary or transient stage of creep, and then reaches a slower, longer-term secondary or steady-state stage of creep (Figure 3.1). Steady-state creep can be sustained for a long period of time, particularly under low deviatoric stresses. With continued deformation, the sample reaches a tertiary, accelerated stage of creep, and failure follows. The behaviour of the large mass of salt surrounding an opening in salt such as a tunnel or borehole is generally assumed to be in or near steady-state creep (Dusseault et al., 1987).

The mechanism by which salt creeps is not the same for all stress and temperature conditions (Senseny et al, 1992; Munson, 1997). Results from laboratory creep studies indicate that two deformation mechanisms tend to dominate under the temperature and stress conditions encountered in many underground excavations. These mechanisms are:

- dislocation glide with diffusion- or cross-slip-controlled climb, and
- pressure solution.

The mechanical deformation of salt grains is dominated by dislocation glide at high deviatoric stresses and temperatures. Under low deviatoric stresses, pressure solution is the dominant mechanism. The implication of multiple deformation mechanisms is that creep rates can be dramatically affected by changes in stress and temperature conditions if

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Footnote: See Appendix A: Bibliography for the references cited in this section of the report.

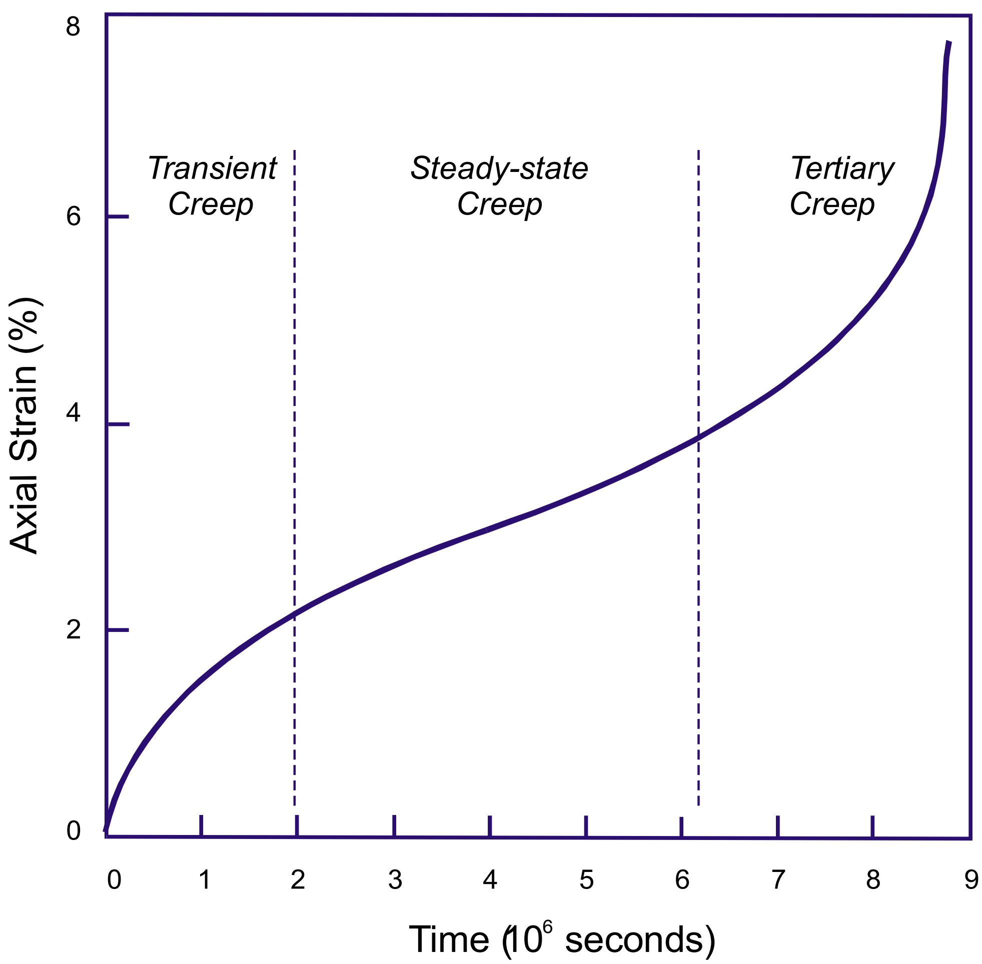



**Figure 3.1: Schematic of strain-time curve showing the various stages of creep in a typical laboratory test on salt (modified after Jeremic, 1994).**

these changes result in a shift from one dominant mechanism to the other (Dusseault 1989). Increased temperature generally increases the creep rate for a given set of conditions, and reduces the tendency for cracking at higher deviatoric stresses and lower confining stress (Wawersik, 1988; Dusseault, 1989; Senseny et al., 1992).

Dusseault et al. (1987) describe the shift in deformation mechanism from dislocation glide to pressure solution by defining the Prandtl limit (K). The Prandtl limit is defined as the shear stress above which crack growth and healing will control the creep of salt. Immediately adjacent to an opening, the salt rock mass will most likely be damaged by elastic-plastic processes if stresses around the hole exceed the salt strength. In-situ permeability and ultrasonic velocity measurements indicate that damage to salt in the form of microcracks is typically restricted to within about one excavation radius from the wall (Stormont and Daemen, 1992; Munson et al., 1995; Stormont, 1997). Within the disturbed zone around an excavation, Dusseault et al. (1987) propose that the deviatoric stress will equilibrate at twice the Prandtl limit. Further from the excavation, the deviatoric stresses are below this limit, and the dominant deformation mechanism shifts to dislocation glide and then to pressure solution with decreasing stress (Figure 3.2). Reeves et al. (1988) report that the Prandtl limit K is 8.8 MPa for New Brunswick potash, and ranges from 6.5 to 9.5 MPa for Saskatchewan potash, depending on the carnallite content.

The focus of much of the published experimental work has been to delineate the conditions under which different mechanisms are acting, and derive general equations which describe the dependence of salt creep rate on the most critical factors. These constitutive equations generally relate the creep rate to the deviatoric stress, temperature, and the activation energy associated with the dominant creep mechanism. For example, several authors (e.g. Dusseault 1989; Weertman 1968) describe secondary creep using a power law of the form:

$$\dot{\varepsilon} = \mathrm{A}\left(\frac{\sigma}{G}\right)^{n} \exp\left[\frac{-Q}{RT}\right] \tag{3.1}$$

where: $\dot{\varepsilon}$ = steady-state creep rate, n = stress exponent, σ = deviatoric stress, Q = activation energy, T = temperature, A = material constant, R = universal gas constant, and G = shear modulus. Wawersik (1988) provides background on creep model alternatives and parameters for rock salt at temperatures below 160°C. He quotes values of effective activation energy between 50 and 90 kJ/mole for the rock salts considered.

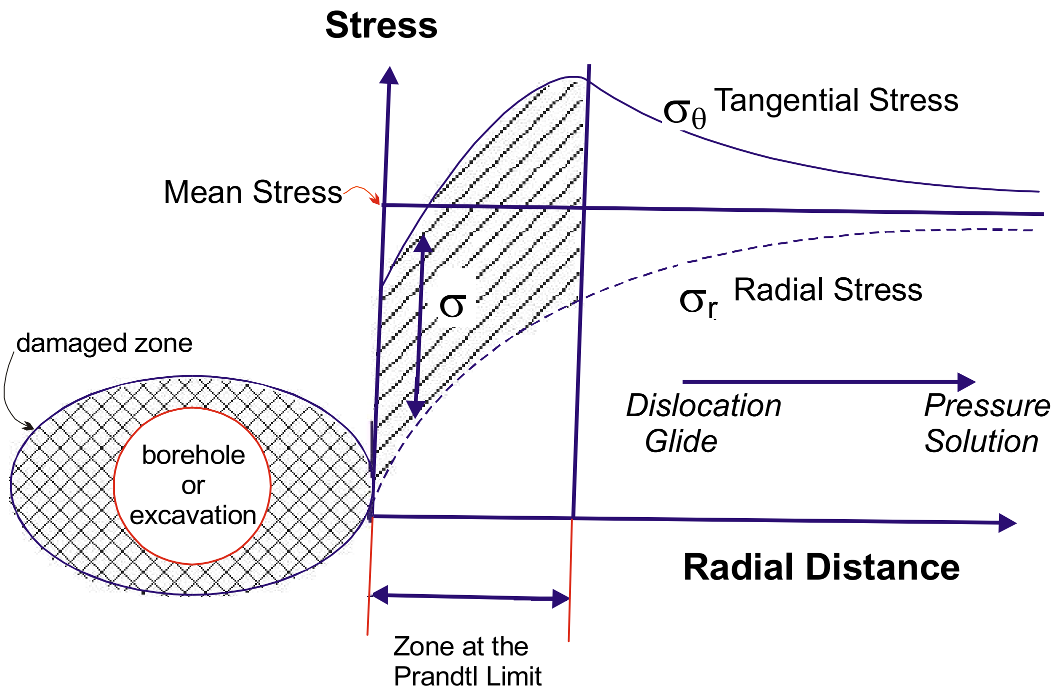



**Figure 3.2: Schematic figure showing the distribution of radial ($\sigma_r$) and tangential ($\sigma_\theta$) stresses with distance away from a borehole or excavation in salt. Inside the damaged zone, the deviatoric stress ($\sigma$) equilibrate at twice the Prandtl limit (2K). With increasing radial distance and decreasing $\sigma$, pressure solution dominates over dislocation glide (after Dusseault, 1989).**

In this form the steady-state creep rate is proportional to the deviatoric stress raised to an exponent n, where n ranges from 3 to 9 assuming dislocation glide dominates (Hansen and Carter, 1981; Vouille et al., 1981; Blum and Fleischman, 1988; DeVries, 1988; Wawersik, 1988; Senseny et al., 1992). Several researchers have found that under relatively low deviatoric stress, creep behaviour is better described by a power-law with a lower stress exponent n, approximately equal to 1. This is interpreted as reflecting a dominance of pressure solution, rather than dislocation glide, as the mechanism of deformation under these conditions (Dusseault and Mraz, 1983; Hambley et al., 1988; Spiers et al., 1988; Dusseault, 1989; Campos de Orellana, 1996).

The parameters in Equation 3.1 are usually determined experimentally, measuring creep rate as a function of temperature and deviatoric stress. Wawersik (1988) found that the effective activation energy used in the power law is typically less than measured values for the dislocation core diffusion of chlorine (Q = 146 kJ/mole). Other more complex equations have also been developed for implementation in numerical modelling simulations of the closure of openings in salt (e.g., DeVries, 1988; Munson, 1997). Wawersik (1988) provides typical parameter values for three creep equations, and compares the fit of each to a data set based on five rock salts.

Mean stress or confining stress ($\sigma_c$) conditions also affect geomechanical behaviour. A high confining stress or mean stress acts to suppress the formation of microcracks (Dusseault et al., 1987), resulting in a lower creep rate when other factors are constant. The effect of confining stress is most significant for $0 < \sigma_3 < 3.4$ MPa, where microcracks would otherwise dramatically increase the creep rate under a given deviatoric stress (Senseny et al., 1992). Internal pressure in cavities in salt is therefore an important controlling factor on creep rate.

The effect of increasing moisture content is to generally increase creep rates (Spiers et al., 1988; Horseman, 1988; Dusseault, 1989; Senseny et al., 1992). The specific cause of this effect is not well understood, however, it is most prominent if the porosity is caused by a pervasive, connected network of microcracks, such as would be found within the disturbed zone adjacent to a borehole or opening. Further from the excavation, fluids are typically found within isolated pores as brine or as films along grain boundaries, which may play a role in creep by pressure solution at lower deviatoric stresses (Spiers et al., 1988). The effect of moisture is less prominent when samples are confined, as this reduces both the crack porosity and permeability.

Creep studies of various salts from the southern USA show that impure bedded salts are slightly more creep resistant than pure salts (Hansen, 1988). His impure samples ranged from 86 to 98% halite with an average grain size on the order of 5 to 10 mm. The pure sample was 99.1% halite. An additional study by Hansen et al. (1988) suggests that the fraction of anhydrite present has a stronger correlation with creep behaviour than the fraction of halite. In general there is significant variation among presumably identical samples which reflects variability in testing conditions and other factors, thus obscuring a clear correlation with mineral composition (Senseny, 1988).

Grain size acts in combination with deviatoric stress and temperature to affect the creep rate of salt. Under relatively low deviatoric stress, creep behaviour by pressure solution is facilitated by a fine grain size, whereas creep resulting from the mechanical deformation of grains by dislocation glide is more prevalent in rocks with a larger grain size (Hambley et al., 1988; Spiers et al., 1988; Dusseault, 1989; Campos de Orellana, 1996). Fuzesy (1983) reports that halite found within the potash beds of the Prairie Evaporite Formation can have salt crystals as large as 5 to 15 mm. A fine grain size (1-2 mm) has been linked with enhanced creep rates in potash under conditions where pressure solution is dominant.

### 3.2 Rock Mechanical Properties of Salts

Rock mechanical properties typically measured in standard laboratory tests for non-creeping rock include Young's modulus, Poisson's ratio, and strength parameters that define peak and residual strength envelopes (e.g., cohesion and friction angle), and post-peak deformation behaviour (e.g., dilation angle). Young's modulus and Poisson's ratio are often cast in terms of a bulk and shear modulus. Given the highly non-linear and time-dependent behaviour of salt, these parameters are of less importance in predicting deformation response around underground openings in relatively deep settings where stresses and temperature conditions are conducive to creep (A. Coode, IMC Colonsay, pers. com.). Nonetheless, these parameters are required as input for numerical models simulating creep behaviour.

Hansen et al. (1988) summarize results from triaxial compression tests conducted on samples from ten different locations in the USA to obtain elastic deformation and strength properties. Their findings showed that elastic moduli do not vary significantly among sites, but the strength parameters do vary considerably, with no apparent correlation to petrographic analysis. Lajtai and Duncan (1988) showed that the compressive strength of potash depends upon the deviatoric stress, the confining stress and loading rate. Reeves and Stead (1991) describe a proprietary database, called SALTDATA, which contains data on the physical properties of rocks commonly associated with the mining of salt and potash in Saskatchewan. The reference tables in this proprietary database contain details of more than one thousand technical documents, from both European and North American sources. Typical rock mechanical properties for salt are given in Tables 3.1 and 3.2. Figure 3.3 shows typical failure criteria for potash and halite from Saskatchewan (Reeves et al., 1988).

**Table 3.1: Typical mechanical properties for salt**

| Parameter | Value or Range |
|---|---|
| Young's modulus, E | 30 GPa |
| Shear modulus, G | 12 GPa |
| Poisson's ratio, $\nu$ | 0.25 |
| Unconfined compressive strength, UCS | 15-18 MPa |
| Prandtl limit | 6.5 – 9.5 MPa |

**Table 3.2: Elastic properties at room temperature for natural rock salts (after Senseny et al., 1992)**

| Site | Young's modulus (GPa) | | Poisson's ratio | |
|---|---|---|---|---|
| | Mean | Range | Mean | Range |
| WIPP | N/A | 29.6-36.5 | N/A | 0.17-0.26 |
| Permian | 26.6 | 19.0-33.4 | 0.33 | 0.04-0.41 |
| Paradox | 31.0 | 25.2-36.3 | 0.36 | 0.09-0.50 |
| Jefferson Island | 29.5 | 25.0-34.4 | 0.29 | 0.17-0.39 |
| Week's Island | 30.5 | 21.5-42.3 | N/A | N/A |
| Cote Blance | 24.1 | N/A | 0.41 | N/A |
| Avery Island | 30.6 | 21.0-38.2 | 0.38 | 0.31-0.47 |
| Richton | 31.5 | 26.7-36.4 | 0.36 | 0.21-0.55 |
| Vacherie | 31.1 | 26.7-37.6 | 0.34 | 0.29-0.39 |

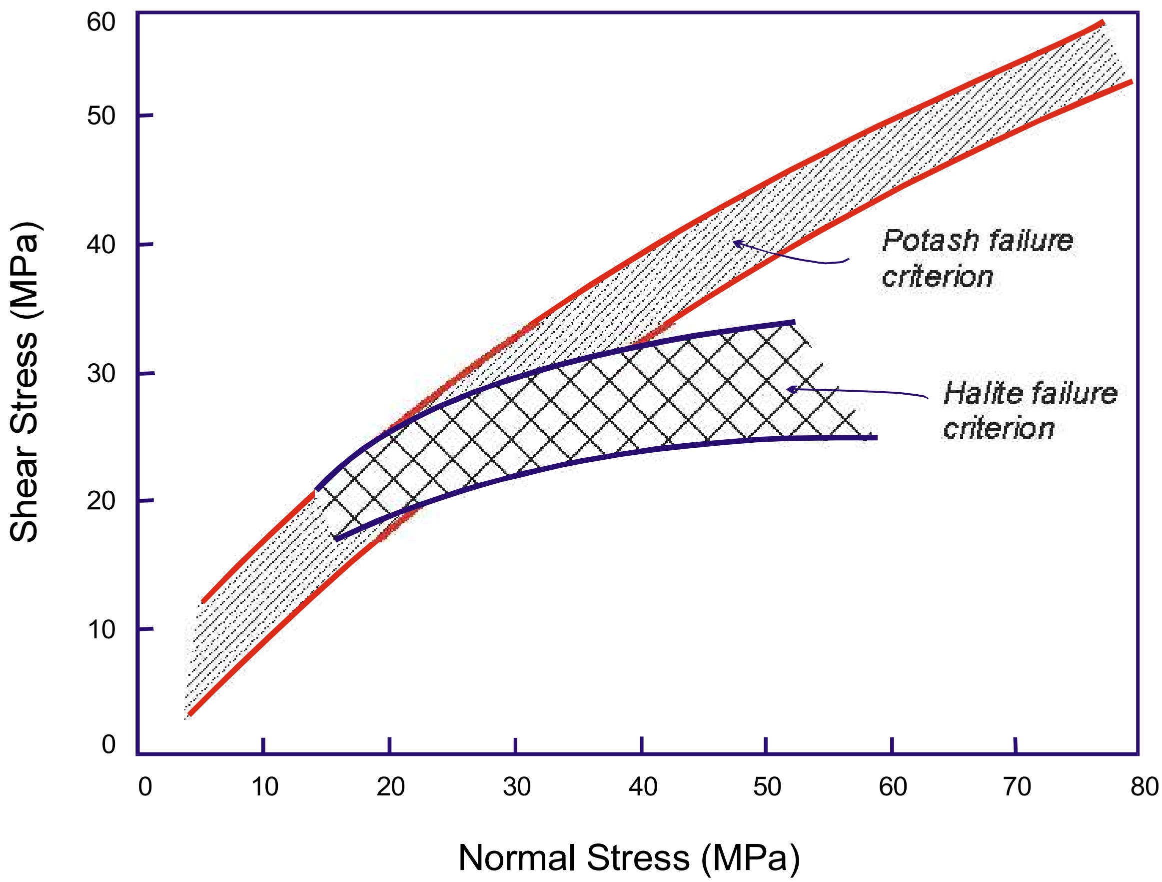



**Figure 3.3: Typical failure criteria for potash and halite. (Source: Reeves et al., 1988).**

Holter (1969) provides an extensive overview of the Prairie Evaporite Formation in Saskatchewan. This report includes depositional history, mineralogy, geochemistry and a summary of wild cat, non-confidential and confidential wells intersecting one or more members of the Prairie Evaporite Formation. Additional information on potash in Saskatchewan is contained in a report by Fuzesy (1982).

There are only a few references in the literature to the mechanical properties of evaporites of the Western Canada Sedimentary Basin. In general, the focus is on the economically significant potash deposits in Saskatchewan. Lajtai and Duncan (1988) report results of uniaxial tests on Rocanville potash. Uniaxial strengths ranged from 15 to 18 MPa. King and Acar (1970) report results of uniaxial creep tests on 'model pillars' of Saskatchewan potash, under axial stresses between 34 and 48 MPa and temperatures of 80°C and 110°C. Samples were tested for periods of 1000 hours. At times greater than 200 hours, the creep strain could be related to time by a simple power law. The rate of creep in all cases decreased with time.

High temperatures can have a significant effect on the mechanical properties of salt. The average geothermal gradient in the study area is generally between 20-30°C/km, with the mean annual surface temperature varying between 5 and 7°C (Bachu and Burwash, 1994). The evaporite beds of the Elk Point Group are typically found between 300 and 1700 m below surface, hence the expected in-situ temperature range is between 11°C and 60°C. Senseny et al. (1992) provided data to show that the unconfined compressive strength of Lower San Andres Unit 4 salt is not significantly affected by an increase in temperature from 20 to 50°C.

At the temperatures expected within potential $CO_2$ disposal sites in the salt formations of the study area, there is considerable variability among creep rates measured in the samples from the different salt formations outside of Alberta. No doubt this variability relates to the specific characteristics of the suite of samples tested. In general, for deviatoric stresses within the expected range of failure strengths (from 10 to 25 MPa), the creep rates are consistently on the order of $10^{-10}$ to $10^{-9}$ $s^{-1}$. Creep rates of $10^{-10}$ $s^{-1}$ are typically observed in deep potash mines of Western Canada (Dusseault, 1989). In some Saskatchewan mines, creep rates in potash are 5 to 8 times larger than those in the adjacent salt beds (A. Coode, IMC Colonsay, pers. com.).

Obtaining reliable laboratory creep data for extrapolation to long-term in-situ behaviour requires creep tests to be sustained for days or weeks (Reeves et al., 1988). Special apparatus is required which can carefully control test parameters and monitor very small deformations over these periods of time. Given the complexities of the geomechanical behaviour of salt, and the wide variability in possible creep behaviour, creep tests on fresh, preserved 4” diameter core samples under representative applied stress and temperature conditions are recommended for calibration of predictive models (A. Coode, IMC Colonsay, pers. com.).

Microcrack damage to cores during recovery affects the mechanical properties of specimens. This has led some researchers to anneal salt samples under high hydrostatic pressure prior to creep testing in order to better reproduce the in-situ condition of the salt (Dusseault and Mraz, 1983; Allemandou and Dusseault, 1993). Istvan et al. (1997) describe a case where such recovery-induced damage to laboratory specimens may have led to conservative estimates of salt strength, causing mine designers to believe that the salt was too weak to support an excavation, whereas in fact, the excavation was quite stable. Hence, in order to obtain valid properties, rock mechanical testing should be conducted on representative samples unaffected by sample disturbance.

### 3.3 In-situ Stress Measurements in Salt

Because of the complexity of salt behaviour, a knowledge of the expected in-situ stress conditions is important for understanding how salt may respond to an excavation. The stress state within an undisturbed pure salt formation is typically (and perhaps conveniently) assumed to be isotropic, on the assumption that creep has occurred over geologic time, thus reducing deviatoric stresses (Jeremic, 1994). There are data to support this assumption in some salt settings. For example, Wawersik and Stone (1986) used hydraulic fracturing to show that the stress state in the Salado salt formation near Carlsbad, New Mexico was isotropic.

Stress measurements taken in a potash mine in Brazil have shown that anisotropic stress states can be sustained by some salts (R. Corthesy, Ecole Polytechnique, pers. com.). Anisotropic stresses in salt have also been reported in German salt mines (J.C. Roeigers, University of Oklahoma, pers. com.). Eriksson and Michalski (1986) present a compilation of results on deviatoric stresses in salt domes and bedded salts. They conclude that the maximum virgin in-situ deviatoric stress in normal rock salt (halite) appears to be on the order of 1 to 2 MPa. However, they also conclude that a higher deviatoric stress may occur in association with the presence of impure rock salt, foreign non-salt materials, and geologic structures. Therefore naturally-occurring in-situ stress differences in salt formations cannot be ruled out, although the assumption of isotropic stresses may be sufficient for some purposes. Assuming an average vertical stress gradient of 24 kPa/m (Bell et al., 1994), the range of isotropic stresses for the depths of the Elk Point Group salt formations would be 7 to 40 MPa.

Drilling a borehole introduces a decrease in the radial confining stress, an increase in the tangential stress, and hence an increase in deviatoric stress in the zone surrounding the hole. Furthermore, the excavation of the borehole usually creates a damaged zone adjacent to the hole, and the potential for exposure to fluids which would not otherwise contact the salt. The damaged zone typically extends less than one borehole radius from an excavation. For example, Munson et al. (1995) describe this extent of damage for a shaft bored through salt. All these factors will influence the near-field stress regime, possibly the mechanism by which the salt deforms, and therefore the rate at which creep occurs near a borehole or excavation.

The creep behaviour of salt in the Elk Point Group is expected to have a non-linear dependence on the deviatoric stress over much of the stress range that would be encountered around a deep borehole or cavity in the heavy oil areas of Alberta and Saskatchewan. The internal pressure in a cavity excavated in salt will determine to a large extent the total amount of creep closure expected.

### 3.4 Waste Disposal and Hydrocarbon Storage Caverns

Previous investigations of salt formations have been conducted to assess the feasibility of long term storage of hydrocarbons or waste materials in evaporite deposits (Lentz, 1992; Crossley, 1997; Davidson et al., 1994; Gomm and Quast, 1989). Lentz (1992) described the process by which waste sand produced with heavy oil by Amoco Canada (later Ranger Oil) was disposed of into a salt cavern in the Elk Point area. The Lotsberg Formation was chosen for this purpose due to its purity and thickness, allowing for a cavern size up to 300,000 $m^3$. Shale stringers in the Prairie Evaporite Formation were thought to have the potential to disrupt the integrity of the cavern and the Cold Lake Formation was not sufficiently thick.

Site specific engineering reports from Alberta and Saskatchewan for waste disposal or hydrocarbon storage caverns in salt may provide a source of measured or calculated in-situ stresses in or close to the study area. These types of reports cannot be readily purchased for Saskatchewan, however, selected extracts may be viewed at the Saskatchewan Department of Energy and Mines office in Saskatoon.

A copy of Husky Oil Operations Limited's application dated December 12, 1995 to construct and operate a salt cavern facility in the Lloydminster area for oily waste disposal was obtained from the Saskatchewan Department of Energy and Mines. The application was reviewed for details on salt cavern geotechnical design parameters and stress measurements. This salt cavern application targets the Prairie Evaporite Formation which in this area has the following characteristics:

- it is relatively pure, coarse grained halite;
- it is relatively free of shale interbeds and other insolubles with the exception of the White Bear Marker which is a regional 0.5 m argillaceous dolomite stringer that occurs midway through the Prairie Evaporite;
- it is sufficiently thick (approximately 143 m) at the proposed site for the development of a large cavern; and
- it is directly overlain by the impermeable Second Red Beds of the Dawson Bay Formation and underlain by the Shell Lake Member of the Prairie Evaporites.

The proposed design capacity of the initial salt cavern is 330,000 $m^3$. Proposed cavern development involves solution mining using normal circulation to create an initial 18 m high, 60 m diameter cavern, then progressive washing as the hanging string is raised to increase the cavern height to 133 m. Sonar surveys are proposed to confirm cavern size and shape. No mention is made of stress conditions expected in the Prairie Evaporite Formation or their impact on the cavern design.

A total of sixteen applications related to salt caverns and salt water disposal wells in Alberta were identified from the AEUB library database. Copies of these applications are available on microfiche from AEUB Information Services in Calgary. A listing of these applications is contained in Section 9 of Appendix A. Based on discussions with AEUB

Information Services staff, geological and geotechnical reports associated with such applications may be proprietary.

Of the AEUB applications reviewed, nine were related specifically to salt storage caverns in Alberta. The details of these applications are summarized in Table 5.4. Between 1971 and 1983, eight applications were made to the AEUB for development of salt caverns in the Lotsberg Formation in the Fort Saskatchewan area. A 1966 application for cavern development in the Hardisty area targeted the Elk Point Salt for storage of propane/butane. These caverns were all excavated using solution mining, and were designed to store hydrocarbon liquids or natural gas. With the exception of application 820504 which contains some information on operating and pressure testing criteria, and salt shear strength (21 MPa), the other applications contain no information on in situ stresses or relevant cavern geotechnical design parameters.

## Table 3.3: Summary of AEUB Applications Related to Salt Caverns

| No. | Year | Company | Location | Details of Application |
|---|---|---|---|---|
| 830529 | 1983 | Northwestern Utilities Ltd. | Fort Saskatchewan (Redwater) | Amends approval 3673 for four storage caverns in Upper Lotsberg Formation (1784 m depth, 91 m thick) to include an additional 150,000 $m^3$ storage cavern for sweet natural gas. Cavern to be 80 m diameter at base, and developed using two hanging string solution mining. No stress values or design parameters. Approval 3673A. |
| 820504 | 1982 | Northwestern Utilities Ltd. | Fort Saskatchewan (Redwater) | Application for four storage caverns in Upper Lotsberg Formation (1791 m depth, 80 m thick), each with minimum capacity of 120,000 $m^3$ for natural gas storage. Salt described as clear, very coarse crystalline halite with some red shale inclusions and some shale interbeds. Caverns 73 m diameter, spaced 162.5 m. Pressure testing at 18 kPa/m gradient. Maximum wellhead pressure 9.6 MPa during cavern development. Operating pressure 28.5 MPa (15.84 kPa/m gradient). Fracture pressure in excess of 40.7 MPa (22.6 kPa/m gradient). Caverns to be developed using single and two hanging string solution mining. Shear strength of 20.685 MPa for salt provided by Gabriel Fernandez (Consultant). Provides a table of seven gas storage facilities in salt formations in Canada and the USA. No stress values. Approval 3673. |
| 790326 | 1979 | Dome Petroleum Ltd. | Fort Saskatchewan | Amends approval 2358 for the development of two salt caverns in the Lotsberg Formation (1862 m depth, 67 m thick). Capacity 79,490 $m^3$. Caverns 45 to 60 m diameter spaced 183 m on centre. Sonar logs used to check size and shape. No stress values or design parameters. Approval 2358A. |
| 009520 | 1976 | Dome Petroleum Ltd. | Fort Saskatchewan | Application for development of six storage caverns (500 MB each) in the Lotsberg Formation (6074' – 6311') for light hydrocarbon liquids. Solution mining using standard techniques. No stress or geotechnical design parameters. Approval 2358. |
| 008154 | 1974 | M-P Petroleum Ltd. | Fort Saskatchewan | Application for four underground caverns for LPG storage in the Upper Lotsberg Formation (5900' depth, 245' thick). Cavern capacity 500 MB (150' diameter spaced 667') measured using regular brine volume monitoring and sonar surveys. Salt clear, very coarse crystalline halite with some red shale inclusions and some shale interbeds. Anhydrite and carbonate interbeds not present. Core tested for insolubles for cavern design. No stress values or design parameters. Approval 2101. |
| 007578 | 1974 | Imperial Pipeline Company Ltd. | Redwater | Application to construct and operate a salt cavern storage facility for butane in the Upper Lotsberg Formation (235' thick at 5820' depth). Cavern capacity 350 MB. Cavern stability a function of cavern diameter, purity and thickness of salt. Spans of 140 to 165' stable by experience. Two hanging string method used. RM Hardy report on brine pond design included. No stress values or design parameters. Approval 2039. |
| 007325 | 1973 | Dome Petroleum Ltd. | Fort Saskatchewan | Application for construction and operation of an underground salt cavern storage facility with two caverns (300 MB each) for light hydrocarbon liquids. Caverns 150 to 200' diameter spaced 600' in the Lotsberg Formation (6100' depth, 200' thick). Halite with interbedded marls. Sonar logs used to measure cavern dimensions. No stress values or design parameters. Approval 1932. |
| 005672 | 1971 | Chevron Standard Ltd. | Fort Saskatchewan | Application to construct and operate six storage caverns for propane/butane (500 MB each) in the Lotsberg Formation (6100' depth, 240' thick). Clear halite with interbedded marls. Core taken in salt for solubility testing. Caverns 140 to 160' diameter spaced 660'. Sonar surveys used to measure cavern dimensions. No stress values or design parameters. Approval 1547. |
| 003021 | 1966 | Home Oil Company Ltd. | Hardisty | Application for disposal of brine produced during development of storage caverns in Elk Point Salt (4448' depth, 358' thick). Three or four caverns (400 MB each) to store propane/butane. Core taken to measure percent solubility by weight, natural density, solubility rate and residual solubility. No stress values or design parameters. Approval 878, 885. |

# 4. IN-SITU STRESS DETERMINATION METHODOLOGY

## 4.1 Vertical Stress Magnitude

The in-situ stress state can be described by the magnitude of the vertical stress and the magnitudes and orientations of the maximum and minimum horizontal stress components. These stresses correspond to principal stress components if the vertical stress is a principal stress. To calculate effective stresses, the formation (or pore) pressure is also required.

The magnitude of the vertical stress (or vertical stress gradient)[2] at a given depth can be calculated by integrating a bulk density log from the ground surface to the depth of interest. Density logs comprise the standard suite of wireline logs ran in Alberta, and therefore tend to provide good spatial coverage of a study area. Since density logs are not usually run over surface casing sections, the bulk density of strata in these sections must be estimated. Water well records can be used in some cases to obtain lithologic information and water level data to constrain the estimate of bulk density of near-surface units. Alternatively, surficial geology maps can provide approximate thicknesses of near-surface sediments, and representative properties can be estimated from published values. Typical criteria for ranking the quality of bulk density logs are discussed in Section 5.2.1.

## 4.2 Horizontal Stress Magnitudes

As described by Bell et al (1994), there are numerous techniques that have been used in parts of Western Canada to measure the value of the minimum horizontal principal stress, $\sigma_{Hmin}$, the results of which have been compiled to provide regional stress estimates. The most reliable of these techniques are small volume microfracture tests conducted over isolated intervals, preferably done openhole with a low viscosity fluid such as water. Minifrac tests, which are usually done with tens of cubic meters of gelled frac fluid, provide a less reliable measurement of $\sigma_{Hmin}$. Because oil and gas operators are not required to release fracture treatment pressure records, these data are not recorded in the AEUB database, and are not publicly available.

[2] The vertical stress gradient at a particular depth is defined as the vertical stress magnitude normalized to the depth below surface. The local stress gradient is defined as the tangent to the vertical stress vs. depth curve at a specific depth.

Another type of fracture test that can sometimes provide a rough estimate of the upper bound value of $\sigma_{Hmin}$ is a casing integrity, or formation leakoff test (CIT, LOT or FLOT). This type of test is required in Alberta after surface casing has been run and cemented in a well. Sometimes a FLOT is run after intermediate casing has been set, however it is not required by regulation. For a standard leakoff test, a short 3 to 5 m section of hole is drilled out through the cement shoe and then pressurized to test the integrity of the casing and cement. If the pressure is taken to a maximum, and the cement and casing remain intact, a small hydraulic fracture can be initiated in the formation with the drilling fluid. Usually the test is terminated at this point; however, if a quantity of mud is pumped into the fracture, and then the well is shut-in, the declining pressure record can give a rough measure of $\sigma_{Hmin}$, much like a minifrac test.

A rough estimate of the upper bound for $\sigma_{Hmin}$ can sometimes also be derived from the calculated bottomhole instantaneous shut-in pressure obtained from propped fracture treatments. However, these data are also not readily available in the public domain. Special arrangements with service companies and operators who possess these data may be possible, but were not pursued as part of this study.

A complementary approach to determine horizontal stress magnitudes is to back analyze measurements of hole enlargement due to breakouts to estimate the ratio of horizontal stresses. If the strength and formation pressure of the strata containing the breakout are known, then the magnitude of the horizontal stress components can be approximated using a borehole stability model, such as STABView (Advanced Geotechnology Inc., 2000). If the stress state in a salt formation is assumed to be isotropic, the horizontal stress magnitudes and their spatial variation can be approximated from the vertical stress data.

## 4.3 Horizontal Stress Orientations

### 4.3.1 Borehole Breakouts

Under certain conditions, the azimuth of the long axis of an enlarged borehole cross-section can be used to determine the orientations of the in-situ principal horizontal stresses. Unequal horizontal stress components create compressive stress concentrations at the borehole wall in the direction of $\sigma_{Hmin}$, which, if large enough, will cause material to yield and ultimately detach or "breakout." The long axis caliper of a 4-arm dipmeter tool (or other oriented caliper tools such as Schlumberger's FMS or FMI) will track this hole enlargement and yield the azimuth of $\sigma_{Hmin}$ and $\sigma_{Hmax}$ (Bell and Gough, 1979; Plumb and Hickman, 1985). Often in weak rocks such as shales, or in highly stressed areas, the borehole diameter enlarges in all directions. These types of enlargements, sometimes called "washouts" can still yield in-situ stress directions as long as spalling is greater in the direction of $\sigma_{Hmin}$. Hole enlargement from key seating of the drill string or from pipe wear must also be filtered from the breakout data. These hole segments can be avoided by eliminating data from intervals where the borehole is inclined more than about $5^o$ from vertical. Typical criteria for ranking breakout quality are described in Section 5.3.2.

The orientation of the horizontal stress components in the original study area were initially estimated on the basis of regional stress data published in the Geological Atlas of Western Canada (Bell et al, 1994). Detailed variations in the horizontal stress orientation were determined from borehole breakouts in units within or adjacent to the Elk Point Group or the overlying Beaverhill Lake Group.

### 4.3.2 Coring-Induced Fractures

The orientation of certain types of coring-induced fractures can also be used to determine the direction of the principal horizontal stresses (Li and Schmitt, 1997). Figure 4.1 shows three types of coring-induced fractures most commonly used for this purpose. The first is called a "saddle" fracture. The direction of $\sigma_{Hmax}$ parallels the long axis of the saddle, as indicated in Figure 4.1a. The second is called a "petal" fracture. Petal fractures initiate at the exterior of the core, and generally periodically repeat on opposite sides of the core (Figure 4.1b). The direction of $\sigma_{Hmax}$ is parallel to the strike of these petal fractures. The third type of fracture is a "centreline" fracture which forms parallel to $\sigma_{Hmax}$.

In a typical study of coring-induced or natural fractures, the cores are assembled into continuous segments by fitting adjacent core pieces together. Such segments are typically bounded by mill points, spin-offs, rubble zones, core run connections, saw cuts, or missing pieces. A master orientation line (MOL) is then marked along the length of each segment. The orientations of all coring-induced fractures are measured using a computerized goniometer, which is a device for digitizing 3-dimensional features. A minimum of 3 points on the fracture surface are recorded to define fracture orientation in space relative to the MOL. The data are then restored to in-situ coordinates using either the orientation survey (if the core was oriented), an image log, or paleomagnetics (Gillen et al., 1998).

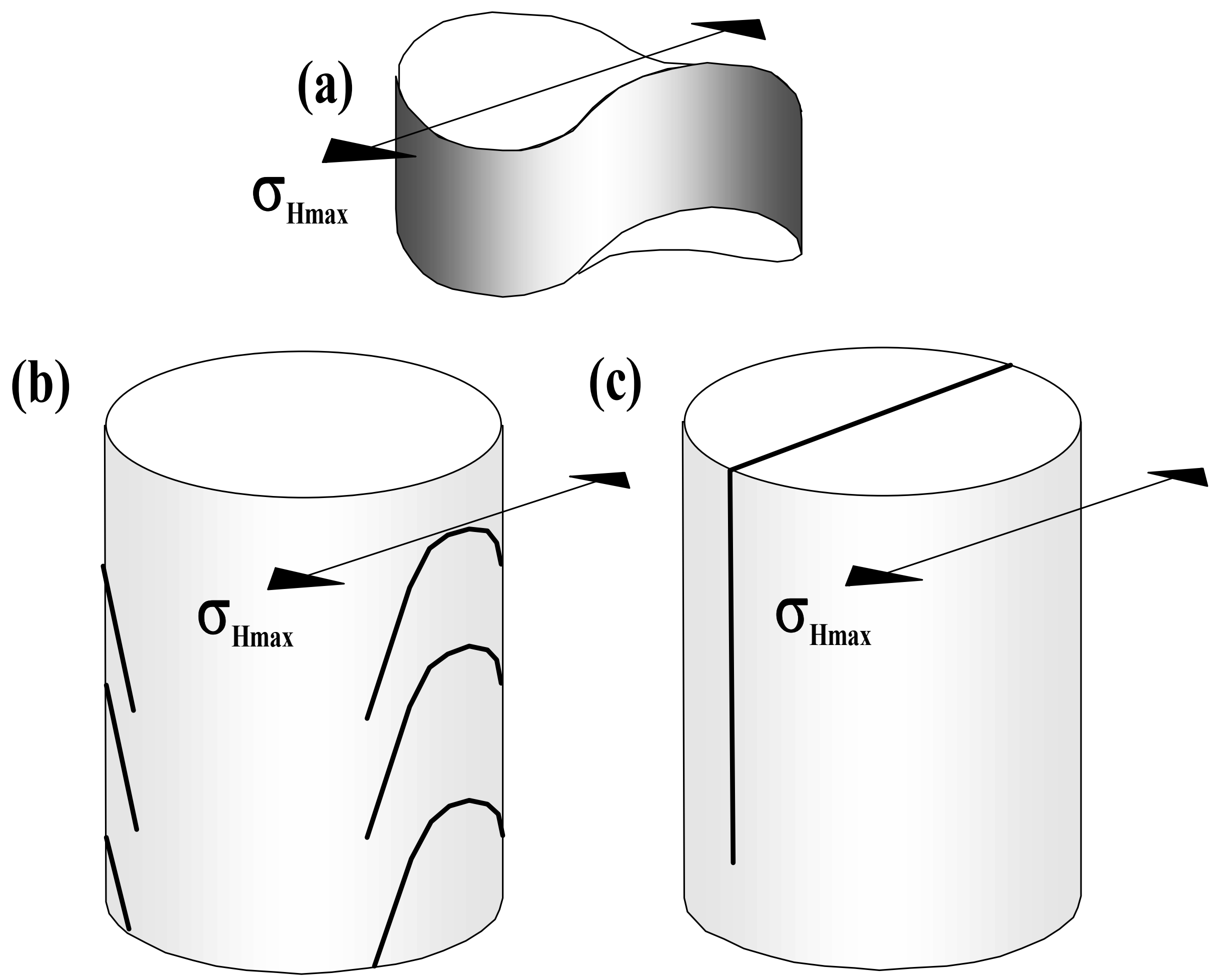



**Figure 4.1: Induced fractures in core. (a) saddles fracture and (b) petal fractures and (c) a centre-line fracture. The orientation of $\sigma_{Hmax}$ is indicated.**

# 5. DATA REVIEW AND ANALYSIS

## 5.1 Relevant Wells in the Study Area

### 5.1.1 Original Study Area

A number of wells were initially identified in the public AEUB database which could provide information on the in-situ stresses in and adjacent to the salt formations of the Elk Point Group. Table 5.1 provides a summary of the relevant wells in the original study area of Phase 1 of this project, and the search criteria used in their review.

Bulk density logs for 92 wells identified in Phase 1 were reviewed for their suitability in determining vertical stress and vertical stress gradient values at the top of the Elk Point Group, Prairie Evaporite Formation, and at the top of the Basal Red Beds Formation. Details on the 92 wells included in the bulk density log review are contained in Table B.1 in Appendix B. In total, 65 and 49 wells were identified for vertical stress analysis to the top of the Prairie Evaporite Formation and Basal Red Beds Formation respectively. The analysis of these results is presented in Section 5.2.

Dipmeter logs from the Elk Point Group or Beaverhill Lake Group for 99 wells were also reviewed in Phase 1 as part of an assessment of horizontal stress orientations in the original study area. Details on the 99 wells are contained in Table B.2 in Appendix B. Only three wells with dipmeter coverage in the Elk Point Group were identified in the original study area, and two of these wells had dipmeter logs from 1956. These latter logs were not four-arm caliper logs and could not be used for breakout analysis. Although a determination of the minimum stress orientation within the Elk Point Group was preferred, the search was expanded to include dipmeter logs with coverage in the overlying Beaverhill Lake Group to increase the data set. A total of 96 additional wells having dipmeter logs with some coverage in the overlying Beaverhill Lake Group were identified, 24 of which were post-1970 with coverage over at least 15 m in the Beaverhill Lake Group. These wells were further reviewed for the availability of breakout data as described in Section 5.3.

In addition to identifying wells with bulk density and dipmeter data, 64 wells with core from the Elk Point Group were identified in Phase 1 for possible future examination and analysis of drilling- or coring-induced fractures. There are also 10 wells that have core taken from the Beaverhill Lake Group (Table 5.1). Details on the wells with core are contained in Table B.3 in Appendix B. The quality and availability of this core is uncertain, but access to core provides the possibility of identifying saddle, petal and centreline fractures which can be used to estimate horizontal stress orientations. Following the search conducted in Phase 1 of the study, Dr. Bachu of the AGS asked that an examination of core from the original study area not be undertaken in subsequent phases of the study.

AGS supplied data from 10 formation leak-off tests in the original study area. No publicly-available hydraulic fracture tests in Devonian strata in the study area were found. The limitations introduced by the poor quality or paucity of data in terms of the assessment of horizontal stress magnitudes is discussed in Section 5.4.1.

As requested by the AGS, those wells in the study area for which both bulk density logs and DST data in the Elk Point Group are available were identified. A total of 31 DSTs for non-salt rocks of the Elk Point Group in the study area were found in the Geovista database. Details on these DSTs are contained in Table B.4 in Appendix B. The format and quality of these data are uncertain. The value of formation pressure measurements in a study of in-situ stresses in salt is questionable, as pore fluids cannot exist in pure halite salt strata. Following discussion of the Phase 1 search results with AGS, it was decided that DST data would not be examined further in subsequent phases of the study.

Based on the data in Table 5.1, it was determined in Phase 1 of the study that there were sufficient well data to proceed with analysis of the in-situ stress state in the original study area. The location of the wells identified in Phase 1 of the study containing bulk density logs, dipmeter logs, and core within the original study area are shown respectively in Figures 5.1, 5.2 and 5.3.

### 5.1.2 Expanded Study Area

The availability of relevant dipmeter and bulk density well log data in the expanded study areas in eastern Alberta and western Saskatchewan was investigated in Phase 2 and Phase 3 of this study, respectively. The analysis of these data was performed in Phase 3. The search results of the AEUB and Saskatchewan databases in the expanded study areas are summarized in Table 5.2 and Table 5.3, respectively. Details on the bulk density and dipmeter wells identified in the search result are given in Appendix C.

The wells with bulk density log data in the expanded Alberta study area were divided into those covering the top of the Elk Point Group (843), and those covering the entire Elk Point Group (406). This last subset was further filtered in the Phase 3 analysis to include wells where the amount of incomplete bulk density data below the surface was minimized. Wells that were outside the Prairie Evaporite Formation area as identified by AGS were also removed from the data set. In addition, for areas with dense clusters of available bulk density data, a limited number of the higher quality wells were selected to reduce total number of wells for further analysis to the more reasonable number of 90.

Search results of the expanded western Saskatchewan area found 32 wells that had data coverage to at least the top of the Prairie Evaporite Formation. However, with further analysis it was determined that 8 of these wells were outside the Prairie Evaporite Formation area as defined by AGS and 2 of the wells had poor quality data. Therefore, 22 wells were used for vertical stress determination in the expanded Saskatchewan study area. A map showing the location of bulk density wells identified in the initial search results and the locations of wells used for analysis is shown in Figure 5.4.

A total of 120 wells with dipmeter log data in the Elk Point Group were identified in the expanded Alberta study area during Phase 2. A total of 61 microfiche supplied by AGS were screened to identify 13 wells that had all the necessary information available to analyze borehole breakouts.

A total of 32 wells with dipmeter log data in the Paleozoic-age formations were identified in the expanded Saskatchewan study area during Phase 3. Only 1 well had dipmeter log coverage over the Elk Point Group but it could not be used for the determination of the minimum stress orientation since it was logged with a three-arm dipmeter in 1967. A total of 25 wells with > 4m coverage in the Paleozoic-age formations were identified (Table 5.3). Microfiche from these 25 wells were used to identify 6 wells that had all the necessary information available to analyze borehole breakouts. The dipmeter wells were further analyzed in Section 5.3.

**Table 5.1: Summary of data search results for the original study area**

| **Total number of wells in study area** | **45,040** |
|---|---|
| **Density log data for vertical stress determinations** | |
| Total number of wells in study area with bulk density logs | 28,810 |
| Total number of wells in study area with bulk density logs to top of Elk Point Group | 84 |
| Total number of wells in study area with bulk density logs to top of Prairie Evaporite Formation within the Prairie Evaporite Formation area as defined by AGS | 65 |
| Total number of wells in study area with bulk density logs to top of Basal Red Beds | 49 |
| Total number of wells in study area with bulk density logs to top of Elk Point Group and having some coverage over the upper 100 m below ground surface | 23 |
| **Dipmeter data for horizontal stress orientation determinations** | |
| Total number of wells in study area with dipmeter logs | 1,317 |
| Total number of wells in study area with dipmeter logs covering all or part of the Elk Point Group (2 wells in 1956, 1 well in 1976) | 3 |
| Total number of wells in study area with dipmeter logs covering all or part of the Beaverhill Lake Group | 96 |
| Subset of wells having greater than 15 m of log coverage | 24 |
| Subset of wells having greater than 15 m of log coverage and logged after 1970 | 24 |
| **Cored wells with the potential to assess horizontal stress orientations using paleomagnetics and coring- / drilling-induced fractures** | |
| Total number of cored wells in the study area | 12,052 |
| Total number of cored wells in the study area that have some core taken from the Elk Point Group | 64 |
| Total number of cored wells in the study area that have some core taken from the Beaverhill Lake Group | 10 |
| **Formation leak-off and hydraulic fracture tests** | |
| Formation Leak-off test results made available to the study by AGS | 10 |
| Number of useful formation leak-off tests below 500m | 0 |
| Number of publicly available hydraulic fracture tests in the Devonian in the study area | 0 |
| **Formation pressure measurements** | |
| Drill stem tests in the Elk Point Group for wells with a bulk density log to the top of the Elk Point Group | 31 |

Based on searches using the AEUB well database, provided by CDPubco.

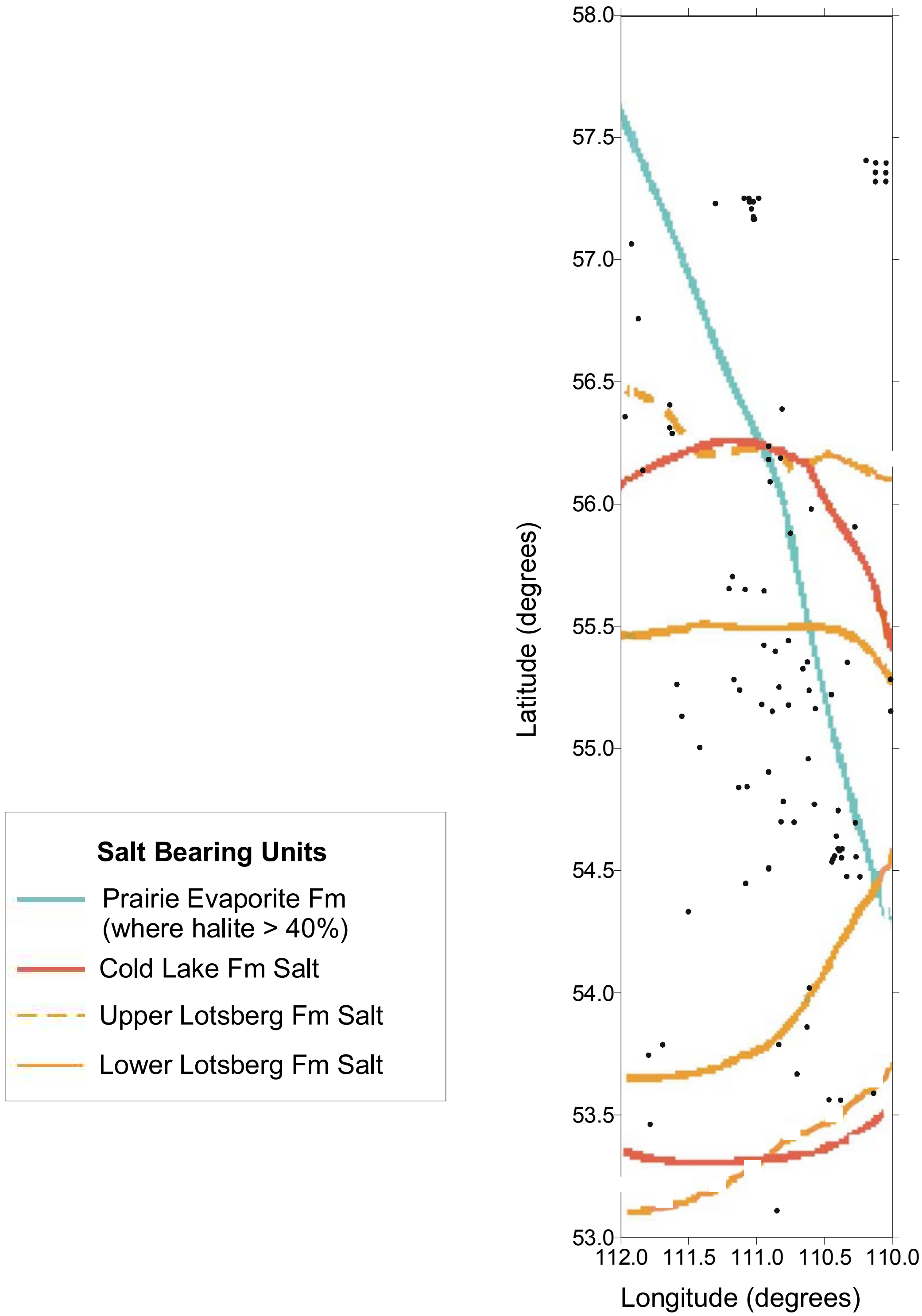



**Figure 5.1: Original Phase 1 study area bounded by 53 - 58° latitude N and 110 - 112° longitude W showing location of available bulk density log data for the Elk Point Group (92 wells, 84 containing relevant information). Data from these wells were evaluated in Phase 2 to determine vertical stress magnitudes.**

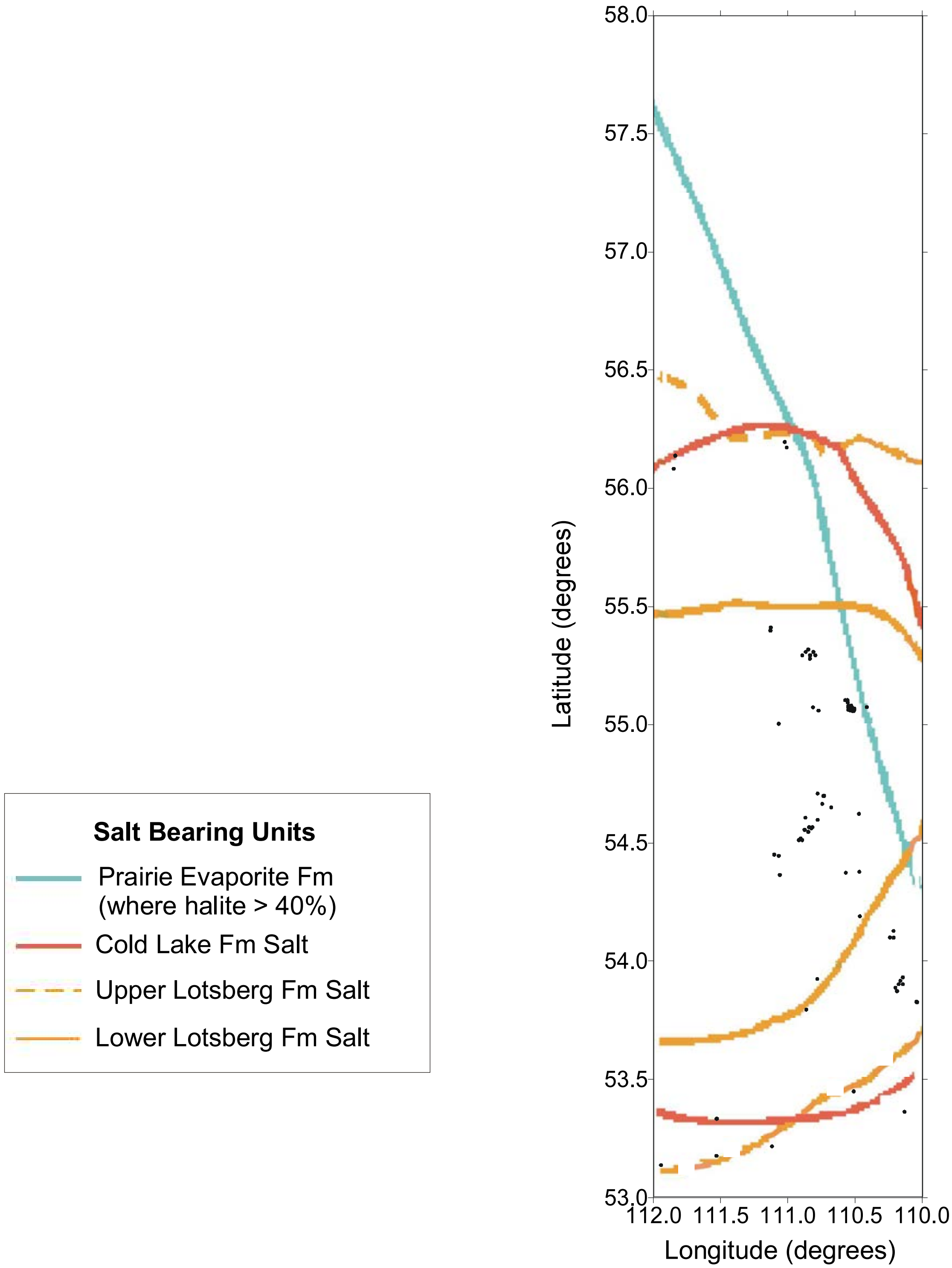



**Figure 5.2: Original Phase 1 study area bounded by 53 - 58° latitude N and 110 - 112° longitude W showing available dipmeter log data for the Elk Point and Beaverhill Lake Groups (99 wells). Data for these wells were further examined in Phase 2 to derive horizontal stress orientations from borehole breakouts.**

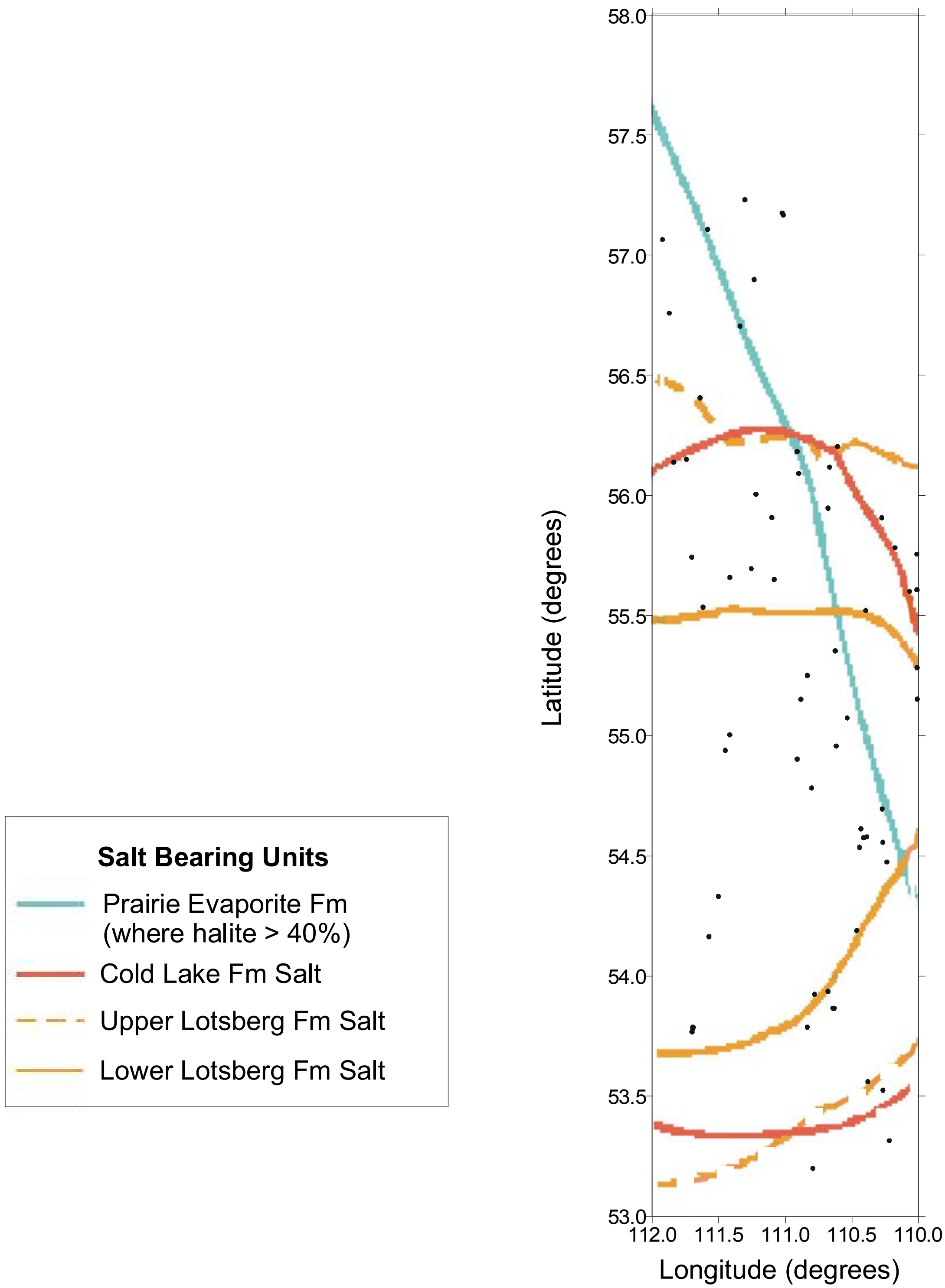



**Figure 5.3: Original Phase 1 study area bounded by 53 - 58° latitude N and 110 - 112° longitude W showing location of wells containing core from the Elk Point Group (64 wells). No cores were analyzed in the study.**

**Table 5.2: Search result summary for the Phase 2 expanded study area in Alberta**

| **Total number of wells in the expanded study area in Alberta** | **98,819** |
|---|---|
| **Density log data for vertical stress determinations** | |
| Total number of wells in expanded Alberta study area with bulk density logs | 53,403 |
| Total number of wells in expanded Alberta study area with bulk density logs having coverage in the Elk Point Group | 843 |
| Number of wells that have coverage over entire Elk Point Group | 406 |
| Subset of wells selected wells for further analysis | 90 |
| **Dipmeter data for horizontal stress orientation determinations** | |
| Total number of wells in expanded Alberta study area with dipmeter logs | 897 |
| Total number of wells in expanded Alberta study area with dipmeter logs covering all or part of the Elk Point Group or Beaverhill Lake Group | 120 |
| Total number of wells in expanded Alberta study area with dipmeter logs covering all or part of both the Elk Point Group and Beaverhill Lake Group | 84 |
| Total number of wells in expanded Alberta study area with dipmeter logs covering only all or part of the Elk Point Group (i.e., no Beaverhill Lake Group coverage) | 10 |
| Total number of wells in expanded Alberta study area with dipmeter logs covering > 15 m coverage in Beaverhill Lake Group | 26<br>23 |
| **Cored wells with the potential to assess horizontal stress orientations using paleomagnetics and coring / drilling induced fractures** | |
| Total number of cored wells in the expanded study area | 12,445 |
| Total number of cored wells in the expanded study area that have some core taken from the Elk Point Group | 1,109 |
| Total number of cored wells in the expanded study area that have some core taken from the Beaverhill Lake Group | 233 |

Based on searches using the AEUB well database, provided by CDPubco.

**Table 5.3: Search result summary for the Phase 3 expanded study area in Saskatchewan**

| **Total number of wells in the expanded Saskatchewan study area** | **40,233** |
|---|---|
| **Density log data for vertical stress determinations** | |
| Total number of wells in expanded study area with bulk density logs | 14,822 |
| Total number of wells in expanded study area with bulk density logs having coverage in the Prairie Evaporite Formation | 30 |
| Subset of wells selected for further analysis | 22 |
| **Dipmeter data for horizontal stress orientation determinations** | |
| Total number of wells in expanded study area with dipmeter logs | 71 |
| Total number of wells in expanded Saskatchewan study area with dipmeter logs covering all or part of the Elk Point Group | 1 |
| Total number of wells in expanded Saskatchewan study area with dipmeter logs with > 4 m coverage in the Paleozoic-age formations | 25 |

Based on searches using the AEUB well database, provided by CDPubco.

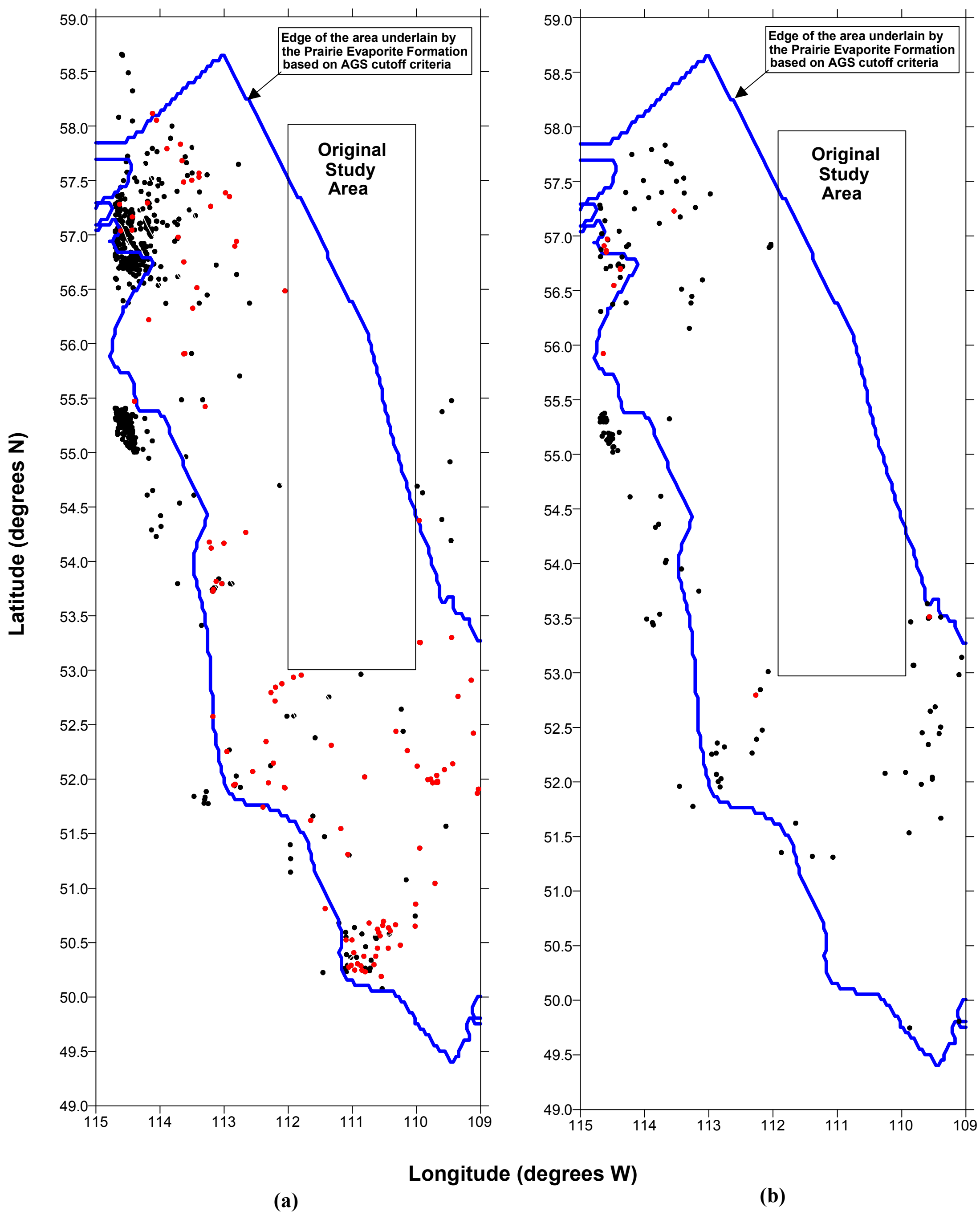



**Figure 5.4: Expanded study area showing (a) location of 883 wells with available bulk density log data covering the Elk Point Group (843 from the expanded Alberta area and 30 from the expanded Saskatchewan area) and (b) location of 145 wells screened for available dipmeter log data (120 from the expanded Alberta area and 25 from expanded Saskatchewan area). The 11 dipmeter wells and 112 bulk density wells used in the final Phase 3 analysis are shown in red.**

### 5.2 Bulk Density Log Data for Vertical Stress

The vertical stress magnitude and average vertical stress gradients were determined from bulk density log data to evaluate the in-situ stress conditions within the Elk Point Group salt formations. In consultation with AGS, the top of the Prairie Evaporite Formation was selected as the top of the Elk Point Group salt formations, and the top of the Basal Red Beds was selected as the bottom of the salt formations in the original study area. The top of the Basal Red Beds was chosen because: (1) the top is easy to identify from logs which makes it accurate and consistent across the study area, and (2) the Basal Reds Beds are generally uniformly located below the lower Lotsberg Formation as opposed to the top of the Cambrian or Precambrian age formations which are often picked as the base of the Elk Point Group. For the expanded study area, the vertical stress was not determined at the bottom of the Elk Point Group because of the difficulty in selecting a formation that is uniformly distributed over the entire study area which could be selected as a base of the Elk Point Group.

Contour maps of the top of the Prairie Evaporite Formation (depth and elevation) and vertical stress (magnitude and gradient) were developed for the areal extent of the Prairie Evaporite Formation in the entire study area. Contour maps of the top of the Basal Red Beds Formations (depth and elevation) and vertical stress (magnitude and gradient) were developed for areal extent of the Elk Point Group salt formations in the original study area. These maps provide the necessary information to estimate in-situ stress conditions in salt formations of the Elk Point Group. Table D.1 of Appendix D and Table E.1 of Appendix E provide a detailed summary of the vertical stress analysis based on bulk density logs for the original and expanded areas, respectively.

#### 5.2.1 Log Quality Analysis

As a first step in the analysis of vertical stresses in the study area, the quality of the bulk density log data was assessed. The log quality for all the wells used for vertical stress analysis in the original and expanded areas are given in summary Tables D.1 and E.1. Due to discrepancies in reported and recorded bulk density data, it was found that 84 of the 92 wells in the original study area had coverage to the top of the Elk Point Group. All 92 wells are included in the analysis summary in Table D.1 for completeness.

The quality of bulk density log data in the original study area was assessed using the criteria listed in Table 5.4. The log quality was classified as poor, fair, good, or very good. Logs run before 1985 were given a poor or fair quality rating because tools prior to this year (when service companies such as Schlumberger launched their improved litho-density tools - LDT) were less accurate due to the lower count rates used and lower vertical resolution. Log quality was also assessed based on hole size since density tools such as the LDT give good values for smooth holes up to 381 mm in diameter (Schlumberger Educational Services, 1989). In addition, when the bulk density correction exceeds 100 kg/m$^3$, the measured bulk density is poorly compensated for mudcake and surface borehole effects, which leads to lower quality measurements. Rough holes indicated by spiky data and higher bulk density correction values are also prone to anomalously low densities due to poor pad contact with the formation. Details of the bulk density log quality determined for each well are given in Table D.1 of Appendix D and Table E.1 of Appendix E. Figures showing the bulk density profile, vertical stress, and local vertical stress gradients for each well listed in Table D.1 are given in Appendix D, Figures D.1.1 to D.1.92.

A summary of the quality of bulk density logs used in the vertical stress calculations at the top of the Prairie Evaporite Formation, and top of the Basal Red Beds, is shown in Figure 5.5. The locations of wells used for with vertical stress analysis, and their respective bulk density log quality, are shown in Figure 5.6.

**Table 5.4: Criteria used to determine bulk density quality in this study**

| Quality | Criteria |
|---|---|
| Poor | Rough hole, spiky and anomalous data present; large washout intervals (borehole diameter >380 mm); large intervals with high density correction (>100 kg/m$^3$); logged with older, less accurate density tools prior to 1985. |
| Fair | Intermittent intervals with rough borehole, washouts, intervals of high density correction, logged prior to 1985. |
| Good | Very short intervals with rough borehole, washout, higher density correction (>100 kg/m$^3$), logged after 1985. |
| Very Good | No anomalous spikes, smooth borehole, hole not washed out (hole diameter <380 mm), good density correction between 0-100 kg/m$^3$, logged after 1985 with more accurate tools. |

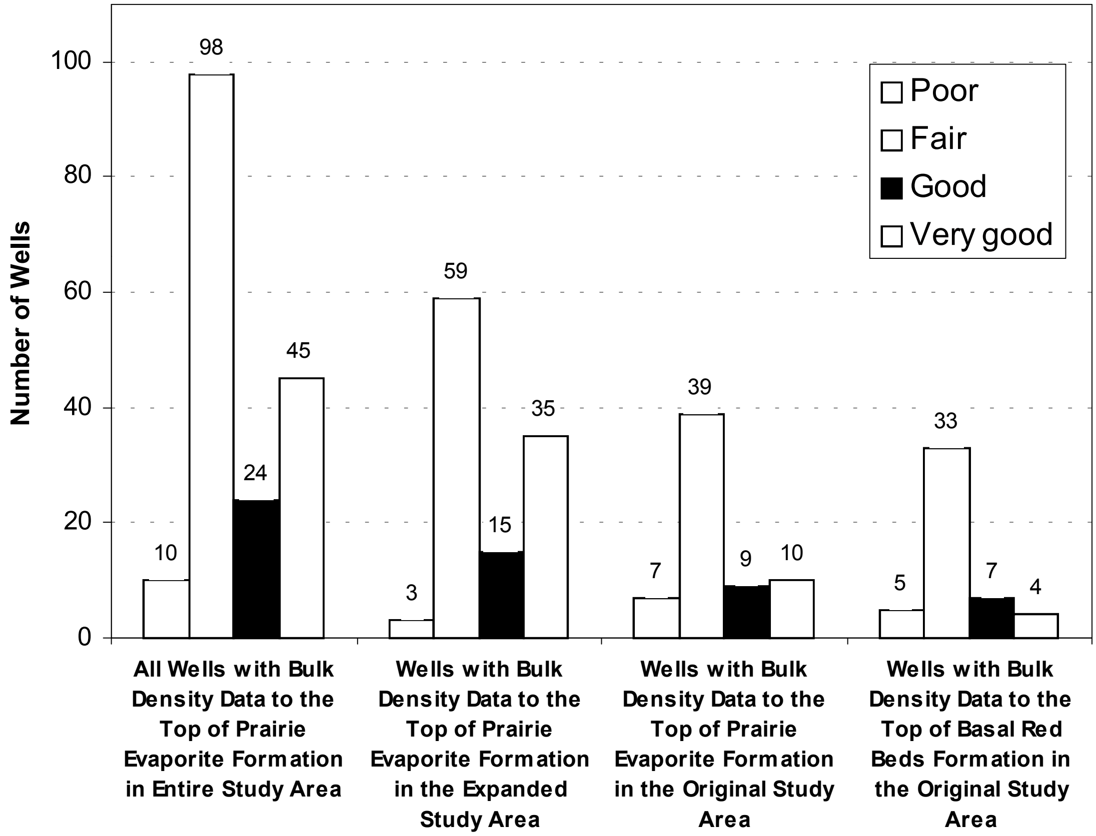



**Figure 5.5: Summary of bulk density log quality of the wells used to determine the vertical stress in the original study and expanded study areas.**

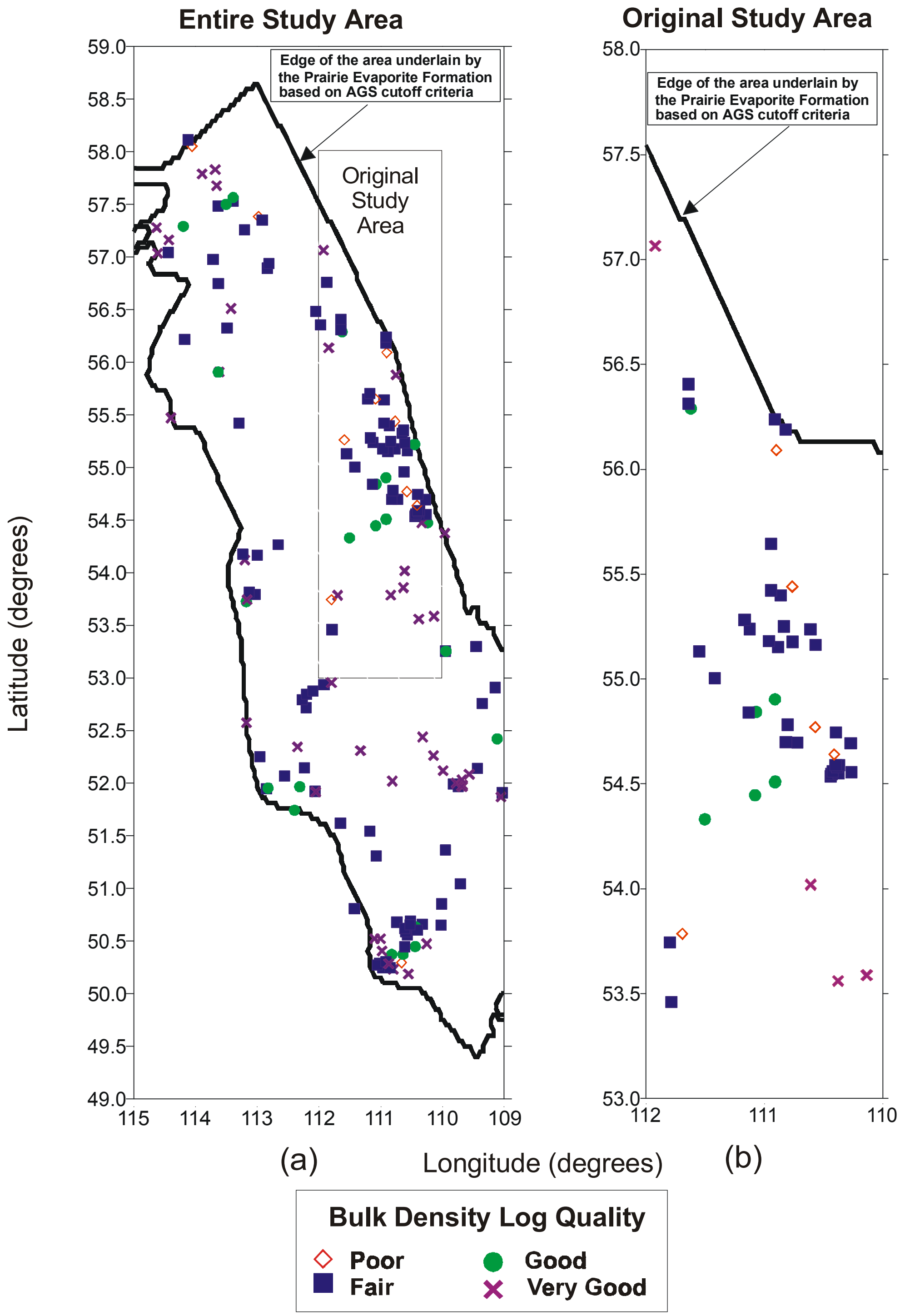



**Figure 5.6: Map showing bulk density log quality for wells used to calculate vertical stresses at (a) the top of the Prairie Evaporite Formation (65 wells in the original study area, 112 wells in the expanded study area) and (b) the top of the Basal Red Beds Formation (49 wells in the original study area).**

### 5.2.2 Estimation of Near-surface Bulk Density

The average vertical stress gradient is calculated by integrating the bulk density log curve. For most wells in the database, bulk density data were not recorded over the section covered by surface casing. Bulk density information of fair or better quality within 100 m of surface and above the Prairie Evaporite Formation was available in 8 wells within the original study area (Table 5.5). These latter data were used to calculate an average near-surface bulk density for wells in the original study area. Based on the data in Table 5.5 an average bulk density of 2150 kg/m$^3$ was used for wells without near-surface data in both the original and expanded study areas.

As shown in Figure 5.7, the possible error in estimated vertical stress or vertical stress gradient increases as the proportion of the well length lacking bulk density measurements increases, and/or the difference between the assumed average value of 2150 kg/m$^3$ and actual bulk density in this zone increases. For example, assuming an uncertainty of 100 kg/m$^3$ in the bulk density estimate in the uphole section behind casing, the majority of the wells have less than a 2% possible error in the determined vertical stress magnitude or gradient. As the relative proportion of well length lacking bulk density data decreases, e.g., vertical stress calculations for the deeper Basal Red Beds, the possible error also decreases. The proportion of well length lacking bulk density data for wells from surface to the top of the Prairie Evaporite and to the top of the Basal Red Beds is given in Table D.1 of Appendix D. The proportion of well length lacking bulk density data for wells from surface to the top of the Prairie Evaporite is given in Table E.1 of Appendix E. These values can be used to estimate the possible error in vertical stress and stress gradient estimates. The proportion of well length lacking bulk density data above the Prairie Evaporite Formation is shown in Figure 5.8.

**Table 5.5: Average bulk density for wells with coverage in the upper 100 m from surface and data of fair or better quality within the area underlain by the Prairie Evaporite Formation of the original study area**

| Well Name | UWI | Average Bulk Density (kg/m$^3$) | | |
|---|---|---|---|---|
| | | **0-100 m** | **0-200 m** | **100-200 m** |
| Esso Marie OV 15-20-64-2 | 1AA/15-20-064-02W4/00 | 2101 | 2113 | 2122 |
| Esso 79 SWD Coldlk 7-18-64-3 | 100/07-18-064-03W4/00 | 2128 | 2144 | 2158 |
| Esso 81 SWD Ethellk 3-29-64-3 | 100/03-29-064-03W4/00 | 2125 | 2168 | 2203 |
| Esso Medley OV 6-8-66-2 | 1AA/06-08-066-02W4/00 | 2254 | 2211 | 2177 |
| Esso Medley OV 14-28-66-3 | 1AA/14-28-066-03W4/00 | 2199 | 2179 | 2163 |
| BP PCI Marglk 10-8-66-5 | 100/10-08-066-05W4/00 | 2248 | 2133 | 2034 |
| Cigol et al Horse 11-10-85-13 | 100/11-10-085-13W4/00 | 2063 | 2111 | 2113 |
| Suncor Clarke 2-32Prev-89-12 | 100/02-32-089-12W4/00 | 2117 | 2182 | 2191 |
| | **Mean** | **2154** | **2155** | **2145** |
| | Standard Deviation | 71 | 36 | 55 |

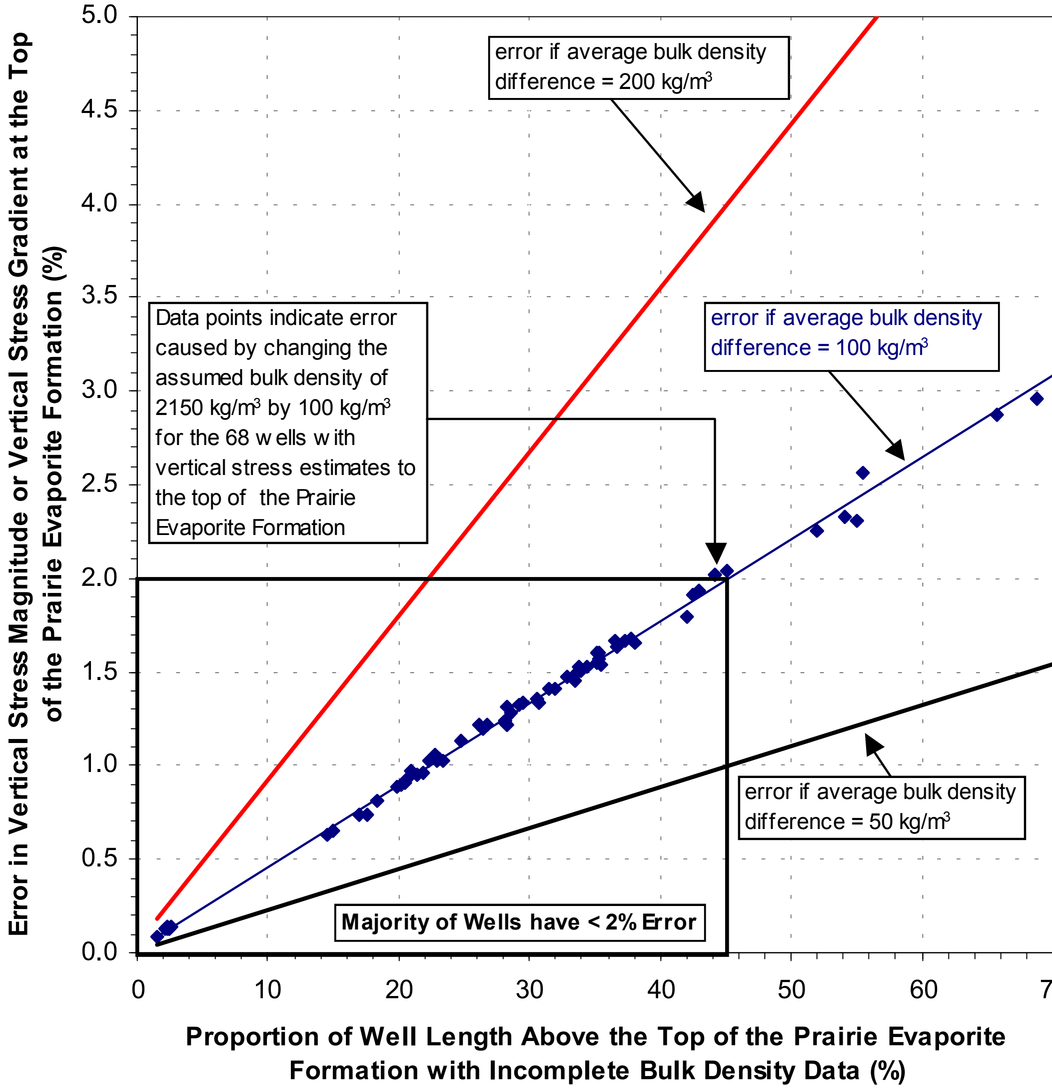



**Figure 5.7: Possible error in vertical stress and vertical stress gradient determination at the top of the Prairie Evaporite Formation related to proportion of well length lacking bulk density data, and difference between average and actual near-surface bulk density.**

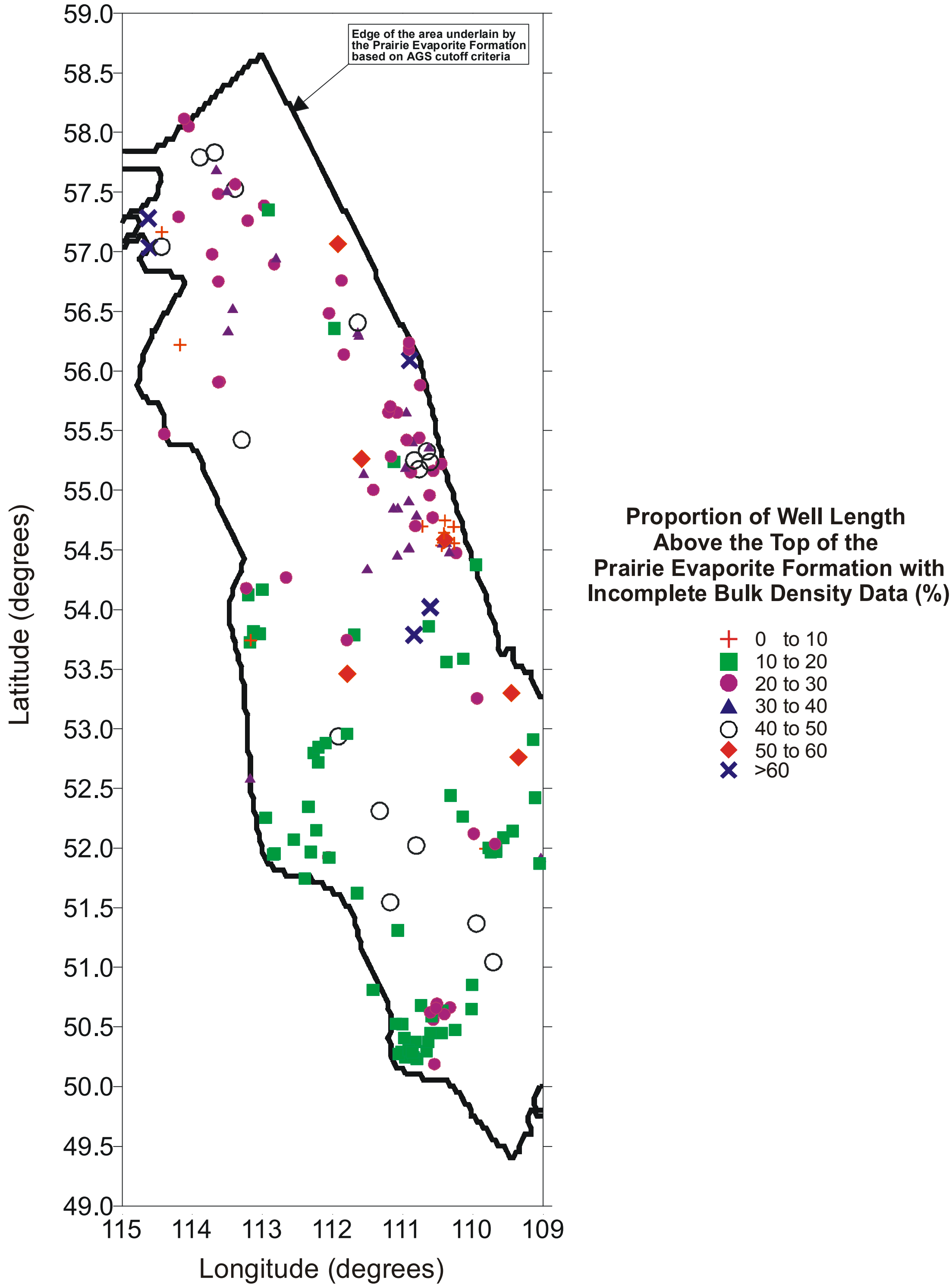



**Figure 5.8: Complete study area showing location of wells used for the calculation of vertical stress magnitude to the top of the Prairie Evaporite Formation. The proportion of well length above the Prairie Evaporite Formation with an incomplete bulk density data set is shown with different symbols.**

### 5.2.3 Calculation of Vertical Stress

In the original study area, a total of 68 bulk density logs in digital format were acquired from International Datashare Corp. (IDC) in Calgary to analyze the vertical stress magnitude at the top of the Prairie Evaporite Formation. A total of 49 bulk density logs were analyzed to calculate the vertical stress to the top of the Basal Red Beds Formation in this area. In the expanded study areas, a total of 112 bulk density logs (90 for the expanded Alberta area and 22 for the expanded Saskatchewan area) were acquired from IDC. The locations of the wells are represented as black dots in a set of colour contour plots which have been prepared to show spatial variations in the parameter. Vertical stress magnitudes and gradients were determined using the methodology outlined in Section 4.1.

A typical bulk density log through the Elk Point Group is shown in Figure 5.9. Contour plots of elevation, depth, vertical stress magnitude, and vertical stress gradient for the top of the Prairie Evaporite Formation in the complete study area are shown in Figures 5.10 and 5.11. The same plots of the Basal Red Beds Formation in the original study area are shown in Figures 5.12 and 5.13

Figure 5.10a and Figure 5.10b show that the top of the Prairie Evaporite Formation dips to the southwest and ranges from 300 to 1400 m depth below ground surface in the original study area and from 400 to 2250 m in the expanded study area. The northeast portion of the original study area is not underlain by this formation. In the expanded study area of western Saskatchewan, the top of the Prairie Evaporite dips generally towards the south. Anomalies in overburden thickness are a result of topography, subsurface salt dissolution on the northeast edge, and varying depositional environments on the southwest edge. As shown in Figure 5.11, the vertical stress at the top of the Prairie Evaporite Formation ranges from 7.4 to 31.7 MPa in the original study area and from 10.2 to 54.0 MPa in the expanded study area. The vertical stress gradient at the top of the Prairie Evaporite Formation ranges from 21.3 to 23.9 kPa/m in the original study area, decreasing towards the eastern boundary of the Prairie Evaporite Formation. The vertical stress gradient at the top of the Prairie Evaporite Formation in the expanded study area ranges from 21.5 to 24.7 kPa/m, with the lower vertical stress gradients in the northeast and the higher vertical stress gradients in the southwest. This trend is mainly a result of northeastward-thickening Quaternary and Cretaceous sediments of relatively lower density, and the increase in density of formations above the Prairie Evaporite towards the southwest.

Figure 5.12 indicates that the top of the Basal Red Beds Formation ranges from about 500 to 1700 m below ground surface in the original study area, increasing in depth towards the southwest. The northeast corner of the study area is not underlain by salt formations of the Elk Point Group and was therefore not contoured. The vertical stress at the top of this formation ranges from 13.5 to 39.1 MPa, increasing to the southwest. The vertical stress gradient at the top of the Basal Red Beds Formation in the original study area ranges from 21.3 to 23.6 kPa/m. A concentric zone of lower vertical stress gradients is evident at the top of this formation. This anomaly is associated with thicker occurrences of the relatively low-density Lotsberg and Cold Lake salt formations in this part of the original study area.

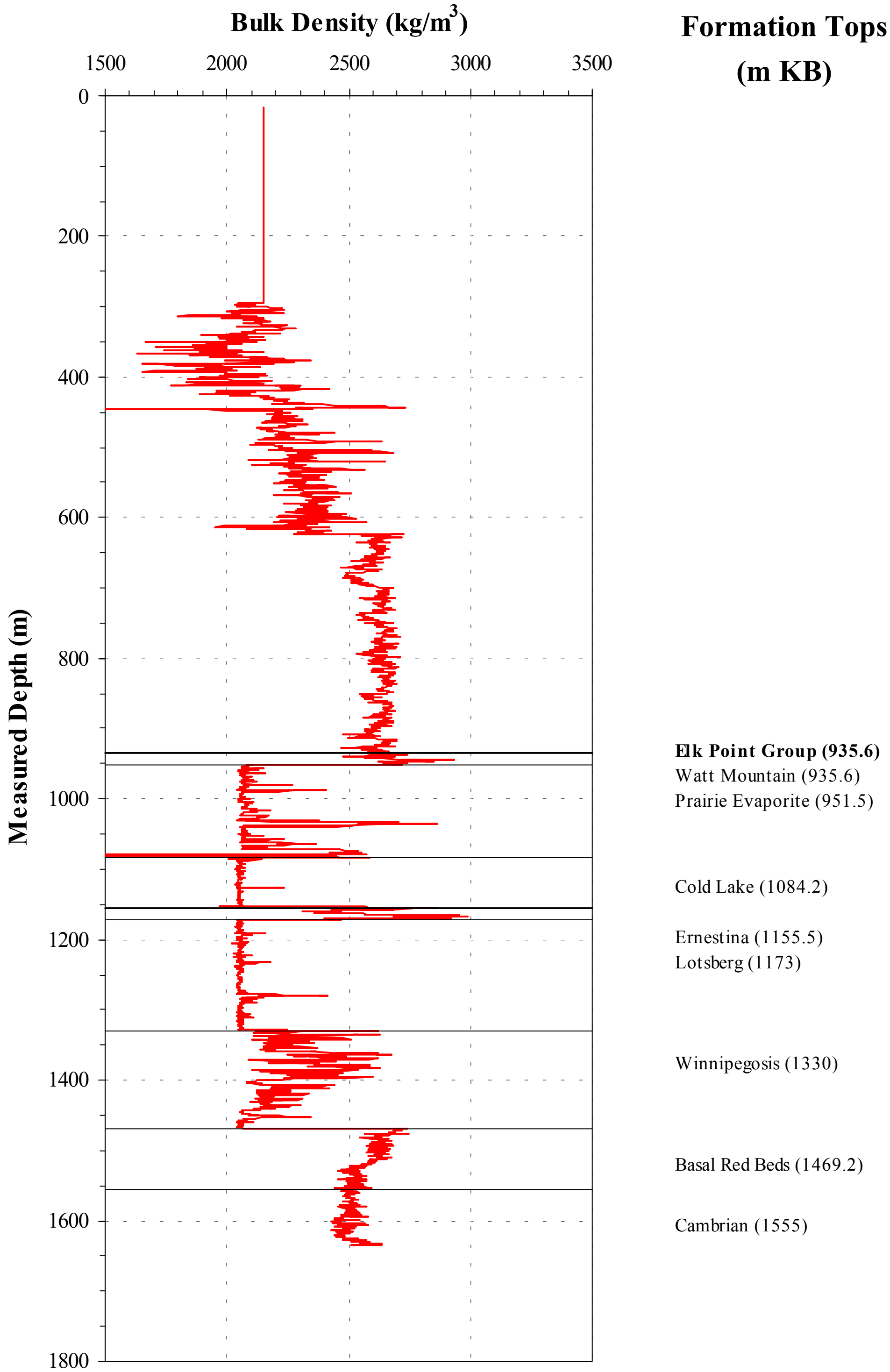



**Figure 5.9: Typical digital bulk density log data through the Elk Point Group from Saskoil Sugden 8-1-62-11W4.**

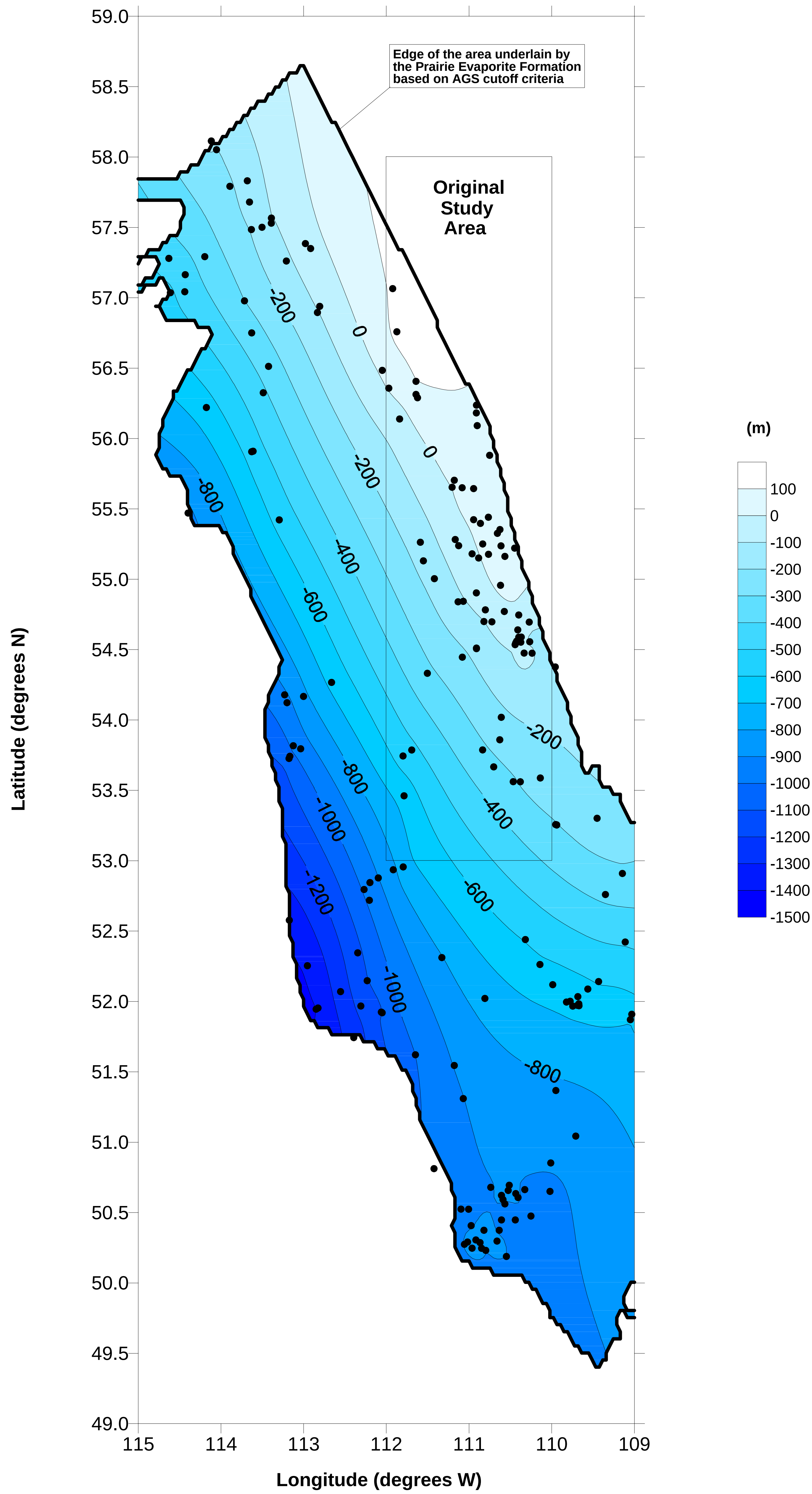



**Figure 5.10 (a): Map of original study and expanded study areas showing elevation (m) of the top of the Prairie Evaporite Formation. Wells used for elevation contours are indicated by a small black circle.**

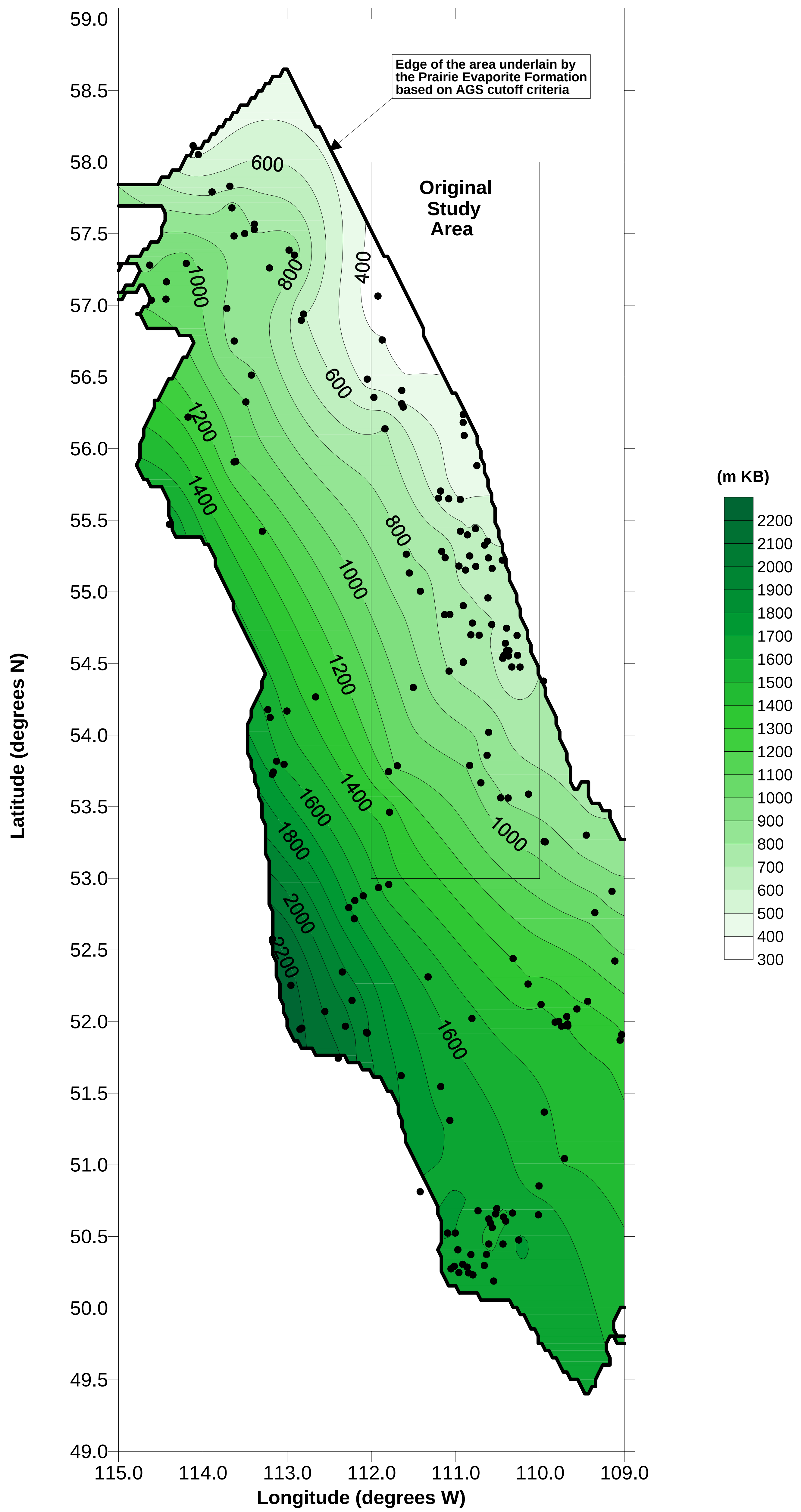



**Figure 5.10 (b): Map of original study and expanded study areas showing depth (m KB) of the Prairie Evaporite Formation. Wells used for depth contouring are indicated by a small black circle.**

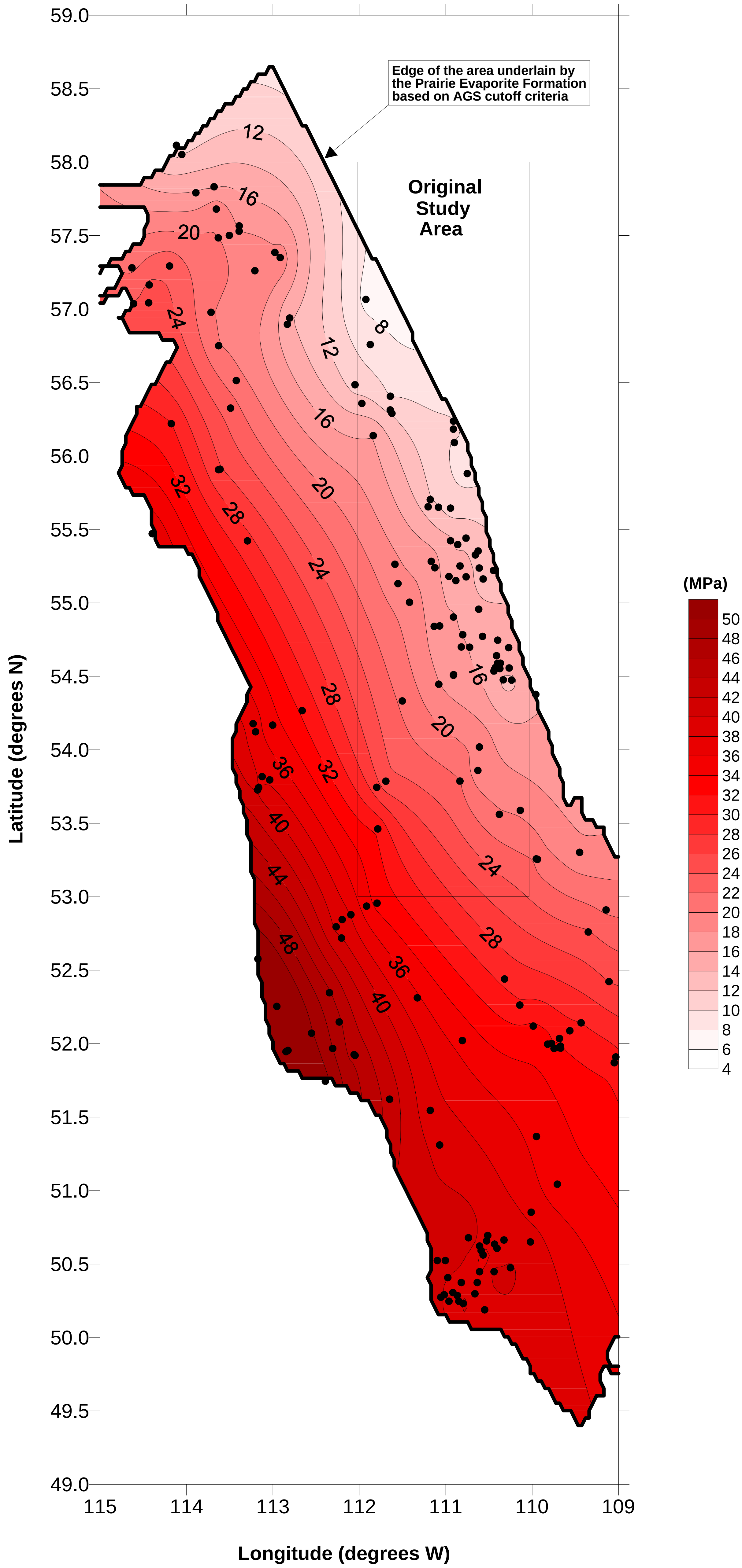



**Figure 5.11 (a): Map of original study and expanded study areas showing the vertical stress magnitude (MPa) at the top of the Prairie Evaporite Formation. Wells used in vertical stress calculations are indicated by a small black circle.**

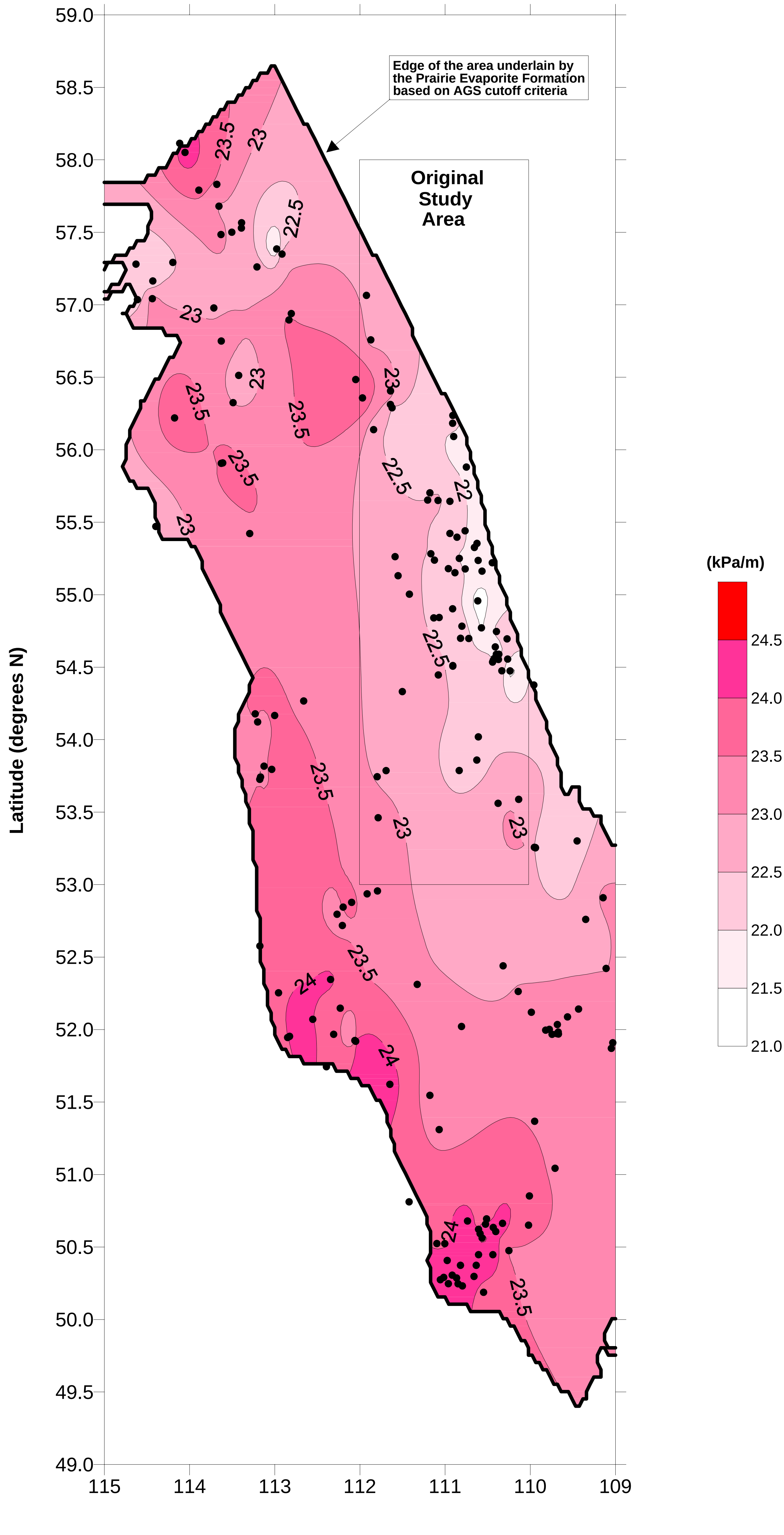



**Figure 5.11 (b): Map of original study and expanded study areas showing the vertical stress gradient (kPa/m) at the top of the Prairie Evaporite Formation. Wells used in vertical gradient calculations are indicated by a small black circle.**

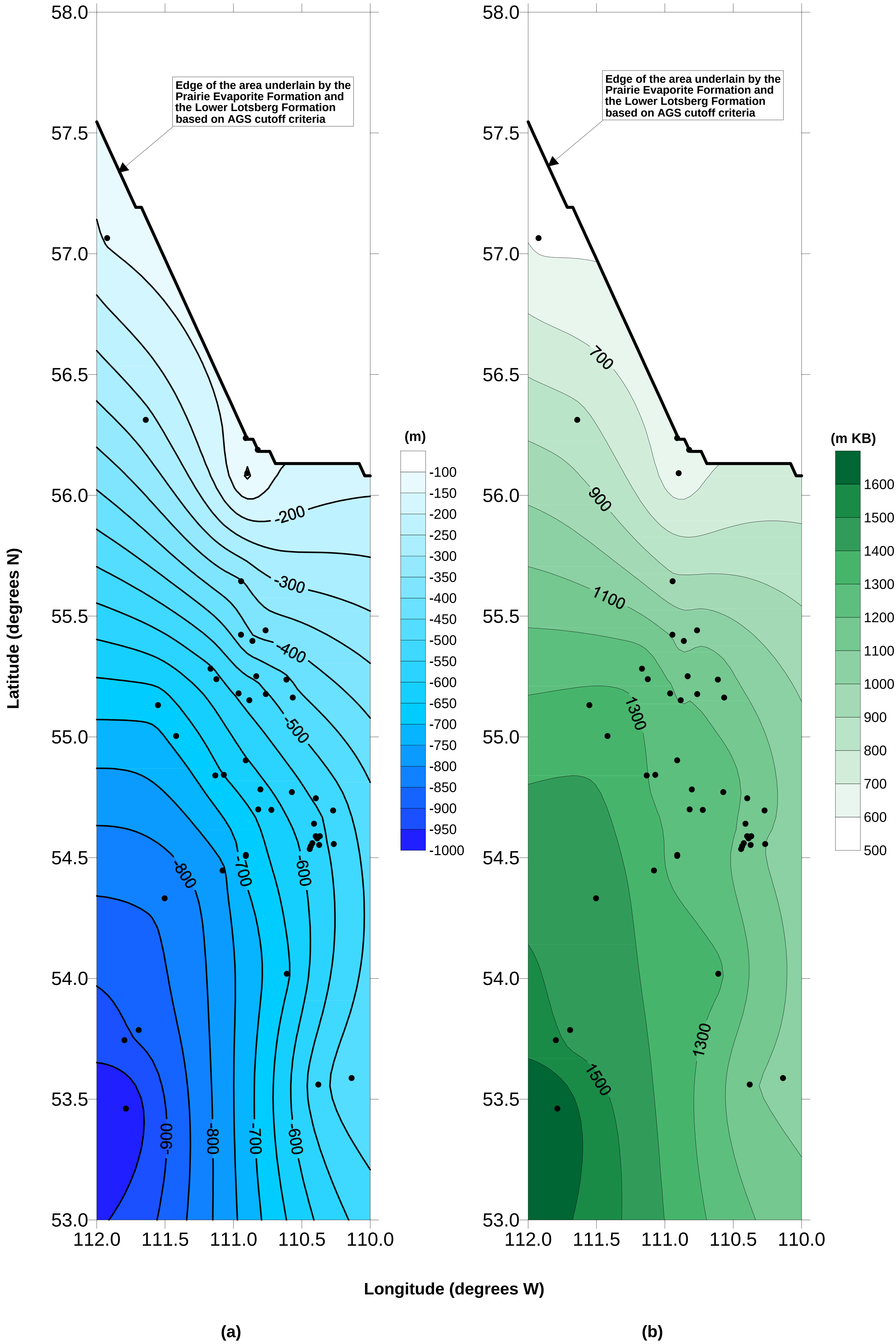



**Figure 5.12: Original study area showing (a) elevation (m) at the top of the Basal Red Beds Formation and (b) depth (m KB) to the top of the Basal Red Beds Formation. Wells used in calculations are indicated by a small black circle.**

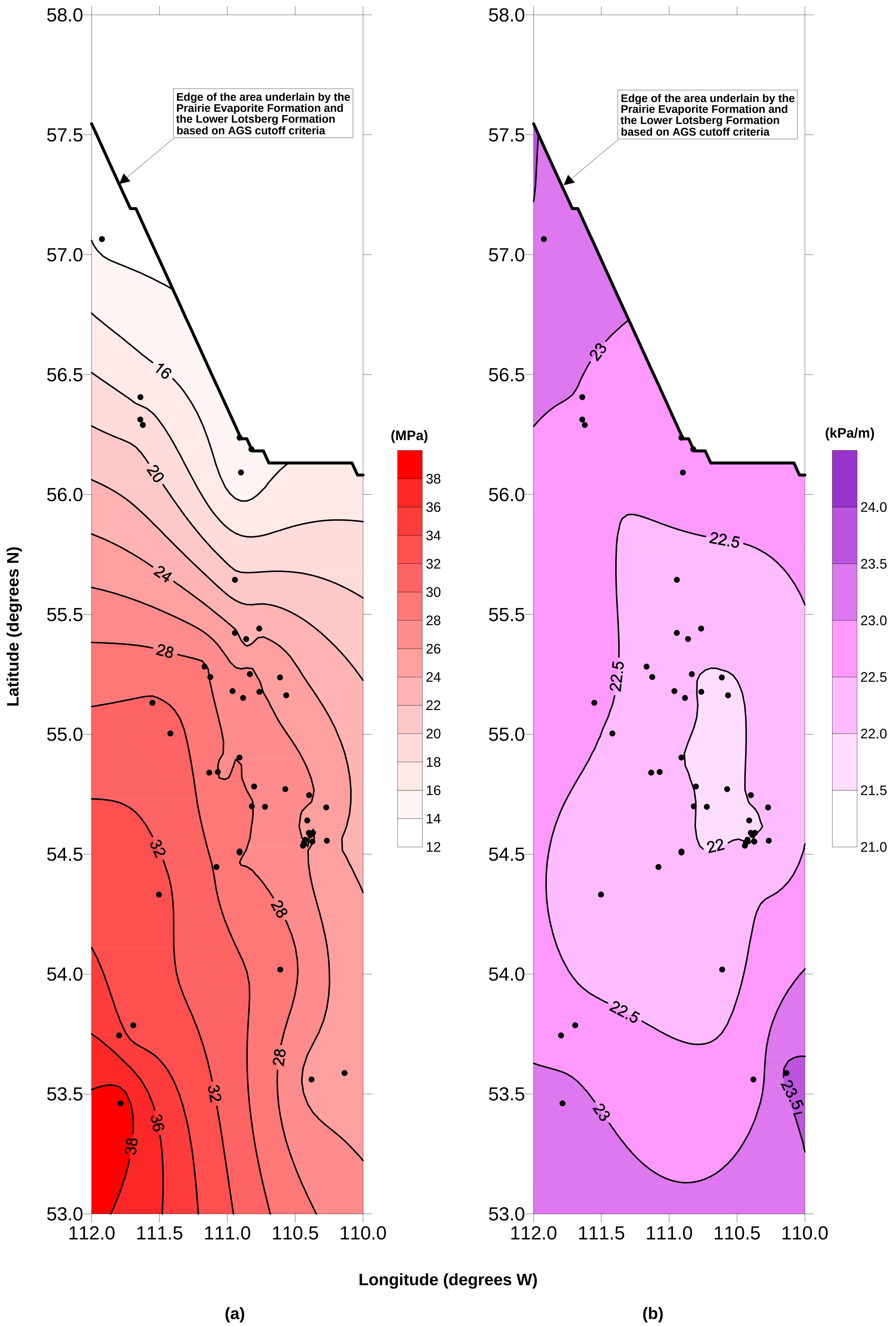



**Figure 5.13: Original study area showing (a) vertical stress magnitude (MPa) at the top of the Basal Red Beds Formation and (b) vertical stress gradient (kPa/m) at the top of the Basal Red Beds Formation. Wells used in calculations are indicated by a small black circle.**

## 5.3 Horizontal Stress Orientation

### 5.3.1 Regional Stress Data

The work of Bell et al. (1994) in the Geological Atlas of Western Canada shows that the horizontal stress trajectories over much of the Western Canada Sedimentary Basin are regionally consistent. For Paleozoic-age strata in the original and expanded study areas, there are 8 wells in the atlas with measured breakout orientations (Figure 5.14). The original study area, expanded Alberta study area, and expanded Saskatchewan study area have breakout orientations from one, six and one well(s), respectively.

A statistical summary of the borehole breakout data is given below each roseplot figure. The average minimum horizontal stress orientation of the breakout data is reported as the vector mean in the summary. The bi-directional azimuth values (0-360º) in the statistical summary were converted to unidirectional values (0-180º) within the text to simplify comparisons. For example, 330º is the same orientation as 150º since they are 180º apart. The confidence interval in the statistical summary represents the 95% confidence interval, in degrees, around the reported vector mean. In other words, one can say with 95% confidence that the breakout azimuth, and hence the minimum horizontal stress orientation is within the reported confidence interval.

The dataset of 8 atlas wells has an average minimum horizontal stress orientation of 137° with a confidence interval of 16° and with a range from 118° to 156°. Although not found in these 8 wells, some of the wells identified in the atlas also have a second population. This population is classified as subordinate or "minor" by the authors, and is generally orientated NE-SW. A roseplot showing the minimum horizontal stress orientation for these 8 wells is shown in Figure 5.15. These measurements indicate a NW-SE direction for the minimum horizontal stress for Paleozoic-age formations. Similar trends are also shown in the Mesozoic strata of the study area.

During the investigation of breakout data in the original study area, it was determined that two of the wells shown in the atlas and on Figure 5.14 for the Paleozoic-age formations in the study area are mislocated. The southernmost well (SOUTHROY JARVIE 7-4-63-26W4M) is actually located west of the original study area but within the expanded study area. The central well plotted on the map from the Atlas was missing in the summary data table in the atlas. The northernmost well (GULF RESDELN 7-24-83-7W4M) is located properly.

It is important to note that the breakouts identified in the atlas for the Paleozoic-age strata in the study area are located above the Beaverhill Lake Group, and therefore do not appear in the search results in this study for the original and expanded Alberta study areas (we had elected to look for breakouts only in the Beaverhill Lake and Elk Point Groups). Also, note that since the dipmeter search in the expanded Saskatchewan area included all Paleozoic-age formations, the one well identified in the atlas within the expanded Saskatchewan area having breakout in the Paleozoic-age formations was included in the search. However, this well did not have caliper orientation data presented on the microfiche dipmeter log provided for this study and, therefore, could not be used to determine a stress orientation.

**MESOZOIC** **PALEOZOIC**

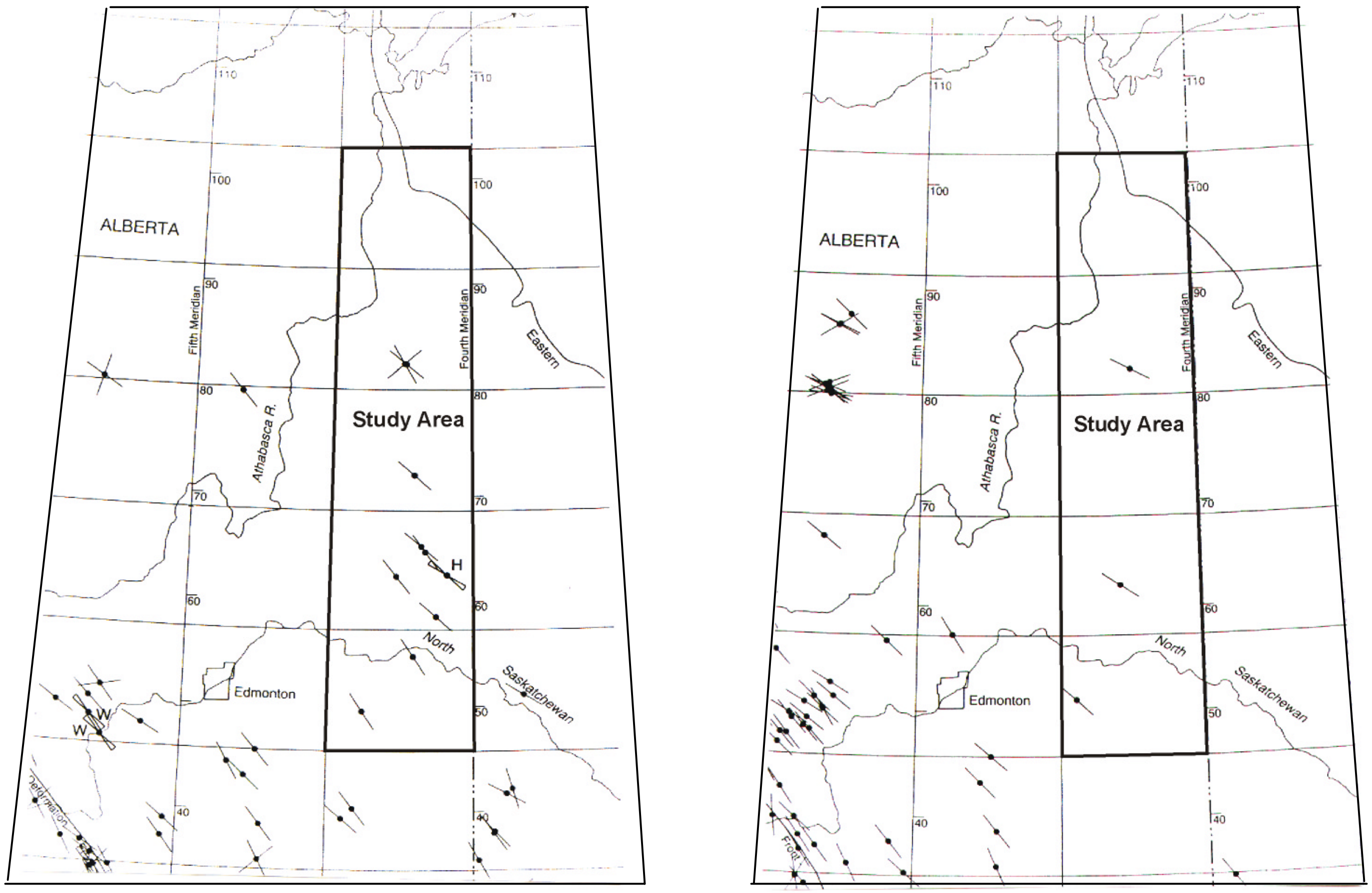
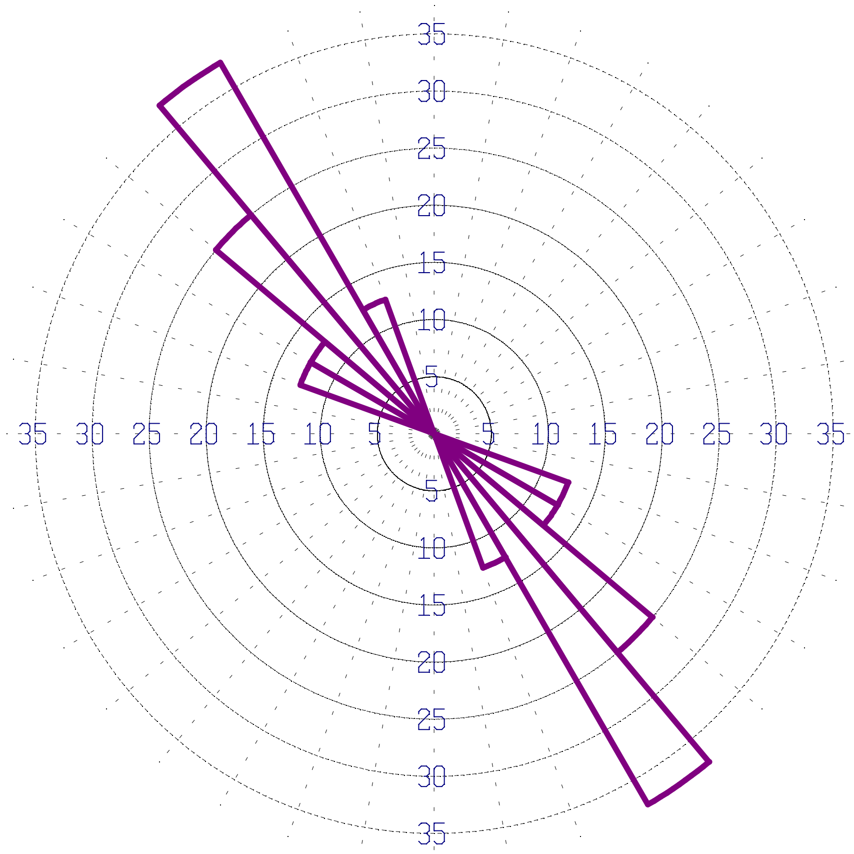



**Figure 5.14: Orientation of the minimum horizontal stress in Mesozoic and Paleozoic-age strata of the original study area (Source: Geological Atlas of the Western Canada Sedimentary Basin, Bell et al., 1994)**




**Population 1**

Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 8
Maximum Percentage ... 37.5 Percent
Mean Percentage ...... 20 Percent
Standard Deviation ... 10.54 Percent
Vector Mean .......... 317.02 Degrees
Confidence Interval .. 16.22 Degrees
R-mag ................ 0.92

**Figure 5.15: Roseplot of the minimum horizontal stress orientation from the 8 wells in the complete study area from the Geological Atlas of Western Canada, Bell et al. (1994).**

### 5.3.2 Borehole Breakout Data

Examination of microfiche logs for the 99 wells from the original study area was undertaken to determine which, if any, dipmeter logs showed borehole breakouts. Details on the dipmeter logs for each well are contained in Table B.2 of Appendix B. Table 5.5 summarizes the results of the dipmeter log review. Of the 99 wells identified, 31 did not have dipmeter logs on microfiche. Of the remaining 68 wells, the dipmeter logs from only five wells in the original study area were found to contain breakout data that could be confidently analyzed for horizontal stress orientations.

Microfiche for the dipmeter wells identified in the expanded Alberta and Saskatchewan study areas were examined to determine which dipmeter logs contained breakouts. Details on the dipmeter logs for each well are contained in Table C.2 and Table C.4 of Appendix C for the expanded Alberta and Sasktachewan study areas, respectively. Tables 5.6 and 5.7 summarize the results of the dipmeter log review for the expanded study areas. A total of 11 wells were identified that had breakouts that could be analyzed for horizontal stresses in the expanded study area.

**Table 5.5: Summary of the breakout data search results from dipmeter logs in the original study area with coverage in the Elk Point and Beaverhill Lake Groups**

| No. of Wells | Search Results |
|---|---|
| 99 | Total number of wells with dipmeter logs with some coverage in the Beaverhill Lake or Elk Point Groups within original study area |
| 31 | Wells without the dipmeter log recorded on the microfiche |
| 68 | Wells with the dipmeter log recorded on the microfiche* |
| 45 | Subset of wells without breakout within the Beaverhill Lake or Elk Point Group |
| 16 | Subset of wells without all the necessary data for breakout analysis (e.g., missing a caliper curve or caliper orientation information) |
| 2 | Subset of wells with apparent breakout caused by pipe wear or drag in a deviated hole (not included in analysis) |
| **5** | **Subset of wells with breakouts within the Beaverhill Lake or Elk Point Group (2 of which are questionable or poor quality)** |

*26 dipmeter logs from the 68 wells with dipmeter logs recorded on the microfiche were obtained from MJ Systems in Calgary, as the dipmeter logs for these wells were not recorded on microfiche provided by the AEUB.

**Table 5.6: Summary of the breakout data search results from dipmeter logs with coverage in the Elk Point Group in the expanded Alberta study area**

| No. of Wells | Search Results |
|---|---|
| 120 | Total number of wells with dipmeter logs with some coverage in the Elk Point and Beaverhill Lake Groups within expanded study area |
| 61 | Wells without the dipmeter log recorded on the microfiche |
| 47 | Wells with the dipmeter log recorded on the microfiche |
| 44 | Subset of wells without all the necessary data for breakout analysis |
| | 21 logs pre-1966 with 3-arm dipmeter caliper that do not show curves for individual calipers |
| | 23 (missing a relevant caliper or pad 1 azimuth curve) |
| 13 | Subset of wells with all curves required for breakout analysis available |
| **10** | **Wells with breakout present** |

**Table 5.7: Summary of the breakout data search results from dipmeter logs with coverage in the Paleozoic-age formations in the expanded Saskatchewan study area**

| No. of wells | Search Results |
|---|---|
| 25 | Total number of wells with dipmeter logs with > 4 m coverage in the Paleozoic-age formations in the expanded Saskatchewan study area |
| 3 | Wells without the dipmeter log recorded on the microfiche |
| 22 | Wells with the dipmeter log recorded on the microfiche |
| 16 | Subset of wells without all the necessary data for breakout analysis; missing a relevant caliper or pad 1 azimuth curve |
| 6 | Subset of wells with all curves required for breakout analysis available |
| **1** | **Wells with breakout present** |

The quality of breakout data was established using the criteria listed in Table 5.8. Of the 5 dipmeter logs containing breakouts in the original study area, two of these had breakouts of questionable or poor quality. The remaining three dipmeter logs had one good quality breakout in the Elk Point Group, and two good quality breakouts in the Beaverhill Lake

Group. There were more breakout data in the expanded area since log data were available over the thicker Elk Point Group. The details of the breakout quality for the 11 wells analyzed in the expanded area are given Table E.2 of Appendix E.

**Table 5.8: Criteria used to determine breakout quality in this study**

| Quality | Criteria |
|---|---|
| Poor | Relatively straight azimuth trace, ratty caliper(s), difference in caliper readings <4% (i.e., small enlargement) |
| Fair | Straight azimuth trace, relatively smooth caliper traces, difference in caliper readings <4% |
| Good | Straight azimuth trace, smooth calipers, difference in caliper readings >4%, C1-C3 and C2-C4 both >gauge |
| Very Good | Straight azimuth trace, smooth calipers, difference in caliper readings >4%, smaller caliper reading within 2% of gauge |

Analysis of the 16 dipmeter logs containing breakouts involved calculating the breakout azimuth and the amount of hole enlargement on a per metre basis over the length of each breakout interval. As was the case for the original data of Bell et al. (1994), most of the breakouts showed the development of only one breakout population while a few have a second population. The minor second population was filtered out between 0 and 80 degrees (NE-SW orientation) and was not included in the determination of the minimum horizontal stress orientation. The results of the breakout analyses for the original area are contained in Table D.2 with roseplots of the breakout data for each well in Figures D.2.1 to D.2.6 of Appendix D. The results of the breakout analyses for the expanded area are contained in Table E.2 with roseplots of the breakout data for each well in Figures E.2.1 to E.2.14 of Appendix E. The roseplots use an azimuth class interval of 10° and indicate the mean orientation and confidence interval for each breakout interval.

The results of the analysis of the minimum horizontal stress orientation data are summarized for each well in Figure 5.16. A summary of the minimum stress orientation for each well is also given in Table 5.9. Figure 5.17 is a roseplot for the 16 wells analyzed in the entire study area weighted by the length of the breakout interval. The average minimum horizontal stress orientation calculated from the 16 wells analyzed varies from azimuth 101° to 152°, similar to the measurements of Bell et al. (1994) in the Paleozoic-age formations. The average minimum horizontal stress orientation is 120° with a confidence interval of 5°. The average orientation of the minor population from 5 wells varies from an azimuth of 40° to 76°. The average minor population of the wells is 58° with a confidence interval of 12°.

All wells exhibiting borehole breakout in the Elk Point Group employed a salt-based mud for drilling except for the 14-9-92-4W5 well which used an oil-based mud. Since none of the wells analyzed for breakout within the Elk Point Group employed a water-based mud during drilling, one can assume that borehole enlargement was not caused by salt dissolution. This leads to confidence that the breakouts seen in the Elk Point Group were caused by stress anisotropy.

An interesting observation is the trend of a more NNW-SSE minimum horizontal stress orientation in the Elk Point Group, Beaverhill Lake Group, and Paleozoic-age formations above the Beaverhill Lake Group. The average minimum horizontal stress orientation determined in the Elk Point Group was 116° with a confidence interval of 5° (Figure 5.18). The average minimum horizontal stress orientation determined in the Beaverhill Lake Group for 114 metres of breakout was 124° with a confidence interval of 8° (Figure 5.19). The average minimum horizontal stress orientation determined from 9 wells in Paleozoic-age formations above the Beaverhill Lake Group was 139° with a confidence interval of 16° (Figure 5.20). However, Bell et al. (1993) noted that the minimum stress orientation was similar over various formations and ages. The mean of the average minimum horizontal stress orientation for all 24 wells is 129° with a confidence interval of 13° (Figure 5.21).

**Table 5.9: Summary of borehole breakout data for all 24 wells in the complete study area (8 wells from the Geological Atlas of Western Canada, Bell et al., 1994, and 16 new wells analyzed in this study)**

| No. | Well Name | Combined | | Average Population 1 | | |
|---|---|---|---|---|---|---|
| | | Average Population 1 (degrees) | Average Population 2 (degrees) | Elk Point Group (degrees) | Beaverhill Lake Group (degrees) | Above Beaverhill Lake Group (degrees) |
| 1 | Gulf Resdeln 7-24-83-7 | 118 | - | - | - | 118 |
| 2 | Southroy Jarvie 7-4-63-26 | 124 | - | - | - | 124 |
| 3 | Bearspaw et al Fenn West 8-11-36-21 | 156 | - | - | - | 156 |
| 4 | CNRL Erskine 16-24-39-21 | 142 | - | - | - | 142 |
| 5 | Guyer et al Malmo 14-10-44-22 | 135 | - | - | - | 135 |
| 6 | Altex Perl Bittern Lk 11-27-46-21 | 130 | - | - | - | 130 |
| 7 | Baytex et al FBA 14-9-58-24 | 148 | - | - | - | 148 |
| 8 | Saskoil Norcen Plover Lake 9-6-35-26 | 143 | - | - | - | 143 |
| 9 | Voyager et al Bruce 6-14-48-14 | - | 76 | - | - | - |
| 10 | AEC D1 Fisher 1-21-70-4 | 145 | - | - | 145 | - |
| 11 | AEC A8 Fisher 8-21-70-4 | 101 | - | - | 101 | - |
| 12 | AEC B3 Fisher 3-22-70-4 | 115 | - | - | 115 | - |
| 13 | AEC Fisher 6-33-70-4 | 140 | - | - | 140 | - |
| 14 | Unocal et al Trout 8-10-89-3 | 129 | 49 | 132 | 128 | - |
| 15 | Murphy Trout 9-3-89-3 | 114 | - | 114 | - | - |
| 16 | Unocal et al Kidney 9-5-91-7-4 | 134 | 74 | 109 | 140 | - |
| 17 | Unocal Kidney 10-32-90-4 | 136 | - | 127 | 136 | - |
| 18 | PCI Liege 11-8-95-22 | 130 | - | 109 | - | - |
| 19 | Dorset et al Martenck 11-12-80-5 | 109 | - | 117 | 99 | - |
| 20 | Suncor Strome 11-16-44-16 | 101 | 40 | | 102 | - |
| 21 | Murphy et al Graham 12-18-87-3 | 124 | 73 | 126 | 116 | - |
| 22 | NCE Ener Senex 14-9-92-4 | 119 | - | 119 | - | - |
| 23 | Colin et al Kidney 10-19-91-4 | 111 | - | 111 | - | - |
| 24 | Sceptre Murphy T'Flags A1-26-52-25 | 152 | - | - | - | 152 |
| | Mean of Average | 129 | 62 | 118 | 122 | 139 |

* Wells 1 to 8 from Geological Atlas of Western Canada, Bell et al, 1994
** No population 1 data for well No.9

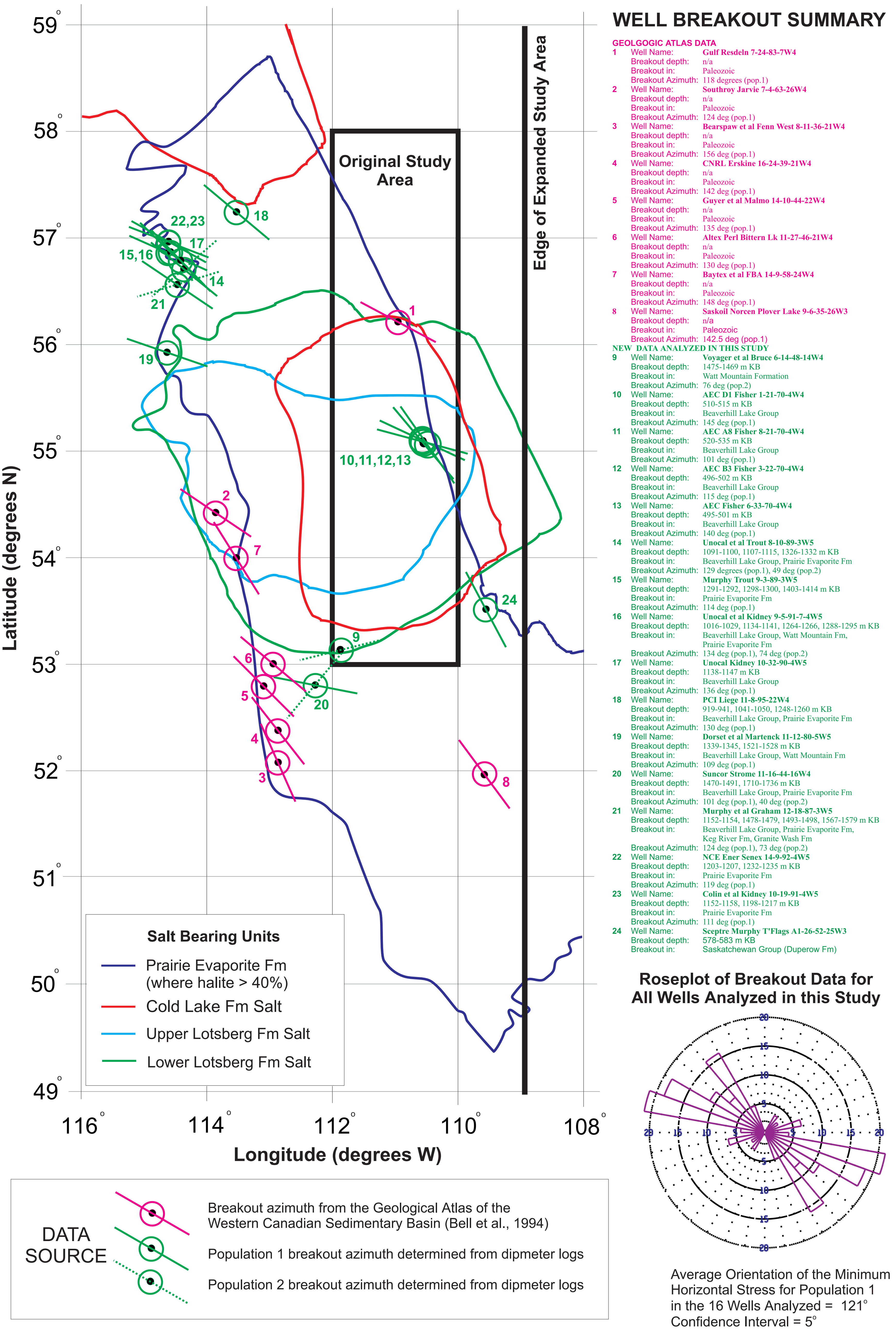
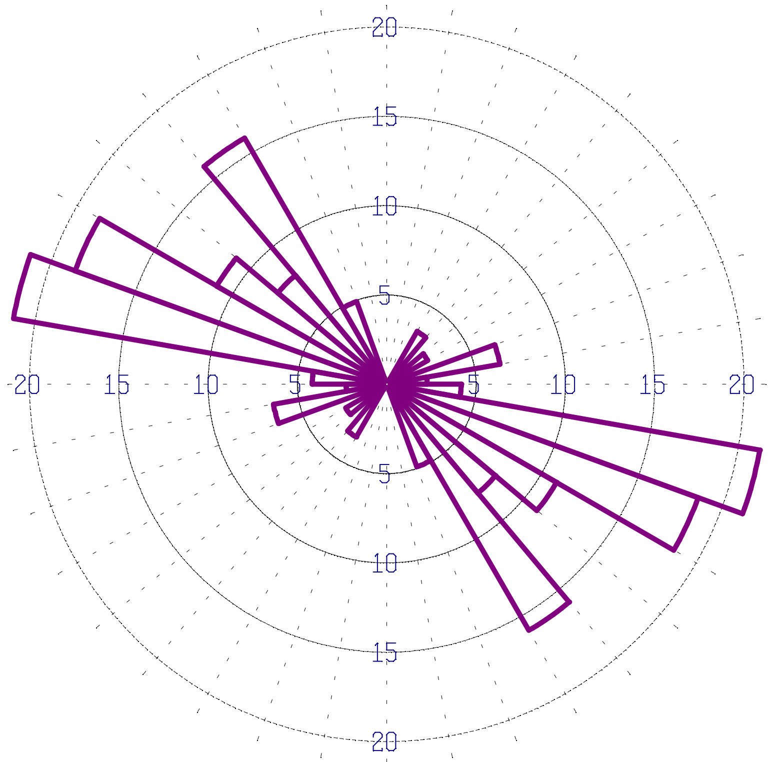



**Figure 5.16: Minimum horizontal stress orientation determined from borehole breakouts using dipmeter logs in the Paleozoic-age formations for the entire study area.**




**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Activated
Minimum Azimuth ... 80 Degrees
Maximum Azimuth ... 180 Degrees
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 222
Maximum Percentage ... 25.2 Percent
Mean Percentage ...... 12.5 Percent
Standard Deviation ... 8.57 Percent
Vector Mean .......... 300.76 Degrees
Confidence Interval .. 4.71 Degrees
R-mag ................ 0.82

**Population 2**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Activated
Minimum Azimuth ... 0 Degrees
Maximum Azimuth ... 80 Degrees
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 37
Maximum Percentage ... 45.9 Percent
Mean Percentage ...... 20 Percent
Standard Deviation ... 15.87 Percent
Vector Mean .......... 58.31 Degrees
Confidence Interval .. 11.5 Degrees
R-mag ................ 0.82

**Figure 5.17: Roseplot data of the combined borehole breakout data for all 16 wells analyzed in the study weighted by the length of the breakout interval.**

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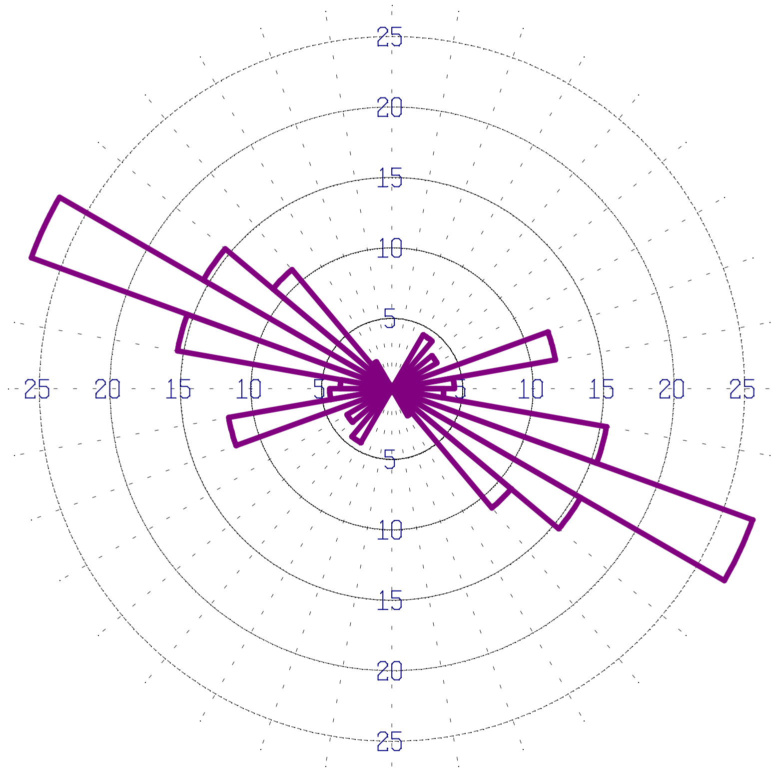
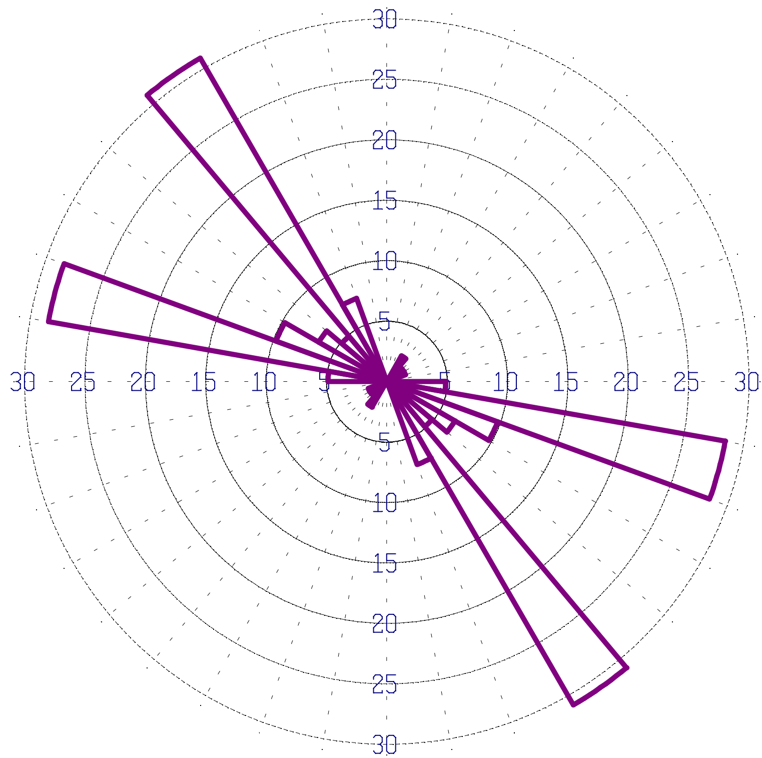



**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Activated
Minimum Azimuth ... 80 Degrees
Maximum Azimuth ... 180 Degrees
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 103
Maximum Percentage ... 35.9 Percent
Mean Percentage ...... 14.3 Percent
Standard Deviation ... 12.01 Percent
Vector Mean .......... 296.16 Degrees
Confidence Interval .. 4.79 Degrees
R-mag ................ 0.91

**Population 2**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Activated
Minimum Azimuth ... 0 Degrees
Maximum Azimuth ... 80 Degrees
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 28
Maximum Percentage ... 57.1 Percent
Mean Percentage ...... 25 Percent
Standard Deviation ... 21.09 Percent
Vector Mean .......... 61.57 Degrees
Confidence Interval .. 13.23 Degrees
R-mag ................ 0.82

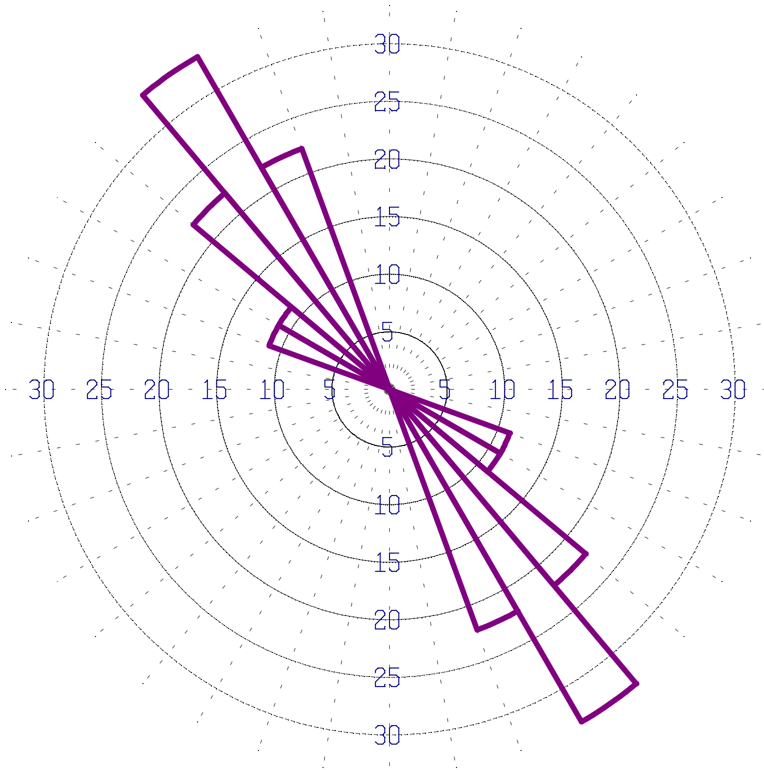
**Figure 5.18: Roseplot data of the borehole breakout data within the Elk Point Group in the 16 wells analyzed in the study weighted by length of the breakout interval.**




**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Activated
Minimum Azimuth ... 80 Degrees
Maximum Azimuth ... 180 Degrees
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 114
Maximum Percentage ... 33.3 Percent
Mean Percentage ...... 14.3 Percent
Standard Deviation ... 11.79 Percent
Vector Mean .......... 304.28 Degrees
Confidence Interval .. 7.7 Degrees
R-mag ................ 0.76

**Population 2**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Activated
Minimum Azimuth ... 0 Degrees
Maximum Azimuth ... 80 Degrees
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 9
Maximum Percentage ... 33.3 Percent
Mean Percentage ...... 20 Percent
Standard Deviation ... 8.76 Percent
Vector Mean .......... 48.83 Degrees
Confidence Interval .. 18.01 Degrees
R-mag ................ 0.89

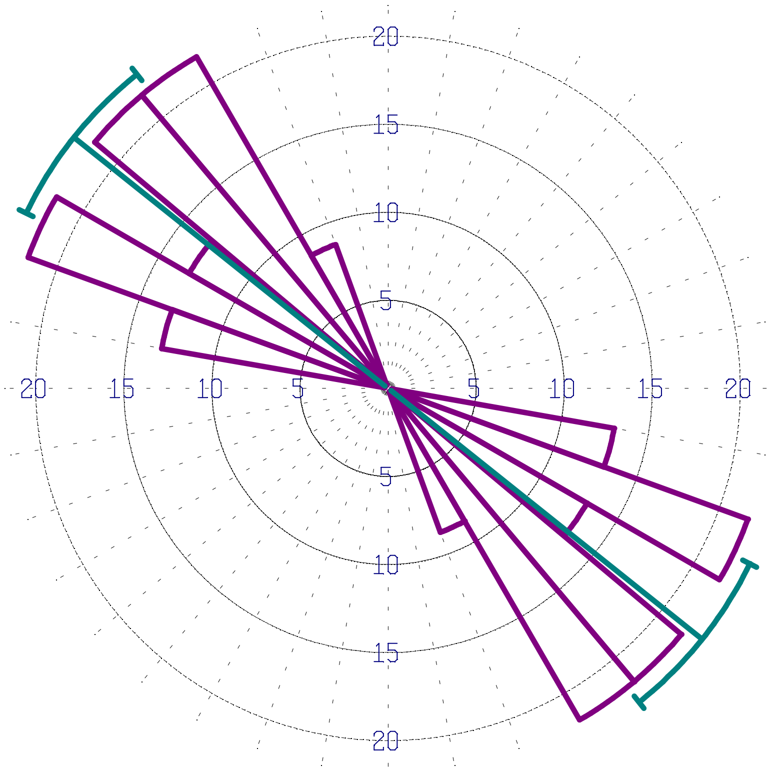
**Figure 5.19: Roseplot data of the borehole breakout data within the Beaverhill Lake Group for the 16 wells analyzed in the study weighted by length of the breakout interval.**




**Population 1**

Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 9
Maximum Percentage ... 33.3 Percent
Mean Percentage ...... 20 Percent
Standard Deviation ... 8.76 Percent
Vector Mean .......... 318.77 Degrees
Confidence Interval .. 16.2 Degrees
R-mag ................ 0.91

**Figure 5.20: Roseplot data of the average minimum horizontal stress orientation in Paleozoic-age formations above the Beaverhill Lake Group (8 wells from the Geological Atlas of Western Canada, Bell et al., 1994 and 1 well from the expanded Saskatchewan study area). Note that these breakout data are not weighted by the length of the breakout interval: A single value of the breakout azimuth irrespective of the length of breakout was assigned to each well.**




**Population 1**

Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Activated
Minimum Azimuth ... 80 Degrees
Maximum Azimuth ... 180 Degrees
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 23
Maximum Percentage ... 21.7 Percent
Mean Percentage ...... 16.7 Percent
Standard Deviation ... 5.51 Percent
Vector Mean .......... 308.61 Degrees
Confidence Interval .. 12.75 Degrees
R-mag ................ 0.86

**Figure 5.21: Roseplot data of the average minimum horizontal stress orientation determined from population 1 data for all 24 wells (16 from this study and 8 from the Geological Atlas of the Western Canadian Sedimentary Basin).**

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### 5.4 Horizontal Stress Magnitudes

#### 5.4.1 Formation Leak-off Test and Hydraulic Fracture Data

Formation leak-off test (FLOT) data in the original Phase 1 study area was provided by Dr. Matt Grobe (AGS) in conjunction with the AEUB in Calgary. Of the 10 tests provided to AGI none are below 500 m depth. As shown in Figure 5.22, there is considerable scatter in the data. We do not believe that these data are of high value for estimating the horizontal stress magnitudes in or adjacent to the Elk Point Group. Following discussion of the Phase 1 search results with AGS, it was decided that formation leak-off test data would not be examined further in subsequent phases of the study.

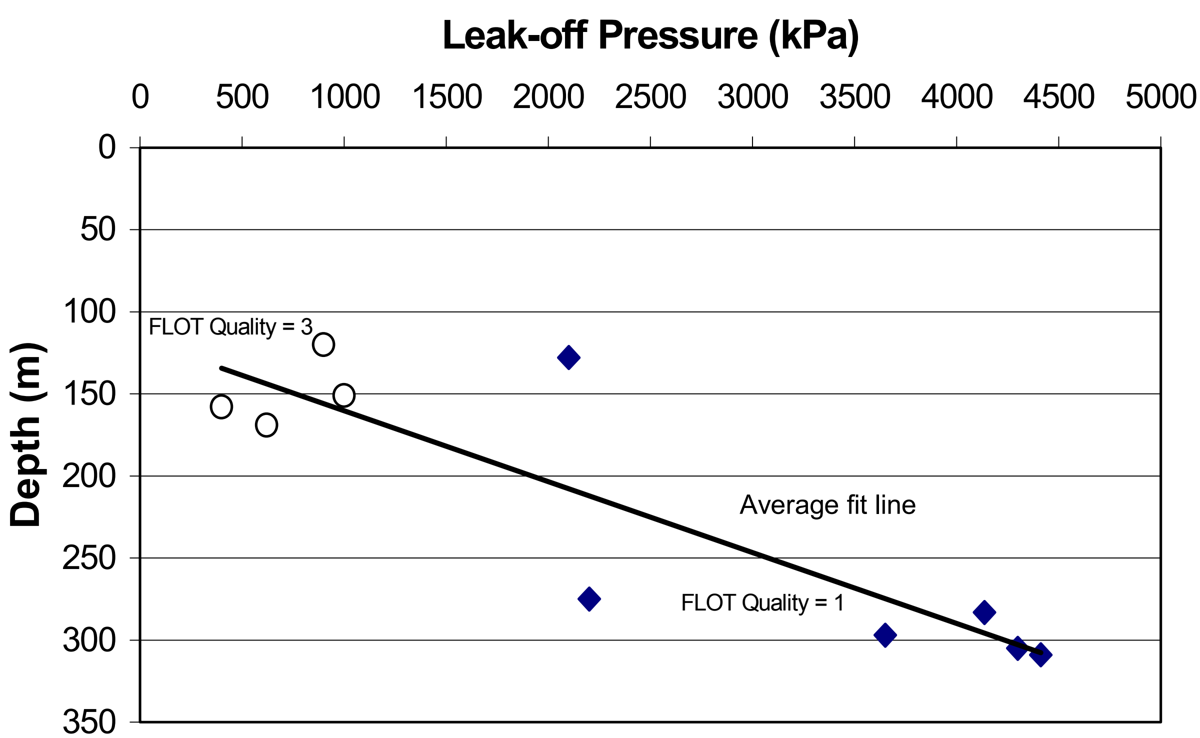


**Figure 5.22: Summary of formation leak-off test data in the original study area that were provided by the AGS.**

There were no publicly-available hydraulic fracture data identified in the original study area. Data of this type may be available for purchase from selected service or operating companies, but would require considerable effort and cost to locate, process and analyze. These tasks were beyond the scope of the current study, but could be conducted at some later date.

Without good quality data from either formation leakoff tests or hydraulic fracture tests, there is not enough information available to confidently estimate variations in the magnitude of the minimum horizontal stress in the original or expanded study areas. In the absence of hard data, and given the propensity of salt to creep over geologic time, a first-order estimate of the magnitude of the mean horizontal stress would be a value equal to the vertical stress.

### 5.4.2 Back-Analysis of Horizontal Stress Ratios from Borehole Breakouts

A back-analysis of borehole breakouts in Voyager et al Bruce 6-14-48-14W4 was conducted using AGI's STABView borehole stability software (Advanced Geotechnology Inc., 2000) to investigate whether the horizontal stress ratio can be estimated from caliper data (Figure 5.23). McLellan et al. (1999) demonstrated how back-analysis procedures can be used to estimate the best-fit horizontal stresses to match enlarged hole ellipticity observed on caliper logs. Caliper measurements in the Voyager 6-14 well indicate an average hole ellipticity (major to minor axis ratio, a/b) of about 1.07 for the interval from 1459 to 1475 m KB. Note that inverse modelling does not determine a unique solution for the horizontal in-situ stress ratio, so a range of results is given.

Estimates of rock mechanical properties were obtained from compressional sonic logs, giving a peak cohesion value of 6 to 7 MPa, and peak friction angle from 30 to 40°. The ratio of maximum to minimum horizontal stress was calculated to fall between 1.24 to 1.37. These values are dependent on the rock strength properties in the interval and assume that the entire yielded zone predicted by STABView detaches to create the breakout. Better stress ratio estimates can be obtained when rock mechanical properties are measured on core samples or determined from logs and minimum horizontal in-situ stresses are interpreted from extended leak-off or minifrac tests. Back-analysis of borehole breakouts was not conducted for Phase 3 of this study.

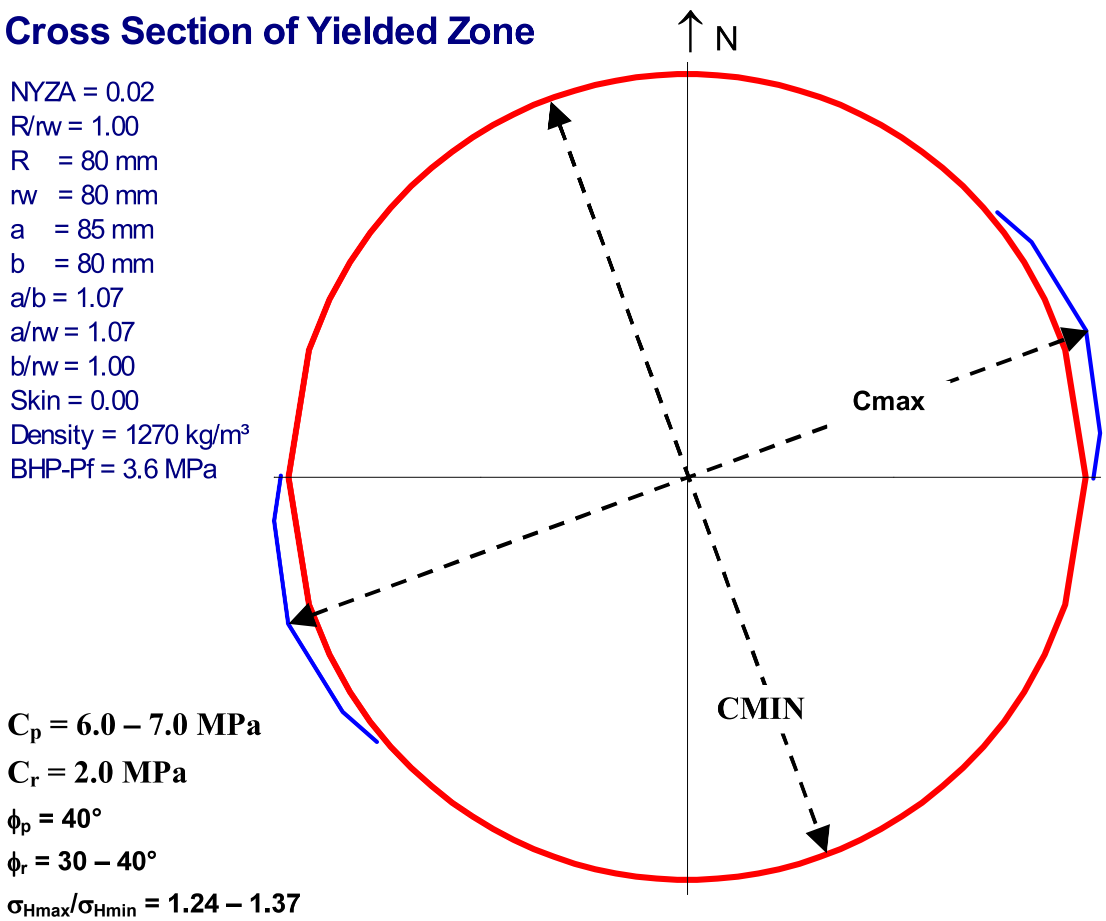


**Figure 5.23: Back–analysis of a borehole breakout to estimate the horizontal stress ratio using Advanced Geotechnology's STABView software. Breakout data are from 1459 to 1475 mKB in the Watt Mountain Formation, Voyager et al. Bruce 6-14-48-14W4.**

# 6. DISCUSSION OF RESULTS

A three phase investigation was undertaken to quantify in-situ stresses in and adjacent to salt formations of the Elk Point Group. Phase 1 included: (1) a literature review on the subject of stresses and rock mechanical properties in salt, (2) data compilation and review for the original study area. Phase 2 included: (1) analysis of data from the original study area, and (2) data compilation and review for an expanded Alberta study area. Phase 3 included: (1) analysis data from the expanded Alberta study area, (2) compilation, review and analysis of data from the expanded Saskatchewan study area and (3) compilation of the results from all three phases.

## 6.1 Literature Review

The literature review shows that the geomechanical behaviour of salt adjacent to underground openings is complex, often involving brittle fracturing near the opening resulting from elastic deformation, and creep deformation in a zone around the opening. Creep deformation dominates the long-term response under deviatoric stress conditions. Creep rates are a function of many parameters and can vary widely from one setting to the next, or from one salt to the next. Because the factors controlling creep deformation are formation-specific and depth-specific, the relevant creep response parameters of the salt formations of interest are best-determined on well-preserved core samples in controlled laboratory tests. Tests of this type have been undertaken on salt and potash samples at the University of Saskatchewan, the University of Manitoba, and by the mining industry in Saskatchewan. Anecdotal evidence (A. Coode, IMC Colonsay) suggests that creep rates for potash can be 5 to 8 times greater than those for halite in some Saskatchewan settings.

Although there have been numerous rock mechanical tests conducted on potash that are described in published literature, there were no reported rock mechanical properties on halite from the Elk Point Group identified in the literature review. One shear strength value of 21 MPa (believed to be either an unconfined or triaxial compressive strength value) for the Upper Lotsberg Formation is contained in Northwestern Utilities Ltd.'s AEUB application 820504. In general, published values for elastic deformation properties of salt do not vary over a wide range, but strength parameters vary considerably for different salts.

Of the AEUB applications related to salt cavern development that were reviewed, none contained specific cavern geotechnical design parameters. Solution mining is the only reported method employed for cavern development, using either a single or two-hanging string approach to control cavern geometry. Large caverns of this type for gas and liquid petroleum storage or oily waste disposal are common in the Lotsberg Formation in the Fort Saskatchewan area, the Prairie Evaporite Formation near Lloydminster, and the Elk Point Group salt near the Hardisty area. Upper limit operating pressures and cavern spacing are selected to avoid fracturing of the salt formation, and lower limit operating pressures are selected to avoid excessive creep closure during drawdown. Cavern diameters up to 80 m have been approved in Alberta (e.g., Northwestern Utilities Ltd., AEUB application no. 830529).

## 6.2 Data Review

There were no suitable formation leakoff or hydraulic fracture test data identified in the public domain for analyses of minimum horizontal stress magnitudes in the original study area. Core from the original and expanded study areas is available for analysis using paleomagnetic orientation methods to supplement the information from dipmeter logs on horizontal stress orientation.

In the original study area, 65 wells were used to determine the vertical stress at the top of the Prairie Evaporite Formation and 49 wells were used to determine the vertical stress at the top of the Basal Red Beds Formation. In the expanded study area, 112 wells were used to determine the vertical stress at the top of the Prairie Evaporite Formation (90 from the expanded Alberta study area and 22 from the expanded Saskatchewan study area).

In total, there were 24 minimum stress orientations available in the complete study area for Paleozoic-age formations (8 from the Geological Atlas of the Western Canadian Sedimentary Basin and 16 from this report). This includes 9 wells with minimum stress orientation determined in formations above the Beaverhill Lake Group, 10 wells with minimum stress orientation determined within the Beaverhill Lake Group, and 9 wells with minimum stress orientation determined within the Elk Point Group.

## 6.3 Analysis of Vertical Stresses

The analysis of bulk density log data provided estimates of the vertical stresses and vertical stress gradients at the top of the Prairie Evaporite Formation in the original and expanded study area. The analysis of bulk density data provided estimates of the vertical stresses and vertical stress gradients at the top of the Basal Red Beds Formation (which were used to define the bottom of the Elk Point Group) in the original area. The vertical stress ranged from 13.5 to 39.1 MPa at the top of the Basal Red Beds in the original study area. The vertical stress gradient at the top of the Basal Red Beds Formation in the original study area ranges from 21.3 to 23.6 kPa/m. A concentric zone of lower vertical stress gradient is evident at the top of this formation. This anomaly is associated with thicker occurrences of the relatively low-density Lotsberg and Cold Lake Formations in this region of the original study area.

Contour plots indicate that the vertical stress at the top of the Prairie Evaporite Formation ranges from 7.4 to 31.7 MPa in the original study area and from 10.2 to 54.0 MPa in the expanded area. The vertical stress gradient at the top of the Prairie Evaporite Formation ranges from 21.3 to 23.9 kPa/m in the original study area, decreasing towards the eastern boundary of the Prairie Evaporite Formation. The vertical stress gradient at the top of the Prairie Evaporite Formation in the expanded study area ranges from 21.5 to 24.7 kPa/m, with the lower vertical stress gradients being in the NE and the higher vertical stress gradients being in the SW. This trend may be a result of northeastward-thickening Quaternary or Cretaceous deposits of relatively low density, and the increase in density of formations above the Prairie Evaporite towards the SW. Despite sparse data coverage in some parts of the study area such as the Wood Buffalo National Park, the contour plots for the vertical stress and the vertical stress gradient are considered representative of in-situ conditions.

## 6.4 Analysis of Horizontal Stresses

The horizontal stress orientations calculated from breakouts in the study area generally agree with those from the Geological Atlas of Western Canada (Bell et al., 1994), although there were some data inconsistencies noted in the atlas.

The dataset of 8 wells from the Geological Atlas of the Western Canadian Sedimentary Basin has an average minimum stress orientation of 137° (confidence interval 16°) with a range from 118° to 148°. The average minimum horizontal stress orientation determined from the 16 wells analyzed in this report is 120° with a confidence interval of 16° with a range from azimuth 101° to 152°, similar to the atlas measurements in the Paleozoic-age formations. It is important to note that the dataset from the Atlas was from Paleozoic-age formations above the Beaverhill Lake Group whereas 15 of the 16 wells analyzed in this report had breakouts from the Beaverhill Lake Group and/or Elk Point Groups. The average minimum horizontal stress orientation for all 24 wells is 129° with a confidence interval of 13°.

A rotation of the minimum horizontal stress in the upper Paleozoic formations to a more NNW – SSE orientation can be seen in the dataset. The average minimum horizontal stress orientation determined in the Elk Point Group was 116° (confidence interval 5°), the average minimum horizontal stress orientation determined in the Beaverhill Lake Group was 124° (confidence interval 8°), and the average minimum horizontal stress orientation determined in other Paleozoic formations above the Beaverhill Lake Group was 139° (confidence interval 16°). Bell et al. (1993) note, that in general, the minimum stress orientation was similar over most formations of a variety of ages.

Deviatoric horizontal stresses result in a non-uniform distribution of compressive stresses at the periphery of an underground opening. This may in turn effect localized brittle damage and non-uniform creep rates at different locations around the opening. If knowledge of the deviatoric stress magnitude is deemed necessary for cavern design, privately-held hydraulic fracture test data could possibly be accessed. Small volume, controlled micro-fracture tests are recommended prior to cavern development to obtain site-specific design data.

STABView software was used to back analyze the range of horizontal in-situ stress ratios possible for a breakout in one well in the study area. However, because there were no publicly-available data on the magnitude of the minimum horizontal in-situ stress, the absolute magnitudes of the two horizontal stresses in the original study area are not known. To reduce the uncertainty in this type of stress ratio prediction, the mechanical properties of the rock in question should be determined from cores or calculated from sonic logs.

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# APPENDIX A

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## APPENDIX A: Bibliography on Salt Geomechanics (March 1, 2001)



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**Author(s)** Munson, Darrell E. Sandia National Laboratories,
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**Title** Development and validation of a predictive technology for creep closure of underground rooms in salt.
**Author(s)** Sandia National Laboratories, Munson, Darrell E.
**Pubdate** October 1990
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**Author(s)** Sandia National Laboratories, Munson, Darrell E.
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**Author(s)** Sandia National Laboratories, Morgan, Harold S.
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**Author(s)** Sandia National Laboratories, Brodsky, Nancy S.
**Pubdate** January 1991
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**Author(s)** Sandia National Laboratories, Daemen, Jaak Joseph K.
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**Author(s)** Sandia National Laboratories, Argüello, Jose Guadalupe,
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**Author(s)** Sandia National Laboratories, Munson, Darrell E.
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**Title** The Effect of brine on the creep of WIPP salt in laboratory tests.
**Author(s)** Sandia National Laboratories, Brodsky, Nancy S.
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**Title** Measured and calculated closures of open and brine filled shafts and deep vertical boreholes in salt
**Author(s)** Munson, Darrell E. Sandia National Laboratories,
**Pubdate** December 1991
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**Title** Changes in rock salt permeability due to nearby excavation.
**Author(s)** Sandia National Laboratories, Stormont, John C.
**Pubdate** July 1991
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**Title** Experimental and modeling results for reconsolidation of crushed natural rock salt under varying physical conditions.
**Author(s)** Sandia National Laboratories, Zeuch, David Henry
**Pubdate** November 1991
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**Author(s)** Sandia National Laboratories, Munson, Darrell E.
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**Author(s)** Sandia National Laboratories, Munson, Darrell E.
**Pubdate** January 1993
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**Title** Two and three dimensional scaled tests of a constitutive model for salt creep.
**Author(s)** Sandia National Laboratories, Munson, Darrell E.
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**Title** The effect of brine injection on the creep of WIPP salt during laboratory tests.
**Author(s)** Sandia National Laboratories, Brodsky, Nancy S.
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**Title** Computational implementation of the multi-mechanism deformation coupled fracture model for salt.
**Author(s)** Sandia National Laboratories, Koteras, James Richard
**Pubdate** December 1995
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**Title** Computational implementation of the multi-mechanism deformation coupled fracture model for salt.
**Author(s)** Sandia National Laboratories, Koteras, James Richard
**Pubdate** March 1996
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND95-2983C
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**Title** Comparison between predicted and measured south drift closures at the WIPP using a transient creep model for salt.
**Author(s)** Sandia National Laboratories, Munson, Darrell E.
**Pubdate** 1985
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**Title** Computational implementation of the multi-mechanism deformation coupled fracture model for salt.
**Author(s)** Sandia National Laboratories, Koteras, James Richard
**Pubdate** March 1996
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**Title** Three dimensional finite element simulations of room and pillar mines in rock salt.
**Author(s)** Sandia National Laboratories, Hoffman, Edward L.
**Pubdate** March 1996
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**Title** Using three dimensional structural simulations to study the interactions of multiple excavations in salt.
**Author(s)** Sandia National Laboratories,
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| **Title** | Using three dimensional structural simulations to study the interactions of multiple excavations in salt. |
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| **Title** | Micromechanics and homogenization techniques for analyzing the continuum damage of rock salt. |
| **Author(s)** | Sandia National Laboratories, DeVries, Kerry L. |
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| **Author(s)** | Sandia National Laboratories, Pfeifle, Tom W. |
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| **Call Number** | USGS-OFR-79-1133 |

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| **Title** | Experimental determination of the relationship between permeability and microfracture-induced damage in bedded salt. |
| **Author(s)** | Sandia National Laboratories, Pfeifle, Tom W. |
| **Pubdate** | February 1998 |
| **Location** | WIPP Library |
| **Call Number** | SAND98-0411C |
| **Location** | Nuclear Waste Management Programs Library |
| **Call Number** | SAND98-0411C |
| **Location** | Technical Library/NM |

**Call Number** SAND98-0411C

**Title** Application of isochronous healing curves in predicting damage evolution in salt structure.
**Author(s)** Sandia National Laboratories, Chan, Kwai S.
**Pubdate** February 1998
**Location** WIPP Library
**Call Number** SAND97-3146J
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND97-3146J
**Location** Technical Library/NM
**Call Number** SAND97-3146J

**Title** Rock mechanics models evaluation report.
**Author(s)** Fluor Technology, Inc. Morrison-Knudsen Engineers, Inc.
**Pubdate** August 1987
**Location** Nuclear Waste Management Programs Library
**Call Number** DOE/CH/46656-09
**Location** Nuclear Waste Management Programs Library
**Call Number** DOE/CH/46656-09

**Title** A study of the extent of the disturbed rock zone surrounding long-term excavations in rock salt.
**Author(s)** Sandia National Laboratories, Miller, Joel D.
**Pubdate** August 1998
**Location** WIPP Library
**Call Number** SAND98-1755A
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND98-1755A
**Location** Technical Library/NM
**Call Number** SAND98-1755A

**Title** Assessing the disturbed rock zone (DRZ) around an eight hundred meter vertical shaft in salt using ultrasonic waves.
**Author(s)** Sandia National Laboratories, Holcomb, David Joseph
**Pubdate** February 1999
**Location** Technical Library/NM
**Call Number** SAND99-0442A

**Title** Numerical modeling of deformation in salt basins : technical report /
**Author(s)** Battelle Memorial Institute. Chang, C. Y. Battelle Memorial Institute.
**Pubdate** [1987]
**Location** Nuclear Waste Management Programs Library
**Call Number** BMI/ONWI-649

**Title** Surface displacements and pillar stresses associated with nuclear waste disposal in salt.
**Author(s)** MINNESOTA UNIV., MINNEAPOLIS Hardy, M. P. Union Carbide Corporation.
**Pubdate** June 1977
**Location** Nuclear Waste Management Programs Library
**Call Number** Y/OWI/SUB-7118/P1

**Title** Comparison and evaluation of field and numerical results from the Site A heater test at Avery Island
**Author(s)** RE/SPEC Inc. Wagner, Ralph A. Battelle Memorial Institute.
**Pubdate** [1985].
**Location** Nuclear Waste Management Programs Library
**Call Number** ONWI-300

**Title** Computation of the extent of the disturbed rock zone surrounding long-term excavations in rock salt.
**Author(s)** Sandia National Laboratories, Miller, Joel D.
**Pubdate** April 1999
**Location** WIPP Library
**Call Number** SAND99-0858A
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND99-0858A
**Location** Technical Library/NM
**Call Number** SAND99-0858A

**Title** NWTS in situ test needs workshop : August 29/30, 1978.
**Author(s)** NWTS In Situ Test Needs Workshop Dames & Moore.
**Pubdate** 1978.
**Location** Nuclear Waste Management Programs Library
**Call Number** ONWI-7

**Title** Parametric study involving thermo/viscoelastic analyses of a room and pillar configuration : technical report /
**Author(s)** Battelle Memorial Institute. Wagner, Ralph A. Battelle Memorial Institute.
**Pubdate** 1983.
**Location** Nuclear Waste Management Programs Library
**Call Number** ONWI-115

**Title** Key geomechanics issues at the Waste Isolation Pilot Plant.
**Author(s)** Sandia National Laboratories, Hansen, Francis D.
**Pubdate** June 1999
**Location** WIPP Library
**Call Number** SAND99-1281C
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND99-1281C
**Location** Technical Library/NM
**Call Number** SAND99-1281C

**Title** Critical parameters for a high-level waste repository.
**Author(s)** United States. Binnall, E. P. Lawrence Livermore Laboratory.
**Pubdate** 1985-1987.
**Location** Nuclear Waste Management Programs Library
**Call Number** NUREG/CR-4161, v.1
**Location** Nuclear Waste Management Programs Library
**Call Number** NUREG/CR-4161, v.2
**Location** Nuclear Waste Management Programs Library
**Call Number** NUREG/CR-4161, v.3

**Title** Assessing the disturbed rock zone (DRZ) around a 655 meter vertical shaft in salt using ultrasonic waves : an update.
**Author(s)** Sandia National Laboratories, Hardy, Robert Douglas
**Pubdate** February 2000
**Location** Technical Library/NM
**Call Number** SAND2000-0668C

**Title** Low temperature creep mechanics in rock salt.
**Author(s)** Sandia National Laboratories, Wawersik, Wolfgang R.
**Pubdate** September 1982

**Location** Nuclear Waste Management Programs Library
**Call Number** SAND82-2071A
**Location** Technical Library/NM
**Call Number** SAND82-2071A

**Title** The Effect of a random variation of rock salt creep on closure calculations for an excavated opening in a complex stratigraphy.
**Author(s)** Sandia National Laboratories, Branstetter, Linda J.
**Pubdate** September 1982
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND82-2256A
**Location** Technical Library/NM
**Call Number** SAND82-2256A

**Title** Using hydraulic fracturing and mineback to determine in situ stresses in rock salt.
**Author(s)** Sandia National Laboratories, Wawersik, Wolfgang R.
**Pubdate** April 1988
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND88-1113A
**Location** Technical Library/NM
**Call Number** SAND88-1113A

**Title** Three-dimensional finite element simulation of creep deformation in rock salt.
**Author(s)** Sandia National Laboratories, Weatherby, Joe Randall
**Pubdate** March 1993
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND92-1537C
**Location** Technical Library/NM
**Call Number** SAND92-1537C

**Title** Recursive adaptive meshing and discrete fracture modeling in rock salt.
**Author(s)** Sandia National Laboratories, Chieslar, Jack D.
**Pubdate** September 1992
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND92-1628A
**Location** Technical Library/NM
**Call Number** SAND92-1628A

**Title** Creep rupture of rock salt
**Author(s)** Munson, Darrell E. Sandia National Laboratories,
**Pubdate** February 1994
**Location** Technical Library/NM
**Call Number** SAND93-3902J

**Title** A Constitutive model for representing coupled creep, fracture, and healing in Rock Salt.
**Author(s)** Sandia National Laboratories, Chan, Kwai S.
**Pubdate** January 1996
**Location** Technical Library/NM
**Call Number** SAND95-1150A

**Title** Buoyancy flow in fractured rock with a salt gradient in the groundwater--an initial study /
**Author(s)** Swedish Nuclear Fuel and Waste Management Company (SKB), Claesson, Johan Lund University.
**Pubdate** February 1992.
**Location** Nuclear Waste Management Programs Library

**Call Number** SKB-TR-92-05

**Title** Buoyancy flow in fractured rock with a salt gradient in the groundwater : a second study of coupled salt and thermal buoyancy /
**Author(s)** Swedish Nuclear Fuel and Waste Management Company (SKB), Claesson, Johan Lund University.
**Pubdate** November 1992.
**Location** Nuclear Waste Management Programs Library
**Call Number** SKB-TR-92-41

**Title** Brine migration test : Asse Salt Mine, Federal Republic of Germany : final report /
**Series** GSF-Bericht ;
**Author(s)** GSF - Gesellschaft für Strahlen- und Umweltforschung München Rothfuchs, T. Battelle Memorial Institute.
**Pubdate** c1988.
**Location** WIPP Library
**Call Number** GSF-R 6/88
**Location** Nuclear Waste Management Programs Library
**Call Number** GSF-R 6/88

**Title** Consolidation of crushed rock salt, part I : experimental results for dry salt analyzed using a hot-pressing model.
**Author(s)** Sandia National Laboratories, Holcomb, David Joseph
**Pubdate** October 1988
**Location** WIPP Library
**Call Number** SAND88-1469
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND88-1469
**Location** Technical Library/CA
**Call Number** SAND88-1469

**Title** Transmittal of English translations of German papers on sealing and backfilling.
**Author(s)** Battelle Memorial Institute.
**Pubdate** March 1987
**Location** Nuclear Waste Management Programs Library
**Call Number** ONWI-015-87-050

**Title** ANALYSIS OF CREEP DATA FOR VARIOUS NATURAL ROCK SALTS
**Author(s)** Herrmann, Walter Sandia National Laboratories,
**Pubdate** December 1981
**Location** WIPP Library
**Call Number** SAND81-2567
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND81-2567
**Location** Technical Library/NM
**Call Number** SAND81-2567

**Title** Measurements of very large deformations in "Potash Salt" in conjuction with an ongoing mining operation.
**Author(s)** Sandia National Laboratories, Sattler, Allan R.
**Pubdate** June 1980
**Location** WIPP Library
**Call Number** SAND79-2254
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND79-2254

**Location** Technical Library/NM
**Call Number** SAND79-2254

**Title** Evaluation of potential crushed-salt constitutive models.
**Author(s)** Sandia National Laboratories, Callahan, Gary D. RE/SPEC Inc.
**Pubdate** December 1995
**Location** WIPP Library
**Call Number** SAND95-2143
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND95-2143
**Location** Technical Library/CA
**Call Number** SAND95-2143

**Title** Preliminary constitutive properties for salt and nonsalt rocks from four potential repository sites technical report.
**Author(s)** Battelle Memorial Institute. Pfeifle, Tom W. RE/SPEC Inc.
**Pubdate** July 1983
**Location** Nuclear Waste Management Programs Library
**Call Number** ONWI-450
**Location** Nuclear Waste Management Programs Library
**Call Number** ONWI-450

**Title** The Permeability of salt-crystal interfaces to brine /
**Series** ORNL (Oak Ridge National Laboratory) ;
**Author(s)** Oak Ridge National Laboratory, Gilpatrick, L. O. Oak Ridge National Laboratory,
**Pubdate** 1982.
**Location** Nuclear Waste Management Programs Library
**Call Number** ORNL-5874

**Title** Proceedings of the National Waste Terminal Storage Program Information Meeting, Columbus, Ohio, October 30-November 1, 1979 : sponsored by the U.S. Dept. of Energy, Richland Operations Office.
**Author(s)** National Waste Terminal Storage Program Information Meeting National Waste Terminal Storage Program Office (U.S.).
**Pubdate** 1979]
**Location** Nuclear Waste Management Programs Library
**Call Number** ONWI-62

**Title** Mechanical behavior of Avery Island halite, a preliminary analysis : technical report /
**Author(s)** Battelle Memorial Institute. Carter, Neville L. RE/SPEC Inc.
**Pubdate** 1980.
**Location** Nuclear Waste Management Programs Library
**Call Number** ONWI-100

**Title** Evaluation of salt bodies and their overburden in the Netherlands for the disposal of radioactive waste : e. geological barrier model.
**Author(s)** Geological Survey of the Netherlands (RGD). Ruizendaal, A. Netherlands.
**Pubdate** November 1993
**Location** Nuclear Waste Management Programs Library
**Call Number** NWML/1999/0061

**Title** Physical properties data for rock salt /
**Series** NBS monograph ; 167
**Author(s)** Gevantman, L. H.

**Pubdate** 1981.
**Location** Nuclear Waste Management Programs Library
**Call Number** NBS-MONO-167
**Location** Technical Library/NM
**Call Number** TN 902 - -G337-81

**Title** The effect of a random variation of rock salt creep on calculations of storage room closure for the WIPP project.
**Author(s)** Sandia National Laboratories, Branstetter, Linda J.
**Pubdate** December 1982
**Location** WIPP Library
**Call Number** SAND82-0024
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND82-0024
**Location** Technical Library/CA
**Call Number** SAND82-0024

**Title** Review and comparison of transient creep laws used for natural rock salt.
**Author(s)** Sandia National Laboratories, Herrmann, Walter
**Pubdate** April 1981
**Location** WIPP Library
**Call Number** SAND81-0738
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND81-0738
**Location** Technical Library/NM
**Call Number** SAND81-0738

**Title** IMPLEMENTATION OF A TRANSIENT CREEP MODEL FOR NATURAL ROCK SALT AS A MATERIAL RESPONSE SUBROUTINE FOR SANCHO
**Author(s)** Sandia National Laboratories, Montgomery, Stephen T. Sandia National Laboratories,
**Pubdate** August 1981
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND81-1163
**Location** Technical Library/NM
**Call Number** SAND81-1163

**Title** REVISED THEORY OF WATER TRANSPORT IN ROCK SALT
**Author(s)** Hadley, G. Ronald Sandia National Laboratories,
**Pubdate** October 1981
**Location** WIPP Library
**Call Number** SAND80-2398
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND80-2398
**Location** Technical Library/NM
**Call Number** SAND80-2398

**Title** Interim summary of Sandia creep experiments on rock salt from the WIPP study area, southeastern New Mexico
**Author(s)** Sandia National Laboratories, Wawersik, Wolfgang R.
**Pubdate** February 1979
**Location** WIPP Library
**Call Number** SAND79-0115
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND79-0115

**Location** Technical Library/CA
**Call Number** SAND79-0115
**Location** Technical Library/NM
**Call Number** SAND79-0115

**Title** Constitutive models applied in the analysis of creep of rock salt.
**Author(s)** Sandia National Laboratories, Dawson, Paul Richard
**Pubdate** April 1979
**Location** WIPP Library
**Call Number** SAND79-0137
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND79-0137
**Location** Technical Library/CA
**Call Number** SAND79-0137

**Title** Compressibility of granulated rock salt.
**Author(s)** Sandia National Laboratories, Stinebaugh, Robert E.
**Pubdate** August 1979
**Location** WIPP Library
**Call Number** SAND79-1119
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND79-1119
**Location** Technical Library/NM
**Call Number** SAND79-1119

**Title** THERMAL PROPERTIES MEASUREMENT ON ROCK SALT SAMPLES FROM THE SITE OF THE PROPOSED WASTE ISOLATION PILOT PLANT
**Author(s)** Sweet, James N. Sandia National Laboratories,
**Pubdate** May 1980
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND80-0799
**Location** Technical Library/NM
**Call Number** SAND80-0799

**Title** CREEP HEALING OF FRACTURES IN ROCK SALT
**Author(s)** Costin, Laurence S. Sandia National Laboratories,
**Pubdate** August 1980
**Location** WIPP Library
**Call Number** SAND80-0392
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND80-0392
**Location** Technical Library/CA
**Call Number** SAND80-0392

**Title** MODEL FOR TRANSIENT CREEP OF SOUTHEASTERN NEW MEXICO ROCK SALT
**Author(s)** Herrmann, Walter Sandia National Laboratories,
**Pubdate** November 1980
**Location** WIPP Library
**Call Number** SAND80-2172
**Location** Nuclear Waste Management Programs Library
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**Location** Technical Library/CA
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| **Title** | A Comparison of unified creep-plasticity and conventional creep models for rock salt based on predictions of creep behavior measured in several in situ and bench-scale experiments. |
| **Author(s)** | Sandia National Laboratories, Morgan, Harold S. |
| **Pubdate** | April 1988 |
| **Location** | WIPP Library |
| **Call Number** | SAND87-1867 |
| **Location** | Nuclear Waste Management Programs Library |
| **Call Number** | SAND87-1867 |
| **Location** | Technical Library/CA |
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| **Title** | Interim report on the effects of brine-saturation and shear stress on consolidation of crushed, natural rock salt from the Waste Isolation Pilot Plant (WIPP). |
| **Author(s)** | Sandia National Laboratories, Zeuch, David Henry |
| **Pubdate** | July 1991 |
| **Location** | WIPP Library |
| **Call Number** | SAND91-0105 |
| **Location** | WIPP Library |
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| **Title** | In situ measurements of rock salt permeability changes due to nearby excavation. |
| **Author(s)** | Sandia National Laboratories, Stormont, John C. |
| **Pubdate** | July 1991 |
| **Location** | WIPP Library |
| **Call Number** | SAND90-3134 |
| **Location** | Nuclear Waste Management Programs Library |
| **Call Number** | SAND90-3134 |
| **Location** | Technical Library/CA |
| **Call Number** | SAND90-3134 |

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| **Title** | Multiaxial creep of natural rock salt. |
| **Author(s)** | Sandia National Laboratories, Mellegard, K. D. |
| **Location** | WIPP Library |
| **Call Number** | SAND91-7083 |
| **Location** | Nuclear Waste Management Programs Library |
| **Call Number** | SAND91-7083 |
| **Location** | Technical Library/CA |
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| **Title** | Indicator tests for the creep of rock salt from borehole Moss Bluff 2, Moss Bluff Dome, Texas |
| **Author(s)** | Wawersik, Wolfgang R. Sandia National Laboratories, |
| **Pubdate** | November 1992 |
| **Location** | Technical Library/CA |
| **Call Number** | SAND92-2122 |
| **Location** | Technical Library/NM |
| **Call Number** | SAND92-2122 |

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| **Title** | Dilation-induced permeability changes in rock salt |
| **Author(s)** | Stormont, John C. Sandia National Laboratories, |
| **Pubdate** | November 1993 |

**Location** WIPP Library
**Call Number** SAND93-2670C
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND93-2670C
**Location** Technical Library/NM
**Call Number** SAND93-2670C

**Title** Triaxial creep measurements on rock salt from the Jennings dome, Louisiana, Borehole LA-1, Core #8
**Author(s)** Wawersik, Wolfgang R. Sandia National Laboratories,
**Pubdate** May 1994
**Location** Technical Library/CA
**Call Number** SAND94-1432

**Title** Mechanical behavior of New Mexico rock salt in triaxial compression up to 200 degrees C.
**Author(s)** Sandia National Laboratories, Wawersik, Wolfgang R.
**Pubdate** July 1979
**Location** WIPP Library
**Call Number** SAND77-1192
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND77-1192

**Title** Mechanical behavior of New Mexico rock salt in triaxial compression up to 200 degrees C.
**Author(s)** Sandia National Laboratories, Wawersik, Wolfgang R.
**Pubdate** July 1979
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND77-1192C

**Title** Untersuchungen zur dichte und schallgeschwindigkeit des steinsalzes der Asse in situ und im labor.
**Author(s)** GSF - Gesellschaft für Strahlen- und Umweltforschung München Gommlich, G. Institut für Tieflagurung Abteilung für Endlagertechnologie.
**Pubdate** 1993
**Location** Nuclear Waste Management Programs Library
**Call Number** GSF-R-22/93

**Title** Distribution of chloride in a salt-saturated grout in contact with rock salt.
**Author(s)** Army Engineer Waterways Experiment Station, Wakeley, Lillian D.
**Pubdate** September 1985
**Location** Nuclear Waste Management Programs Library
**Call Number** WES/MP/SL-85-15

**Title** Fluid and ionic transport properties of deformed salt rock : final report, January 1984-June 1985 /
**Series** Nuclear science and technology (Commission of the European Communities)
**Author(s)** Commission of the European Communities Peach, C. J. Commission of the European Communities.
**Pubdate** 1987.
**Location** Nuclear Waste Management Programs Library
**Call Number** EUR-10926-EN

**Title** Experimental consolidation of granulated rock salt with application to sleeve buckling.
**Author(s)** RE/SPEC Inc. Hansen, Francis D. Oak Ridge National Laboratory,
**Pubdate** 1976.
**Location** Nuclear Waste Management Programs Library
**Call Number** ORNL-SUB-4269-21

**Title** Thermal conductivity of rock salt from Louisiana salt domes /
**Author(s)** Oak Ridge National Laboratory. Morgan, M. T. United States.
**Pubdate** June 1979.
**Location** Nuclear Waste Management Programs Library
**Call Number** ORNL/TM-6809

**Title** Influence of deformation on the fluid transport properties of salt rocks = Invloed van deformatie op de vloeistoftransporteigenschappen van zoutgesteenten /
**Series** Geologica ultraiectina no. 77
**Author(s)** Peach, Colin Jack, Rijksuniversiteit te Utrecht.
**Pubdate** 1991.
**Location** Technical Library/NM
**Call Number** TN 900 - -P42 -91

**Title** THERMAL PROPERTIES MEASUREMENT ON ROCK SALT SAMPLES FROM THE SITE OF THE PROPOSED WASTE ISOLATION PILOT PLANT
**Author(s)** Sweet, James N. Sandia National Laboratories,
**Pubdate** 1980
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND80-0799A
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND80-0799A

**Title** Field tests of stress measurement techniques in rock salt.
**Author(s)** Sandia National Laboratories, Stormont, John C.
**Pubdate** April 1984
**Location** WIPP Library
**Call Number** SAND83-2507
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND83-2507
**Location** Technical Library/CA
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**Title** Analysis of borehole inclusion stress measurement concepts proposed for use in the Waste Isolation Pilot Plant in situ testing program.
**Author(s)** Sandia National Laboratories, Morgan, Harold S.
**Pubdate** June 1982
**Location** WIPP Library
**Call Number** SAND82-1192
**Location** WIPP Library
**Call Number** SAND82-1192
**Location** Nuclear Waste Management Programs Library
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**Location** Technical Library/NM
**Call Number** SAND82-1192

**Title** Preliminary deformation-mechanism map for salt (with application to WIPP).
**Author(s)** Sandia National Laboratories, Munson, Darrell E.
**Pubdate** January 1979
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND79-0076
**Location** Technical Library/NM
**Call Number** SAND79-0076

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| **Title** | Structural analysis of Weeks Island Mine/petroleum repository. |
| **Author(s)** | Sandia National Laboratories, Hilton, Peter D. |
| **Pubdate** | August 1979 |
| **Location** | Nuclear Waste Management Programs Library |
| **Call Number** | SAND79-0595 |
| **Location** | Technical Library/NM |
| **Call Number** | SAND79-0595 |

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| **Title** | ANALYSIS OF STEADY STATE CREEP OF SOUTHEASTERN NEW MEXICO BEDDED SALT |
| **Author(s)** | Herrmann, Walter Sandia National Laboratories, |
| **Pubdate** | March 1980 |
| **Location** | WIPP Library |
| **Call Number** | SAND80-0558 |
| **Location** | Nuclear Waste Management Programs Library |
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| **Call Number** | SAND80-0558 |

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| **Title** | Borehole-inclusion stressmeter measurements in bedded salt. |
| **Author(s)** | Sandia National Laboratories, Cook, C. Wayne |
| **Pubdate** | July 1980 |
| **Location** | Nuclear Waste Management Programs Library |
| **Call Number** | SAND79-0377 |
| **Location** | Technical Library/NM |
| **Call Number** | SAND79-0377 |

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| **Title** | Proceedings of the International Conference and Exposition on Fatigue, Corrosion Cracking, Fracture Mechanics and Failure Analysis, 1985, Salt Lake City, V 02, Corrosion Cracking |
| **Author(s)** | Goel, V. S. American Society for Metals |
| **Pubdate** | 1986 |
| **Location** | Technical Library/CA |
| **Call Number** | TA 409 - -C67 -85 2 |

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| **Title** | Creep tests on clean and argillaceous salt from the Waste Isolation Pilot Plant. |
| **Author(s)** | Sandia National Laboratories, Mellegard, K. D. |
| **Pubdate** | May 1993 |
| **Location** | WIPP Library |
| **Call Number** | SAND92-7291 |
| **Location** | Nuclear Waste Management Programs Library |
| **Call Number** | SAND92-7291 |
| **Location** | Technical Library/NM |
| **Call Number** | SAND92-7291 |

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| **Title** | Review of waste package verification tests : Semiannual report covering the period April 1985 - September 1985. |
| **Author(s)** | Brookhaven National Laboratory, Soo, P. United States. |
| **Pubdate** | January 1986 |
| **Location** | Nuclear Waste Management Programs Library |
| **Call Number** | NUREG/CR-3091, v.7 |

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| **Title** | Thermoelastic/plastic analysis of waste-container sleeve : III. Influence of salt strength on sleeve loading. |
| **Author(s)** | RE/SPEC Inc. Pariseau, William G. Oak Ridge National Laboratory, |

**Pubdate** 1975.
**Location** Nuclear Waste Management Programs Library
**Call Number** ORNL-SUB-4269-2

**Title** Field evaluation of stress measurement techniques in rock salt.
**Author(s)** Sandia National Laboratories, Stormont, John C.
**Pubdate** September 1983
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND83-2051A
**Location** Technical Library/NM
**Call Number** SAND83-2051A

**Title** Field tests of stress measurement techniques in rock salt.
**Author(s)** Sandia National Laboratories, Stormont, John C.
**Pubdate** December 1983
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND83-2507C
**Location** Technical Library/NM
**Call Number** SAND83-2507C

**Title** RECENT MEASUREMENTS OF POWER LAW STRESS EXPONENTS - ACTIVATION ENERGIES AND CREEP TRANSIENTS - ABSTRACT
**Author(s)** Sandia National Laboratories, Wawersik, Wolfgang R. Sandia National Laboratories,
**Pubdate** April 1981
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND81-1117A
**Location** Technical Library/NM
**Call Number** SAND81-1117A

**Title** COMPUTER MODELING OF STRESS STATES ASSOCIATED WITH FLUID MIGRATION EXPERIMENTS
**Author(s)** Trucano, Timothy Guy Sandia National Laboratories,
**Pubdate** September 1981
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND81-2008
**Location** Technical Library/NM
**Call Number** SAND81-2008

**Title** ON THE DESCRIPTION OF LOW STRESS - LOW TEMPERATURE CREEP OF ROCK SALT - ABSTRACT
**Author(s)** Wawersik, Wolfgang R. Sandia National Laboratories,
**Pubdate** March 1982
**Location** Technical Library/NM
**Call Number** SAND82-0797A

**Title** A Transient creep model for salt during stress loading and unloading.
**Author(s)** Sandia National Laboratories, Munson, Darrell E.
**Pubdate** September 1982
**Location** WIPP Library
**Call Number** SAND82-0962
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND82-0962
**Location** Technical Library/NM
**Call Number** SAND82-0962

**Title** Consolidation and permeability of crushed WIPP salt under hydrostatic and shear stress states.
**Author(s)** Sandia National Laboratories, Brodsky, Nancy S.
**Pubdate** February 1992
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND92-0383A
**Location** Technical Library/NM
**Call Number** SAND92-0383A

**Title** Extension of the M-D model for treating stress drops in salt
**Author(s)** Munson, Darrell E. Sandia National Laboratories,
**Pubdate** June 1993
**Location** Technical Library/NM
**Call Number** SAND93-0377C

**Title** Stress measurements in rock salt using hydraulic fracturing.
**Author(s)** Sandia National Laboratories, Wawersik, Wolfgang R.
**Pubdate** April 1986
**Location** WIPP Library
**Call Number** SAND86-1034C
**Location** Nuclear Waste Management Programs Library
**Call Number** SAND86-1034C

**Title** Effects of temperature, temperature gradients, stress, and irradiation on migration of brine inclusions in a salt repository /
**Author(s)** Oak Ridge National Laboratory, Jenks, Glenn Herbert, Oak Ridge National Laboratory.
**Pubdate** July 1979.
**Location** Nuclear Waste Management Programs Library
**Call Number** ORNL-5526

## 9. EUB Applications Related to Salt Caverns (Source: EUB Library)

**Record number:** 16867
**Application number:** BT1A
**Company:** NUCO PETROLEUMS LTD.
**Summary:** FOR A SCHEME TO DISPOSE OF PRODUCED SALT WATER INTO THE BEAVERHILL LAKE FORMATION IN THE LLOYDMINSTER FIELD
**Department:** DEVELOPMENT
**Descriptors:** Water disposal
**Area/Field:** LLOYDMINSTER
**Date registered:** 19550101
**Decision/Approval/Order:** DECISION NOT AVAILABLE
**Date of hearing:** 19550922
**Hearing location:** PETROLEUM AND NATURAL GAS CONSERVATION BOARD, CALGARY
**Notice date:** 19550901
**Number of interventions:** 1
**Note:** NOTICE AND DECISION NOT AVAILABLE APPLICATION NOT AVAILABLE
**Date created:** May 27, 1997
**Updated:** July 21, 1997
**Status:** Completed

**Record number:** 222
**Application number:** 910420
**Company:** Amoco Canada Petroleum Company Ltd.
**Summary:** To add a well for water disposal to dispose of brine water associated with salt cavern sand
**Department:** Drilling and Production
**Descriptors:** Water disposal; Waste disposal
**Area/Field:** Lindbergh
**Date registered:** 19910315
**Decision/Approval/Order:** Approval 7139
**Note:** Approval 6424 is rescinded
**Box number:** 965
**Date created:** May 27, 1997
**Updated:** June 23, 1997
**Status:** Completed

**Record number:** 27084
**Application number:** 830529
**Company:** Northwestern Utilities Ltd
**Summary:** AMEND APPROVAL NO. 3673. FOR THE CONSTRUCTION AND OPERATION OF ONE ADDITIONAL SALT STORAGE CAVERN FOR THE PURPOSE OF STORING NATURAL GAS
**Department:** DEVELOPMENT
**Descriptors:** Gas storage; Amendment; Gas storage
**Area/Field:** REDWATER
**Date registered:** 19830603
**Decision/Approval/Order:** Approval 3673A
**Notice date:** 19830810

**Objection date:** 19830901
**Date created:** May 27, 1997
**Updated:** December 07, 1997
**Status:** Completed

**Record number:** 31696
**Application number:** 820506
**Company:** Northwestern Utilities Ltd
**Summary:** DISPOSE OF BRINE PRODUCED IN ASSOCIATION WITH THE CONSTRUCTION OF THE CAVERN STORAGE FACILITIES
**Department:** DEVELOPMENT
**Descriptors:** Gas storage; SALT; Underground storage
**Area/Field:** FORT SASKATCHEWAN; REDWATER
**Date registered:** 19820526
**Decision/Approval/Order:** Approval 3673
**Notice date:** 19820820
**Objection date:** 19820914
**Related application:** 820504; 820505
**Date created:** May 27, 1997
**Updated:** December 07, 1997
**Status:** Completed

**Record number:** 31698
**Application number:** 820504
**Company:** Northwestern Utilities Ltd
**Summary:** CONSTRUCTION AND OPERATION OF A SALT CAVERN STORAGE FACILITY FOR THE PURPOSE OF STORING NATURAL GAS
**Department:** DEVELOPMENT
**Descriptors:** Gas storage; SALT; Underground storage
**Area/Field:** FORT SASKATCHEWAN; REDWATER
**Date registered:** 19820526
**Decision/Approval/Order:** Approval 3673 ; Approval 3674
**Notice date:** 19820820
**Objection date:** 19820914
**Related application:** 820505; 820506
**Date created:** May 27, 1997
**Updated:** December 07, 1997
**Status:** Completed

**Record number:** 20453
**Application number:** 790326
**Company:** DOME PETROLEUM LIMITED
**Summary:** TO AMEND APPROVAL NO. 2358 FOR THE CONSTRUCTION AND OPERATION OF TWO ADDITIONAL SALT STORAGE CAVERNS
**Department:** DEVELOPMENT
**Descriptors:** Gas storage; Amendment; Underground storage
**Area/Field:** FORT SASKATCHEWAN
**Date registered:** 19790516
**Decision/Approval/Order:** Approval 2358A
**Notice date:** 19790807
**Objection date:** 19790823

**Date created:** May 27, 1997
**Updated:** December 07, 1997
**Status:** Completed

**Record number:** 23385
**Application number:** 770520
**Company:** DOME PETROLEUM LIMITED
**Summary:** FOR THE DISPOSAL OF BRINE PRODUCED IN CONJUNCTION WITH THE CONSTRUCTION AND OPERATION OF SALT CAVERN STORAGE FACILITIES IN THE FORT SASKATCHEWAN AREA
**Department:** DEVELOPMENT
**Descriptors:** Waste disposal; WASTE DUMP
**Area/Field:** FORT SASKATCHEWAN
**Date registered:** 19770704
**Decision/Approval/Order:** Approval 2520
**Notice date:** 19770719
**Objection date:** 19770810
**Date created:** May 27, 1997
**Updated:** December 08, 1997
**Status:** Completed

**Record number:** 30714
**Application number:** 770101
**Company:** CHEVRON STANDARD LIMITED
**Summary:** FOR STORAGE AND DISPOSAL OF LIQUID HYDROCARBONS
**Department:** Gas
**Descriptors:** Gas storage; Liquefied natural gas; Underground storage; Salt
**Area/Field:** FORT SASKATCHEWAN
**Date registered:** 19770203
**Decision/Approval/Order:** Approval 1547D
**Box number:** 1003
**Date created:** May 27, 1997
**Updated:** December 08, 1997
**Status:** Completed

**Record number:** 26819
**Application number:** 008154
**Company:** M-P PETROLEUM LTD.
**Summary:** TO CONSTRUCT AND OPERATE A SALT CAVERN L.P.G STORAGE FACILITY
**Department:** DEVELOPMENT
**Descriptors:** Gas storage; Underground storage
**Area/Field:** FORT SASKATCHEWAN
**Date registered:** 19741028
**Decision/Approval/Order:** Approval 2101
**Notice date:** 19750107
**Objection date:** 19750210
**Date created:** May 27, 1997
**Updated:** December 08, 1997
**Status:** Completed

**Record number:** 27004
**Application number:** 007756
**Company:** DOME PETROLEUM LIMITED
**Summary:** AMENDMENT OF APPROVAL NO. 1932 FOR A SCHEME TO CONSTRUCT AND OPERATE A SALT CAVERN STORAGE FACILITY
**Department:** DEVELOPMENT
**Descriptors:** Gas storage; Amendment; Underground storage
**Area/Field:** FORT SASKATCHEWAN
**Date registered:** 19740501
**Decision/Approval/Order:** Approval 2042
**Notice date:** 19740703
**Objection date:** 19740725
**Date created:** May 27, 1997
**Updated:** December 08, 1997
**Status:** Completed

**Record number:** 27470
**Application number:** 007659
**Company:** SHELL CANADA LIMITED
**Summary:** AMENDMENT OF APPROVAL NO. 1849 FOR THE INJECTION AND STORAGE OF NATURAL GAS LIQUIDS
**Department:** Gas
**Descriptors:** Gas storage; Liquefied natural gas; Salt
**Area/Field:** SIMONETTE
**Date registered:** 19740314
**Decision/Approval/Order:** Approval 1849A
**Date created:** May 27, 1997
**Updated:** December 08, 1997
**Status:** Completed

**Record number:** 26489
**Application number:** 007578
**Company:** IMPERIAL PIPELINE COMPANY, LIMITED
**Summary:** TO CONSTRUCT AND OPERATE A SALT CAVERN STORAGE FACILITY
**Department:** DEVELOPMENT
**Descriptors:** Gas storage; Underground storage
**Area/Field:** REDWATER
**Date registered:** 19740131
**Decision/Approval/Order:** Approval 2039
**Notice date:** 19740625
**Objection date:** 19740715
**Special report:** REPORT - BRINE POND, DESIGN RECOMMENDATIONS, REDWATER, ALBERTA, 731116; BRINE POND REDWATER, ALBERTA, DESIGN RECOMMENDATION, 740124
**Date created:** May 27, 1997
**Updated:** December 08, 1997
**Status:** Completed

**Record number:** 28900
**Application number:** 007325
**Company:** DOME PETROLEUM LIMITED
**Summary:** FOR CONSTRUCTION AND OPERATION OF AN UNDERGROUND SALT CAVERN STORAGE FACILITY
**Department:** DEVELOPMENT
**Descriptors:** Gas storage; Liquefied natural gas; Salt
**Area/Field:** FORT SASKATCHEWAN
**Date registered:** 19730904
**Decision/Approval/Order:** Approval 1932
**Box number:** APPL. NO. 33
**Accession number:** 16-4-60
**Date created:** May 27, 1997
**Updated:** December 08, 1997
**Status:** Completed

**Record number:** 31143
**Application number:** 006461
**Company:** CHEVRON STANDARD LIMITED
**Summary:** TO AMEND APPROVAL NO. 1547 FOR APPROVAL TO OPERATE A FRACTIONATION PLANT AND RELATED SURFACE FACILITIES ASSOCIATED WITH THE STORAGE OF LIQUID PETROLEUM GASES IN SALT CAVERNS
**Department:** Gas
**Descriptors:** Gas storage; Liquefied natural gas; Salt
**Area/Field:** FORT SASKATCHEWAN
**Date registered:** 19720630
**Decision/Approval/Order:** Approval 1547A
**Box number:** {APPL. NO. 3
**Accession number:** ARC 18-13-65
**Date created:** May 27, 1997
**Updated:** November 28, 1997
**Status:** Completed

**Record number:** 29507
**Application number:** 005673
**Company:** CHEVRON STANDARD LIMITED
**Summary:** FOR APPROVAL FOR THE CONSTRUCTION AND OPERATION OF A SALT CAVERN STORAGE FACILITY
**Department:** Gas
**Descriptors:** Underground storage; Gas storage; Salt
**Area/Field:** FORT SASKATCHEWAN
**Date registered:** 19710329
**Decision/Approval/Order:** Approval 1534
**Date of hearing:** 19710511
**Hearing location:** ENERGY RESOURCES CONSERVATION BOARD, CALGARY
**Notice date:** 19710415
**Objection date:** 19710505
**Number of interventions:** 2
**Exhibits:** 5

**Related application:** 005672
**Special report:** PROPOSED BRINE PONDS - FORT SASKATCHEWAN FRACTIONIZATION PLANT,; DATED 710400
**Note:** NO TRANSCRIPTS ON FILE
**Box number:** APPL. NO. 17
**Accession number:** 16-4-72
**Date created:** May 27, 1997
**Updated:** December 08, 1997
**Status:** Completed

**Record number:** 29508
**Application number:** 005672
**Company:** CHEVRON STANDARD LIMITED
**Summary:** FOR STORAGE AND DISPOSAL OF LIQUID HYDROCARBONS
**Department:** Gas
**Descriptors:** Gas storage; Liquefied natural gas
**Area/Field:** FORT SASKATCHEWAN
**Date registered:** 19710329
**Decision/Approval/Order:** Approval 1547
**Date of hearing:** 19710511
**Hearing location:** ENERGY RESOURCES CONSERVATION BOARD, CALGARY
**Notice date:** 19710415
**Objection date:** 19710505
**Number of interventions:** 2
**Exhibits:** 1
**Box number:** APPL. NO. 16
**Accession number:** 19-6-30
**Date created:** May 27, 1997
**Updated:** December 08, 1997
**Status:** Completed

**Record number:** 24877
**Application number:** 009520
**Company:** DOME PETROLEUM LIMITED
**Summary:** FOR THE STORAGE AND DISPOSAL OF LIQUID HYDROCARBONS IN UNDERGROUND CAVERNS IN THE FORT SASKATCHEWAN AREA
**Department:** DEVELOPMENT
**Descriptors:** Gas storage; Underground storage
**Area/Field:** FORT SASKATCHEWAN
**Date registered:** 19760727
**Decision/Approval/Order:** Approval 2358
**Notice date:** 19761129
**Objection date:** 19761222
**Date created:** May 27, 1997
**Updated:** December 08, 1997
**Status:** Completed

**Record number:** 18781
**Application number:** 003021
**Company:** HOME OIL COMPANY LIMITED
**Summary:** APPROVAL OF A SCHEME FOR DISPOSAL OF BRINE

PRODUCED DURING DEVELOPMENT OF STORAGE CAVERNS IN SALT

| | |
|---|---|
| **Department:** | DEVELOPMENT |
| **Descriptors:** | Water disposal; Underground storage; Water disposal; HYDROCARBON |
| **Area/Field:** | HARDISTY |
| **Date registered:** | 19660718 |
| **Decision/Approval/Order:** | Approval 878 ; Approval 885 |
| **Notice date:** | 19660804 |
| **Objection date:** | 19660815 |
| **Date created:** | May 27, 1997 |
| **Updated:** | December 08, 1997 |
| **Status:** | Completed |

# APPENDIX B

## DATA SUMMARY TABLES – ORIGINAL STUDY AREA

**Table B.1: Bulk density log data available in the original study area for the Elk Point Group (source: AEUB well database)**

| No. | UWI | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Total Depth (m KB) | Top Elk Point GP (m KB) | Top of Fm in the Elk Point Group Logged with Density | Bottom Fm Depth (m KB) | Lowest Formation Logged by Density | EUB Digital Data? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00/06-05-048-06W4/0 | HUSKY D.H. WILDMERE 6-5-48-6 | 1970 | 610 | 975 | 1405 | 1180 | ELK POINT GRP | 1377 | ORDOVICIAN | N |
| 2 | 00/02-19-053-01W4/0 | HUSKY 2C FROG LAKE 2-19-53-1 | 1996 | 132 | 1133 | 1140 | 842 | ELK POINT GRP | 1080 | BASAL RED BEDS | Y |
| 3 | 00/10-17-054-05W4/00 | HUSKY DH ETHELWYN 10D-17-54-5 | 1971 | 366 | 965 | | 948 | ELK POINT GRP | 964 | PRAIRIE EVAPORITE | N |
| 4 | 00/16-27-055-12W4/0 | CHEMCELL DUVERNAY NACL 16-27-55-12 | 1969 | 187 | 1448 | | 1066 | ELK POINT GRP | 1442 | BASAL RED BEDS | N |
| 5 | 00/16-13-071-01W4/0 | AEC ET AL SCHELTENS 16-13-71-1 | 1985 | 184 | 824 | 825 | 751 | ELK POINT GRP | 751 | ELK POINT GRP | N |
| 6 | 00/07-12-071-11W4/0 | RAX ET AL MILLS 7-12-71-11 | 1978 | 309 | 1373 | | 799 | ELK POINT GRP | 1331 | BASAL RED BEDS | N |
| 7 | 00/06-26-072-11W4/0 | PAN AM A-1 BEHAN 6-26-72-11 | 1969 | 427 | 1035 | | 800 | ELK POINT GRP | 1030 | CONTACT RAPIDS | N |
| 8 | 00/07-08-082-06W4/0 | GULF RESDELN 7-8-82-6 | 1981 | 370 | 654 | | 424 | ELK POINT GRP | 603 | GRANITE WASH | N |
| 9 | 00/07-32-083-06W4/0 | NORTHSTAR ET AL SURMONT 7-32-83-6 | 1980 | 25 | 703 | 703 | 457 | ELK POINT GRP | 703 | TOTAL DEPTH | N |
| 10 | W0/05-23-094-07W4/0 | CHEVRON STEEPBANK EX 8-22-94-7 | 1981 | 12 | 414 | 416 | 329 | ELK POINT GRP | 397 | METHY FM | N |
| 11 | 00/03-14-095-07W4/0 | HUSKY TENN NOVA 3-14-95-7 | 1981 | 45 | 403 | 404 | 275 | ELK POINT GRP | 404 | PRECAMBRIAN | N |
| 12 | 00/03-15-095-07W4/0 | HUSKY TENN NOVA 3-15-95-7 | 1981 | 43 | 391 | 393 | 261 | ELK POINT GRP | 377 | PRECAMBRIAN | N |
| 13 | 00/04-22-095-07W4/0 | HUSKY TENN NOVA 4-22-95-7 | 1981 | 45 | 383 | 383 | 252 | ELK POINT GRP | 371 | GRANITE WASH | N |
| 14 | 00/01-24-095-07W4/0 | CDCOG TENN MUSKEGR 1-24-95-7 | 1980 | 129 | 412 | 412 | 283 | ELK POINT GRP | 405 | GRANITE WASH | N |
| 15 | AA/12-07-095-08W4/0 | ESSO 90PC OSLO 12-7-95-8 | 1990 | 10 | 311 | 312 | 184 | ELK POINT GRP | 307 | PRECAMBRIAN | N |
| 16 | 00/15-08-096-01W4/0 | GULF FIREBAG 15-8-96-1 | 1976 | 15 | 134 | 135 | 129 | ELK POINT GRP | | | N |
| 17 | 00/08-09-053-03W4/0 | HUSKY 8B MARWAYNE 8-9-53-3 | 1996 | 132 | 1393 | 1400 | 869 | WATT MTN | 1149 | PRECAMBRIAN | Y |
| 18 | 00/06-12-053-04W4/0 | STERLING ET AL DEWBERRY 6-12-53-4 | 1998 | 425 | 1104 | 1105 | 899 | WATT MTN | 1062 | WINNIPEGOSIS | N |
| 19 | 03/16-23-056-05W4/0 | CANSALT L-2 NACL LIND 16-23-56-5 | 1989 | 156 | 1218 | 1253 | 824 | WATT MTN | 1133 | LOTSBERG | N |
| 20 | 11/15-13-058-05W4/2 | MURPHY SWD 5 LIND 15-13-58-5 | 1987 | 178 | 1549 | 1573 | 870 | WATT MTN | 1502 | BASAL SANDSTONE UNIT | N |
| 21 | 00/08-01-062-11W4/0 | SASKOIL SUGDEN 8-1-62-11 | 1991 | 296 | 1635 | 1635 | 936 | WATT MTN | 1555 | CAMBRIAN | N |
| 22 | 02/01-28-063-02W4/0 | RENAISSANCE COLD LAKE 1-28-63-2 | 1989 | 170 | 794 | 805 | 618 | WATT MTN | 744 | WINNIPEGOSIS | N |
| 23 | 02/08-26-063-03W4/0 | CON BEACON PARA COLDLK 8-26-63-3 | 1992 | 177 | 1243 | 1249 | 589 | WATT MTN | 1174 | CAMBRIAN | N |
| 24 | 02/06-13-063-08W4/0 | CDNOXY SWD 2 SUGDEN 6-13-63-8 | 1986 | 270 | 1461 | 1462 | 783 | WATT MTN | 1474 | PRECAMBRIAN | N |
| 25 | AA/15-20-064-02W4/0 | ESSO MARIE OV 15-20-64-2 | 1979 | 20 | 1206 | 1207 | 652 | WATT MTN | 1203 | PRECAMBRIAN | N |
| 26 | 00/07-18-064-03W4/0 | ESSO 79 SWD COLDLK 7-18-64-3 | 1979 | 20 | 1291 | 1288 | 666 | WATT MTN | 1288 | PRECAMBRIAN | N |
| 27 | 00/01-19-064-03W4/0 | ESSO 85 SWD ETHELLK 1-19-64-3 | 1985 | 250 | 1232 | 1293 | 657 | WATT MTN | 1221 | PRECAMBRIAN | N |
| 28 | 00/11-22-064-03W4/0 | ESSO 83 SWD ETHELLK 11-22-64-3 | 1983 | 252 | 1276 | 1279 | 654 | WATT MTN | 1279 | PRECAMBRIAN | N |
| 29 | 00/03-29-064-03W4/0 | ESSO 81 SWD ETHELLK 3-29-64-3 | 1981 | 20 | 1309 | 1309 | 672 | WATT MTN | 1303 | PRECAMBRIAN | N |
| 30 | 00/08-33-064-03W4/0 | ESSO 83 INJ ETHELLK 8-33-64-3 | 1993 | 256 | 1318 | 1318 | 706 | WATT MTN | 1318 | PRECAMBRIAN | N |
| 31 | 00/05-06-064-06W4/0 | MOBIL GARTH 5-6-64-6 | 1989 | 20 | 1403 | 1404 | 736 | WATT MTN | 1384 | PRECAMBRIAN | N |

**Table B.1: Bulk density log data available in the original study area for the Elk Point Group (source: AEUB well database)**

| No. | UWI | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Total Depth (m KB) | Top Elk Point GP (m KB) | Top of Fm in the Elk Point Group Logged with Density | Bottom Fm Depth (m KB) | Lowest Formation Logged by Density | EUB Digital Data? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 32 | 00/12-06-064-06W4/0 | MOBIL GARTH 12-6-64-6 | 1985 | 18 | 1412 | 1413 | 744 | WATT MTN | 1394 | PRECAMBRIAN | N |
| 33 | 00/03-04-065-03W4/0 | ESSO SWD LEMING ETHELLK 3-4-65-3 | 1978 | 395 | 1318 | 1319 | 692 | WATT MTN | 1309 | PRECAMBRIAN | N |
| 34 | AA/09-20-065-03W4/0 | ESSO 81 ETHELLK OV 9-20-65-3 | 1999 | 37 | 1211 | 1262 | 624 | WATT MTN | 1258 | PRECAMBRIAN | N |
| 35 | AA/06-08-066-02W4/0 | ESSO MEDLEY OV 6-8-66-2 | 1979 | 18 | 1213 | 1218 | 677 | WATT MTN | 1210 | PRECAMBRIAN | N |
| 36 | AA/14-28-066-03W4/0 | ESSO MEDLEY OV 14-28-66-3 | 1979 | 16 | 1251 | 1254 | 644 | WATT MTN | 1245 | PRECAMBRIAN | N |
| 37 | 00/10-08-066-05W4/0 | BP PCI MARGLK 10-8-66-5 | 1984 | 15 | 1352 | 1354 | 707 | WATT MTN | 1335 | PRECAMBRIAN | N |
| 38 | 00/10-10-066-06W4/0 | BP LEMING 10-10-66-6 | 1981 | 157 | 1363 | 1363 | 720 | WATT MTN | 1351 | PRECAMBRIAN | N |
| 39 | 02/10-05-067-04W4/0 | AMOCO 1084 MOORE 10-5-67-4 | 1985 | 168 | 1338 | 1340 | 694 | WATT MTN | 1321 | PRECAMBRIAN | N |
| 40 | 00/07-11-067-06W4/0 | ESSO AEC 85 FISHCK 7-11-67-6 | 1985 | 250 | 1340 | 1342 | 701 | WATT MTN | 1327 | PRECAMBRIAN | N |
| 41 | 00/12-31-067-07W4/0 | ESSO AEC 85 FISHCK 12-31-67-7 | 1985 | 15 | 1333 | 1334 | 698 | WATT MTN | 1322 | PRECAMBRIAN | N |
| 42 | 00/07-34-067-08W4/0 | ESSO AEC 85 FISHCK 7-34-67-8 | 1985 | 249 | 1385 | 1386 | 753 | WATT MTN | 1374 | PRECAMBRIAN | N |
| 43 | 00/11-19-068-06W4/0 | ESSO AEC 85 FISHCK 11-19-68-6 | 1985 | 15 | 1317 | 1340 | 715 | WATT MTN | 1392 | PRECAMBRIAN | N |
| 44 | 07/08-12-069-05W4/0 | AECOG (NE) FISHER 8D-12-69-5 | 1990 | 196 | 922 | 921 | 665 | WATT MTN | 904 | CONTACT RAPIDS | N |
| 45 | 00/11-26-069-10W4/0 | ARCO HEART LAKE 11-26-69-10 | 1967 | 189 | 190 | 1432 | 832 | WATT MTN | 1421 | BASAL RED BEDS | N |
| 46 | 00/05-21-071-04W4/0 | AMOCO AEC KIRBY 5-21-71-4 | 1980 | 154 | 1159 | 1160 | 591 | WATT MTN | 1160 | PRECAMBRIAN | N |
| 47 | 00/06-30-071-05W4/0 | AMOCO AEC IPIATIK 6-30-71-5 | 1980 | 282 | 1222 | 1222 | 648 | WATT MTN | 1222 | PRECAMBRIAN | N |
| 48 | 00/10-17-071-06W4/0 | AMOCO AEC IPIATIK GRIST 10-17-71-6 | 1980 | 156 | 1225 | 1225 | 642 | WATT MTN | 1217 | PRECAMBRIAN | N |
| 49 | 00/10-26-071-07W4/0 | AEC PHILLIPS WIAU 10-26-71-7 | 1980 | 10 | 1230 | 1230 | 672 | WATT MTN | 1225 | PRECAMBRIAN | N |
| 50 | 00/16-36-072-01W4/0 | AEC ET AL FOSTERCK 16-36-72-1 | 1985 | 199 | 771 | 805 | 657 | WATT MTN | 754 | CONTACT RAPIDS | N |
| 51 | 00/11-18-072-04W4/0 | AMOCO AEC IPIATIK 11-18-72-4 | 1979 | 284 | 1188 | 1189 | 610 | WATT MTN | 1178 | CONTACT RAPIDS | N |
| 52 | 00/10-22-072-06W4/0 | AMOCO KIRBY 10-22-72-6 | 2000 | 299 | 1214 | 1214 | 672 | WATT MTN | 1205 | BASAL RED BEDS | N |
| 53 | 00/11-14-072-08W4/0 | AEC PHILLIPS WIAU 11-14-72-8 | 1980 | 151 | 1278 | 1279 | 721 | WATT MTN | 1254 | BASAL RED BEDS | N |
| 54 | 00/10-33-072-08W4/0 | AEC PHILLIPS WIAU 10-33-72-8 | 1980 | 10 | 1292 | 1292 | 746 | WATT MTN | 1271 | BASAL RED BEDS | N |
| 55 | 00/10-14-073-05W4/0 | AMOCO AEC IPIATIK KIRBY 10-14-73-5 | 1979 | 281 | 1119 | 1120 | 600 | WATT MTN | 938 | LOTSBERG FM | N |
| 56 | 00/11-30-074-05W4/0 | AMOCO KIRBY 11-30-74-5 | 1977 | 0 | 1108 | 1110 | 606 | WATT MTN | 943 | LOTSBERG FM | N |
| 57 | 00/10-09-074-06W4/0 | AMOCO KIRBY 10-9-74-6 | 1977 | 188 | 1094 | 1094 | 583 | WATT MTN | 1079 | BASAL RED BEDS | N |
| 58 | 00/06-24-074-07W4/0 | AMOCO KIRBY 6-24-74-7 | 1977 | 190 | 1142 | 1144 | 632 | WATT MTN | 1137 | BASAL RED BEDS | N |
| 59 | 02/10-01-077-07W4/0 | HOME LEISMER A10-1-77-7 | 1987 | 191 | 958 | 959 | 466 | WATT MTN | 952 | PRECAMBRIAN | N |
| 60 | 00/03-07-077-07W4/0 | HOME LEISMER 3-7-77-7 | 1998 | 128 | 788 | 788 | 521 | WATT MTN | 775 | CONTACT RAPIDS | N |
| 61 | 00/02-08-077-08W4/0 | NORCEN POR LEISMER 2-8-77-8 | 1982 | 168 | 782 | 782 | 568 | WATT MTN | 767 | WINNIPEGOSIS | N |
| 62 | 00/10-28-077-08W4/0 | ALTANA HUBER CHRISTINA 10-28-77-8 | 1971 | 118 | 788 | 789 | 513 | WATT MTN | 729 | WINNIPEGOSIS | N |
| 63 | 00/10-05-080-02W4/0 | HOME WINNEFRED LAKE 10-5-80-2 | 1967 | 116 | 558 | 558 | 478 | WATT MTN | 537 | CONTACT RAPIDS | N |

**Table B.1: Bulk density log data available in the original study area for the Elk Point Group (source: AEUB well database)**

| No. | UWI | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Total Depth (m KB) | Top Elk Point GP (m KB) | Top of Fm in the Elk Point Group Logged with Density | Bottom Fm Depth (m KB) | Lowest Formation Logged by Density | EUB Digital Data? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 64 | 00/11-32-080-04W4/0 | HOMESTEAD CANOXY COWPAR 11-32-80-4 | 1976 | 62 | 365 | 503 | 395 | WATT MTN | 490 | WINNIPEGOSIS | N |
| 65 | 00/10-29-082-12W4/0 | HUSKY ET AL DIVIDE 10-29-82-12 | 1988 | 201 | 964 | 965 | 689 | WATT MTN | 941 | CONTACT RAPIDS | N |
| 66 | 00/10-08-083-06W4/0 | GULF RESDELN 10-8-83-6 | 1981 | 120 | 624 | 625 | 482 | WATT MTN | 560 | WINNIPEGOSIS | N |
| 67 | 00/01-14-083-06W4/0 | TEXCAN COTTONWOOD 1-14-83-6 | 1969 | 113 | 685 | 685 | 433 | WATT MTN | 678 | PRECAMBRIAN | N |
| 68 | 00/15-14-084-11W4/0 | JACOS WD HANGST 15-14-84-11 | 1990 | 183 | 883 | 885 | 522 | WATT MTN | 872 | PRECAMBRIAN | N |
| 69 | 02/09-27-084-11W4/0 | PCI PCEJ HANGST 9-27-84-11 | 1988 | 80 | 863 | 865 | 498 | WATT MTN | 852 | PRECAMBRIAN | N |
| 70 | 00/14-24-085-06W4/0 | RAX NEWBY 14-24-85-6 | 1988 | 119 | 470 | 471 | 337 | WATT MTN | 449 | CONTACT RAPIDS | N |
| 71 | 00/16-27-085-11W4/0 | TEXCAN CS HORSE 16-27-85-11 | 1969 | 183 | 779 | 779 | 418 | WATT MTN | 771 | PRECAMBRIAN | N |
| 72 | 00/11-10-085-13W4/0 | CIGOL ET AL HORSE 11-10-85-13 | 1970 | 97 | 875 | 875 | 526 | WATT MTN | 872 | PRECAMBRIAN | N |
| 73 | 00/02-32-089-12W4/0 | SUNCOR CLARKE 2-32PREV-89-12 | 1981 | 86 | 717 | 717 | 398 | WATT MTN | 713 | PRECAMBRIAN | N |
| 74 | 00/06-18-093-12W4/0 | AOSTRA WDW1 ATHABASCA 6-18-93-12 | 1991 | 179 | 599 | 600 | 315 | WATT MTN | 583 | PRECAMBRIAN | N |
| 75 | 00/13-23-094-07W4/0 | CHEVRON WDW STEEPBANK 13-23-94-7 | 1991 | 180 | 396 | 398 | 284 | WATT MTN | 329 | WINNIPEGOSIS | N |
| 76 | 02/14-28-055-06W4/0 | AMOCO INJ LINDBERGH 14-28-55-6 | 1991 | 188 | 1398 | 1398 | 989 | PRAIRIE EVAPORITE | 1282 | LOTSBERG FM | N |
| 77 | 00/06-01-052-13W4/0 | VOYAGER PLAIN 6-1-52-13 | 1978 | 749 | 2100 | 2100 | 1356 | PRAIRIE EVAPORITE | 2008 | BASAL SANDSTONE UNIT | N |
| 78 | 00/02-13-055-13W4/0 | WESTMIN HAIRY 2-13-55-13 | 1984 | 334 | 1734 | 1745 | 1170 | PRAIRIE EVAPORITE | 1723 | PRECAMBRIAN | N |
| 79 | 02/02-03-065-03W4/0 | ESSO 83 SWD ETHELLK 2-3-65-3 | 1984 | 256 | 1312 | 1313 | 712 | PRAIRIE EVAPORITE | 1259 | CAMBRIAN | N |
| 80 | 00/07-07-072-03W4/0 | AEC FOSTER CREEK 7-7-72-3 | 1996 | 170 | 836 | 839 | 624 | PRAIRIE EVAPORITE | 813 | CONTACT RAPIDS | Y |
| 81 | 00/06-25-073-03W4/0 | AEC FOSTER CREEK 6-25-73-3 | 1997 | 149 | 812 | 825 | 685 | PRAIRIE EVAPORITE | 685 | PRAIRIE EVAPORITE | Y |
| 82 | 00/09-25-073-05W4/0 | AMOCO KIRBY 9-25-73-5 | 1980 | 223 | 845 | 845 | 601 | PRAIRIE EVAPORITE | 835 | CONTACT RAPIDS | N |
| 83 | 00/14-29-079-05W4/0 | LAKEWOOD ET AL CHARD 14-29-79-5 | 1991 | 128 | 604 | 604 | 426 | PRAIRIE EVAPORITE | 571 | CONTACT RAPIDS | N |
| 84 | 00/06-23-094-07W4/0 | CHEVRON STEEPBANK 6-23-94-7 | 1992 | 189 | 424 | 438 | 334 | WINNIPEGOSIS FM | 334 | WINNIPEGOSIS | N |
| 85 | 00/01-03-095-07W4/0 | CDCOG TENN MUSKEGR 1-3-95-7 | 1980 | 119 | 408 | 408 | 306 | PRAIRIE EVAPORITE | 318 | KEG RIVER | N |
| 86 | 00/01-20-095-07W4/0 | HUSKY TENN MUSKEGR 1-20-95-7 | 1980 | 105 | 338 | 338 | 105 | BASE OF DRIFT | 324 | PRECAMBRIAN | N |
| 87 | 00/14-11-096-01W4/0 | GULF FIREBAG 14-11-96-1 | 1976 | 9 | 132 | 133 | 130 | ELK POINT GRP | | | N |
| 88 | 00/06-26-096-01W4/0 | GULF FIREBAG 6-26-96-1 | 1976 | 14 | 162 | 162 | 161 | ELK POINT GRP | | | N |
| 89 | 00/07-29-096-01W4/0 | GULF FIREBAG 7-29-96-1 | 1976 | 11 | 113 | 114 | 112 | ELK POINT GRP | | | N |
| 90 | 00/02-08-097-01W4/0 | GULF FIREBAG 2-8-97-1 | 1976 | 7 | 126 | 127 | 123 | ELK POINT GRP | | | N |
| 91 | 00/02-11-097-01W4/0 | GULF FIREBAG 2-11-97-1 | 1976 | 12 | 171 | 171 | 170 | ELK POINT GRP | | | N |
| 92 | 00/13-12-097-02W4/0 | GULF FIREBAG 13-12-97-2 | 1976 | 10 | 147 | 147 | 145 | ELK POINT GRP | | | N |

**Table B.2: Dipmeter log data available in the original study area for the Elk Point and Beaverhill Groups (source: AEUB well database)**

| No. | UWI | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Total Depth (m KB) | Top Fm Depth (m KB) | Top Formation Logged with Dipmeter | Top of Lowest Logged Fm (m KB) | Interval of Interest (m) | Lowest Formation Logged by Dipmeter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00/07-14-057-06W4/0 | TEXEX ET AL ELK POINT 7-14-57-6 | 1956 | 546 | 1585 | 1589 | 403 | BLAIRMORE GRP | 1587 | 1039 | PRECAMBRIAN |
| 2 | 00/10-13-060-04W4/0 | TEXEX ET AL CHAR LAKE 10-13-60-4 | 1956 | 597 | 1433 | 1437 | 551 | BEAVERHILL LAKE FM | 1433 | 836 | PRECAMBRIAN |
| 3 | 02/10-30-048-10W4/0 | NUL KINSELLA 10-30-48-10 | 1978 | 579 | 937 | 938 | 542 | SWS | 811 | 126 | IRETON |
| 4 | 00/06-14-048-14W4/0 | VOYAGER ET AL BRUCE 6-14-48-14 | 1982 | 891 | 2087 | 894 | 890 | CALMAR | 892 | 1195 | NISKU |
| 5 | 00/14-09-049-08W4/0 | PCP MANNVILLE SOUTH 14-9-49-8 | 1983 | 520 | 813 | 813 | 488 | SWS | 782 | 31 | WOODBEND GRP |
| 6 | 00/16-31-050-01W4/0 | CNRL B LLOYD 16-31-50-1 | 1981 | 534 | 705 | 706 | 521 | COLONY MBR | 697 | 9 | WOODBEND GRP |
| 7 | 00/14-22-050-11W4/0 | SIGNALTA ET AL BIRCH 14-22-50-11 | 1971 | 506 | 718 | 721 | 493 | BASE FISH SCALES | 712 | 6 | IRETON FM |
| 8 | 00/11-34-051-04W4/0 | CDNOXY P9 MORGAN EX 11-34-51-4 | 1980 | 115 | 622 | 623 | 254 | COLORADO GRP | 615 | 7 | WOODBEND GRP |
| 9 | 00/06-32-055-06W4/0 | AMOCO LINDBERGH 6-32-55-6 | 1996 | 450 | 681 | 683 | 450 | VIKING | 678 | 3 | WOODBEND GRP |
| 10 | AR/10-11-056-01W4/0 | AMOCO AQ JOHN LAKE EX 10-11-56-1 | 1983 | 400 | 634 | 635 | 392 | VIKING | 605 | 29 | BEAVERHILL LAKE |
| 11 | AB/15-11-056-01W4/0 | AMOCO AB JOHN LAKE EX 15-11-56-1 | 1983 | 333 | 630 | 630 | 311 | SWS | 601 | 29 | BEAVERHILL LAKE |
| 12 | 00/15-26-056-02W4/0 | TEXACO FROG LAKE 15-26-56-2 | 1983 | 390 | 603 | 604 | 381 | VIKING | 585 | 19 | BEAVERHILL LAKE |
| 13 | 00/13-35-056-02W4/0 | ESSO FROG LAKE 13-35-56-2 | 1984 | 400 | 621 | 621 | 383 | VIKING | 590 | 31 | BEAVERHILL LAKE |
| 14 | 00/14-06-057-01W4/0 | CNRL JOHN LAKE 14-6-57-1 | 1984 | 450 | 667 | 667 | 424 | VIKING | 620 | 47 | BEAVERHILL LAKE |
| 15 | 00/14-18-057-01W4/0 | TEXACO FROG LAKE 14-18-57-1 | 1984 | 390 | 641 | 642 | 389 | VIKING | 602 | 40 | BEAVERHILL LAKE |
| 16 | 00/13-01-057-02W4/0 | TEXACO FROG LAKE 13-1-57-2 | 1984 | 420 | 640 | 635 | 414 | VIKING | 620 | 21 | BEAVERHILL LAKE |
| 17 | 00/15-12-057-02W4/0 | CNRL JOHN LAKE 15-12-57-2 | 1984 | 390 | 620 | 620 | 373 | VIKING | 584 | 35 | BEAVERHILL LAKE |
| 18 | 00/07-15-059-02W4/0 | CNRL CHANDLER 7-15-59-2 | 1989 | 470 | 589 | 590 | 446 | SPARKY MBR | 576 | 13 | BEAVERHILL LAKE |
| 19 | 00/07-16-059-02W4/0 | SUNCOR ET AL CHANDLER 7-16-59-2 | 1983 | 25 | 584 | 585 | 234 | COLORADO GRP | 570 | 14 | BEAVERHILL LAKE |
| 20 | 00/07-27-059-02W4/0 | TRANSWEST CHANDLER 7-27-59-2 | 1983 | 450 | 554 | 558 | 411 | SPARKY MBR | 544 | 11 | BEAVERHILL LAKE |
| 21 | 00/06-20-062-04W4/0 | GENESIS ET AL FTKENT 6-20-62-4 | 1985 | 275 | 525 | 527 | 259 | VIKING | 520 | 6 | WOODBEND GRP |
| 22 | 00/11-24-062-04W4/0 | GENESIS ET AL FTKENT 11-24-62-4 | 1985 | 268 | 504 | 505 | 202 | BASE FISH SCALES | 495 | 9 | BEAVERHILL LAKE |
| 23 | 00/09-13-062-08W4/0 | AMOCO ET AL SUGDEN 9-13-62-8 | 1994 | 143 | 499 | 547 | 157 | SWS | 489 | 10 | WOODBEND GRP |
| 24 | 00/01-13-063-08W4/0 | CDNOXY ET AL SUGDEN 1-13-63-8 | 1985 | 251 | 500 | 511 | 223 | BASE FISH SCALES | 497 | 3 | WOODBEND GRP |
| 25 | 00/11-14-063-08W4/0 | NUMAC 11A WOLF LAKE 11-14-63-8 | 1997 | 300 | 513 | 513 | 315 | GRAND RAPIDS | 499 | 14 | WOODBEND GRP |
| 26 | 02/16-06-064-06W4/0 | MOBIL GARTH 16-6-64-6 | 1981 | 300 | 525 | 525 | | NO PICKS | | | |
| 27 | 00/03-07-064-06W4/0 | MOBIL GARTH 3-7-64-6 | 1990 | 290 | 513 | 515 | | NO PICKS | | | |
| 28 | AA/14-20-064-06W4/0 | MOBIL GARTH OV 14-20-64-6 | 1980 | 335 | 547 | 550 | 317 | VIKING | 541 | 7 | WOODBEND GRP |
| 29 | AA/02-21-064-06W4/0 | MOBIL GARTH EX 2-21-64-6 | 1983 | 315 | 504 | 505 | 263 | JOLI FOU FM | 495 | 9 | WOODBEND GRP |
| 30 | AA/03-27-064-06W4/0 | MOBIL GARTH EX 3-27-64-6 | 1982 | 300 | 521 | 514 | | NO PICKS | | | |
| 31 | AA/09-27-064-06W4/0 | MOBIL GARTH EX 9-27-64-6 | 1981 | 300 | 530 | 530 | | NO PICKS | | | |

**Table B.2: Dipmeter log data available in the original study area for the Elk Point and Beaverhill Groups (source: AEUB well database)**

| No. | UWI | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Total Depth (m KB) | Top Fm Depth (m KB) | Top Formation Logged with Dipmeter | Top of Lowest Logged Fm (m KB) | Interval of Interest (m) | Lowest Formation Logged by Dipmeter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 32 | AA/09-28-064-06W4/0 | MOBIL GARTH OV 9-28-64-6 | 1980 | 160 | 520 | 526 | 205 | SWS | 517 | 3 | WOODBEND GRP |
| 33 | 00/16-01-064-07W4/0 | MOBIL SUGDEN 16-1-64-7 | 1980 | 280 | 519 | 521 | 273 | VIKING | 506 | 13 | WOODBEND GRP |
| 34 | 02/07-13-065-04W4/0 | ESSO 83 B3-20 COLDLK 7-13-65-4 | 1984 | 20 | 195 | 564 | | NO PICKS | | | |
| 35 | 00/06-27-065-05W4/0 | BP LEMING 6-27-65-5 | 1981 | 159 | 561 | 562 | 224 | SWS | 559 | 2 | BEAVERHILL LAKE |
| 36 | 00/07-31-065-05W4/0 | BP LEMING 7-31-65-5 | 1981 | 153 | 551 | 551 | 225 | SWS | 550 | 2 | WOODBEND GRP |
| 37 | 00/11-01-065-06W4/0 | BP MARGUERITE LAKE 11-1-65-6 | 1981 | 150 | 550 | 552 | 227 | SWS | 549 | 2 | WOODBEND GRP |
| 38 | 00/07-08-065-06W4/0 | BP MARGUERITE LAKE 7-8-65-6 | 1981 | 154 | 561 | 561 | 227 | SWS | 560 | 1 | WOODBEND GRP |
| 39 | 11/12-08-066-05W4/0 | BP PCI 21 MARGLK 12-8-66-5 | 1981 | 150 | 528 | 529 | | NO PICKS | | | |
| 40 | 14/12-08-066-05W4/0 | BP PCI 24 MARGLK 12-8-66-5 | 1981 | 155 | 526 | 526 | | NO PICKS | | | |
| 41 | 17/12-08-066-05W4/0 | BP PCI 13-81 OB MARG LK 12-8-66-5 | 1981 | 156 | 522 | 533 | | NO PICKS | | | |
| 42 | 00/06-13-066-06W4/0 | BP MARGUERITE 6-13-66-6 | 1981 | 157 | 519 | 521 | 210 | SWS | 517 | 3 | WOODBEND GRP |
| 43 | 00/12-30-069-07W4/0 | AEC FISHER 12-30-69-7 | 1988 | 436 | 534 | 543 | 423 | CLEARWATER SD | 533 | 1 | BEAVERHILL LAKE |
| 44 | 00/08-20-070-03W4/0 | AEC FISHER 8-20-70-3 | 1997 | 124 | 531 | 533 | 319 | GRAND RAPIDS | 519 | 12 | BEAVERHILL LAKE |
| 45 | 03/05-14-070-04W4/0 | AEC 03 FISHER 5-14-70-4 | 1996 | 355 | 538 | 538 | 293 | GRAND RAPIDS | 522 | 16 | BEAVERHILL LAKE |
| 46 | 05/05-14-070-04W4/0 | AEC 06 FISHER 5-14-70-4 | 1996 | 375 | 560 | 562 | 299 | GRAND RAPIDS FM | 546 | 14 | BEAVERHILL LAKE |
| 47 | 00/11-14-070-04W4/0 | AECOG C11 FISHER 11-14-70-4 | 1998 | 124 | 514 | 515 | 297 | GRAND RAPIDS | 499 | 15 | BEAVERHILL LAKE |
| 48 | 00/12-14-070-04W4/0 | AEC 01 FISHER 12-14-70-4 | 1996 | 450 | 550 | 557 | 306 | GRAND RAPIDS | 541 | 9 | BEAVERHILL LAKE |
| 49 | 00/07-15-070-04W4/0 | AECOG A7 FISHER 7-15-70-4 | 1998 | 380 | 507 | 510 | 295 | GRAND RAPIDS | 500 | 7 | BEAVERHILL LAKE |
| 50 | 00/08-15-070-04W4/0 | AEC 02 FISHER 8-15-70-4 | 1996 | 390 | 540 | 540 | 301 | GRAND RAPIDS | 540 | 0 | BEAVERHILL LAKE |
| 51 | 00/11-15-070-04W4/0 | AEC FISHER 11-15-70-4 | 1996 | 405 | 515 | 517 | 295 | GRAND RAPIDS | 500 | 15 | BEAVERHILL LAKE |
| 52 | 00/13-15-070-04W4/0 | AEC 13A FISHER 13-15-70-4 | 1997 | 124 | 514 | 515 | 290 | GRAND RAPIDS | 500 | 14 | BEAVERHILL LAKE |
| 53 | 00/15-15-070-04W4/0 | AEC B15 FISHER 15-15-70-4 | 1997 | 359 | 504 | 510 | 291 | GRAND RAPIDS | 496 | 8 | BEAVERHILL LAKE |
| 54 | 00/09-16-070-04W4/0 | AEC A9 FISHER 9-16-70-4 | 1997 | 350 | 510 | 517 | 293 | GRAND RAPIDS | 503 | 8 | BEAVERHILL LAKE |
| 55 | 00/10-16-070-04W4/0 | AEC FISHER 10-16-70-4 | 1997 | 371 | 529 | 529 | 304 | GRAND RAPIDS | 515 | 14 | BEAVERHILL LAKE |
| 56 | 00/15-16-070-04W4/0 | AEC A15 FISHER 15-16-70-4 | 1997 | 114 | 518 | 524 | 295 | GRAND RAPIDS | 510 | 8 | BEAVERHILL LAKE |
| 57 | 00/16-16-070-04W4/0 | AEC B16 FISHER 16-16-70-4 | 1997 | 100 | 522 | 522 | 295 | GRAND RAPIDS | 509 | 14 | BEAVERHILL LAKE |
| 58 | 00/01-21-070-04W4/0 | AEC B1 FISH 1-21-70-4 | 1997 | 360 | 510 | 515 | 298 | GRAND RAPIDS | 504 | 6 | BEAVERHILL LAKE |
| 59 | 02/01-21-070-04W4/0 | AEC 1A FISHER 1-21-70-4 | 1997 | 400 | 511 | 514 | 292 | GRAND RAPIDS | 498 | 13 | BEAVERHILL LAKE |
| 60 | 03/01-21-070-04W4/0 | AEC C1 FISHER 1-21-70-4 | 1997 | 325 | 500 | 510 | 291 | GRAND RAPIDS | 497 | 4 | BEAVERHILL LAKE |
| 61 | 04/01-21-070-04W4/0 | AEC D1 FISHER 1-21-70-4 | 1997 | 375 | 515 | 565 | 141 | COLORADO GRP | 500 | 15 | BEAVERHILL LAKE |

Table B.2: Dipmeter log data available in the original study area for the Elk Point and Beaverhill Groups (source: AEUB well database)

| No. | UWI | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Total Depth (m KB) | Top Fm Depth (m KB) | Top Formation Logged with Dipmeter | Top of Lowest Logged Fm (m KB) | Interval of Interest (m) | Lowest Formation Logged by Dipmeter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 62 | 00/02-21-070-04W4/0 | AEC C2 FISHER 2-21-70-4 | 1997 | 350 | 500 | 509 | 288 | GRAND RAPIDS | 494 | 6 | BEAVERHILL LAKE |
| 63 | 00/08-21-070-04W4/0 | AEC A8 FISHER 8-21-70-4 | 1997 | 350 | 500 | 514 | 147 | COLORADO GRP | 500 | 0 | BEAVERHILL LAKE |
| 64 | 00/10-21-070-04W4/0 | AEC A10 FISHER 10-21-70-4 | 1997 | 369 | 519 | 520 | 297 | GRAND RAPIDS | 505 | 14 | BEAVERHILL LAKE |
| 65 | 02/10-21-070-04W4/0 | AEC B10 FISHER 10-21-70-4 | 1997 | 350 | 515 | 515 | 290 | GRAND RAPIDS | 498 | 17 | BEAVERHILL LAKE |
| 66 | 02/15-21-070-04W4/0 | AEC 15B FISHER 15-21-70-4 | 1997 | 350 | 510 | 518 | 293 | GRAND RAPIDS | 502 | 8 | BEAVERHILL LAKE |
| 67 | 00/02-22-070-04W4/0 | AECOG D2 FISHER 2-22-70-4 | 1997 | 375 | 507 | 507 | 290 | GRAND RAPIDS | 494 | 13 | BEAVERHILL LAKE |
| 68 | 00/03-22-070-04W4/0 | AEC B3 FISHER 3-22-70-4 | 1997 | 375 | 500 | 511 | 291 | GRAND RAPIDS | 496 | 4 | BEAVERHILL LAKE |
| 69 | 00/04-22-070-04W4/0 | AEC 4C FISHER 4-22-70-4 | 1997 | 96 | 518 | 519 | 295 | GRAND RAPIDS | 504 | 14 | BEAVERHILL LAKE |
| 70 | 04/05-22-070-04W4/2 | AEC 104 FISHER 5-22-70-4 | 1996 | 450 | 525 | 554 | | NO PICKS | | | |
| 71 | 05/05-22-070-04W4/0 | AECOG 105 FISHER 5-22-70-4 | 1997 | 390 | 530 | 529 | | NO PICKS | | | |
| 72 | 06/05-22-070-04W4/0 | AECOG A5 FISHER 5-22-70-4 | 1997 | 73 | 220 | 522 | | NO PICKS | | | |
| 73 | 00/06-22-070-04W4/0 | AEC 6A FISHER 6-22-70-4 | 1997 | 110 | 515 | 522 | | NO PICKS | | | |
| 74 | 00/07-22-070-04W4/0 | AECOG(E) A7 FISHER 7-22-70-4 | 2000 | 130 | 516 | 516 | | NO PICKS | | | |
| 75 | 00/11-22-070-04W4/0 | AEC 11B FISHER 11-22-70-4 | 1997 | 350 | 514 | 515 | 345 | LOWER GRAND RAPIDS | 500 | 14 | BEAVERHILL LAKE |
| 76 | 04/11-22-070-04W4/0 | AECOG 2B11 FISHER 11-22-70-4 | 1997 | 70 | 513 | 516 | | NO PICKS | | | |
| 77 | 00/12-22-070-04W4/0 | AEC FISHER 12-22-70-4 | 1996 | 400 | 515 | 515 | 345 | LOWER GRAND RAPIDS | 501 | 14 | BEAVERHILL LAKE |
| 78 | 03/12-22-070-04W4/0 | AEC 12C FISHER 12-22-70-4 | 1997 | 347 | 516 | 518 | 340 | LOWER GRAND RAPIDS | 503 | 14 | BEAVERHILL LAKE |
| 79 | 02/14-22-070-04W4/0 | AEC C14 FISHER 14-22-70-4 | 1997 | 340 | 502 | 506 | 295 | GRAND RAPIDS | 491 | 12 | BEAVERHILL LAKE |
| 80 | 00/03-23-070-04W4/0 | AECOG A3 FISHER 3-23-70-4 | 1998 | 123 | 513 | 515 | 296 | GRAND RAPIDS | 501 | 13 | BEAVERHILL LAKE |
| 81 | 00/14-28-070-04W4/0 | AECOG A14 FISHER 14-28-70-4 | 1998 | 125 | 513 | 511 | 293 | GRAND RAPIDS | 496 | 17 | BEAVERHILL LAKE |
| 82 | 00/07-32-070-04W4/0 | AEC FISHER 7-32-70-4 | 1996 | 375 | 525 | 523 | 289 | GRAND RAPIDS | 508 | 17 | BEAVERHILL LAKE |
| 83 | 00/06-33-070-04W4/0 | AEC FISHER 6-33-70-4 | 1997 | 400 | 500 | 502 | 287 | GRAND RAPIDS | 487 | 14 | BEAVERHILL LAKE |
| 84 | 00/08-13-070-06W4/0 | AEC FISHER 8-13-70-6 | 1988 | 491 | 585 | 561 | 477 | MCMURRAY | 551 | 34 | BEAVERHILL LAKE |
| 85 | 00/05-23-070-06W4/0 | AEC FISHER 5D-23-70-6 | 1987 | 275 | 544 | 545 | 261 | VIKING | 535 | 10 | BEAVERHILL LAKE |
| 86 | 00/10-34-072-06W4/0 | AMOCO AEC KIRBY 10-34-72-6 | 1980 | 160 | 588 | 589 | 331 | GRAND RAPIDS | 571 | 18 | BEAVERHILL LAKE |
| 87 | 02/12-01-073-06W4/0 | AEC 07 KIRBY 12-1-73-6 | 1983 | 108 | 569 | 568 | 324 | BASE OF DRIFT | 560 | 9 | BEAVERHILL LAKE |
| 88 | 00/07-03-073-06W4/0 | AMOCO AEC IPIATIK 7-3-73-6 | 1980 | 160 | 577 | 578 | 328 | GRAND RAPIDS | 559 | 18 | BEAVERHILL LAKE |
| 89 | 00/10-03-073-06W4/0 | AMOCO AEC IPIATIK KIRBY 10A-3-73-6 | 1984 | 160 | 579 | 580 | 309 | BASE OF DRIFT | 561 | 18 | BEAVERHILL LAKE |
| 90 | 00/06-05-073-06W4/0 | AMOCO AEC KIRBY 6-5-73-6 | 1990 | 100 | 572 | 573 | 338 | GRAND RAPIDS | 550 | 22 | BEAVERHILL LAKE |
| 91 | 00/11-09-073-06W4/0 | AMOC AEC IPIATIK 11-9-73-6 | 1995 | 160 | 534.9 | 535 | 288 | BASE OF DRIFT | 514 | 21 | BEAVERHILL LAKE |

**Table B.2: Dipmeter log data available in the original study area for the Elk Point and Beaverhill Groups (source: AEUB well database)**

| No. | UWI | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Total Depth (m KB) | Top Fm Depth (m KB) | Top Formation Logged with Dipmeter | Top of Lowest Logged Fm (m KB) | Interval of Interest (m) | Lowest Formation Logged by Dipmeter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 92 | 00/10-11-073-06W4/0 | AEC AMOCO IPIATIK KIRBY 10-11-73-6 | 1984 | 160 | 605 | 605 | 308 | BASE OF DRIFT | 586 | 19 | BEAVERHILL LAKE |
| 93 | 00/04-15-073-06W4/0 | AECOG ET AL KIRBY 4-15-73-6 | 1997 | 96 | 528.5 | 529 | | NO PICKS | | | |
| 94 | 00/12-11-074-08W4/0 | ISH KIRBY 12-11-74-8 | 1997 | 440 | 530 | 529 | | NO PICKS | | | |
| 95 | 00/12-14-074-08W4/0 | ISH KIRBY 12-14-74-8 | 2000 | 440 | 519.3 | 521 | 280 | VIKING | 519 | 0 | WOODBEND GRP |
| 96 | 00/14-05-082-12W4/0 | TRANSWEST DIVIDE 14-5-82-12 | 1987 | 275 | 535 | 536 | 202 | SWS | 520 | 16 | WOODBEND GRP |
| 97 | 00/10-29-082-12W4/0 | HUSKY ET AL DIVIDE 10-29-82-12 | 1988 | 382 | 461 | 965 | 379 | WABISKAW MBR | 439 | 22 | WOODBEND GRP |
| 98 | 00/16-03-083-07W4/0 | GULF RESDELN 16-3-83-7 | 1981 | 175 | 505 | 505 | 225 | GRAND RAPIDS | 451 | 54 | BEAVERHILL LAKE |
| 99 | AA/11-15-083-07W4/0 | GULF RESDELN 11-15-83-7 | 1997 | 400 | 500 | 502 | 316 | CLEARWATER | 489 | 11 | BEAVERHILL LAKE |

**Table B.3: Core available in the original study area for the Elk Point Group (source: AEUB well database)**

| No. | UWI | Well Name | Year | Top Core Interval (m KB) | Bottom Core Interval (m KB) | Analyzed | Formation Names covered by Core | Top Fm (m KB) |
|---|---|---|---|---|---|---|---|---|
| 1 | 00/10-03-049-06W4/0 | HUSKY DH WILDMERE 10-3-49-6 | 1967 | 678.8 | 680.3 | N | LLOYDMINSTER MBR | 643.1 |
| | | | | | | | WOODBEND GRP | 679.7 |
| | | | | 1110.7 | 1154 | N | WATT MTN | 1099.7 |
| | | | | | | | PRAIRIE EVAPORITE | 1112.5 |
| 2 | A0/12-15-050-02W4/0 | BLACKFOOT DEVONIAN TEST SYNDICATE #1 | 1948 | 802.2 | 884.2 | N | DEVONIAN SYSTEM | 741.3 |
| | | | | 934.5 | 962.6 | N | BEAVERHILL LAKE | 805.9 |
| | | | | 964.7 | 1041.2 | N | ELK POINT GRP | 1010.1 |
| | | | | | | | FIRST SALT | 1024.1 |
| 3 | 00/14-29-052-02W4/0 | CALSTAN PACIFIC MARWAYNE 14-29-52-2 | 1958 | 780.3 | 826 | N | BEAVERHILL LAKE | 690.1 |
| | | | | 902.2 | 917.4 | N | ELK POINT GRP | 901.9 |
| | | | | 1062.2 | 1074.1 | N | PRAIRIE EVAPORITE | 915.6 |
| | | | | 1118.9 | 1148.8 | N | RED RIVER FM | 1115.9 |
| | | | | | | | CAMBRIAN | 1148.2 |
| 4 | 00/08-09-053-03W4/0 | HUSKY 8B MARWAYNE 8-9-53-3 | 1996 | 1029 | 1038 | Y | WINNIPEGOSIS | 1025 |
| 5 | 02/14-28-055-06W4/0 | AMOCO INJ LINDBERGH 14-28-55-6 | 1991 | 1260 | 1289.3 | Y | ERNESTINA LK | 1258.7 |
| | | | | | | Y | LOTSBERG | 1281.5 |
| 6 | 00/11-22-055-12W4/0 | WHITE ROSE DUVERNAY 11-22-55-12 | 1961 | 1255.8 | 1286.6 | N | FIRST SALT | 1125.3 |
| | | | | | | | WINNIPEGOSIS | 1258.8 |
| 7 | 02/10-27-055-12W4/0 | WESTERN CHEMICALS NO. 27-10S | 1953 | 1086.6 | 1087.5 | N | ELK POINT GRP | 1077.5 |
| 8 | 00/15-27-055-12W4/0 | WESTERN DUVERNAY 27-15 | 1952 | 1068.3 | 1209.1 | N | BEAVERHILL LAKE | 833 |
| | | | | | | | ELK POINT GRP | 1069.2 |
| 9 | 02/15-27-055-12W4/0 | CHEMICALS DUVERNAY SBP A15-27-55-12 | 1960 | 1079 | 1093.9 | N | ELK POINT GRP | 1067.1 |
| | | | | | | | FIRST SALT | 1082.3 |
| 10 | 00/16-27-055-12W4/0 | CHEMCELL DUVERNAY NACL 16-27-55-12 | 1969 | 1342 | 1449.6 | N | LOTSBERG | 1339.6 |
| | | | | | | | BASAL RED BEDS | 1441.7 |
| 11 | 00/05-26-056-05W4/0 | CANSALT 3 LINDBERGH NACL 5-26-56-5 | 1966 | 805 | 936.7 | N | ELK POINT GRP | 796.1 |
| | | | | | | | FIRST SALT | 859.5 |
| | | | | | | | SECOND SALT | 907.7 |
| 12 | 00/07-26-056-05W4/0 | ELK POINT WELL NO. 1 | 1946 | 848 | 997 | N | FIRST SALT | 845.8 |
| | | | | 1030.8 | 1197.6 | N | SECOND SALT | 1060.7 |
| | | | | | | | THIRD SALT | 1128.4 |

**Table B.3: Core available in the original study area for the Elk Point Group (source: AEUB well database)**

| No. | UWI | Well Name | Year | Top Core Interval (m KB) | Bottom Core Interval (m KB) | Analyzed | Formation Names covered by Core | Top Fm (m KB) |
|---|---|---|---|---|---|---|---|---|
| 13 | 00/02-21-057-05W4/0 | ANGLO-CAN. ELK POINT NO. 11 | 1949 | 1020.2 | 1033.6 | N | PRAIRIE EVAPORITE | 884.5 |
| | | | | 1324.9 | 1356 | Y | WINNIPEGOSIS | 1027.2 |
| | | | | | | | CONTACT RAPIDS | 1070.2 |
| | | | | | | | COLD LAKE | 1115.9 |
| | | | | | | | ERNESTINA LK | 1159.8 |
| | | | | | | | LOTSBERG | 1180.5 |
| | | | | | | | BASAL RED BEDS | 1301.5 |
| | | | | | | | CAMBRIAN | 1350.3 |
| 14 | 00/07-14-057-06W4/0 | TEXEX ET AL ELK POINT 7-14-57-6 | 1956 | 859.2 | 872 | Y | BEAVERHILL LAKE | 631.5 |
| | | | | | | Y | WATT MTN | 866.2 |
| 15 | 00/10-13-060-04W4/0 | TEXEX ET AL CHAR LAKE 10-13-60-4 | 1956 | 808 | 811.1 | Y | PRAIRIE EVAPORITE | 746.5 |
| | | | | 1251.2 | 1299.4 | Y | BASAL RED BEDS | 1225.3 |
| | | | | | | | EARLIE | 1297.8 |
| 16 | 00/13-03-060-11W4/0 | CNRL ASHMONT 13-3-60-11 | 1949 | 799.8 | 807.1 | N | BEAVERHILL LAKE | 802.2 |
| | | | | 848 | 848.6 | N | ELK POINT GRP | 1036.3 |
| | | | | 912.9 | 915.6 | N | PRAIRIE EVAPORITE | 1056.1 |
| | | | | 975.4 | 982.1 | N | WINNIPEGOSIS | 1197.3 |
| | | | | 1051.3 | 1059.2 | N | CONTACT RAPIDS | 1232.9 |
| | | | | 1260.7 | 1267.1 | N | BASAL RED BEDS | 1546.9 |
| | | | | 1267.7 | 1274.7 | N | EARLIE | 1604.8 |
| | | | | 1581 | 1594.1 | N | ELDON | 1627.6 |
| | | | | 1687.4 | 1694.7 | N | BASAL SANDSTONE UNIT | 1664.2 |
| | | | | 1727 | 1728.5 | N | PRECAMBRIAN | 1741 |
| 17 | 00/08-01-062-11W4/0 | SASKOIL SUGDEN 8-1-62-11 | 1991 | 1103 | 1121 | Y | COLD LAKE | 1084.2 |
| | | | | 1160 | 1166.2 | Y | ERNESTINA LK | 1155.3 |
| 18 | 02/01-28-063-02W4/0 | RENAISSANCE COLD LAKE 1-28-63-2 | 1989 | 751 | 752.8 | N | WINNIPEGOSIS | 744 |
| 19 | AA/15-20-064-02W4/0 | ESSO MARIE OV 15-20-64-2 | 1979 | 1140 | 1206.2 | Y | BASAL RED BEDS | 1092.5 |
| | | | | | | | CAMBRIAN | 1144.5 |
| 20 | 00/07-18-064-03W4/0 | ESSO 79 SWD COLDLK 7-18-64-3 | 1979 | 1217 | 1288 | Y | BASAL RED BEDS | 1171 |
| | | | | | | | CAMBRIAN | 1218.5 |
| 21 | 00/01-32-064-03W4/0 | ESSO 83 SWD ETHELLK 1-32-64-3 | 1984 | 1273 | 1335.1 | Y | BASAL RED BEDS | 1225 |
| | | | | | | | CAMBRIAN | 1274.5 |

**Table B.3: Core available in the original study area for the Elk Point Group (source: AEUB well database)**

| No. | UWI | Well Name | Year | Top Core Interval (m KB) | Bottom Core Interval (m KB) | Analyzed | Formation Names covered by Core | Top Fm (m KB) |
|---|---|---|---|---|---|---|---|---|
| 22 | 00/08-33-064-03W4/0 | ESSO 83 INJ ETHELLK 8-33-64-3 | 1983 | 1260 | 1317 | Y | BASAL RED BEDS | 1211 |
| | | | | | | | CAMBRIAN | 1262.5 |
| 23 | 00/12-08-065-03W4/0 | ESSO 79 SWD ETHELLK 12-8-65-3 | 1979 | 1222 | 1267.4 | Y | BASAL RED BEDS | 1175 |
| | | | | | | | CAMBRIAN | 1225 |
| 24 | AA/06-08-066-02W4/0 | ESSO MEDLEY OV 6-8-66-2 | 1979 | 1173 | 1217.5 | Y | BASAL RED BEDS | 1142.5 |
| | | | | | | | CAMBRIAN | 1182 |
| 25 | 00/07-11-067-06W4/0 | ESSO AEC 85 FISHCK 7-11-67-6 | 1985 | 1305 | 1332 | Y | BASAL RED BEDS | 1261 |
| | | | | | | | CAMBRIAN | 1308 |
| 26 | 00/11-19-068-06W4/0 | ESSO AEC 85 FISHCK 11-19-68-6 | 1985 | 1298.8 | 1330 | Y | BASAL RED BEDS | 1275.8 |
| | | | | | | | CAMBRIAN | 1324 |
| 27 | 07/08-12-069-05W4/0 | AECOG (NE) FISHER 8D-12-69-5 | 1990 | 856 | 897.5 | Y | WINNIPEGOSIS FM | 855.4 |
| 28 | 00/04-03-069-10W4/0 | MOBIL PAN AM HEART LAKE 4-3-69-10 | 1958 | 1136 | 1151.2 | N | ELK POINT GRP | 929.9 |
| 29 | 00/11-26-069-10W4/0 | ARCO HEART LAKE 11-26-69-10 | 1967 | 1018.6 | 1061.9 | Y | WINNIPEGOSIS | 1018.6 |
| | | | | | | | CONTACT RAPIDS | 1060.7 |
| 30 | 02/05-22-070-04W4/2 | AEC 102 FISHER 5-22-70-4 | 1996 | 801 | 834 | Y | WINNIPEGOSIS | 794.5 |
| 31 | 00/16-13-071-01W4/0 | AEC ET AL SCHELTENS 16-13-71-1 | 1985 | 750 | 768 | Y | ELK POINT GRP | 751.4 |
| 32 | 00/10-17-071-06W4/0 | AMOCO AEC IPIATIK GRIST 10-17-71-6 | 1980 | 643 | 656.6 | Y | WATT MTN FM | 641.8 |
| | | | | 1187 | 1199 | Y | BASAL RED BEDS | 1185 |
| 33 | 00/16-36-072-01W4/0 | AEC ET AL FOSTERCK 16-36-72-1 | 1985 | 693.5 | 693.5 | Y | KEG RIVER FM | 677.1 |
| 34 | 00/10-22-072-06W4/0 | AMOCO KIRBY 10-22-72-6 | 1980 | 862 | 880 | Y | WINNIPEGOSIS | 860 |
| 35 | 00/09-25-073-05W4/0 | AMOCO KIRBY 9-25-73-5 | 1980 | 777 | 794 | Y | PRAIRIE EVAPORITE | 601 |
| | | | | | | | WINNIPEGOSIS | 784 |
| 36 | 00/01-28-075-03W4/0 | HOME WINEFRED LAKE 1-28-75-3 | 1967 | 669 | 708.1 | Y | PRAIRIE EVAPORITE | 648.6 |
| | | | | | | | WINNIPEGOSIS | 680 |
| | | | | | | | CONTACT RAPIDS | 699.2 |
| 37 | 00/02-34-075-11W4/0 | FINA CAL AM WAPPAU 2-34-75-11 | 1966 | 974.1 | 989.1 | N | KEG RIVER | 951.6 |
| 38 | 00/10-22-076-01W4/0 | HOME WINEFRED LAKE 10-22-76-1 | 1967 | 564.2 | 591 | Y | WATT MTN | 534.6 |
| | | | | | | | WINNIPEGOSIS | 572.1 |
| 39 | 00/01-25-076-01W4/0 | HOME SWEEZY 1-25-76-1 | 1969 | 518.2 | 545.6 | Y | WINNIPEGOSIS | 512.7 |
| 40 | 00/03-07-077-07W4/0 | HOME LEISMER 3-7-77-7 | 1980 | 726 | 744.3 | Y | PRAIRIE EVAPORITE | 534.5 |
| | | | | | | | WINNIPEGOSIS | 726.5 |

**Table B.3: Core available in the original study area for the Elk Point Group (source: AEUB well database)**

| No. | UWI | Well Name | Year | Top Core Interval (m KB) | Bottom Core Interval (m KB) | Analyzed | Formation Names covered by Core | Top Fm (m KB) |
|---|---|---|---|---|---|---|---|---|
| 41 | 00/02-25-077-09W4/0 | CHRISTINA RIVER HARDY NO. 1 WELL | 1949 | 342 | 794.6 | N | BEAVERHILL LAKE | 370.3 |
| | | | | | | | ELK POINT GRP | 548.6 |
| | | | | | | | PRAIRIE EVAPORITE | 578.2 |
| | | | | | | | WINNIPEGOSIS | 765 |
| 42 | 00/11-12-077-10W4/0 | PACIFIC MAY RIVER 11-12-77-10 | 1958 | 884.2 | 887.3 | N | KEG RIVER | 856.5 |
| 43 | 00/07-13-078-01W4/0 | HOME SWEEZY 7-13-78-1 | 1969 | 478.5 | 506 | Y | WINNIPEGOSIS | 476.7 |
| 44 | 00/03-25-078-02W4/0 | HOME WINEFRED LAKE 3-25-78-2 | 1967 | 530.7 | 583.1 | Y | WINNIPEGOSIS | 514.8 |
| 45 | 00/06-07-078-11W4/0 | R O CORP CHRISTINA RIVER 6-7-78-11 | 1958 | 971.1 | 994 | N | KEG RIVER | 957.1 |
| 46 | 00/10-05-080-02W4/0 | HOME WINNEFRED LAKE 10-5-80-2 | 1967 | 522.1 | 540.4 | Y | WINNIPEGOSIS | 519.1 |
| | | | | | | | CONTACT RAPIDS | 537.1 |
| 47 | 00/05-23-080-05W4/0 | R O CORP JANVIER 5-23-80-5 | 1958 | 484.3 | 491.9 | N | ELK POINT GRP | 353.6 |
| | | | | 521.8 | 522.7 | Y | RED BEDS | 543.8 |
| | | | | 684.9 | 692.5 | N | | |
| 48 | 00/09-01-080-08W4/0 | R O CORP PONY CREEK 9-1-80-8 | 1958 | 371.9 | 508.4 | N | BEAVERHILL LAKE | 397.8 |
| | | | | 509 | 549.2 | N | ELK POINT GRP | 515.7 |
| 49 | 00/06-08-081-08W4/0 | R O CORP ET AL CORNER LK 6-8-81-8 | 1958 | 842.2 | 847.6 | N | ELK POINT GRP | 640.1 |
| | | | | 856.5 | 862.6 | N | | |
| 50 | 00/02-23-082-05W4/0 | R O CORP COTTONWOOD 2-23-82-5 | 1958 | 417.6 | 420.6 | N | ELK POINT GRP | 378.3 |
| 51 | 00/07-08-082-06W4/0 | GULF RESDELN 7-8-82-6 | 1981 | 302.5 | 311.5 | Y | BEAVERHILL LAKE | 305 |
| | | | | 585.5 | 654 | Y | WINNIPEGOSIS | 511.8 |
| | | | | | | | GRANITE WASH | 603.2 |
| 52 | 00/10-29-082-12W4/0 | HUSKY ET AL DIVIDE 10-29-82-12 | 1988 | 891 | 900.2 | Y | WINNIPEGOSIS | 878.9 |
| 53 | 00/06-36-082-12W4/0 | R O CORP ET AL DIVIDE 6-36-82-12 | 1958 | 944.9 | 952.5 | N | ELK POINT GRP | 733 |
| 54 | 00/04-20-083-04W4/0 | DOME GORDON LAKE 4-20-83-4 | | 454.5 | 459.3 | Y | PRAIRIE EVAPORITE | 406.9 |
| | | | | 477.6 | 479.1 | N | | |
| 55 | 00/10-08-083-06W4/0 | GULF RESDELN 10-8-83-6 | 1981 | 561.9 | 570.9 | Y | WINNIPEGOSIS | 559.7 |
| | | | | 571 | 625 | Y | | |
| 56 | 00/16-27-085-11W4/0 | TEXCAN CS HORSE 16-27-85-11 | 1969 | 694 | 699.8 | | KEG RIVER | 693.4 |
| 57 | AA/08-10-089-09W4/0 | TH INDUSTRIAL MINERALS #1 | 1936 | 0 | 273.4 | N | BEAVERHILL LAKE | 30.6 |
| | | | | | | | SLAVE POINT | 149.4 |
| | | | | | | | PRAIRIE EVAPORITE | 150.4 |

**Table B.3: Core available in the original study area for the Elk Point Group (source: AEUB well database)**

| No. | UWI | Well Name | Year | Top Core Interval (m KB) | Bottom Core Interval (m KB) | Analyzed | Formation Names covered by Core | Top Fm (m KB) |
|---|---|---|---|---|---|---|---|---|
| 58 | 00/02-32-089-12W4/0 | SUNCOR CLARKE 2-32PREV-89-12 | 1981 | 345 | 713.5 | N | WATT MTN | 397.8 |
| | | | | | | | PRAIRIE EVAPORITE | 406.2 |
| | | | | | | | WINNIPEGOSIS | 606 |
| | | | | | | | CONTACT RAPIDS | 675 |
| 59 | 00/13-16-091-08W4/0 | BAYSEL STEEPBANK 13-16-91-8 | 1957 | 459.6 | 461.2 | N | ELK POINT GRP | 302.1 |
| | | | | 477.6 | 477.9 | | GRANITE WASH | 463.3 |
| 60 | 00/04-32-093-10W4/0 | BEAR VAMPIRE #2 | 1949 | 147.8 | 269.1 | N | ELK POINT GRP | 157 |
| | | | | | | | RED BEDS | 262 |
| 61 | 00/06-18-093-12W4/0 | AOSTRA WDW1 ATHABASCA 6-18-93-12 | 1991 | 487 | 532.9 | Y | WINNIPEGOSIS | 479 |
| 62 | 00/06-23-094-07W4/0 | CHEVRON STEEPBANK 6-23-94-7 | 1996 | 350 | 359 | Y | WINNIPEGOSIS | 334 |
| 63 | 00/13-23-094-07W4/0 | CHEVRON WDW STEEPBANK 13-23-94-7 | 1991 | 360 | 369.5 | Y | WINNIPEGOSIS | 329 |
| 64 | AA/12-07-095-08W4/0 | ESSO 90PC OSLO 12-7-95-8 | 1990 | 129.6 | 310.9 | Y | BEAVERHILL LAKE | 129.5 |
| | | | | | | | ELK POINT GRP | 183.5 |
| | | | | | | | METHY FM | 213 |
| | | | | | | | CONTACT RAPIDS | 268 |

**Table B.4: DST data available in the original study area for wells that had bulk density log data (source: AEUB well database)**

| No. | UWI | Well Name | DST Description | DST Description |
|---|---|---|---|---|
| 1 | 00/10-17-054-05W4/00 | HUSKY DH ETHELWYN 10D-17-54-5 | 1971/08/14 FM:PRAIRIE EVAPORITE FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 1112.50-1127.80<br>Rec Depth:1106.40 SP: 11797 FFP: 159 VO: 60 (min.)<br>HP:13548 ,13548 SIP:11836 /11349 /0 /0 SIT:60 /90 /0 /0<br>FP:124 /179 /0 /0 /0 /0 /0 /0 FT:15 /60 /0 /0<br>Recovery: MUD 1.50 M | |
| 2 | 00/16-13-071-01W4/0 | AEC ET AL SCHELTENS 16-13-71-1 | 1985/02/21 FM:ELK POINT GRP -<br>MECHANICALLY GOOD LIMITED RECOVERY DST FM Dep: 753.00-761.00<br>Rec Depth:740.10 SP: 4646 FFP: 2563 VO: 148 (min.)<br>HP:8090 ,7943 SIP:2563 /4646 /0 /0 SIT:0 /148 /0 /0<br>FP:431 /0 /0 /0 /0 /0 /0 /0 FT:10 /0 /0 /0<br>Recovery: MUD-CUT WATER 40.00 M<br>Recovery: BRACKISH WATER 200.00 M | 1985/02/23 FM:ELK POINT GRP -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 754.00-759.50<br>Rec Depth:741.00 SP: 4764 FFP: 3462 VO: 55 (min.)<br>HP:8114 ,7973 SIP:4764 /4758 /0 /0 SIT:60 /182 /0 /0<br>FP:263 /855 /1109 /3462 /0 /0 /0 /0 FT:5 /55 /0 /0 |
| 3 | 00/07-12-071-11W4/0 | RAX ET AL MILLS 7-12-71-11 | 1978/02/25 FM:ERNESTINA LK FM - LOTSBERG FM<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 1121.10-1136.90<br>Rec Depth:1121.70 SP: 3758 FFP: 185 VO: 60 (min.)<br>HP:14727 ,14665 SIP:3758 /2358 /0 /0 SIT:60 /90 /0 /0<br>FP:241 /103 /0 /0 /0 /0 /0 /0 FT:10 /60 /0 /0<br>Recovery: MUD 3.00 M | 1978/02/26 FM:ERNESTINA LK FM - LOTSBERG FM<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 1111.90-1127.80<br>Rec Depth:1112.50 SP: 1724 FFP: 165 VO: 60 (min.)<br>HP:0 ,0 SIP:0 /0 /0 /0 SIT:60 /90 /0 /0<br>FP:0 /0 /0 /0 /0 /0 /0 /0 FT:15 /60 /0 /0<br>Recovery: 0.00 M |
| 4 | 00/06-26-072-11W4/0 | PAN AM A-1 BEHAN 6-26-72-11 | 1969/02/10 FM:COOKING LAKE FM - BEAVERHILL LAKE FM<br>MECHANICALLY GOOD LIMITED RECOVERY DST FM Dep: 557.50-615.70<br>Rec Depth:614.20 SP: 3930 FFP: 1620 VO: 120 (min.)<br>HP:6867 ,6860 SIP:3930 /3909 /0 /0 SIT:60 /60 /0 /0<br>FP:917 /1620 /0 /0 /0 /0 /0 /0 FT:120 /0 /0 /0<br>Recovery: SULPHUROUS WATER 51.80 M<br>Recovery: MUD 18.30 M | 1969/02/24 FM:PRAIRIE EVAPORITE FM - WINNIPEGOSIS FM<br>MECHANICALLY GOOD LIMITED RECOVERY DST FM Dep: 978.40-988.50<br>Rec Depth:973.20 SP: 10563 FFP: 110 VO: 60 (min.)<br>HP:11880 ,11397 SIP:386 /8177 /0 /0 SIT:30 /30 /0 /0<br>FP:290 /290 /0 /0 /0 /0 /0 /0 FT:60 /0 /0 /0<br>Recovery: MUD 6.10 M |
| 5 | 00/07-08-082-06W4/0 | GULF RESDELN 7-8-82-6 | 1981/03/14 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 582.00-602.00<br>Rec Depth:577.10 SP: 296 FFP: 251 VO: 60 (min.)<br>HP:8078 ,8078 SIP:217 /296 /0 /0 SIT:60 /60 /0 /0<br>FP:365 /137 /217 /251 /0 /0 /0 /0 FT:10 /60 /0 /0<br>Recovery: MUD 19.00 M | |
| 6 | 00/01-24-095-07W4/0 | CDCOG TENN MUSKEGR 1-24-95-7<br><br>(CONTACT RAPIDS 385 m KB) | 1980/03/04 FM:METHY FM - GRANITE WASH<br>MECHANICALLY GOOD CONVENTIONAL DST FM Dep: 384.00-412.00<br>Rec Depth:374.00 SP: 78 FFP: 56 VO: 60 (min.)<br>HP:4374 ,4374 SIP:300 /300 /0 /0 SIT:60 /120 /0 /0<br>FP:300 /300 /0 /0 /0 /0 /0 /0 FT:10 /30 /0 /0<br>Recovery: MUD 1.00 M | |

**Table B.4: DST data available in the original study area for wells that had bulk density log data (source: AEUB well database)**

| No. | UWI | Well Name | DST Description | DST Description |
|---|---|---|---|---|
| 7 | 00/08-09-053-03W4/0 | HUSKY 8B MARWAYNE 8-9-53-3 | 1996/11/19 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD LIMITED RECOVERY DST FM Dep: 1025.00-1046.00<br>Rec Depth:1027.91 SP: 665 FFP: 294 VO: 32 (min.)<br>Recovery: MUD 30.00 M<br>1988/06/10 FM:WINNIPEGOSIS FM - TOTAL DEPTH | |
| 8 | 00/06-12-053-04W4/0 | STERLING ET AL DEWBERRY 6-12-53-4 | MECHANICALLY GOOD LIMITED RECOVERY DST FM Dep: 1071.00-1105.00<br>Rec Depth:1061.00 SP: 4275 FFP: 90 VO: 62 (min.)<br>HP:13872 ,13856 SIP:2957 /4274 /0 /0 SIT:57 /118 / /<br>FP:131 /82 /158 /89 /0 /0 /0 /0 FT:12 /62 / /<br>Recovery: MUD 1.00 M | 1988/06/11 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 1063.20-1067.00<br>Rec Depth:1051.90 SP: 0 FFP: 0 VO: 61 (min.)<br>HP:13748 ,13748 SIP:68 /48 /0 /0 SIT:62 /118 / /<br>FP:117 /117 /117 /117 /0 /0 /0 /0 FT:9 /61 / / |
| 9 | 00/08-01-062-11W4/0 | SASKOIL SUGDEN 8-1-62-11 | 1991/07/18 FM:BASAL RED BEDS - CAMBRIAN SYSTEM<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 1525.00-1556.00<br>Rec Depth:1529.94 SP: 13702 FFP: 5210 VO: 60 (min.)<br>HP:19787 ,19732 SIP:13513 /12665 /0 /0 SIT:60 /120 / /<br>FP:806 /2158 /2578 /4936 /0 /0 /0 /0 FT:10 /60 / /<br>Recovery: MUD 75.00 M<br>Recovery: SALT WATER 323.00 M | |
| 10 | 02/01-28-063-02W4/0 | RENAISSANCE COLD LAKE 1-28-63-2 | 1989/07/05 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 744.00-752.00<br>Rec Depth:747.00 SP: 466 FFP: 224 VO: 16 (min.)<br>HP:9266 ,9273 SIP:468 /330 /0 /0 SIT:54 /27 / /<br>FP:330 /220 /330 /220 /0 /0 /0 /0 FT:12 /16 / /<br>Recovery: MUD 25.00 M | |
| 11 | 02/08-26-063-03W4/0 | CON BEACON PARA COLDLK 8-26-63-3 | 1992/12/13 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD CONVENTIONAL DST FM Dep: 764.80-799.00<br>Rec Depth:767.00 SP: 8618 FFP: 4411 VO: 60 (min.)<br>Recovery: MUD 152.00 M<br>Recovery: WATER 175.00 M | 1992/12/15 FM:ERNESTINA LK FM - LOTSBERG FM<br>MECHANICALLY GOOD CONVENTIONAL DST FM Dep: 914.00-928.00<br>Rec Depth:917.64 SP: 8978 FFP: 255 VO: 30 (min.)<br>Recovery: MUD 1.00 M |
| 12 | 02/06-13-063-08W4/0 | CDNOXY SWD 2 SUGDEN 6-13-63-8 | 1986/12/28 FM:BASAL RED BEDS - CAMBRIAN SYSTEM<br>MECHANICALLY GOOD CONVENTIONAL DST FM Dep: 1350.00-1384.00<br>Rec Depth:1344.40 SP: 12750 FFP: 12743 VO: 60 (min.)<br>HP:18181 ,17940 SIP:12741 /12748 /0 /0 SIT:60 /90 / /<br>FP:11645 /11776 /12003 /6 /0 /0 /0 /0 FT:10 /60 / /<br>Recovery: MUD-CUT SALT WATER 240.00 M<br>Recovery: SALT WATER 780.00 M | |

**Table B.4: DST data available in the original study area for wells that had bulk density log data (source: AEUB well database)**

| No. | UWI | Well Name | DST Description | DST Description |
|---|---|---|---|---|
| 13 | 00/10-10-066-06W4/0 | BP LEMING 10-10-66-6 | 1981/03/05 FM:BASAL RED BEDS - PRECAMBRIAN SYSTEM<br>MECHANICALLY GOOD CONVENTIONAL DST FM Dep: 1310.00-1362.00<br>Rec Depth:1312.00 SP: 11496 FFP: 11447 VO: 120 (min.)<br>HP:16484 ,16484 SIP:11356 /11497 /0 /0 SIT:60 /120 /0 /0<br>FP:11197 /11426 /0 /0 /0 /0 /0 /0 FT:5 /120 /0 /0<br>Recovery: MUD 80.00 M<br>Recovery: MUD-CUT SALT WATER 870.00 M | 1981/03/06 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 910.00-935.00<br>Rec Depth:899.00 SP: 1432 FFP: 1355 VO: 60 (min.)<br>HP:11162 ,11162 SIP:8446 /0 /0 /0 SIT:60 /120 /0 /0<br>FP:177 /813 /0 /0 /0 /0 /0 /0 FT:5 /60 /0 /0<br>Recovery: MUD 72.00 M<br>Recovery: MUD-CUT SALT WATER 14.00 M |
| 14 | 00/11-26-069-10W4/0 | ARCO HEART LAKE 11-26-69-10 | 1967/03/22 FM:LOTSBERG FM - BASAL RED BEDS<br>MECHANICALLY GOOD CONVENTIONAL DST FM Dep: 1414.30-1432.00<br>Rec Depth:1407.60 SP: 545 FFP: 110 VO: 30 (min.)<br>HP:18292 ,18326 SIP:552 /269 /0 /0 SIT:30 /45 /0 /0<br>FP:138 /138 /0 /0 /0 /0 /0 /0 FT:5 /30 /0 /0<br>Recovery: MUD 1.50 M<br>1967/03/23 FM:CONTACT RAPIDS FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 1082.00-1103.40<br>Rec Depth:1074.40 SP: 207 FFP: 76 VO: 35 (min.)<br>HP:13865 ,13748 SIP:248 /186 /0 /0 SIT:30 /90 /0 /0<br>FP:16706 /0 /0 /0 /0 /0 /0 /0 FT:5 /35 /0 /0<br>Recovery: MUD 1.50 M | 1967/03/22 FM:ERNESTINA LK FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 1155.80-1163.10<br>Rec Depth:1146.00 SP: 1496 FFP: 62 VO: 30 (min.)<br>HP:14920 ,14865 SIP:1158 /1531 /0 /0 SIT:30 /55 /0 /0<br>FP:159 /117 /0 /0 /0 /0 /0 /0 FT:5 /30 /0 /0<br>Recovery: MUD 1.50 M<br>1967/03/23 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 1021.70-1054.60<br>Rec Depth:1015.00 SP: 290 FFP: 138 VO: 30 (min.)<br>HP:13231 ,13190 SIP:296 /331 /0 /0 SIT:30 /90 /0 /0<br>FP:200 /159 /0 /0 /0 /0 /0 /0 FT:5 /30 /0 /0<br>Recovery: MUD 1.50 M |
| 15 | 00/10-17-071-06W4/0 | AMOCO AEC IPIATIK GRIST 10-17-71-6 | 1980/02/22 FM:BEAVERHILL LAKE FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 515.00-530.00<br>Rec Depth:506.00 SP: 2948 FFP: 63 VO: 60 (min.)<br>HP:6099 ,6099 SIP:3090 /3090 /0 /0 SIT:60 /120 /0 /0<br>FP:269 /323 /0 /0 /0 /0 /0 /0 FT:10 /60 /0 /0<br>Recovery: OIL-CUT MUD 3.00 M | 1980/03/08 FM:ERNESTINA LK FM - LOTSBERG FM<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 973.00-983.00<br>Rec Depth:963.00 SP: 97 FFP: 32 VO: 90 (min.)<br>HP:12428 ,12510 SIP:333 /166 /0 /0 SIT:90 /120 /0 /0<br>FP:333 /166 /0 /0 /0 /0 /0 /0 FT:10 /60 /0 /0<br>Recovery: MUD 0.50 M |
| 16 | 00/16-36-072-01W4/0 | AEC ET AL FOSTERCK 16-36-72-1 | 1985/03/07 FM:KEG RIVER FM -<br>MECHANICALLY GOOD WIRELINE FORMATION TEST FM Dep: 680.50-680.50<br>Rec Depth:680.50 SP: 7147 FFP: 0 VO: 0 (min.) | |
| 17 | 00/11-14-072-08W4/0 | AEC PHILLIPS WIAU 11-14-72-8 | 1980/01/30 FM:LOTSBERG FM - BASAL RED BEDS<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 1250.00-1260.00<br>Rec Depth:1240.70 SP: 263 FFP: 200 VO: 60 (min.)<br>HP:16648 ,16811 SIP:351 /282 /0 /0 SIT:60 /60 /0 /0<br>FP:326 /326 /0 /0 /0 /0 /0 /0 FT:5 /60 /0 /0<br>Recovery: MUD 7.00 M<br>1980/02/01 FM:PRAIRIE EVAPORITE FM - WINNIPEGOSIS FM<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 905.00-915.00<br>Rec Depth:895.70 SP: 10853 FFP: 303 VO: 60 (min.)<br>HP:11978 ,12021 SIP:10973 /10607 /0 /0 SIT:60 /90 /0 /0<br>FP:326 /313 /0 /0 /0 /0 /0 /0 FT:5 /60 /0 /0<br>Recovery: MUD 7.00 M | 1980/02/01 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 910.00-920.00<br>Rec Depth:900.70 SP: 11730 FFP: 217 VO: 60 (min.)<br>HP:12088 ,12240 SIP:11911 /11478 /0 /0 SIT:60 /105 /0 /0<br>FP:320 /313 /0 /0 /0 /0 /0 /0 FT:5 /60 /0 /0<br>Recovery: MUD 7.00 M |

**Table B.4: DST data available in the original study area for wells that had bulk density log data (source: AEUB well database)**

| No. | UWI | Well Name | DST Description | DST Description |
|---|---|---|---|---|
| 18 | 00/10-14-073-05W4/0 | AMOCO AEC IPIATIK KIRBY 10-14-73-5 | 1979/02/04 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 793.00-820.00<br>Rec Depth:785.00 SP: 5383 FFP: 5331 VO: 60 (min.)<br>HP:4247 ,0 SIP:5534 /5534 /0 /0 SIT:30 /120 /0 /0<br>FP:4615 /5534 /0 /0 /0 /0 /0 /0 FT:10 /60 /0 /0<br>Recovery: MUD-CUT SALT WATER 60.00 M | |
| 19 | 00/10-09-074-06W4/0 | AMOCO KIRBY 10-9-74-6 | 1977/02/21 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 810.20-813.80<br>Rec Depth:812.30 SP: 6543 FFP: 345 VO: 30 (min.)<br>HP:10446 ,10411 SIP:614 /634 /0 /0 SIT:30 /60 /0 /0<br>FP:248 /290 /0 /0 /0 /0 /0 /0 FT:10 /30 /0 /0<br>Recovery: MUD 12.20 M<br>1977/02/21 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 801.00-804.70<br>Rec Depth:802.50 SP: 6440 FFP: 345 VO: 30 (min.)<br>HP:10411 ,10446 SIP:634 /614 /0 /0 SIT:30 /75 /0 /0<br>FP:248 /290 /324 /0 /0 /0 /0 /0 FT:10 /30 /0 /0<br>Recovery: MUD<br>1977/02/21 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD WIRELINE FORMATION TEST FM Dep: 786.40-786.40<br>Rec Depth:786.40 SP: 5992 FFP: 0 VO: 0 (min.) | 1977/02/21 FM:ERNESTINA LK FM -<br>MECHANICALLY GOOD WIRELINE FORMATION TEST FM Dep: 917.40-917.40<br>Rec Depth:917.40 SP: 4426 FFP: 0 VO: 0 (min.)<br>HP:10446 ,10411 SIP:614 /634 /0 /0 SIT:30 /60 /0 /0<br>FP:248 /290 /0 /0 /0 /0 /0 /0 FT:10 /30 /0 /0<br><br>1977/02/21 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD WIRELINE FORMATION TEST FM Dep: 813.20-813.20<br>Rec Depth:813.20 SP: 110 FFP: 0 VO: 0 (min.)<br>HP:10411 ,10446 SIP:634 /614 /0 /0 SIT:30 /75 /0 /0<br>FP:248 /290 /324 /0 /0 /0 /0 /0 FT:10 /30 /0 /0 |
| 20 | 02/10-01-077-07W4/0 | HOME LEISMER A10-1-77-7 | 1975/02/08 FM:GRANITE WASH - PRECAMBRIAN SYSTEM<br>MECHANICALLY GOOD CONVENTIONAL DST FM Dep: 929.60-959.20<br>Rec Depth:932.40 SP: 221 FFP: 207 VO: 20 (min.)<br>HP:12128 ,12087 SIP:207 /207 /0 /0 SIT:20 /20 /0 /0<br>FP:207 /207 /0 /0 /0 /0 /0 /0 FT:20 /20 /0 /0<br>Recovery: 0.00 M | |
| 21 | 00/10-28-077-08W4/0 | ALTANA HUBER CHRISTINA 10-28-77-8 | 1971/02/03 FM:PRAIRIE EVAPORITE FM - WINNIPEGOSIS FM<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 727.90-740.70<br>Rec Depth:721.50 SP: 9880 FFP: 1951 VO: 60 (min.)<br>HP:8963 ,9067 SIP:9880 /9349 /0 /0 SIT:70 /60 /0 /0<br>FP:579 /1951 /0 /0 /0 /0 /0 /0 FT:5 /60 /0 /0<br>Recovery: MUD-CUT SALT WATER 170.70 M | 1971/02/03 FM:BEAVERHILL LAKE FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 375.50-378.90<br>Rec Depth:369.10 SP: 676 FFP: 345 VO: 60 (min.)<br>HP:4585 ,4571 SIP:676 /0 /0 /0 SIT:60 /60 /0 /0<br>FP:324 /345 /0 /0 /0 /0 /0 /0 FT:5 /60 /0 /0<br>Recovery: WATER-CUT MUD 25.90 M |
| 22 | 00/10-05-080-02W4/0 | HOME WINNEFRED LAKE 10-5-80-2 | 1967/03/11 FM:PRAIRIE EVAPORITE FM - CONTACT RAPIDS FM<br>MECHANICALLY GOOD CONVENTIONAL DST FM Dep: 516.90-557.80<br>Rec Depth:556.60 SP: 4289 FFP: 2427 VO: 150 (min.)<br>HP:5288 ,5288 SIP:3896 /3620 /0 /0 SIT:60 /150 /0 /0<br>FP:276 /1951 /0 /0 /0 /0 /0 /0 FT:150 /0 /0 /0<br>Recovery: SALT WATER 131.10 M<br>Recovery: MUD 73.20 M | |

**Table B.4: DST data available in the original study area for wells that had bulk density log data (source: AEUB well database)**

| No. | UWI | Well Name | DST Description | DST Description |
|---|---|---|---|---|
| 23 | 00/11-32-080-04W4/0 | HOMESTEAD CANOXY COWPAR 11-32-80-4 | 1976/01/21 FM:PRAIRIE EVAPORITE FM - WINNIPEGOSIS FM<br>MECHANICALLY GOOD CONVENTIONAL DST FM Dep: 487.70-499.90<br>Rec Depth:491.90 SP: 4557 FFP: 1386 VO: 60 (min.)<br>HP:5633 ,5543 SIP:4551 /4420 /0 /0 SIT:60 /90 /0 /0<br>FP:621 /1379 /0 /0 /0 /0 /0 /0 FT:10 /60 /0 /0<br>Recovery: SALT WATER 112.80 M | |
| 24 | 00/10-08-083-06W4/0 | GULF RESDELN 10-8-83-6 | 1981/02/22 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 579.00-588.50<br>Rec Depth:570.00 SP: 3150 FFP: 1125 VO: 60 (min.)<br>HP:7738 ,7695 SIP:3266 /2795 /0 /0 SIT:60 /115 /0 /0<br>FP:559 /0 /0 /0 /0 /0 /0 /0 FT:5 /60 /0 /0<br>Recovery: MUD 65.00 M | |
| 25 | 00/01-14-083-06W4/0 | TEXCAN COTTONWOOD 1-14-83-6 | 1969/02/15 FM:KEG RIVER FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 548.00-564.50<br>Rec Depth:556.60 SP: 4261 FFP: 3799 VO: 60 (min.)<br>HP:6729 ,6647 SIP:3868 /4006 /0 /0 SIT:60 /90 /0 /0<br>FP:1165 /3530 /0 /0 /0 /0 /0 /0 FT:5 /60 /0 /0<br>Recovery: SALT WATER 320.00 M | |
| 26 | 00/15-14-084-11W4/0 | JACOS WD HANGST 15-14-84-11 | 1990/02/22 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD WIRELINE FORMATION TEST FM Dep: 781.60-781.60<br>Rec Depth:781.60 SP: 9980 FFP: 0 VO: 0 (min.)<br>1990/02/22 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD WIRELINE FORMATION TEST FM Dep: 747.10-747.10<br>Rec Depth:747.10 SP: 9595 FFP: 0 VO: 0 (min.) | 1990/02/22 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD WIRELINE FORMATION TEST FM Dep: 781.50-781.50<br>Rec Depth:781.50 SP: 10026 FFP: 0 VO: 0 (min.)<br>1990/02/22 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD WIRELINE FORMATION TEST FM Dep: 747.10-747.10<br>Rec Depth:747.10 SP: 9597 FFP: 0 VO: 0 (min.) |
| 27 | 00/06-01-052-13W4/0 | VOYAGER PLAIN 6-1-52-13 | 1978/09/12 FM:ERNESTINA LK FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 1581.00-1585.00<br>Rec Depth:1583.00 SP: 6965 FFP: 192 VO: 60 (min.)<br>HP:18809 ,18809 SIP:1204 /6965 /0 /0 SIT:30 /90 /0 /0<br>FP:209 /192 /0 /0 /0 /0 /0 /0 FT:10 /60 /0 /0<br>Recovery: MUD 1.00 M | |
| 28 | 00/02-13-055-13W4/0 | WESTMIN HAIRY 2-13-55-13 | 1983/09/08 FM:BASAL RED BEDS -<br>MECHANICALLY GOOD REVERSE-CIRCULATION DST FM Dep:1635.00-1644.00<br>Rec Depth:1627.30 SP: 688 FFP: 90 VO: 60 (min.)<br>HP:21024 ,21024 SIP:180 /682 /0 /0 SIT:60 /90 /0 /0<br>FP:144 /144 /198 /126 /0 /0 /0 /0 FT:15 /60 /0 /0<br>Recovery: 0.00 M3 | |
| 29 | 00/07-07-072-03W4/0 | AEC FOSTER CREEK 7-7-72-3 | 1996/01/24 FM:WINNIPEGOSIS FM -<br>MECHANICALLY GOOD LIMITED RECOVERY DST FM Dep: 777.00-802.00<br>Rec Depth:779.91 SP: 5335 FFP: 5334 VO: 60 (min.)<br>To Surface: GAS: 0 (min.) Max Fl: 0.3 E3m3/d Final Fl: 0.0 E3m3/d | |

**Table B.4: DST data available in the original study area for wells that had bulk density log data (source: AEUB well database)**

| No. | UWI | Well Name | DST Description | DST Description |
|---|---|---|---|---|
| 30 | 00/01-03-095-07W4/0 | CDCOG TENN MUSKEGR 1-3-95-7 | 1980/02/18 FM:KEG RIVER SS -<br>MECHANICALLY GOOD CONVENTIONAL DST FM Dep: 375.00-408.00<br>Rec Depth:376.00 SP: 1736 FFP: 255 VO: 60 (min.)<br>HP:3456 ,3373 SIP:329 /1728 /0 /0 SIT:60 /120 /0 /0<br>FP:247 /247 /0 /0 /0 /0 /0 /0 FT:10 /30 /0 /0<br>Recovery: SALT WATER 0.30 M<br>1980/02/20 FM:BEAVERHILL LAKE FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 258.00-290.00<br>Rec Depth:260.00 SP: 790 FFP: 527 VO: 30 (min.)<br>HP:25505 ,25505 SIP:2468 /8226 /0 /0 SIT:60 /120 /0 /0<br>FP:0 /6582 /0 /0 /0 /0 /0 /0 FT:10 /30 /0 /0<br>Recovery: MUD 72.00 M | 1980/02/20 FM:BEAVERHILL LAKE FM - PRAIRIE EVAPORITE FM<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 300.00-316.00<br>Rec Depth:302.00 SP: 1110 FFP: 773 VO: 30 (min.)<br>HP:3109 ,3021 SIP:977 /977 /0 /0 SIT:60 /120 /0 /0<br>FP:355 /622 /0 /0 /0 /0 /0 /0 FT:10 /30 /0 /0<br>Recovery: WATER-CUT MUD 65.00 M |
| 31 | 00/01-20-095-07W4/0 | HUSKY TENN MUSKEGR 1-20-95-7 | 1980/03/11 FM:GRANITE WASH - PRECAMBRIAN SYSTEM<br>MECHANICALLY GOOD CONVENTIONAL DST FM Dep: 310.00-338.00<br>Rec Depth:300.30 SP: 223 FFP: 11 VO: 30 (min.)<br>HP:3427 ,3427 SIP:1108 /1108 /0 /0 SIT:30 /120 /0 /0<br>FP:1108 /1108 /0 /0 /0 /0 /0 /0 FT:10 /30 /0 /0<br>Recovery: MUD 1.00 M<br>1980/03/12 FM:BEAVERHILL LAKE FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 202.00-224.00<br>Rec Depth:192.30 SP: 764 FFP: 747 VO: 30 (min.)<br>HP:2304 ,2304 SIP:901 /901 /0 /0 SIT:30 /120 /0 /0<br>FP:901 /901 /0 /0 /0 /0 /0 /0 FT:10 /30 /0 /0<br>Recovery: MUD 65.00 M | 1980/03/12 FM:BEAVERHILL LAKE FM - KEG RIVER FM<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 226.00-254.00<br>Rec Depth:216.30 SP: 903 FFP: 675 VO: 60 (min.)<br>HP:2287 ,2287 SIP:892 /1003 /0 /0 SIT:30 /120 /0 /0<br>FP:167 /836 /0 /0 /0 /0 /0 /0 FT:10 /30 /0 /0<br>Recovery: MUD 92.00 M<br>1980/03/12 FM:BEAVERHILL LAKE FM -<br>MECHANICALLY GOOD STRADDLE DST FM Dep: 190.00-200.00<br>Rec Depth:191.00 SP: 484 FFP: 202 VO: 30 (min.)<br>HP:2004 ,2004 SIP:1202 /701 /0 /0 SIT:30 /120 /0 /0<br>FP:200 /200 /0 /0 /0 /0 /0 /0 FT:10 /30 /0 /0<br>Recovery: MUD 9.00 M |

# APPENDIX C

## DATA SUMMARY TABLES – EXPANDED STUDY AREA

# APPENDIX C

## DATA SUMMARY TABLES – EXPANDED STUDY AREA

**Table C.1** **Bulk density log data available in expanded study area for the Elk Point Group**

**Table C.2** **Dipmeter log data available in expanded study area for the Elk Point Group**

# Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 00/01-01-091-05W5/0 | 1986/04/01 | 15 | 1446 | 0000 | 7940 | N | 0.01 | |
| 2 | 00/01-03-073-04W5/0 | 1991/11/30 | 300 | 1619 | 0000 | 7820 | N | 0.19 | |
| 3 | 00/01-03-089-03W5/0 | 1987/09/26 | 25 | 1468 | 0000 | 9800 | Y | 0.02 | |
| 4 | 00/01-04-070-03W5/0 | 1988/02/24 | 470 | 1739.1 | 2060 | 7820 | N | 0.27 | |
| 5 | 00/01-05-071-03W5/0 | 1992/08/04 | 275 | 1779.7 | 0000 | 7820 | N | 0.15 | |
| 6 | 00/01-06-090-03W5/0 | 1998/02/14 | 1085 | 1508 | 0004 | 9800 | Y | 0.72 | |
| 7 | 00/01-07-036-18W4/0 | | 354 | 2121 | 0000 | 7700 | N | 0.17 | |
| 8 | 00/01-07-074-04W5/0 | 1993/03/07 | 195.2 | 1643.9 | 0000 | 7820 | N | 0.12 | |
| 9 | 00/01-07-093-04W5/0 | 1987/03/06 | 295 | 1326 | 0000 | 9800 | Y | 0.22 | |
| 10 | 00/01-08-094-03W5/0 | 1993/01/05 | 807.6 | 1352.2 | 7170 | 9800 | Y | 0.60 | |
| 11 | 00/01-11-073-04W5/0 | 1998/08/20 | 273.5 | 1626 | 0000 | 7820 | N | 0.17 | |
| 12 | 00/01-11-090-03W5/0 | 1994/02/12 | 1012.8 | 1481.6 | 7170 | 7880 | N | 0.68 | |
| 13 | 00/01-11-091-05W5/0 | 1986/02/20 | 16 | 1371.5 | 0000 | 9760 | Y | 0.01 | |
| 14 | 00/01-11-101-02W5/0 | | 609.6 | 1082.6 | 7440 | 9800 | Y | 0.56 | |
| 15 | 00/01-12-060-21W4/0 | | 20 | 1492 | 0000 | 7700 | N | 0.01 | |
| 16 | 00/01-15-090-05W5/0 | 1988/08/07 | 450 | 1535 | 0000 | 9999 | Y | 0.29 | |
| 17 | 00/01-15-093-02W5/0 | 1995/08/24 | 787 | 1310.1 | 7170 | 9999 | Y | 0.60 | |
| 18 | 00/01-16-074-04W5/0 | 1990/10/07 | 1330 | 1668.8 | 7170 | 7820 | N | 0.80 | |
| 19 | 00/01-17-092-04W5/0 | 1987/03/15 | 794 | 1298.1 | 7170 | 9800 | Y | 0.61 | |
| 20 | 00/01-19-089-03W5/0 | 1988/11/16 | 1141 | 1531 | 7440 | 9800 | Y | 0.75 | |
| 21 | 00/01-20-090-03W5/0 | 1993/03/22 | 960.6 | 1443.79 | 7170 | 7880 | N | 0.67 | |
| 22 | 00/01-20-094-03W5/0 | 1996/02/09 | 30 | 1345.7 | 0000 | 9800 | Y | 0.02 | Y |
| 23 | 00/01-22-089-03W5/0 | 1988/02/08 | 20 | 1481 | 0000 | 9800 | Y | 0.01 | |
| 24 | 00/01-23-095-05W5/0 | 1985/03/11 | 246 | 1239.5 | 0000 | 9800 | Y | 0.20 | |
| 25 | 00/01-24-071-04W5/0 | 1989/02/26 | 181 | 1743.2 | 0000 | 7820 | N | 0.10 | |
| 26 | 00/01-24-090-03W5/0 | 1985/11/11 | 854 | 1389 | 7170 | 9800 | Y | 0.61 | |
| 27 | 00/01-25-096-05W5/0 | 1987/01/16 | 15 | 1272 | 0000 | 9800 | Y | 0.01 | Y |
| 28 | 00/01-28-089-03W5/0 | 1988/10/26 | 20 | 1521.2 | 0000 | 9999 | Y | 0.01 | |
| 29 | 00/01-28-092-04W5/0 | 1988/03/05 | 20 | 1335 | 0000 | 9800 | N | 0.01 | Y |
| 30 | 00/01-29-101-24W4/0 | 1985/03/15 | 281 | 1068 | 7170 | 9999 | Y | 0.26 | Y |
| 31 | 00/01-30-089-03W5/0 | 1986/12/21 | 356 | 1529 | 0000 | 9800 | Y | 0.23 | |
| 32 | 00/01-31-095-04W5/0 | 1985/01/26 | 290 | 1208.2 | 0000 | 9999 | N | 0.24 | |
| 33 | 00/01-32-089-02W5/0 | 1993/11/13 | 20 | 1459.4 | 0000 | 7880 | N | 0.01 | |
| 34 | 00/01-33-090-01W5/0 | 1986/01/31 | 793.5 | 1223.4 | 7440 | 9999 | Y | 0.65 | |
| 35 | 00/01-34-089-04W5/0 | 1991/02/09 | 1050.2 | 1491.7 | 7170 | 9999 | Y | 0.70 | |
| 36 | 00/01-36-093-04W5/0 | 1995/01/08 | 63.7 | 1285.5 | 0000 | 7880 | N | 0.05 | |
| 37 | 00/02-01-074-05W5/0 | 1988/08/12 | 275 | 1645 | 0000 | 7820 | N | 0.17 | |
| 38 | 00/02-01-090-04W5/0 | 1993/07/11 | 1443.6 | 1453.3 | 7820 | 7880 | N | 0.99 | |
| 39 | 00/02-01-094-02W5/0 | 1997/02/19 | 10 | 1329.9 | 0000 | 9800 | Y | 0.01 | Y |
| 40 | 00/02-02-042-14W4/0 | 1987/05/27 | 830 | 1624.7 | 2360 | 7860 | N | 0.51 | |
| 41 | 00/02-03-070-03W5/0 | 1993/10/19 | 400 | 1688 | 0000 | 7820 | N | 0.24 | |
| 42 | 00/02-03-072-04W5/0 | 1990/11/18 | 450 | 1807.5 | 0000 | 7820 | N | 0.25 | |
| 43 | 00/02-03-090-03W5/0 | 1992/08/25 | 1028 | 1478.7 | 7170 | 7880 | N | 0.70 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 44 | 00/02-04-015-11W4/0 | 1997/10/16 | 362 | 1691.4 | 0000 | 7700 | N | 0.21 | |
| 45 | 00/02-04-071-03W5/0 | | 1249.7 | 1706.9 | 7160 | 7820 | N | 0.73 | |
| 46 | 00/02-04-072-04W5/0 | 1992/11/27 | 1725 | 1816.5 | 7440 | 7820 | N | 0.95 | |
| 47 | 00/02-04-089-03W5/0 | 1987/10/17 | 1021 | 1535 | 7170 | 9800 | Y | 0.67 | |
| 48 | 00/02-05-073-04W5/0 | 1986/08/21 | 13 | 1658.1 | 0000 | 7820 | N | 0.01 | |
| 49 | 00/02-05-074-04W5/0 | 1988/02/12 | 205.3 | 1628.4 | 0000 | 7820 | N | 0.13 | |
| 50 | 00/02-05-090-02W5/0 | 1988/02/29 | 963 | 1491 | 7170 | 9800 | Y | 0.65 | |
| 51 | 00/02-06-072-03W5/0 | 1993/03/05 | 250 | 1694.5 | 0000 | 7820 | N | 0.15 | |
| 52 | 00/02-06-074-04W5/0 | 1988/09/06 | 318 | 1652 | 0000 | 9999 | N | 0.19 | |
| 53 | 00/02-07-090-02W5/0 | 1993/03/30 | 25 | 1396.3 | 0000 | 7880 | N | 0.02 | |
| 54 | 00/02-10-055-22W4/0 | 1985/09/27 | 505 | 1876.2 | 1600 | 7960 | N | 0.27 | |
| 55 | 00/02-10-074-05W5/0 | 1987/11/01 | 180.5 | 1693 | 0000 | 7820 | N | 0.11 | |
| 56 | 00/02-10-089-03W5/0 | | 30.5 | 1450.8 | 0000 | 9800 | Y | 0.02 | |
| 57 | 00/02-10-102-23W4/0 | 1985/02/06 | 325.7 | 1074.9 | 0000 | 9800 | Y | 0.30 | Y |
| 58 | 00/02-11-089-03W5/0 | 1988/03/16 | 1046.5 | 1501 | 7320 | 9800 | Y | 0.70 | |
| 59 | 00/02-12-093-05W5/0 | 1987/03/01 | 10 | 1337.3 | 0000 | 9800 | Y | 0.01 | Y |
| 60 | 00/02-13-073-04W5/0 | 1991/01/29 | 1350 | 1605.5 | 7170 | 7820 | N | 0.84 | |
| 61 | 00/02-13-073-05W5/0 | 1991/03/02 | 1624.5 | 1649.8 | 7620 | 7820 | N | 0.98 | |
| 62 | 00/02-14-090-05W5/0 | 1992/03/19 | 3.7 | 1491.8 | 0000 | 7880 | N | 0.00 | |
| 63 | 00/02-14-091-05W5/0 | 1986/08/25 | 30 | 1401 | 0000 | 9800 | Y | 0.02 | |
| 64 | 00/02-15-072-04W5/0 | 1990/11/23 | 450 | 1788.5 | 0000 | 7820 | N | 0.25 | |
| 65 | 00/02-15-074-05W5/0 | 1987/12/01 | 1000 | 1779.4 | 6580 | 7820 | N | 0.56 | |
| 66 | 00/02-15-089-03W5/0 | 1987/11/18 | 20 | 1552.1 | 0000 | 9800 | Y | 0.01 | |
| 67 | 00/02-16-074-05W5/0 | | 195 | 1795.7 | 0000 | 7820 | N | 0.11 | |
| 68 | 00/02-18-071-03W5/0 | 1990/01/08 | 1751.3 | 1793.6 | 7580 | 7820 | N | 0.98 | |
| 69 | 00/02-18-072-03W5/0 | 1991/01/26 | 1397.5 | 1724.5 | 7100 | 7820 | N | 0.81 | |
| 70 | 00/02-18-090-02W5/0 | 1986/02/20 | 868 | 1350 | 7170 | 9800 | Y | 0.64 | |
| 71 | 00/02-20-051-23W4/0 | | 200 | 1854.5 | 0000 | 7700 | N | 0.11 | |
| 72 | 00/02-20-073-04W5/0 | 1985/02/23 | 1300 | 1636 | 7100 | 9999 | Y | 0.79 | |
| 73 | 00/02-20-091-02W5/0 | 1986/02/10 | 240 | 1282 | 0000 | 9800 | Y | 0.19 | |
| 74 | 00/02-21-073-04W5/0 | 1992/01/28 | 265 | 1627 | 0000 | 7820 | N | 0.16 | |
| 75 | 00/02-21-091-03W5/0 | 1985/03/17 | 5 | 1394.7 | 0000 | 9800 | Y | 0.00 | |
| 76 | 00/02-21-092-04W5/0 | 1987/10/31 | 15 | 1294.3 | 0000 | 9800 | Y | 0.01 | |
| 77 | 00/02-23-070-04W5/0 | 1993/07/10 | 1790 | 1863.6 | 7440 | 7820 | N | 0.96 | |
| 78 | 00/02-23-072-04W5/0 | 1991/01/21 | 310 | 1663.4 | 0000 | 7820 | N | 0.19 | |
| 79 | 00/02-23-073-04W5/0 | 1991/02/17 | 1518.2 | 1609.2 | 7440 | 7820 | N | 0.94 | |
| 80 | 00/02-23-091-05W5/0 | 1988/08/01 | 848 | 1367.2 | 7170 | 9800 | Y | 0.62 | |
| 81 | 00/02-24-088-03W5/0 | 1987/09/23 | 1018 | 1434 | 7170 | 9800 | Y | 0.71 | |
| 82 | 00/02-25-096-05W5/0 | 1995/01/22 | 1140 | 1222.1 | 7820 | 9800 | Y | 0.93 | |
| 83 | 00/02-26-072-04W5/0 | 1992/07/21 | 250 | 1628 | 0000 | 7820 | N | 0.15 | |
| 84 | 00/02-27-089-03W5/0 | 1988/10/26 | 25 | 1500.2 | 0000 | 9800 | Y | 0.02 | |
| 85 | 00/02-28-070-03W5/0 | | 190.5 | 1751.1 | 0000 | 7820 | N | 0.11 | |
| 86 | 00/02-28-072-04W5/0 | 1992/02/08 | 1588 | 1946.5 | 7440 | 9999 | Y | 0.82 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 87 | 00/02-28-073-04W5/0 | 1988/02/15 | 204 | 1620 | 0000 | 7820 | N | 0.13 | |
| 88 | 00/02-28-094-01W5/0 | 1987/01/25 | 856 | 1463.2 | 7170 | 9800 | Y | 0.59 | |
| 89 | 00/02-30-072-04W5/0 | 1990/12/31 | 300 | 1674.2 | 0000 | 7820 | N | 0.18 | |
| 90 | 00/02-30-088-03W5/0 | 1987/08/20 | 350 | 1586.8 | 0000 | 9800 | Y | 0.22 | |
| 91 | 00/02-30-094-03W5/0 | 1994/12/07 | 813.5 | 1324 | 7170 | 7880 | N | 0.61 | |
| 92 | 00/02-31-072-03W5/0 | 1992/01/25 | 249 | 1605 | 0000 | 7820 | N | 0.16 | |
| 93 | 00/02-31-089-03W5/0 | 1987/11/04 | 20 | 1507 | 0000 | 9800 | Y | 0.01 | |
| 94 | 00/02-31-093-02W5/0 | 1998/01/20 | 709 | 1375 | 7160 | 9800 | Y | 0.52 | |
| 95 | 00/02-32-070-03W5/0 | 1988/08/09 | 560 | 1778.7 | 2480 | 7820 | N | 0.31 | |
| 96 | 00/02-32-073-04W5/0 | 1992/01/21 | 1565 | 1627 | 7440 | 7820 | N | 0.96 | |
| 97 | 00/02-32-089-03W5/0 | 1987/06/11 | 1024 | 1507.7 | 7170 | 9800 | Y | 0.68 | |
| 98 | 00/02-33-072-04W5/0 | 1990/03/17 | 286 | 1639 | 0000 | 9999 | N | 0.17 | |
| 99 | 00/02-34-060-01W5/0 | | 780.2 | 1858.5 | 2480 | 7700 | N | 0.42 | |
| 100 | 00/02-34-090-02W5/0 | 1988/03/28 | 18 | 1341.3 | 0000 | 9800 | Y | 0.01 | |
| 101 | 00/02-35-071-04W5/0 | 1992/06/29 | 250 | 1801 | 0000 | 7820 | N | 0.14 | |
| 102 | 00/02-35-072-04W5/0 | 1990/11/24 | 1545 | 1625 | 7440 | 7820 | N | 0.95 | |
| 103 | 00/02-35-073-05W5/0 | 1985/03/04 | 197.8 | 1649.8 | 0000 | 7820 | N | 0.12 | |
| 104 | 00/02-36-072-04W5/0 | | 210 | 1644.7 | 0000 | 7820 | N | 0.13 | |
| 105 | 00/02-36-090-03W5/0 | 1984/12/05 | 37 | 1404 | 0000 | 9800 | Y | 0.03 | |
| 106 | 00/03-01-074-05W5/0 | 1989/04/06 | 1400 | 1650.6 | 7170 | 7820 | N | 0.85 | |
| 107 | 00/03-01-090-04W5/0 | 1993/08/04 | 1443 | 1461.9 | 7820 | 7880 | N | 0.99 | |
| 108 | 00/03-01-093-05W5/0 | 1987/09/30 | 17 | 1369.8 | 0000 | 9800 | Y | 0.01 | Y |
| 109 | 00/03-03-090-03W5/0 | 1992/12/03 | 1030.4 | 1489.2 | 0000 | 7880 | N | 0.69 | |
| 110 | 00/03-04-031-12W4/0 | 1984/04/04 | 350 | 1876.5 | 0000 | 7777 | N | 0.19 | |
| 111 | 00/03-04-094-04W5/0 | | 990.6 | 1311.9 | 7440 | 7940 | N | 0.76 | |
| 112 | 00/03-05-072-03W5/0 | | 1023.5 | 1684.5 | 6960 | 7820 | N | 0.61 | |
| 113 | 00/03-05-095-03W5/0 | 1996/02/18 | 1240.5 | 1299.5 | 7820 | 7880 | N | 0.95 | |
| 114 | 00/03-07-074-04W5/0 | 1992/12/10 | 190.4 | 1643.2 | 1860 | 7820 | N | 0.12 | |
| 115 | 00/03-07-094-03W5/0 | 1986/02/19 | 380 | 1312 | 0000 | 9800 | Y | 0.29 | |
| 116 | 00/03-08-093-04W5/0 | 1987/10/28 | 806 | 1315 | 7170 | 9800 | Y | 0.61 | |
| 117 | 00/03-11-072-04W5/0 | | 191 | 1800 | 0000 | 7820 | N | 0.11 | |
| 118 | 00/03-15-027-08W4/0 | | 899.2 | 1718.5 | 2140 | 7700 | N | 0.52 | |
| 119 | 00/03-15-089-03W5/0 | 1987/07/11 | 350 | 1509 | 0000 | 9800 | Y | 0.23 | |
| 120 | 00/03-17-096-04W5/0 | 1995/01/07 | 300 | 1148 | 0000 | 7820 | N | 0.26 | |
| 121 | 00/03-18-092-04W5/0 | 1987/12/20 | 825 | 1351 | 7170 | 9800 | Y | 0.61 | |
| 122 | 00/03-18-093-04W5/0 | 1988/01/24 | 10 | 1345.9 | 0000 | 9800 | Y | 0.01 | Y |
| 123 | 00/03-18-094-03W5/0 | 1994/03/23 | 1025.5 | 1304 | 7580 | 7880 | N | 0.79 | |
| 124 | 00/03-19-094-03W5/0 | 1994/12/20 | 808.9 | 1322.8 | 7170 | 7880 | N | 0.61 | |
| 125 | 00/03-20-093-03W5/0 | 1996/01/05 | 615 | 1319.4 | 6700 | 7880 | N | 0.47 | |
| 126 | 00/03-20-094-03W5/0 | 1996/03/09 | 15 | 1351 | 0004 | 7940 | N | 0.01 | |
| 127 | 00/03-22-111-04W5/0 | | 109.1 | 904 | 0000 | 9800 | Y | 0.12 | |
| 128 | 00/03-24-090-03W5/0 | 1984/10/18 | 25 | 1410 | 0000 | 9999 | Y | 0.02 | |
| 129 | 00/03-25-083-02W5/0 | | 1100 | 1500 | 7440 | 7880 | N | 0.73 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 130 | 00/03-27-089-03W5/0 | 1986/03/23 | 982.5 | 1515 | 7170 | 9999 | Y | 0.65 | |
| 131 | 00/03-29-070-03W5/0 | 1992/07/22 | 764 | 1758 | 6440 | 7820 | N | 0.43 | |
| 132 | 00/03-30-109-03W5/0 | | 93 | 843.4 | 7100 | 9800 | Y | 0.11 | |
| 133 | 00/03-32-015-05W4/0 | | 193 | 1717.2 | 0000 | 9160 | Y | 0.11 | Y |
| 134 | 00/03-32-094-03W5/0 | 1996/01/14 | 10 | 1307.9 | 0000 | 7880 | N | 0.01 | |
| 135 | 00/03-34-089-03W5/0 | 1985/12/03 | 1003 | 1512.7 | 7170 | 9800 | Y | 0.66 | |
| 136 | 00/03-35-095-05W5/0 | 1988/03/24 | 810 | 1279 | 7440 | 9800 | Y | 0.63 | |
| 137 | 00/03-35-101-22W4/0 | | 609.6 | 1022.6 | 7540 | 7960 | N | 0.60 | |
| 138 | 00/04-01-045-16W4/0 | 1983/12/03 | 284 | 1802 | 0000 | 7777 | N | 0.16 | |
| 139 | 00/04-01-073-05W5/0 | 1990/03/01 | 180 | 1669.2 | 0000 | 7820 | N | 0.11 | |
| 140 | 00/04-02-073-04W5/0 | 1991/07/05 | 1400 | 1616.2 | 7320 | 7820 | N | 0.87 | |
| 141 | 00/04-02-074-05W5/0 | 1984/01/19 | 184.5 | 1661 | 0000 | 7820 | N | 0.11 | |
| 142 | 00/04-02-090-04W5/0 | 1997/11/26 | 559 | 1494 | 0000 | 9800 | Y | 0.37 | |
| 143 | 00/04-02-093-05W5/0 | 1988/03/12 | 20 | 1356 | 0000 | 7940 | N | 0.01 | |
| 144 | 00/04-03-070-03W5/0 | | 175 | 1708 | 0000 | 7820 | N | 0.10 | |
| 145 | 00/04-04-070-03W5/0 | 1991/10/03 | 1650 | 1719 | 7440 | 7820 | N | 0.96 | |
| 146 | 00/04-05-093-04W5/0 | 1987/09/22 | 30 | 1314 | 0000 | 9999 | Y | 0.02 | Y |
| 147 | 00/04-06-074-04W5/0 | 1989/06/12 | 218.9 | 1649.2 | 0000 | 7820 | N | 0.13 | |
| 148 | 00/04-06-090-03W5/0 | 1993/06/15 | 25 | 1520.1 | 0000 | 9999 | N | 0.02 | |
| 149 | 00/04-06-098-01W5/0 | 1990/01/27 | 35 | 1210.4 | 0000 | 9760 | Y | 0.03 | Y |
| 150 | 00/04-07-073-04W5/0 | 1989/12/17 | 1593 | 1656 | 7440 | 7820 | N | 0.96 | |
| 151 | 00/04-07-093-04W5/0 | 1987/08/21 | 805 | 1344 | 7170 | 7940 | N | 0.60 | |
| 152 | 00/04-08-073-04W5/0 | 1989/03/24 | 1541 | 1651 | 7440 | 7820 | N | 0.93 | |
| 153 | 00/04-08-095-04W5/0 | 1987/03/16 | 794 | 1291.1 | 7440 | 9800 | Y | 0.61 | |
| 154 | 00/04-08-097-02W5/0 | | 847.3 | 1272.8 | 7440 | 9800 | Y | 0.67 | |
| 155 | 00/04-09-074-04W5/0 | 1989/09/25 | 295.5 | 1642.5 | 0000 | 7820 | N | 0.18 | |
| 156 | 00/04-10-073-04W5/0 | | 1519.4 | 1652.5 | 7440 | 7820 | N | 0.92 | |
| 157 | 00/04-10-073-05W5/0 | 1985/02/12 | 1533 | 1702.2 | 7440 | 7820 | N | 0.90 | |
| 158 | 00/04-11-055-22W4/0 | 1994/12/16 | 216.4 | 1939 | 0000 | 8040 | N | 0.11 | |
| 159 | 00/04-11-089-03W5/0 | 1987/11/01 | 15 | 1514 | 0000 | 9800 | Y | 0.01 | |
| 160 | 00/04-11-098-23W4/0 | | 187.8 | 1185.1 | 0000 | 7940 | N | 0.16 | |
| 161 | 00/04-12-073-04W5/0 | 1998/09/24 | 635.8 | 1626.6 | 0004 | 7820 | N | 0.39 | |
| 162 | 00/04-12-090-05W5/0 | 1987/03/17 | 1097.7 | 1522.2 | 0000 | 9800 | Y | 0.72 | |
| 163 | 00/04-13-090-03W5/0 | 1986/02/06 | 10 | 1472 | 0000 | 9800 | Y | 0.01 | |
| 164 | 00/04-14-073-05W5/0 | 1994/02/18 | 1590 | 1663 | 7440 | 7820 | N | 0.96 | |
| 165 | 00/04-15-073-05W5/0 | 1993/02/20 | 1680 | 1753.7 | 7440 | 7820 | N | 0.96 | |
| 166 | 00/04-15-074-04W5/0 | 1993/02/19 | 298.2 | 1659.8 | 0000 | 7820 | N | 0.18 | |
| 167 | 00/04-15-074-05W5/0 | | 209 | 1773 | 0000 | 7820 | N | 0.12 | |
| 168 | 00/04-16-095-02W5/0 | 1988/03/11 | 316.1 | 1373.5 | 0000 | 9800 | Y | 0.23 | Y |
| 169 | 00/04-17-070-03W5/0 | 1990/12/17 | 1678.5 | 1722.5 | 7620 | 7820 | N | 0.97 | |
| 170 | 00/04-17-072-03W5/0 | 1995/02/16 | 1533 | 1687 | 7440 | 7780 | N | 0.91 | |
| 171 | 00/04-17-073-04W5/0 | 1992/02/08 | 1600.7 | 1644.4 | 7580 | 7820 | N | 0.97 | |
| 172 | 00/04-17-093-04W5/0 | 1987/11/12 | 793.5 | 1319 | 7170 | 9800 | Y | 0.60 | Y |

# Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 173 | 00/04-17-094-03W5/0 | 1994/03/17 | 1039.4 | 1319.1 | 7580 | 7880 | N | 0.79 | |
| 174 | 00/04-18-038-01W4/0 | 1994/08/02 | 837.4 | 1570.8 | 3220 | 9000 | Y | 0.53 | Y |
| 175 | 00/04-18-073-04W5/0 | 1990/02/10 | 180 | 1654.3 | 0000 | 9999 | N | 0.11 | |
| 176 | 00/04-18-090-02W5/0 | 1992/03/07 | 497 | 1389.99 | 0000 | 7880 | N | 0.36 | |
| 177 | 00/04-19-071-03W5/0 | 1991/12/10 | 300 | 1734.9 | 0000 | 7820 | N | 0.17 | |
| 178 | 00/04-19-095-04W5/0 | 1985/01/06 | 50 | 1270.3 | 0000 | 9999 | N | 0.04 | |
| 179 | 00/04-20-070-03W5/0 | 1991/09/07 | 1650 | 1737.8 | 7440 | 7820 | N | 0.95 | |
| 180 | 00/04-20-089-03W5/0 | 1987/10/14 | 20 | 1554.4 | 0000 | 9800 | Y | 0.01 | |
| 181 | 00/04-20-094-03W5/0 | 1993/02/12 | 25 | 1332 | 0000 | 7940 | N | 0.02 | |
| 182 | 00/04-21-071-04W5/0 | 1984/12/23 | 1650 | 1781 | 7440 | 7820 | N | 0.93 | |
| 183 | 00/04-24-073-04W5/0 | | 290 | 1614 | 0000 | 7820 | N | 0.18 | |
| 184 | 00/04-25-090-03W5/0 | 1984/03/25 | 182 | 1357 | 0000 | 9999 | Y | 0.13 | |
| 185 | 00/04-25-093-24W4/0 | 1984/03/22 | 40 | 1281.5 | 0000 | 7940 | N | 0.03 | |
| 186 | 00/04-26-073-04W5/0 | 1985/01/05 | 184 | 1611.1 | 0000 | 7820 | N | 0.11 | |
| 187 | 00/04-26-089-04W5/0 | 1989/07/20 | 1099.5 | 1509 | 0000 | 9800 | Y | 0.73 | |
| 188 | 00/04-26-104-01W5/0 | | 129.8 | 855.9 | 7100 | 9800 | Y | 0.15 | Y |
| 189 | 00/04-28-035-20W4/0 | | 1200 | 2249 | 2060 | 7700 | N | 0.53 | |
| 190 | 00/04-28-085-04W5/0 | | 1188.7 | 1651.1 | 7170 | 9800 | Y | 0.72 | |
| 191 | 00/04-29-071-03W5/0 | 1994/02/01 | 680 | 1724.7 | 2480 | 7820 | N | 0.39 | |
| 192 | 00/04-29-071-04W5/0 | 1984/11/18 | 1700 | 1830 | 7440 | 7820 | N | 0.93 | |
| 193 | 00/04-29-098-21W4/0 | 1985/02/09 | 324.5 | 1185.1 | 0000 | 9800 | Y | 0.27 | Y |
| 194 | 00/04-30-091-04W5/0 | 1990/02/28 | 996.4 | 1370 | 7440 | 9800 | Y | 0.73 | |
| 195 | 00/04-31-070-03W5/2 | 1992/09/05 | 380 | 1808.2 | 0000 | 7820 | N | 0.21 | |
| 196 | 00/04-31-072-03W5/0 | | 214.9 | 1607.2 | 0000 | 7820 | N | 0.13 | |
| 197 | 00/04-33-069-03W5/0 | 1984/03/06 | 203 | 1732 | 0000 | 7820 | N | 0.12 | |
| 198 | 00/04-33-072-04W5/0 | 1992/01/23 | 1604.5 | 1647 | 7580 | 7820 | N | 0.97 | |
| 199 | 00/04-33-073-04W5/0 | 1992/02/27 | 250 | 1616.1 | 0000 | 7820 | N | 0.15 | |
| 200 | 00/04-33-096-04W5/0 | 1987/01/14 | 50 | 1210.5 | 0000 | 9800 | Y | 0.04 | Y |
| 201 | 00/04-35-071-04W5/0 | 1991/10/22 | 1781.2 | 1824.8 | 7620 | 7820 | N | 0.98 | |
| 202 | 00/04-36-072-04W5/0 | | 340 | 1622 | 2060 | 7820 | N | 0.21 | |
| 203 | 00/04-36-073-05W5/0 | 1989/03/31 | 300 | 1650.2 | 0000 | 7820 | N | 0.18 | |
| 204 | 00/04-36-092-05W5/2 | 1986/09/20 | 1011 | 1348 | 0000 | 7880 | N | 0.75 | |
| 205 | 00/05-01-090-02W5/0 | 1985/01/16 | 50 | 1383.8 | 0000 | 9800 | Y | 0.04 | |
| 206 | 00/05-02-020-03W4/0 | | 925 | 2194 | 6420 | 9480 | Y | 0.42 | Y |
| 207 | 00/05-02-089-03W5/0 | 1987/12/18 | 35 | 1503.2 | 0000 | 9800 | Y | 0.02 | |
| 208 | 00/05-02-094-01W5/0 | 1997/01/11 | 813 | 1407.4 | 7170 | 9800 | Y | 0.58 | |
| 209 | 00/05-06-104-23W4/0 | | 350.5 | 878.4 | 7520 | 9800 | Y | 0.40 | Y |
| 210 | 00/05-07-090-02W5/0 | 1992/09/04 | 949 | 1421.3 | 0000 | 7940 | N | 0.67 | |
| 211 | 00/05-07-092-04W5/0 | 1987/09/17 | 809 | 1335 | 7170 | 9800 | Y | 0.61 | |
| 212 | 00/05-08-094-04W5/0 | 1986/02/09 | 950 | 1273.6 | 7440 | 9800 | Y | 0.75 | |
| 213 | 00/05-08-100-22W4/2 | 1985/03/29 | 650 | 1212.1 | 0000 | 7920 | N | 0.54 | |
| 214 | 00/05-11-020-06W4/0 | | 1052.2 | 2228.7 | 6440 | 9800 | Y | 0.47 | Y |
| 215 | 00/05-11-065-02W5/0 | | 897.5 | 1815 | 3360 | 7820 | N | 0.49 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 216 | 00/05-11-088-24W4/0 | | 458.7 | 1200.6 | 7160 | 7960 | N | 0.38 | |
| 217 | 00/05-12-089-02W5/0 | 1986/03/21 | 15 | 1527 | 0000 | 9800 | Y | 0.01 | |
| 218 | 00/05-12-092-05W5/0 | 1987/12/07 | 15 | 1363 | 0000 | 9800 | Y | 0.01 | |
| 219 | 00/05-12-092-24W4/0 | | 0 | 1240.5 | 0000 | 9800 | Y | 0.00 | Y |
| 220 | 00/05-12-099-04W5/0 | 1985/02/17 | 501.3 | 1237.4 | 7170 | 9999 | Y | 0.41 | |
| 221 | 00/05-13-070-04W5/0 | 1993/06/20 | 820 | 1842 | 3260 | 7820 | N | 0.45 | |
| 222 | 00/05-13-073-04W5/0 | 1990/02/27 | 290.4 | 1619 | 0000 | 7820 | N | 0.18 | |
| 223 | 00/05-14-094-02W5/0 | 1998/02/06 | 739.7 | 1397.1 | 7170 | 9800 | Y | 0.53 | |
| 224 | 00/05-17-089-04W5/0 | 1994/06/23 | 20 | 1509.2 | 0000 | 7880 | N | 0.01 | |
| 225 | 00/05-19-073-03W5/0 | 1993/06/08 | 1500 | 1595 | 7440 | 7820 | N | 0.94 | |
| 226 | 00/05-20-098-01W5/0 | | 762 | 1132 | 7440 | 7940 | N | 0.67 | |
| 227 | 00/05-22-072-04W5/0 | 1991/02/09 | 1612 | 1655.9 | 7620 | 7820 | N | 0.97 | |
| 228 | 00/05-22-089-03W5/0 | 1986/02/07 | 458 | 1517.8 | 0000 | 9800 | Y | 0.30 | |
| 229 | 00/05-25-092-05W5/0 | 1987/09/06 | 20 | 1357 | 0000 | 9800 | Y | 0.01 | Y |
| 230 | 00/05-27-070-04W5/0 | 1994/01/23 | 857.2 | 1866.5 | 0000 | 7820 | N | 0.46 | |
| 231 | 00/05-29-073-03W5/0 | 1994/01/18 | 560 | 1747.6 | 2480 | 7960 | N | 0.32 | |
| 232 | 00/05-29-091-02W5/0 | 1985/03/30 | 780.8 | 1289.4 | 7170 | 9800 | Y | 0.61 | |
| 233 | 00/05-30-094-04W5/0 | | 334 | 1363.7 | 0000 | 9800 | Y | 0.24 | |
| 234 | 00/05-32-017-02W4/0 | 1986/11/03 | 339 | 1716.3 | 0000 | 7700 | N | 0.20 | |
| 235 | 00/05-32-071-03W5/0 | | 1222 | 1651 | 7100 | 7820 | N | 0.74 | |
| 236 | 00/05-32-089-03W5/0 | 1988/02/29 | 1033 | 1479 | 7170 | 9800 | Y | 0.70 | |
| 237 | 00/05-35-072-04W5/0 | 1990/06/14 | 299 | 1631.4 | 0000 | 7820 | N | 0.18 | |
| 238 | 00/05-36-089-04W5/0 | 1993/09/03 | 1416 | 1464.4 | 7820 | 7880 | N | 0.97 | |
| 239 | 00/06-01-034-24W4/0 | 1992/10/05 | 385.2 | 2525.2 | 0000 | 7700 | N | 0.15 | |
| 240 | 00/06-02-070-03W5/0 | | 185.9 | 1669.7 | 0000 | 7820 | N | 0.11 | |
| 241 | 00/06-02-090-05W5/0 | 1987/10/29 | 17 | 1533 | 0000 | 9999 | Y | 0.01 | |
| 242 | 00/06-02-091-03W5/0 | 1985/02/22 | 41 | 1397 | 0000 | 9999 | Y | 0.03 | |
| 243 | 00/06-02-097-19W4/0 | 1986/02/21 | 238 | 1770 | 0000 | 9999 | Y | 0.13 | Y |
| 244 | 00/06-03-087-22W4/0 | 1988/03/01 | 845 | 1238 | 7540 | 9800 | Y | 0.68 | Y |
| 245 | 00/06-03-090-03W5/0 | 1985/08/26 | 1000 | 1526 | 7170 | 9800 | Y | 0.66 | |
| 246 | 00/06-04-037-16W4/0 | 1989/12/13 | 10 | 2048 | 0000 | 9000 | Y | 0.00 | Y |
| 247 | 00/06-04-087-03W5/0 | 1989/03/15 | 3 | 1622.9 | 0000 | 9800 | Y | 0.00 | Y |
| 248 | 00/06-05-074-04W5/0 | 1988/02/15 | 1172.4 | 1638.3 | 7160 | 7820 | N | 0.72 | |
| 249 | 00/06-06-098-01W5/0 | | 812.9 | 1201.5 | 7540 | 9800 | Y | 0.68 | |
| 250 | 00/06-07-065-23W4/0 | | 406.2 | 1520 | 0000 | 7720 | N | 0.27 | |
| 251 | 00/06-07-095-02W5/0 | 1985/03/16 | 679.6 | 1323 | 7170 | 7940 | N | 0.51 | |
| 252 | 00/06-07-097-23W4/0 | | 888.8 | 1438.4 | 7480 | 7960 | N | 0.62 | |
| 253 | 00/06-08-089-04W5/0 | 1989/04/04 | 5 | 1528.6 | 0000 | 9800 | Y | 0.00 | |
| 254 | 00/06-09-090-03W5/0 | 1993/02/09 | 15 | 1503 | 0000 | 7880 | N | 0.01 | |
| 255 | 00/06-09-091-02W5/0 | | 1005.8 | 1354.8 | 7440 | 7940 | N | 0.74 | |
| 256 | 00/06-11-033-24W4/0 | 1987/01/22 | 1800 | 2553.5 | 6440 | 7700 | N | 0.70 | |
| 257 | 00/06-11-090-03W5/0 | 1987/12/05 | 19.5 | 1526.5 | 0000 | 9800 | Y | 0.01 | |
| 258 | 00/06-11-096-01W5/0 | 1986/01/06 | 305 | 1444.5 | 0000 | 9800 | Y | 0.21 | Y |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 259 | 00/06-12-070-04W5/0 | 1993/07/28 | 1700 | 1789.9 | 7440 | 7820 | N | 0.95 | |
| 260 | 00/06-12-090-03W5/0 | 1985/11/01 | 455 | 1485.7 | 0000 | 9800 | Y | 0.31 | |
| 261 | 00/06-12-093-02W5/0 | 1994/02/27 | 25 | 1307.5 | 0000 | 9800 | Y | 0.02 | Y |
| 262 | 00/06-14-090-05W5/0 | 1988/05/15 | 1053 | 1520 | 7170 | 9800 | Y | 0.69 | |
| 263 | 00/06-14-091-02W5/0 | | 944.3 | 1254.9 | 7440 | 7940 | N | 0.75 | |
| 264 | 00/06-14-101-01W5/0 | | 609.6 | 1082 | 7440 | 9800 | Y | 0.56 | |
| 265 | 00/06-19-092-03W5/0 | | 1280.2 | 1350.9 | 7820 | 7940 | N | 0.95 | |
| 266 | 00/06-21-089-01W5/0 | | 932.1 | 1487.4 | 7170 | 9800 | Y | 0.63 | |
| 267 | 00/06-21-089-03W5/0 | 1987/01/26 | 1100 | 1554.5 | 7440 | 9800 | Y | 0.71 | |
| 268 | 00/06-22-033-25W4/0 | 1992/08/26 | 449 | 2643.2 | 0000 | 7700 | N | 0.17 | |
| 269 | 00/06-23-089-04W5/0 | 1987/09/02 | 408.5 | 1522.6 | 0000 | 9800 | Y | 0.27 | |
| 270 | 00/06-25-019-04W4/0 | | 898.6 | 1691.6 | 6420 | 9160 | Y | 0.53 | Y |
| 271 | 00/06-25-072-05W5/0 | 1994/03/17 | 1590 | 1674.2 | 7440 | 7820 | N | 0.95 | |
| 272 | 00/06-26-090-03W5/0 | 1985/09/26 | 180 | 1385 | 0000 | 9999 | Y | 0.13 | |
| 273 | 00/06-26-093-02W5/0 | 1996/03/17 | 10 | 1308 | 0000 | 7880 | N | 0.01 | |
| 274 | 00/06-26-094-05W5/0 | 1985/03/07 | 352 | 1345 | 0000 | 9999 | Y | 0.26 | |
| 275 | 00/06-28-016-05W4/0 | | 914.4 | 1768.1 | 6420 | 9160 | Y | 0.52 | Y |
| 276 | 00/06-28-018-05W4/0 | | 835 | 1697 | 2480 | 9160 | Y | 0.49 | |
| 277 | 00/06-28-042-02W4/0 | | 290 | 1942 | 0000 | 9800 | Y | 0.15 | Y |
| 278 | 00/06-28-089-03W5/0 | 1992/03/04 | 1053 | 1589 | 0000 | 9999 | N | 0.66 | |
| 279 | 00/06-29-092-04W5/0 | 1987/09/05 | 15 | 1294.1 | 0000 | 9800 | Y | 0.01 | Y |
| 280 | 00/06-30-016-06W4/0 | | 975.4 | 1755 | 3000 | 9160 | Y | 0.56 | Y |
| 281 | 00/06-30-039-11W4/0 | | 1005.8 | 1581 | 2480 | 7700 | N | 0.64 | |
| 282 | 00/06-30-086-13W4/0 | | 96.9 | 779.7 | 2800 | 9800 | Y | 0.12 | Y |
| 283 | 00/06-31-089-03W5/2 | 1995/06/27 | 1015.5 | 1469.5 | 0000 | 7820 | N | 0.69 | |
| 284 | 00/06-31-098-22W4/0 | | 762 | 1213.1 | 7520 | 9800 | Y | 0.63 | |
| 285 | 00/06-33-089-02W5/0 | 1993/03/13 | 968 | 1446 | 7170 | 9999 | Y | 0.67 | |
| 286 | 00/06-33-094-03W5/0 | 1994/12/31 | 150 | 1319.3 | 0000 | 7880 | N | 0.11 | |
| 287 | 00/06-35-091-05W5/0 | 1988/08/07 | 20 | 1356.5 | 0000 | 9800 | Y | 0.01 | |
| 288 | 00/06-36-018-05W4/0 | | 367.7 | 1662.1 | 0000 | 9160 | Y | 0.22 | Y |
| 289 | 00/06-36-019-01W4/0 | | 852 | 2226.8 | 2480 | 9800 | Y | 0.38 | Y |
| 290 | 00/06-36-092-04W5/0 | | 1188.7 | 1362.2 | 7820 | 9800 | Y | 0.87 | |
| 291 | 00/06-36-096-02W5/0 | 1988/02/03 | 400 | 1333.2 | 0000 | 9800 | Y | 0.30 | Y |
| 292 | 00/07-01-087-05W5/0 | 1991/01/24 | 1101.3 | 1625.9 | 7170 | 9800 | Y | 0.68 | |
| 293 | 00/07-01-096-05W5/0 | 1984/02/10 | 628 | 1145 | 0000 | 9800 | Y | 0.55 | |
| 294 | 00/07-02-073-05W5/0 | 1989/03/01 | 1635.5 | 1668.4 | 7620 | 7820 | N | 0.98 | |
| 295 | 00/07-02-095-04W5/0 | 1995/01/26 | 10 | 1268.3 | 0000 | 7880 | N | 0.01 | |
| 296 | 00/07-03-098-25W4/0 | | 882.1 | 1272.5 | 7440 | 7940 | N | 0.69 | |
| 297 | 00/07-04-090-04W5/0 | 1990/12/08 | 1074.3 | 1503.1 | 7170 | 7880 | N | 0.71 | |
| 298 | 00/07-05-070-02W5/0 | | 167.6 | 1783.1 | 0000 | 7880 | N | 0.09 | |
| 299 | 00/07-05-094-03W5/0 | 1993/01/24 | 15 | 1324.1 | 0000 | 7940 | N | 0.01 | |
| 300 | 00/07-06-093-04W5/0 | 1988/01/07 | 15 | 1327.8 | 0000 | 9800 | Y | 0.01 | Y |
| 301 | 00/07-06-100-17W4/0 | | 518.2 | 1044.5 | 7440 | 9800 | Y | 0.50 | Y |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 302 | 00/07-08-089-03W5/0 | 1987/09/11 | 40 | 1541.5 | 0000 | 9800 | Y | 0.03 | |
| 303 | 00/07-08-089-04W5/0 | 1993/12/15 | 10.8 | 1512.5 | 0000 | 7820 | N | 0.01 | |
| 304 | 00/07-08-093-01W5/0 | 1986/01/26 | 15 | 1385.4 | 0000 | 9800 | Y | 0.01 | Y |
| 305 | 00/07-09-092-04W5/0 | 1986/09/21 | 300 | 1299 | 0000 | 9800 | Y | 0.23 | |
| 306 | 00/07-10-091-04W5/0 | 1985/02/05 | 50 | 1396 | 0000 | 9800 | Y | 0.04 | |
| 307 | 00/07-11-019-05W4/0 | | 821.7 | 2131.2 | 6420 | 9800 | Y | 0.39 | Y |
| 308 | 00/07-11-098-03W5/0 | | 91.4 | 1220.1 | 0000 | 7940 | N | 0.07 | |
| 309 | 00/07-12-022-01W4/0 | | 906.5 | 1759 | 6440 | 9160 | Y | 0.52 | Y |
| 310 | 00/07-13-090-03W5/0 | 1984/01/31 | 180 | 1421 | 0000 | 9800 | Y | 0.13 | |
| 311 | 00/07-13-092-24W4/0 | | 300 | 1185 | 0000 | 7960 | N | 0.25 | |
| 312 | 00/07-13-093-05W5/0 | 1992/12/24 | 807 | 1311 | 7170 | 7880 | N | 0.62 | |
| 313 | 00/07-14-093-02W5/0 | 1995/02/13 | 794.5 | 1290.5 | 0000 | 7880 | N | 0.62 | |
| 314 | 00/07-15-040-02W4/0 | 1994/05/19 | 823 | 1500 | 7200 | 7880 | N | 0.55 | |
| 315 | 00/07-15-064-25W4/0 | | 296 | 1665 | 0000 | 7720 | N | 0.18 | |
| 316 | 00/07-16-092-04W5/0 | 1988/02/04 | 21 | 1290.2 | 0000 | 9800 | Y | 0.02 | |
| 317 | 00/07-17-056-21W4/0 | | 187.5 | 1781.6 | 0000 | 8040 | N | 0.11 | |
| 318 | 00/07-17-094-03W5/0 | 1995/02/15 | 810 | 1318.4 | 0000 | 7880 | N | 0.61 | |
| 319 | 00/07-18-019-03W4/0 | | 420 | 1734 | 1600 | 9160 | Y | 0.24 | Y |
| 320 | 00/07-19-061-01W5/0 | | 216 | 2249.5 | 0000 | 9000 | Y | 0.10 | |
| 321 | 00/07-21-072-04W5/0 | 1994/07/06 | 300 | 1659.3 | 0000 | 7820 | N | 0.18 | |
| 322 | 00/07-22-017-05W4/0 | 1984/12/30 | 828 | 1640 | 6420 | 9160 | Y | 0.50 | |
| 323 | 00/07-22-074-22W4/0 | | 562.4 | 1446.3 | 6580 | 7960 | N | 0.39 | |
| 324 | 00/07-25-034-21W4/0 | 1986/01/06 | 337 | 2279.2 | 0000 | 9040 | Y | 0.15 | Y |
| 325 | 00/07-26-021-11W4/0 | | 189.5 | 1899.5 | 0000 | 9160 | Y | 0.10 | Y |
| 326 | 00/07-26-093-02W5/0 | 1996/02/19 | 793 | 1306.8 | 7170 | 7880 | N | 0.61 | |
| 327 | 00/07-27-070-04W5/0 | 1993/06/26 | 1830 | 1877 | 7580 | 7820 | N | 0.97 | |
| 328 | 00/07-27-092-04W5/0 | | 990.6 | 1297.8 | 7440 | 7940 | N | 0.76 | |
| 329 | 00/07-28-091-03W5/0 | | 1005.8 | 1349 | 7540 | 7940 | N | 0.75 | |
| 330 | 00/07-29-017-06W4/0 | 1984/12/05 | 1006.5 | 1750.8 | 6420 | 9160 | Y | 0.57 | |
| 331 | 00/07-29-101-01W5/0 | | 579.1 | 974.8 | 7440 | 7940 | N | 0.59 | |
| 332 | 00/07-31-016-08W4/0 | 1979/10/20 | 780.9 | 1770.9 | 2130 | 9160 | Y | 0.44 | |
| 333 | 00/07-31-092-04W5/0 | 1987/03/15 | 20 | 1320 | 0000 | 9800 | Y | 0.02 | Y |
| 334 | 00/07-31-093-04W5/0 | | 720.5 | 1341.1 | 7170 | 9800 | Y | 0.54 | |
| 335 | 00/07-34-055-21W4/0 | | 207 | 1873.7 | 0000 | 8060 | N | 0.11 | |
| 336 | 00/07-34-071-04W5/0 | 1992/11/14 | 1758.1 | 1791 | 7440 | 7820 | N | 0.98 | |
| 337 | 00/07-34-088-02W5/0 | | 947.5 | 1599 | 7160 | 9800 | Y | 0.59 | |
| 338 | 00/07-34-092-04W5/0 | | 712.9 | 1268 | 7170 | 7880 | N | 0.56 | |
| 339 | 00/07-36-084-23W4/0 | | 584.9 | 1051 | 7104 | 7820 | N | 0.56 | |
| 340 | 00/07-36-100-04W5/0 | | 376.7 | 1060.7 | 7170 | 9800 | Y | 0.36 | |
| 341 | 00/08-01-019-04W4/0 | | 422 | 1716 | 1600 | 9160 | Y | 0.25 | |
| 342 | 00/08-01-092-04W5/0 | | 914.4 | 1300.9 | 7170 | 7880 | N | 0.70 | |
| 343 | 00/08-02-046-14W4/0 | 1984/12/12 | 650 | 1664 | 1860 | 9999 | Y | 0.39 | Y |
| 344 | 00/08-02-093-04W5/0 | 1988/03/14 | 806 | 1314 | 7170 | 7880 | N | 0.61 | |

 

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 345 | 00/08-03-063-27W4/0 | | 1066.8 | 1938.2 | 6780 | 7960 | N | 0.55 | |
| 346 | 00/08-03-088-05W5/0 | 1989/03/31 | 500 | 1538 | 0000 | 9800 | Y | 0.33 | |
| 347 | 00/08-03-094-01W5/0 | 1997/08/21 | 796.5 | 1375.7 | 7170 | 7940 | N | 0.58 | |
| 348 | 00/08-03-094-02W5/0 | 1996/12/22 | 797 | 1340.2 | 7170 | 9999 | Y | 0.59 | |
| 349 | 00/08-07-093-02W5/0 | 1997/03/28 | 801 | 1327.2 | 7170 | 9800 | Y | 0.60 | |
| 350 | 00/08-08-020-09W4/2 | | 1500 | 2209 | 7320 | 9800 | Y | 0.68 | Y |
| 351 | 00/08-08-090-03W5/0 | 1986/01/19 | 25 | 1535 | 0000 | 9800 | Y | 0.02 | |
| 352 | 00/08-10-089-03W5/0 | 1987/11/14 | 590 | 1488 | 0000 | 9999 | Y | 0.40 | |
| 353 | 00/08-11-093-02W5/0 | 1995/09/19 | 28 | 1255 | 0000 | 7880 | N | 0.02 | |
| 354 | 00/08-12-090-03W5/0 | 1985/03/01 | 50 | 1477.9 | 0000 | 9760 | Y | 0.03 | |
| 355 | 00/08-14-040-03W4/2 | 1994/05/31 | 874 | 1488.6 | 7040 | 7880 | N | 0.59 | |
| 356 | 00/08-14-090-03W5/0 | | 10 | 1464 | 0000 | 9800 | Y | 0.01 | |
| 357 | 00/08-14-093-02W5/0 | 1995/10/02 | 766 | 1284.1 | 7170 | 7880 | N | 0.60 | |
| 358 | 00/08-15-096-04W5/0 | 1985/02/10 | 303.6 | 1280 | 0000 | 9999 | Y | 0.24 | |
| 359 | 00/08-16-098-22W4/0 | 1985/02/23 | 220 | 1229 | 0000 | 8020 | N | 0.18 | |
| 360 | 00/08-17-020-04W4/0 | | 455.1 | 2202.8 | 1600 | 9800 | Y | 0.21 | Y |
| 361 | 00/08-17-085-25W4/0 | 1986/02/13 | 25 | 1407.1 | 0000 | 9800 | Y | 0.02 | Y |
| 362 | 00/08-17-105-01W5/0 | | 104.9 | 848.6 | 7100 | 9800 | Y | 0.12 | Y |
| 363 | 00/08-18-090-03W5/0 | 1985/01/09 | 15 | 1499 | 0000 | 9800 | Y | 0.01 | |
| 364 | 00/08-21-089-03W5/0 | 1988/01/14 | 1106 | 1526 | 7440 | 9800 | Y | 0.72 | |
| 365 | 00/08-22-019-05W4/0 | | 975.4 | 1759.9 | 2480 | 9160 | Y | 0.55 | Y |
| 366 | 00/08-23-017-04W4/0 | 1985/01/05 | 935.5 | 1780.5 | 6420 | 9160 | Y | 0.53 | Y |
| 367 | 00/08-23-043-16W4/0 | 1984/07/09 | 329 | 1802 | 0000 | 7920 | N | 0.18 | |
| 368 | 00/08-25-087-03W5/0 | | 929 | 1478 | 7170 | 9800 | Y | 0.63 | |
| 369 | 00/08-25-090-03W5/0 | 1986/02/14 | 20 | 1353 | 0000 | 9800 | Y | 0.01 | |
| 370 | 00/08-28-091-02W5/0 | 1984/03/19 | 738 | 1286 | 7170 | 9800 | Y | 0.57 | |
| 371 | 00/08-29-093-04W5/0 | 1988/03/03 | 1000 | 1299.2 | 7440 | 9800 | Y | 0.77 | |
| 372 | 00/08-34-055-20W4/0 | 1990/04/02 | 251 | 1760.9 | 0000 | 8040 | N | 0.14 | |
| 373 | 00/08-36-092-05W5/0 | 1987/08/04 | 15 | 1331 | 0000 | 9800 | Y | 0.01 | Y |
| 374 | 00/09-01-074-05W5/0 | 1992/06/24 | 650.5 | 1655.7 | 6440 | 7820 | N | 0.39 | |
| 375 | 00/09-03-055-22W4/0 | 1986/05/03 | 216 | 1912 | 0000 | 8040 | N | 0.11 | |
| 376 | 00/09-03-089-03W5/0 | 1987/03/28 | 1013 | 1462.2 | 7170 | 7880 | N | 0.69 | |
| 377 | 00/09-03-094-02W5/0 | 1997/08/01 | 798.2 | 1349.3 | 7170 | 7940 | N | 0.59 | |
| 378 | 00/09-05-074-04W5/0 | 1989/05/20 | 1380 | 1625.4 | 7100 | 7820 | N | 0.85 | |
| 379 | 00/09-05-091-04W5/0 | 1986/12/25 | 25 | 1362.2 | 0000 | 9800 | Y | 0.02 | |
| 380 | 00/09-06-095-04W5/0 | 1986/03/12 | 699.5 | 1277.5 | 7170 | 9800 | Y | 0.55 | |
| 381 | 00/09-07-090-03W5/0 | | 849.2 | 1516.1 | 7160 | 9800 | Y | 0.56 | |
| 382 | 00/09-07-093-02W5/0 | 1997/07/10 | 792.5 | 1305.2 | 7170 | 9999 | Y | 0.61 | |
| 383 | 00/09-08-094-03W5/0 | 1994/11/22 | 820.5 | 1339 | 7170 | 7880 | N | 0.61 | |
| 384 | 00/09-10-088-03W5/0 | 1985/09/09 | 952 | 1490 | 7160 | 9800 | Y | 0.64 | |
| 385 | 00/09-10-089-03W5/0 | 1987/02/19 | 352 | 1539 | 0000 | 9800 | Y | 0.23 | |
| 386 | 00/09-10-095-04W5/0 | 1987/03/13 | 15 | 1290 | 0000 | 9800 | Y | 0.01 | Y |
| 387 | 00/09-11-091-05W5/0 | 1987/07/24 | 390 | 1337.9 | 0000 | 9800 | Y | 0.29 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 388 | 00/09-12-090-03W5/0 | 1993/11/30 | 960.5 | 1437 | 7170 | 9800 | Y | 0.67 | |
| 389 | 00/09-13-090-03W5/0 | 1993/12/26 | 911.2 | 1396.7 | 7170 | 7880 | N | 0.65 | |
| 390 | 00/09-14-090-03W5/0 | 1984/12/22 | 40 | 1438.8 | 0000 | 9800 | Y | 0.03 | |
| 391 | 00/09-14-093-02W5/0 | 1995/01/10 | 772.5 | 1331 | 7170 | 9800 | Y | 0.58 | |
| 392 | 00/09-15-073-04W5/0 | 1993/01/21 | 250 | 1619.9 | 0000 | 7820 | N | 0.15 | |
| 393 | 00/09-16-089-04W5/0 | 1995/09/30 | 1427 | 1454.1 | 7820 | 7880 | N | 0.98 | |
| 394 | 00/09-17-072-04W5/0 | 1992/12/15 | 250 | 1666 | 0000 | 7820 | N | 0.15 | |
| 395 | 00/09-18-032-17W4/0 | 1988/08/09 | 361 | 2158 | 0000 | 7700 | N | 0.17 | |
| 396 | 00/09-18-089-03W5/0 | 1987/04/07 | 27 | 1536 | 0000 | 9760 | Y | 0.02 | |
| 397 | 00/09-18-094-03W5/0 | 1994/02/17 | 1036 | 1358.5 | 7440 | 9800 | Y | 0.76 | |
| 398 | 00/09-19-089-03W5/0 | 1987/07/16 | 20 | 1534 | 0000 | 7940 | N | 0.01 | |
| 399 | 00/09-21-018-05W4/0 | 1984/12/08 | 895 | 1645 | 6420 | 9160 | Y | 0.54 | |
| 400 | 00/09-21-092-04W5/0 | 1987/07/31 | 15 | 1284.5 | 0000 | 9999 | Y | 0.01 | |
| 401 | 00/09-22-090-05W5/0 | 1987/07/28 | 10 | 1515 | 0000 | 9800 | Y | 0.01 | |
| 402 | 00/09-25-091-05W5/0 | 1991/01/25 | 924.8 | 1315.5 | 7440 | 7880 | N | 0.70 | |
| 403 | 00/09-26-095-05W5/0 | 1987/01/19 | 15 | 1219 | 0000 | 9800 | Y | 0.01 | Y |
| 404 | 00/09-27-015-08W4/0 | | 971.4 | 1710 | 6420 | 9160 | Y | 0.57 | Y |
| 405 | 00/09-30-091-03W5/0 | | 1005.8 | 1335 | 7170 | 7940 | N | 0.75 | |
| 406 | 00/09-30-092-04W5/0 | 1987/03/24 | 805.5 | 1309 | 7170 | 9800 | Y | 0.62 | |
| 407 | 00/09-32-070-03W5/0 | 1990/01/04 | 475 | 1749.2 | 2060 | 7820 | N | 0.27 | |
| 408 | 00/09-32-092-04W5/0 | 1987/07/30 | 10 | 1303 | 0000 | 9999 | Y | 0.01 | Y |
| 409 | 00/09-33-055-20W4/2 | 1990/08/08 | 261 | 1765.2 | 0000 | 8020 | N | 0.15 | |
| 410 | 00/09-36-055-26W4/0 | | 202 | 1972.5 | 0000 | 7700 | N | 0.10 | |
| 411 | 00/09-36-095-02W5/0 | | 601.7 | 1378 | 7168 | 9800 | Y | 0.44 | |
| 412 | 00/10-01-017-08W4/0 | 1985/02/03 | 1020 | 1718 | 6420 | 9160 | Y | 0.59 | Y |
| 413 | 00/10-01-073-05W5/0 | 1991/12/31 | 275 | 1669.7 | 0000 | 7820 | N | 0.16 | |
| 414 | 00/10-01-095-05W5/0 | | 666.9 | 1314.6 | 7170 | 9800 | Y | 0.51 | |
| 415 | 00/10-02-073-04W5/0 | 1994/03/05 | 1100 | 1607.5 | 6700 | 7820 | N | 0.68 | |
| 416 | 00/10-02-094-05W5/0 | | 975.4 | 1338.4 | 7440 | 9800 | Y | 0.73 | |
| 417 | 00/10-03-073-04W5/0 | | 1325.9 | 1630.7 | 7170 | 7820 | N | 0.81 | |
| 418 | 00/10-03-090-03W5/0 | 1993/02/25 | 1027 | 1481.1 | 7170 | 9999 | Y | 0.69 | |
| 419 | 00/10-04-070-03W5/0 | 1991/11/09 | 400 | 1719.6 | 0000 | 7820 | N | 0.23 | |
| 420 | 00/10-04-075-03W5/0 | 1993/12/06 | 700 | 1853 | 6440 | 9760 | Y | 0.38 | Y |
| 421 | 00/10-04-089-04W5/0 | 1995/09/19 | 1455 | 1462.3 | 7820 | 7880 | N | 1.00 | |
| 422 | 00/10-05-093-03W5/0 | | 488 | 1369.4 | 6700 | 9800 | Y | 0.37 | Y |
| 423 | 00/10-05-094-03W5/0 | 1995/07/31 | 802.8 | 1304.2 | 7170 | 7880 | N | 0.62 | |
| 424 | 00/10-06-015-08W4/0 | | 953.5 | 1680 | 6420 | 9160 | Y | 0.57 | |
| 425 | 00/10-06-088-01W5/0 | 1985/03/03 | 50 | 1559.3 | 0000 | 9800 | Y | 0.03 | |
| 426 | 00/10-08-070-03W5/0 | 1991/11/30 | 1650 | 1723.9 | 7440 | 7820 | N | 0.96 | |
| 427 | 00/10-08-073-04W5/0 | 1989/03/20 | 1602.8 | 1645 | 7620 | 7820 | N | 0.97 | |
| 428 | 00/10-08-095-03W5/0 | 1995/02/07 | 1235.7 | 1330.1 | 7820 | 8060 | N | 0.93 | |
| 429 | 00/10-09-069-24W4/0 | | 722.1 | 1663 | 2620 | 7920 | N | 0.43 | |
| 430 | 00/10-09-075-24W4/0 | | 1417.3 | 1648.1 | 7620 | 7940 | N | 0.86 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 431 | 00/10-09-090-03W5/0 | 1985/06/12 | 1076 | 1540 | 0000 | 9800 | Y | 0.70 | |
| 432 | 00/10-10-055-22W4/0 | | 579.1 | 1881.5 | 1860 | 8040 | N | 0.31 | |
| 433 | 00/10-10-074-05W5/0 | | 192 | 1730 | 0000 | 7820 | N | 0.11 | |
| 434 | 00/10-11-072-05W5/0 | 1984/12/08 | 1600 | 1736 | 7440 | 7820 | N | 0.92 | |
| 435 | 00/10-12-066-15W4/0 | | 615.7 | 1591.1 | 7160 | 9800 | Y | 0.39 | Y |
| 436 | 00/10-13-073-04W5/0 | 1991/02/27 | 1525 | 1604.2 | 7440 | 7820 | N | 0.95 | |
| 437 | 00/10-13-092-05W5/0 | 1987/03/19 | 324 | 1337 | 0000 | 9800 | Y | 0.24 | |
| 438 | 00/10-14-100-23W4/0 | 1985/02/27 | 319 | 1248 | 2640 | 9999 | Y | 0.26 | Y |
| 439 | 00/10-15-038-21W4/0 | | 1371.6 | 2870 | 6440 | 9800 | Y | 0.48 | Y |
| 440 | 00/10-15-085-22W4/2 | | 944.9 | 1321.9 | 7580 | 9800 | Y | 0.71 | |
| 441 | 00/10-16-027-08W4/0 | | 183 | 1704 | 0000 | 7700 | N | 0.11 | |
| 442 | 00/10-16-073-04W5/0 | 1991/03/07 | 1587.7 | 1630.2 | 7620 | 7820 | N | 0.97 | |
| 443 | 00/10-16-088-03W5/0 | 1987/10/26 | 540 | 1515.5 | 0000 | 9800 | Y | 0.36 | |
| 444 | 00/10-16-088-18W4/0 | | 333.8 | 993 | 7160 | 8020 | N | 0.34 | |
| 445 | 00/10-16-089-20W4/0 | | 609 | 1048.2 | 7500 | 8020 | N | 0.58 | |
| 446 | 00/10-16-091-18W4/0 | | 187.5 | 970.8 | 0000 | 9800 | Y | 0.19 | Y |
| 447 | 00/10-17-073-04W5/0 | | 185 | 1650 | 0000 | 7820 | N | 0.11 | |
| 448 | 00/10-17-094-03W5/0 | 1993/02/26 | 819.8 | 1337.6 | 7170 | 7880 | N | 0.61 | |
| 449 | 00/10-18-070-03W5/0 | 1989/12/13 | 650 | 1752.5 | 2480 | 7820 | N | 0.37 | |
| 450 | 00/10-18-091-01W5/0 | 1988/03/16 | 14 | 1271.4 | 0000 | 9800 | Y | 0.01 | |
| 451 | 00/10-18-092-04W5/0 | 1994/01/21 | 812.5 | 1294.6 | 7170 | 7880 | N | 0.63 | |
| 452 | 00/10-19-072-04W5/0 | 1993/07/18 | 1893.5 | 1936.3 | 7580 | 7820 | N | 0.98 | |
| 453 | 00/10-19-094-03W5/0 | 1994/11/05 | 822 | 1362 | 7170 | 9800 | Y | 0.60 | |
| 454 | 00/10-20-073-04W5/0 | | 188.5 | 1625.5 | 0000 | 7820 | N | 0.12 | |
| 455 | 00/10-21-089-03W5/0 | 1994/01/17 | 1436.9 | 1447.5 | 7820 | 7880 | N | 0.99 | |
| 456 | 00/10-22-073-04W5/0 | 1984/02/10 | 180 | 1614 | 0000 | 7820 | N | 0.11 | |
| 457 | 00/10-22-098-03W5/0 | 1991/01/23 | 258.5 | 1251 | 0000 | 9760 | Y | 0.21 | Y |
| 458 | 00/10-25-072-04W5/0 | | 289 | 1627 | 0000 | 7820 | N | 0.18 | |
| 459 | 00/10-25-089-04W5/0 | 1993/03/02 | 1457 | 1486 | 7820 | 7880 | N | 0.98 | |
| 460 | 00/10-26-073-05W5/0 | 1984/12/10 | 183.4 | 1724 | 0000 | 7820 | N | 0.11 | |
| 461 | 00/10-26-097-01W5/0 | | 152.4 | 1232.3 | 0000 | 7940 | N | 0.12 | |
| 462 | 00/10-27-069-03W5/0 | 1987/02/03 | 1350 | 1688.1 | 7100 | 7820 | N | 0.80 | |
| 463 | 00/10-27-073-05W5/0 | 1984/02/03 | 180 | 1660 | 0000 | 7820 | N | 0.11 | |
| 464 | 00/10-27-089-03W5/0 | 1992/10/23 | 1028 | 1486.7 | 7170 | 9800 | Y | 0.69 | |
| 465 | 00/10-27-092-04W5/0 | | 853 | 1281 | 0000 | 7880 | N | 0.67 | |
| 466 | 00/10-28-107-03W5/0 | | 377.3 | 859.8 | 7520 | 8020 | N | 0.44 | |
| 467 | 00/10-29-077-18W4/0 | | 877.8 | 1331.7 | 7540 | 8060 | N | 0.66 | |
| 468 | 00/10-29-089-23W4/0 | | 262 | 1161 | 6960 | 7960 | N | 0.23 | |
| 469 | 00/10-30-032-23W4/0 | 1988/09/19 | 392.2 | 2560.4 | 0000 | 7700 | N | 0.15 | |
| 470 | 00/10-30-036-16W4/0 | | 203.3 | 2004.7 | 0000 | 7700 | N | 0.10 | |
| 471 | 00/10-30-070-03W5/0 | 1988/03/17 | 1739 | 1798 | 7620 | 7820 | N | 0.97 | |
| 472 | 00/10-32-069-03W5/0 | 1991/11/23 | 473 | 1720 | 2180 | 7820 | N | 0.28 | |
| 473 | 00/10-32-073-04W5/0 | 1984/01/25 | 187.5 | 1625 | 0000 | 9999 | N | 0.12 | |

# Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 474 | 00/10-32-090-04W5/0 | 1986/12/23 | 25 | 1412.4 | 0000 | 9800 | Y | 0.02 | |
| 475 | 00/10-33-061-27W4/0 | | 220.7 | 2087.3 | 0000 | 8040 | N | 0.11 | |
| 476 | 00/10-33-072-04W5/0 | 1990/01/30 | 1575 | 1638 | 7440 | 9999 | Y | 0.96 | |
| 477 | 00/10-33-087-25W4/0 | 1986/02/25 | 20 | 1405.1 | 0000 | 9800 | Y | 0.01 | Y |
| 478 | 00/10-33-089-04W5/0 | 1993/06/29 | 10 | 1459.3 | 0000 | 7880 | N | 0.01 | |
| 479 | 00/10-33-093-25W4/0 | | 610.5 | 1424.6 | 7167 | 9800 | Y | 0.43 | Y |
| 480 | 00/10-34-071-04W5/0 | 1991/07/21 | 420 | 1807.8 | 0000 | 7820 | N | 0.23 | |
| 481 | 00/10-34-073-05W5/0 | 1991/02/18 | 604 | 1660 | 2480 | 7820 | N | 0.36 | |
| 482 | 00/10-34-089-04W5/0 | 1991/11/17 | 1089.8 | 1525 | 7440 | 9800 | Y | 0.71 | |
| 483 | 00/10-34-091-18W4/0 | | 189.9 | 920.2 | 0000 | 7960 | N | 0.21 | |
| 484 | 00/10-34-091-24W4/0 | | 1027.8 | 1222.9 | 7720 | 7940 | N | 0.84 | |
| 485 | 00/10-34-093-02W5/0 | 1997/02/20 | 773 | 1333.9 | 7170 | 7940 | N | 0.58 | |
| 486 | 00/10-35-073-05W5/0 | 1989/02/14 | 237 | 1659.5 | 0000 | 7820 | N | 0.14 | |
| 487 | 00/10-35-090-05W5/0 | | 259.1 | 1499 | 0000 | 9760 | Y | 0.17 | |
| 488 | 00/10-36-098-21W4/0 | | 228.3 | 1197.3 | 0000 | 9800 | Y | 0.19 | Y |
| 489 | 00/11-01-094-05W5/0 | 1986/03/02 | 331 | 1300.7 | 0000 | 9800 | Y | 0.25 | |
| 490 | 00/11-03-072-04W5/0 | 1992/07/11 | 275 | 1808 | 0000 | 7820 | N | 0.15 | |
| 491 | 00/11-05-015-06W4/0 | | 942 | 1747 | 2480 | 9160 | Y | 0.54 | Y |
| 492 | 00/11-05-089-03W5/0 | 1987/10/07 | 30 | 1543 | 0000 | 9800 | Y | 0.02 | |
| 493 | 00/11-05-095-03W5/0 | 1996/02/28 | 1242.3 | 1282.9 | 7820 | 7880 | N | 0.97 | |
| 494 | 00/11-07-089-03W5/0 | 1987/07/19 | 20 | 1576 | 0000 | 9800 | Y | 0.01 | |
| 495 | 00/11-08-089-04W5/0 | 1990/11/27 | 1143 | 1514 | 7440 | 9800 | Y | 0.75 | |
| 496 | 00/11-08-092-03W5/0 | | 1219.2 | 1321.3 | 7820 | 9800 | Y | 0.92 | |
| 497 | 00/11-08-095-22W4/0 | 1985/03/09 | 45 | 1380.2 | 0000 | 9800 | Y | 0.03 | Y |
| 498 | 00/11-09-074-04W5/0 | 1990/01/25 | 305.8 | 1644 | 0000 | 7820 | N | 0.19 | |
| 499 | 00/11-10-073-04W5/0 | 1994/03/05 | 1590 | 1627 | 7620 | 7820 | N | 0.98 | |
| 500 | 00/11-10-075-22W4/0 | | 1224.7 | 1654.5 | 7860 | 8060 | N | 0.74 | |
| 501 | 00/11-10-089-03W5/0 | 1987/10/18 | 19.3 | 1543.8 | 0000 | 9800 | Y | 0.01 | |
| 502 | 00/11-10-089-03W5/2 | 1987/10/30 | 1069.4 | 1533.4 | 7170 | 9800 | Y | 0.70 | |
| 503 | 00/11-10-093-04W5/0 | | 1219.2 | 1317.3 | 7820 | 9800 | Y | 0.93 | |
| 504 | 00/11-12-089-04W5/0 | 1988/07/02 | 10 | 1568 | 0000 | 9800 | Y | 0.01 | |
| 505 | 00/11-13-015-09W4/0 | | 952.9 | 2186 | 6420 | 9800 | Y | 0.44 | |
| 506 | 00/11-13-073-04W5/0 | 1991/01/15 | 1525 | 1610 | 7440 | 7820 | N | 0.95 | |
| 507 | 00/11-13-098-01W5/0 | 1989/02/22 | 365 | 1243.1 | 0000 | 7940 | N | 0.29 | |
| 508 | 00/11-14-018-08W4/0 | 1985/02/22 | 1040 | 1749 | 6420 | 9160 | Y | 0.59 | Y |
| 509 | 00/11-14-090-03W5/0 | 1985/11/10 | 932 | 1430 | 7170 | 9800 | Y | 0.65 | |
| 510 | 00/11-15-034-15W4/0 | 1992/12/31 | 296 | 1974.4 | 0000 | 7920 | N | 0.15 | |
| 511 | 00/11-15-085-17W4/0 | | 609.6 | 1027.8 | 7540 | 9800 | Y | 0.59 | |
| 512 | 00/11-15-089-03W5/0 | 1986/12/31 | 352 | 1538.5 | 0000 | 9999 | Y | 0.23 | |
| 513 | 00/11-15-092-04W5/0 | 1988/02/07 | 360 | 1322.2 | 0000 | 9800 | Y | 0.27 | |
| 514 | 00/11-16-044-16W4/0 | 1983/12/22 | 321 | 1807 | 0000 | 7960 | N | 0.18 | |
| 515 | 00/11-17-072-04W5/0 | | 1615 | 1673.8 | 0000 | 7820 | N | 0.96 | |
| 516 | 00/11-17-089-04W5/0 | 1995/09/07 | 25 | 1594.6 | 0000 | 7880 | N | 0.02 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 517 | 00/11-18-018-08W4/0 | 1985/01/13 | 1039.8 | 2241.5 | 6420 | 9800 | Y | 0.46 | Y |
| 518 | 00/11-18-028-14W4/0 | 1989/08/19 | 351 | 2039.2 | 0000 | 7700 | N | 0.17 | |
| 519 | 00/11-18-090-02W5/0 | | 947.6 | 1404.8 | 7440 | 9800 | Y | 0.67 | |
| 520 | 00/11-20-016-07W4/0 | | 986.8 | 2211.4 | 2480 | 9800 | Y | 0.45 | |
| 521 | 00/11-21-071-04W5/0 | | 190 | 1836 | 0000 | 7820 | N | 0.10 | |
| 522 | 00/11-21-091-03W5/0 | 1986/02/28 | 100 | 1379 | 0000 | 9800 | Y | 0.07 | |
| 523 | 00/11-21-104-03W5/0 | | 426.7 | 956.5 | 7440 | 8060 | N | 0.45 | |
| 524 | 00/11-22-016-08W4/0 | | 987.1 | 1734.9 | 6420 | 9160 | Y | 0.57 | |
| 525 | 00/11-22-089-03W5/0 | 1994/01/11 | 10 | 1467.5 | 0000 | 7880 | N | 0.01 | |
| 526 | 00/11-23-070-04W5/0 | 1994/01/09 | 1780 | 1859 | 7440 | 7820 | N | 0.96 | |
| 527 | 00/11-23-071-05W5/0 | 1995/03/19 | 1800 | 1933.5 | 7440 | 7820 | N | 0.93 | |
| 528 | 00/11-23-090-02W5/0 | 1984/12/21 | 810.5 | 1356 | 0000 | 9800 | Y | 0.60 | |
| 529 | 00/11-23-092-04W5/0 | | 1188.7 | 1293.9 | 7820 | 7940 | N | 0.92 | |
| 530 | 00/11-24-070-04W5/0 | 1993/12/23 | 841.5 | 1842 | 0000 | 7820 | N | 0.46 | |
| 531 | 00/11-24-093-25W4/0 | 1986/02/27 | 356.5 | 1312.5 | 0000 | 9800 | Y | 0.27 | Y |
| 532 | 00/11-25-024-02W4/0 | | 1050 | 1675 | 6600 | 7920 | N | 0.63 | |
| 533 | 00/11-26-092-04W5/0 | | 880 | 1297 | 0000 | 7880 | N | 0.68 | |
| 534 | 00/11-26-093-02W5/0 | 1995/12/14 | 20 | 1368.2 | 0000 | 7940 | N | 0.01 | |
| 535 | 00/11-29-089-04W5/0 | 1987/01/28 | 1200 | 1528 | 7440 | 9800 | Y | 0.79 | |
| 536 | 00/11-29-094-03W5/0 | 1994/12/11 | 15 | 1301.5 | 0000 | 7880 | N | 0.01 | |
| 537 | 00/11-31-092-04W5/0 | 1986/03/29 | 25 | 1325.5 | 0000 | 9800 | Y | 0.02 | Y |
| 538 | 00/11-32-070-01W5/0 | | 181.3 | 1532 | 0000 | 7820 | N | 0.12 | |
| 539 | 00/11-32-093-03W5/0 | 1995/01/05 | 110 | 1288.5 | 0000 | 7880 | N | 0.09 | |
| 540 | 00/11-32-094-03W5/0 | 1994/01/19 | 10 | 1277.1 | 0000 | 7880 | N | 0.01 | |
| 541 | 00/11-33-070-03W5/0 | 1984/08/07 | 275 | 1724.5 | 0000 | 9999 | N | 0.16 | |
| 542 | 00/11-34-089-03W5/0 | 1992/08/15 | 1040 | 1496.7 | 7170 | 7880 | N | 0.69 | |
| 543 | 00/11-35-038-10W4/0 | 1992/01/06 | 750 | 2140 | 1860 | 9999 | Y | 0.35 | Y |
| 544 | 00/11-35-087-05W5/0 | 1988/03/17 | 1099 | 1536 | 7100 | 9800 | Y | 0.72 | |
| 545 | 00/11-36-073-05W5/0 | 1988/03/11 | 210 | 1647.5 | 0000 | 7820 | N | 0.13 | |
| 546 | 00/11-36-093-04W5/0 | 1995/02/11 | 1230.5 | 1267.6 | 7820 | 7880 | N | 0.97 | |
| 547 | 00/12-01-069-02W5/0 | | 1554.5 | 1759.3 | 7440 | 7940 | N | 0.88 | |
| 548 | 00/12-01-073-04W5/0 | 1995/01/07 | 302 | 1606.8 | 0000 | 9999 | N | 0.19 | |
| 549 | 00/12-01-074-05W5/0 | 1989/11/09 | 191 | 1651 | 0000 | 7820 | N | 0.12 | |
| 550 | 00/12-01-080-24W4/0 | 1987/12/15 | 302 | 1465.5 | 2620 | 9800 | Y | 0.21 | |
| 551 | 00/12-02-073-04W5/0 | 1992/11/12 | 1545 | 1619 | 7440 | 7820 | N | 0.95 | |
| 552 | 00/12-02-074-05W5/0 | 1985/02/14 | 197 | 1664 | 0000 | 7820 | N | 0.12 | |
| 553 | 00/12-03-070-03W5/0 | 1993/04/11 | 300 | 1719.9 | 0000 | 7820 | N | 0.17 | |
| 554 | 00/12-04-074-04W5/0 | 1988/09/24 | 189.5 | 1635 | 0000 | 9999 | N | 0.12 | |
| 555 | 00/12-04-099-21W4/0 | 1988/02/23 | 214.7 | 1177.5 | 0000 | 9800 | Y | 0.18 | Y |
| 556 | 00/12-05-071-04W5/0 | 1992/10/28 | 250 | 1872.5 | 0000 | 7820 | N | 0.13 | |
| 557 | 00/12-06-073-04W5/0 | 1992/01/15 | 245 | 1654.4 | 0000 | 7820 | N | 0.15 | |
| 558 | 00/12-07-015-07W4/0 | | 920 | 1675 | 6420 | 9160 | Y | 0.55 | Y |
| 559 | 00/12-07-089-25W4/0 | | 1066.8 | 1382.6 | 7440 | 7960 | N | 0.77 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 560 | 00/12-07-090-02W5/0 | 1985/10/25 | 25 | 1438 | 0000 | 9800 | Y | 0.02 | |
| 561 | 00/12-07-094-23W4/0 | | 914.4 | 1361.8 | 7440 | 7960 | N | 0.67 | |
| 562 | 00/12-08-094-03W5/0 | 1994/03/03 | 1038 | 1299.3 | 7620 | 7880 | N | 0.80 | |
| 563 | 00/12-09-038-21W4/0 | 1984/02/08 | 389 | 2368.5 | 0000 | 9000 | Y | 0.16 | Y |
| 564 | 00/12-09-070-03W5/0 | 1991/08/23 | 1640 | 1721.5 | 7440 | 7820 | N | 0.95 | |
| 565 | 00/12-09-073-04W5/0 | 1990/02/18 | 188.3 | 1633.2 | 0000 | 7820 | N | 0.12 | |
| 566 | 00/12-10-071-03W5/0 | 1993/03/29 | 1620 | 1680.5 | 7440 | 7820 | N | 0.96 | |
| 567 | 00/12-10-073-05W5/0 | 1993/12/29 | 1835.8 | 1862.5 | 7620 | 7820 | N | 0.99 | |
| 568 | 00/12-10-074-05W5/0 | | 190.8 | 1735.8 | 0000 | 7820 | N | 0.11 | |
| 569 | 00/12-10-089-04W5/0 | 1987/11/18 | 545 | 1516 | 0000 | 9800 | Y | 0.36 | |
| 570 | 00/12-11-093-04W5/0 | 1987/12/18 | 816 | 1337 | 7170 | 9999 | Y | 0.61 | |
| 571 | 00/12-11-094-02W5/0 | 1997/03/01 | 1275.6 | 1341.3 | 7820 | 7880 | N | 0.95 | |
| 572 | 00/12-12-015-07W4/0 | | 900 | 2152 | 2480 | 9800 | Y | 0.42 | Y |
| 573 | 00/12-12-071-04W5/0 | 1995/01/21 | 1765 | 1810 | 7580 | 7820 | N | 0.98 | |
| 574 | 00/12-12-093-02W5/0 | 1995/01/09 | 758.9 | 1273.9 | 7170 | 7880 | N | 0.60 | |
| 575 | 00/12-13-055-22W4/0 | 1995/10/05 | 1700 | 1909.6 | 7860 | 8040 | N | 0.89 | |
| 576 | 00/12-13-070-04W5/0 | 1993/12/06 | 1790 | 1851 | 7440 | 7820 | N | 0.97 | |
| 577 | 00/12-13-089-03W5/0 | 1989/03/27 | 20 | 1467.9 | 0000 | 9800 | Y | 0.01 | |
| 578 | 00/12-14-070-04W5/0 | 1993/11/12 | 1829.1 | 1872.1 | 7580 | 7820 | N | 0.98 | |
| 579 | 00/12-14-072-04W5/0 | 1990/12/06 | 400 | 1718.2 | 0000 | 7820 | N | 0.23 | |
| 580 | 00/12-14-073-04W5/0 | 1991/02/15 | 250 | 1622.6 | 0000 | 7820 | N | 0.15 | |
| 581 | 00/12-15-073-04W5/0 | 1993/02/22 | 240 | 1622 | 0000 | 7820 | N | 0.15 | |
| 582 | 00/12-16-092-04W5/0 | 1988/10/11 | 20 | 1276 | 0000 | 9800 | Y | 0.02 | |
| 583 | 00/12-16-094-03W5/0 | 1999/01/24 | 440 | 1320.5 | 0000 | 7880 | N | 0.33 | |
| 584 | 00/12-17-093-04W5/0 | 1987/08/16 | 12 | 1334 | 0000 | 9999 | Y | 0.01 | Y |
| 585 | 00/12-17-095-04W5/0 | 1993/02/15 | 1213 | 1259.5 | 7820 | 7880 | N | 0.96 | |
| 586 | 00/12-18-072-03W5/2 | 1988/11/11 | 1560 | 1672 | 7440 | 7820 | N | 0.93 | |
| 587 | 00/12-18-087-03W5/0 | 1986/01/17 | 285 | 1589.6 | 0000 | 9800 | Y | 0.18 | Y |
| 588 | 00/12-19-014-04W4/0 | 1988/01/25 | 454.8 | 2211.4 | 0000 | 9800 | Y | 0.21 | |
| 589 | 00/12-19-072-03W5/0 | | 203 | 1665 | 0000 | 7820 | N | 0.12 | |
| 590 | 00/12-20-072-04W5/0 | 1990/12/13 | 300 | 1725.7 | 0000 | 7820 | N | 0.17 | |
| 591 | 00/12-20-094-03W5/0 | 1995/02/27 | 12.2 | 1312.2 | 0000 | 9999 | N | 0.01 | |
| 592 | 00/12-21-015-08W4/0 | | 933.2 | 1685 | 6420 | 9160 | Y | 0.55 | Y |
| 593 | 00/12-21-073-04W5/0 | 1993/01/25 | 569.2 | 1619.9 | 3040 | 7820 | N | 0.35 | |
| 594 | 00/12-22-073-04W5/0 | 1991/01/26 | 596 | 1618.2 | 6440 | 7820 | N | 0.37 | |
| 595 | 00/12-22-089-03W5/0 | 1987/09/17 | 18 | 1507.4 | 0000 | 9800 | Y | 0.01 | |
| 596 | 00/12-23-073-04W5/0 | 1985/02/06 | 188.3 | 1616 | 0000 | 9999 | N | 0.12 | |
| 597 | 00/12-23-073-05W5/0 | | 600 | 1659 | 3360 | 7820 | N | 0.36 | |
| 598 | 00/12-24-073-05W5/0 | 1983/12/07 | 24 | 1654 | 0000 | 9999 | N | 0.01 | |
| 599 | 00/12-24-089-04W5/0 | 1993/08/23 | 10 | 1497.5 | 0000 | 7880 | N | 0.01 | |
| 600 | 00/12-24-090-03W5/0 | 1985/11/16 | 10 | 1368.8 | 0000 | 9800 | Y | 0.01 | |
| 601 | 00/12-25-073-05W5/0 | | 1500 | 1662 | 7440 | 7820 | N | 0.90 | |
| 602 | 00/12-26-089-04W5/0 | 1989/03/21 | 1100 | 1507.8 | 7440 | 9800 | Y | 0.73 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 603 | 00/12-27-089-03W5/0 | 1992/02/20 | 200 | 1483.5 | 0000 | 7880 | N | 0.13 | |
| 604 | 00/12-28-069-03W5/0 | 1991/01/13 | 400 | 1719 | 0000 | 7820 | N | 0.23 | |
| 605 | 00/12-28-072-04W5/0 | | 1610 | 1659.5 | 7580 | 7820 | N | 0.97 | |
| 606 | 00/12-28-089-03W5/0 | 1991/12/12 | 1040 | 1499.2 | 7170 | 7880 | N | 0.69 | |
| 607 | 00/12-29-015-08W4/0 | | 977.5 | 1701 | 6420 | 9160 | Y | 0.57 | |
| 608 | 00/12-29-073-04W5/0 | 1989/03/13 | 300 | 1629.1 | 2060 | 7820 | N | 0.18 | |
| 609 | 00/12-30-073-04W5/0 | 1991/02/02 | 225 | 1645 | 0000 | 7820 | N | 0.14 | |
| 610 | 00/12-30-089-03W5/0 | 1987/10/07 | 20 | 1535 | 0000 | 9800 | Y | 0.01 | |
| 611 | 00/12-30-096-04W5/0 | 1987/04/01 | 752 | 1237.1 | 7440 | 9800 | Y | 0.61 | |
| 612 | 00/12-31-072-04W5/0 | 1990/01/29 | 185.2 | 1663.2 | 0000 | 7820 | N | 0.11 | |
| 613 | 00/12-31-073-04W5/0 | 1984/06/19 | 182.9 | 1645 | 1860 | 9999 | Y | 0.11 | |
| 614 | 00/12-31-088-02W5/0 | 1988/03/06 | 15 | 1500.8 | 0000 | 9800 | Y | 0.01 | |
| 615 | 00/12-33-015-07W4/0 | | 939 | 1681 | 6420 | 9160 | Y | 0.56 | Y |
| 616 | 00/12-33-069-03W5/0 | 1991/08/08 | 400 | 1726 | 0000 | 7820 | N | 0.23 | |
| 617 | 00/12-34-069-03W5/0 | 1991/12/14 | 400 | 1709.9 | 0000 | 7820 | N | 0.23 | |
| 618 | 00/12-35-071-02W5/0 | 1987/01/13 | 595 | 1554 | 3060 | 7820 | N | 0.38 | |
| 619 | 00/12-35-072-04W5/0 | 1990/09/22 | 1500 | 1624.7 | 7440 | 7820 | N | 0.92 | |
| 620 | 00/12-35-073-05W5/0 | 1984/11/17 | 179 | 1661.2 | 0000 | 9999 | N | 0.11 | |
| 621 | 00/12-35-092-05W5/0 | 1988/08/11 | 829 | 1392 | 7170 | 9800 | Y | 0.60 | |
| 622 | 00/12-36-087-01W5/0 | 1987/01/29 | 15 | 1408 | 0000 | 9800 | Y | 0.01 | Y |
| 623 | 00/13-01-093-02W5/0 | 1996/03/13 | 20 | 1248 | 0000 | 7880 | N | 0.02 | |
| 624 | 00/13-02-055-22W4/0 | 1988/06/26 | 213.8 | 1950.4 | 0000 | 8040 | N | 0.11 | |
| 625 | 00/13-03-098-02W5/0 | 1987/01/22 | 528 | 1204 | 7170 | 9800 | Y | 0.44 | Y |
| 626 | 00/13-07-073-03W5/0 | 1994/01/30 | 603 | 1735.3 | 6440 | 7820 | N | 0.35 | |
| 627 | 00/13-07-092-04W5/0 | 1987/01/06 | 25 | 1321.9 | 0000 | 9760 | Y | 0.02 | |
| 628 | 00/13-08-093-04W5/0 | 1988/08/27 | 25 | 1339.7 | 0000 | 9800 | Y | 0.02 | Y |
| 629 | 00/13-09-086-21W4/0 | 1991/03/17 | 882.3 | 1225.1 | 7580 | 9800 | Y | 0.72 | |
| 630 | 00/13-10-074-04W5/0 | 1995/12/21 | 1200 | 1700.4 | 7170 | 7820 | N | 0.71 | |
| 631 | 00/13-10-098-04W5/0 | 1988/02/15 | 15 | 1271 | 0000 | 9999 | Y | 0.01 | Y |
| 632 | 00/13-11-091-05W5/0 | 1995/03/27 | 21 | 1404.8 | 0000 | 7880 | N | 0.01 | |
| 633 | 00/13-12-087-01W5/0 | 1985/02/12 | 944 | 1457 | 7170 | 9800 | Y | 0.65 | |
| 634 | 00/13-12-089-04W5/0 | 1987/08/07 | 20 | 1587 | 0000 | 9800 | Y | 0.01 | |
| 635 | 00/13-13-085-04W5/0 | 1982/02/20 | 1068 | 1671 | 7100 | 9800 | Y | 0.64 | |
| 636 | 00/13-13-093-02W5/0 | 1995/03/10 | 810.8 | 1301.1 | 7170 | 9999 | Y | 0.62 | |
| 637 | 00/13-14-089-03W5/0 | 1988/10/11 | 25 | 1544 | 0000 | 9999 | Y | 0.02 | |
| 638 | 00/13-14-089-04W5/0 | 1989/10/14 | 470 | 1557.3 | 0000 | 9800 | Y | 0.30 | |
| 639 | 00/13-14-090-05W5/0 | 1988/03/15 | 1058.5 | 1523 | 7170 | 9800 | Y | 0.70 | |
| 640 | 00/13-15-072-04W5/0 | 1995/02/07 | 1662.4 | 1698 | 7580 | 7820 | N | 0.98 | |
| 641 | 00/13-17-071-03W5/0 | 1991/08/03 | 1413 | 1772.2 | 7170 | 7820 | N | 0.80 | |
| 642 | 00/13-17-089-03W5/0 | 1988/09/28 | 15 | 1551.5 | 0000 | 9800 | Y | 0.01 | |
| 643 | 00/13-17-092-01W5/0 | 1995/01/29 | 702.8 | 1249.6 | 0000 | 9800 | Y | 0.56 | |
| 644 | 00/13-18-095-01W5/0 | 1989/02/08 | 485 | 1408 | 0000 | 9999 | Y | 0.34 | Y |
| 645 | 00/13-19-034-20W4/0 | 1987/06/23 | 610 | 2309 | 0000 | 9040 | Y | 0.26 | Y |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 646 | 00/13-19-073-04W5/0 | 1993/02/10 | 250 | 1642.2 | 0000 | 7820 | N | 0.15 | |
| 647 | 00/13-23-089-04W5/0 | 1988/11/13 | 20 | 1520 | 0000 | 9800 | Y | 0.01 | |
| 648 | 00/13-25-089-04W5/0 | 1997/08/31 | 525 | 1549.1 | 0000 | 7880 | N | 0.34 | |
| 649 | 00/13-28-089-02W5/0 | 1986/03/14 | 977.1 | 1503.8 | 7170 | 9800 | Y | 0.65 | |
| 650 | 00/13-29-072-04W5/0 | 1989/02/22 | 25 | 1775.7 | 0000 | 7820 | N | 0.01 | |
| 651 | 00/13-30-072-03W5/0 | 1989/03/02 | 314.2 | 1620.37 | 0000 | 9999 | N | 0.19 | |
| 652 | 00/13-30-093-02W5/0 | 1997/03/14 | 809.2 | 1388.9 | 6700 | 9800 | Y | 0.58 | |
| 653 | 00/13-31-090-04W5/0 | 1987/02/25 | 336 | 1437 | 0000 | 9800 | Y | 0.23 | |
| 654 | 00/14-01-094-02W5/0 | 1988/02/24 | 902 | 1422.4 | 7440 | 9800 | Y | 0.63 | |
| 655 | 00/14-02-089-04W5/0 | 1991/09/03 | 25 | 1563.7 | 0000 | 9800 | Y | 0.02 | |
| 656 | 00/14-02-099-22W4/0 | | 731.5 | 1158.2 | 7540 | 7960 | N | 0.63 | |
| 657 | 00/14-03-093-03W5/0 | 1986/01/22 | 396 | 1317 | 0000 | 9999 | Y | 0.30 | |
| 658 | 00/14-05-097-21W4/0 | | 199.9 | 1271.9 | 0000 | 8020 | N | 0.16 | |
| 659 | 00/14-07-072-03W5/0 | 1989/11/24 | 308 | 1726 | 0000 | 7820 | N | 0.18 | |
| 660 | 00/14-07-072-04W5/0 | 1984/11/14 | 1550 | 1705 | 7440 | 7820 | N | 0.91 | |
| 661 | 00/14-08-090-04W5/0 | 1986/03/27 | 1024 | 1554 | 7170 | 9800 | Y | 0.66 | |
| 662 | 00/14-09-092-04W5/0 | 1987/06/25 | 15 | 1320 | 0000 | 9800 | Y | 0.01 | |
| 663 | 00/14-11-039-17W4/0 | 1987/11/06 | 1260 | 2022 | 3360 | 9000 | Y | 0.62 | Y |
| 664 | 00/14-11-090-03W5/0 | 1985/09/13 | 1009 | 1506 | 7170 | 9800 | Y | 0.67 | |
| 665 | 00/14-12-016-06W4/0 | | 900 | 1692 | 6420 | 9160 | Y | 0.53 | |
| 666 | 00/14-12-070-04W5/0 | 1993/11/19 | 1750 | 1826 | 7440 | 9999 | Y | 0.96 | |
| 667 | 00/14-12-073-04W5/0 | 1990/03/20 | 1496 | 1617 | 7440 | 7820 | N | 0.93 | |
| 668 | 00/14-12-090-03W5/0 | 1994/01/13 | 958.2 | 1436.6 | 7170 | 7880 | N | 0.67 | |
| 669 | 00/14-13-055-22W4/0 | 1989/12/30 | 212.8 | 1887.8 | 0000 | 8040 | N | 0.11 | |
| 670 | 00/14-15-073-03W5/0 | | 250 | 1584 | 0000 | 7820 | N | 0.16 | |
| 671 | 00/14-16-090-03W5/0 | 1985/10/05 | 10 | 1499.5 | 0000 | 9800 | Y | 0.01 | |
| 672 | 00/14-17-015-06W4/0 | | 974.1 | 1697.1 | 6420 | 9160 | Y | 0.57 | |
| 673 | 00/14-18-070-03W5/0 | 1989/12/14 | 700 | 1773 | 2480 | 7820 | N | 0.39 | |
| 674 | 00/14-18-089-02W5/0 | 1988/03/23 | 1051 | 1564 | 7170 | 9800 | Y | 0.67 | |
| 675 | 00/14-18-094-03W5/0 | 1994/11/28 | 795 | 1303.5 | 7170 | 7880 | N | 0.61 | |
| 676 | 00/14-19-091-04W5/0 | 1988/02/04 | 1017 | 1356 | 7440 | 9800 | Y | 0.75 | |
| 677 | 00/14-19-092-01W5/0 | 1995/01/22 | 701 | 1247.9 | 0000 | 9800 | Y | 0.56 | |
| 678 | 00/14-20-073-04W5/0 | 1992/02/20 | 602.6 | 1625.8 | 6440 | 7820 | N | 0.37 | |
| 679 | 00/14-20-097-04W5/0 | 1988/03/17 | 759 | 1276 | 7170 | 7940 | N | 0.59 | |
| 680 | 00/14-22-092-04W5/0 | 1988/08/25 | 380 | 1317.2 | 0000 | 9999 | Y | 0.29 | |
| 681 | 00/14-26-072-04W5/0 | 1992/01/28 | 1560 | 1630 | 7440 | 9999 | Y | 0.96 | |
| 682 | 00/14-27-070-04W5/0 | 1993/12/08 | 1790 | 1866.7 | 7440 | 7820 | N | 0.96 | |
| 683 | 00/14-29-092-04W5/0 | 1987/11/06 | 15 | 1303 | 0000 | 9800 | Y | 0.01 | Y |
| 684 | 00/14-31-070-03W5/0 | 1989/02/19 | 1788 | 1823 | 7620 | 7820 | N | 0.98 | |
| 685 | 00/14-31-087-01W5/0 | 1988/01/01 | 1098.5 | 1492 | 7440 | 9800 | Y | 0.74 | |
| 686 | 00/14-31-089-03W5/0 | 1988/03/18 | 1037 | 1508.2 | 7170 | 9800 | Y | 0.69 | |
| 687 | 00/14-32-019-04W4/0 | | 424.9 | 1731 | 1600 | 9160 | Y | 0.25 | Y |
| 688 | 00/14-33-090-04W5/0 | 1987/03/05 | 289 | 1396.7 | 0000 | 9800 | Y | 0.21 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 689 | 00/14-35-034-17W4/0 | 1989/01/15 | 339 | 2091.7 | 0000 | 9040 | Y | 0.16 | Y |
| 690 | 00/14-35-071-05W5/0 | 1993/03/22 | 355 | 1870 | 0000 | 7820 | N | 0.19 | |
| 691 | 00/14-35-088-03W5/0 | 1993/03/13 | 1144 | 1449.7 | 7440 | 7880 | N | 0.79 | |
| 692 | 00/14-35-089-04W5/0 | 1991/03/01 | 990.3 | 1508.8 | 0000 | 9800 | Y | 0.66 | |
| 693 | 00/14-35-092-04W5/0 | | 854 | 1281.6 | 0000 | 7880 | N | 0.67 | |
| 694 | 00/14-36-020-01W4/0 | 1994/01/26 | 725 | 1701.6 | 2060 | 7920 | N | 0.43 | |
| 695 | 00/14-36-088-04W5/0 | 1988/07/10 | 1049 | 1601.4 | 7170 | 9800 | Y | 0.66 | |
| 696 | 00/14-36-092-05W5/0 | 1987/09/08 | 15 | 1344 | 0000 | 9800 | Y | 0.01 | Y |
| 697 | 00/14-36-092-05W5/2 | 1987/09/08 | 15 | 1344 | 0000 | 9800 | Y | 0.01 | |
| 698 | 00/15-01-090-04W5/0 | 1988/03/15 | 500 | 1502 | 0000 | 9800 | Y | 0.33 | |
| 699 | 00/15-02-090-03W5/0 | 1984/11/17 | 10 | 1529 | 0000 | 9800 | Y | 0.01 | |
| 700 | 00/15-02-095-04W5/0 | 1997/02/06 | 10 | 1267.7 | 0000 | 7880 | N | 0.01 | |
| 701 | 00/15-03-090-04W5/0 | 1987/10/30 | 1004 | 1512.5 | 7170 | 9800 | Y | 0.66 | |
| 702 | 00/15-03-094-02W5/0 | 1986/02/22 | 847 | 1381 | 7440 | 9800 | Y | 0.61 | |
| 703 | 00/15-04-092-04W5/0 | 1987/03/14 | 20 | 1288 | 0000 | 9800 | Y | 0.02 | |
| 704 | 00/15-05-089-04W5/0 | 1991/03/24 | 25 | 1526.7 | 0000 | 9800 | Y | 0.02 | |
| 705 | 00/15-05-095-03W5/0 | 1998/01/27 | 698 | 1277.1 | 7170 | 7880 | N | 0.55 | |
| 706 | 00/15-06-094-03W5/0 | 1995/02/13 | 8.2 | 1287.3 | 0000 | 9999 | N | 0.01 | |
| 707 | 00/15-07-013-04W4/0 | 1991/01/13 | 211 | 1698.4 | 0000 | 7700 | N | 0.12 | |
| 708 | 00/15-07-093-04W5/0 | 1987/09/09 | 20 | 1341 | 0000 | 9999 | Y | 0.01 | Y |
| 709 | 00/15-08-061-18W4/0 | | 279 | 1358 | 0000 | 7920 | N | 0.21 | |
| 710 | 00/15-08-089-04W5/0 | 1993/12/21 | 1449.8 | 1457.5 | 7820 | 7880 | N | 0.99 | |
| 711 | 00/15-08-092-03W5/0 | 1989/03/18 | 823.8 | 1335 | 0000 | 9999 | Y | 0.62 | |
| 712 | 00/15-09-074-04W5/0 | 1990/08/25 | 295 | 1646.2 | 0000 | 7820 | N | 0.18 | |
| 713 | 00/15-09-092-04W5/0 | 1986/12/08 | 20 | 1299 | 0000 | 9800 | Y | 0.02 | |
| 714 | 00/15-10-055-22W4/0 | | 1652 | 1853.2 | 7860 | 8040 | N | 0.89 | |
| 715 | 00/15-10-089-02W5/0 | 1985/03/28 | 446 | 1476 | 2640 | 9760 | Y | 0.30 | |
| 716 | 00/15-11-090-05W5/0 | 1988/08/21 | 295 | 1529.5 | 0000 | 9800 | Y | 0.19 | |
| 717 | 00/15-12-073-05W5/0 | 1994/02/15 | 624 | 1652.3 | 6440 | 7820 | N | 0.38 | |
| 718 | 00/15-12-090-03W5/0 | 1986/03/08 | 21 | 1465.5 | 0000 | 9800 | Y | 0.01 | |
| 719 | 00/15-13-073-04W5/0 | 1993/06/03 | 298.8 | 1661.1 | 0000 | 7820 | N | 0.18 | |
| 720 | 00/15-14-015-06W4/0 | | 859.5 | 1688.9 | 2480 | 9160 | Y | 0.51 | |
| 721 | 00/15-14-089-04W5/0 | 1989/11/09 | 450 | 1540.8 | 0000 | 9800 | Y | 0.29 | |
| 722 | 00/15-15-089-03W5/0 | 1987/11/05 | 17 | 1533.5 | 0000 | 9999 | Y | 0.01 | |
| 723 | 00/15-17-089-02W5/0 | 1986/02/28 | 55 | 1562.8 | 0000 | 9800 | Y | 0.04 | |
| 724 | 00/15-19-096-18W4/0 | | 171.6 | 1221.9 | 0000 | 9800 | Y | 0.14 | Y |
| 725 | 00/15-20-073-03W5/0 | | 365.8 | 1593.8 | 2180 | 7820 | N | 0.23 | |
| 726 | 00/15-20-095-20W4/0 | | 211.8 | 1246.9 | 0000 | 9800 | Y | 0.17 | Y |
| 727 | 00/15-21-091-04W5/0 | 1986/12/25 | 334 | 1338.2 | 0000 | 9800 | Y | 0.25 | |
| 728 | 00/15-22-089-03W5/0 | 1987/08/30 | 17.8 | 1522.3 | 0000 | 9800 | Y | 0.01 | |
| 729 | 00/15-23-091-05W5/0 | 1986/02/05 | 830.4 | 1353.5 | 7170 | 9800 | Y | 0.61 | |
| 730 | 00/15-24-089-04W5/0 | 1993/06/21 | 1435 | 1491.5 | 7820 | 7880 | N | 0.96 | |
| 731 | 00/15-24-090-03W5/0 | 1988/01/04 | 15 | 1382 | 0000 | 9800 | Y | 0.01 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 732 | 00/15-25-091-05W5/0 | | 934 | 1360.8 | 7440 | 9760 | Y | 0.69 | |
| 733 | 00/15-25-091-05W5/2 | 1986/12/24 | 934 | 1329 | 7440 | 7880 | N | 0.70 | |
| 734 | 00/15-25-092-05W5/0 | 1987/11/26 | 10 | 1361 | 0000 | 9800 | Y | 0.01 | Y |
| 735 | 00/15-26-093-02W5/0 | 1996/01/23 | 807.5 | 1322 | 7170 | 7880 | N | 0.61 | |
| 736 | 00/15-29-092-04W5/0 | 1992/03/15 | 778 | 2612 | 6700 | 7880 | N | 0.30 | |
| 737 | 00/15-30-034-20W4/0 | 1986/06/14 | 1325 | 2393 | 3000 | 9040 | Y | 0.55 | Y |
| 738 | 00/15-30-089-03W5/0 | 1987/09/07 | 20 | 1489.4 | 0000 | 9800 | Y | 0.01 | |
| 739 | 00/15-30-093-03W5/0 | 1995/09/23 | 2.9 | 1254.6 | 0000 | 7880 | N | 0.00 | |
| 740 | 00/15-31-104-04W5/0 | | 487.7 | 975.4 | 7440 | 9800 | Y | 0.50 | |
| 741 | 00/15-34-043-10W4/0 | 1989/04/04 | 555 | 2148 | 1860 | 9800 | Y | 0.26 | Y |
| 742 | 00/15-34-089-03W5/0 | 1992/03/20 | 20 | 1509.3 | 0000 | 9800 | Y | 0.01 | |
| 743 | 00/15-34-092-04W5/0 | | 834 | 1286.5 | 0000 | 7880 | N | 0.65 | |
| 744 | 00/15-34-093-24W4/0 | | 617.5 | 1349.7 | 7170 | 8000 | N | 0.46 | |
| 745 | 00/15-36-089-04W5/0 | 1993/02/21 | 1417 | 1457.7 | 7820 | 7880 | N | 0.97 | |
| 746 | 00/15-36-093-02W5/0 | 1998/01/08 | 740.5 | 1341.8 | 7160 | 9800 | Y | 0.55 | |
| 747 | 00/16-01-056-22W4/0 | | 198.1 | 1908 | 0000 | 7700 | N | 0.10 | |
| 748 | 00/16-01-080-24W4/0 | 1988/01/24 | 319.8 | 1484.9 | 2620 | 9760 | Y | 0.22 | Y |
| 749 | 00/16-01-089-05W5/0 | 1987/10/02 | 1059 | 1537 | 7170 | 9800 | Y | 0.69 | |
| 750 | 00/16-02-096-02W5/0 | | 703 | 1371.5 | 7170 | 9760 | Y | 0.51 | |
| 751 | 00/16-03-030-09W4/0 | | 746.8 | 1820.3 | 1860 | 9160 | Y | 0.41 | Y |
| 752 | 00/16-03-055-22W4/0 | 1986/02/25 | 218.7 | 1946.3 | 0000 | 8040 | N | 0.11 | |
| 753 | 00/16-03-080-23W4/0 | 1988/01/06 | 893 | 1490.5 | 7440 | 9800 | Y | 0.60 | |
| 754 | 00/16-03-100-02W5/0 | 1986/01/26 | 534 | 1158.3 | 7440 | 9800 | Y | 0.46 | Y |
| 755 | 00/16-04-074-04W5/0 | 1993/08/08 | 1500 | 1661 | 7440 | 9999 | Y | 0.90 | |
| 756 | 00/16-07-092-04W5/0 | 1987/03/18 | 15 | 1338 | 0000 | 7940 | N | 0.01 | |
| 757 | 00/16-08-092-04W5/0 | 1988/03/21 | 998 | 1439 | 7440 | 9800 | Y | 0.69 | |
| 758 | 00/16-09-060-22W4/0 | 1984/06/17 | 321.5 | 1806.8 | 0000 | 8040 | N | 0.18 | |
| 759 | 00/16-09-073-02W5/0 | | 1478.3 | 1887 | 7580 | 7820 | N | 0.78 | |
| 760 | 00/16-10-046-13W4/0 | 1984/06/08 | 273 | 1472 | 0000 | 7700 | N | 0.19 | |
| 761 | 00/16-10-091-03W5/0 | | 946.4 | 1407.6 | 7440 | 9800 | Y | 0.67 | |
| 762 | 00/16-11-071-04W5/0 | 1990/01/22 | 185 | 1785.6 | 0000 | 7820 | N | 0.10 | |
| 763 | 00/16-11-093-02W5/0 | 1995/02/03 | 767.3 | 1274.6 | 7170 | 7880 | N | 0.60 | |
| 764 | 00/16-11-100-04W5/0 | 1986/01/21 | 12 | 1159 | 0000 | 9800 | Y | 0.01 | Y |
| 765 | 00/16-13-090-03W5/0 | 1987/12/17 | 901 | 1408 | 7170 | 9800 | Y | 0.64 | |
| 766 | 00/16-15-031-12W4/0 | | 823 | 1770 | 1860 | 7700 | N | 0.46 | |
| 767 | 00/16-15-034-20W4/0 | 1988/03/26 | 1962 | 2284.5 | 7320 | 7920 | N | 0.86 | |
| 768 | 00/16-15-090-05W5/0 | 1988/02/01 | 20 | 1524 | 0000 | 9800 | Y | 0.01 | |
| 769 | 00/16-16-034-15W4/0 | 1985/07/07 | 1200 | 2442.3 | 6440 | 9999 | Y | 0.49 | Y |
| 770 | 00/16-16-073-04W5/2 | 1993/02/04 | 1600 | 1668.2 | 7440 | 7820 | N | 0.96 | |
| 771 | 00/16-16-089-03W5/0 | 1988/03/14 | 1074.5 | 1539 | 7170 | 9800 | Y | 0.70 | |
| 772 | 00/16-17-089-03W5/0 | 1994/03/25 | 1490.7 | 1503.3 | 7820 | 7880 | N | 0.99 | |
| 773 | 00/16-20-092-04W5/0 | 1986/12/30 | 18 | 1272 | 0000 | 9800 | Y | 0.01 | Y |
| 774 | 00/16-21-089-03W5/0 | 1987/11/05 | 20 | 1488 | 0000 | 9800 | Y | 0.01 | |

## Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 775 | 00/16-21-111-04W5/0 | | 426.7 | 925.1 | 7440 | 9800 | Y | 0.46 | |
| 776 | 00/16-22-059-22W4/0 | 1985/02/16 | 314 | 1843.4 | 0000 | 8040 | N | 0.17 | |
| 777 | 00/16-22-094-22W4/0 | 1984/03/10 | 25 | 1343.7 | 0000 | 9800 | Y | 0.02 | Y |
| 778 | 00/16-23-093-02W5/0 | 1986/02/20 | 345 | 1354 | 0000 | 9800 | Y | 0.25 | Y |
| 779 | 00/16-23-096-25W4/0 | 1984/03/15 | 33.8 | 1461 | 0000 | 9999 | Y | 0.02 | Y |
| 780 | 00/16-25-092-02W5/0 | 1994/02/10 | 705.5 | 1251.5 | 7170 | 9800 | Y | 0.56 | |
| 781 | 00/16-27-032-24W4/0 | 1987/04/22 | 456.5 | 2598.4 | 0000 | 7700 | N | 0.18 | |
| 782 | 00/16-27-089-04W5/0 | 1987/11/16 | 517.9 | 1488.5 | 0000 | 9800 | Y | 0.35 | |
| 783 | 00/16-27-102-24W4/0 | | 457.2 | 991.8 | 7520 | 9800 | Y | 0.46 | Y |
| 784 | 00/16-30-090-03W5/0 | 1986/03/11 | 10 | 1406 | 0000 | 9800 | Y | 0.01 | |
| 785 | 00/16-30-091-03W5/0 | 1986/03/26 | 379 | 1369 | 0000 | 9800 | Y | 0.28 | |
| 786 | 00/16-31-092-01W5/0 | 1985/03/21 | 2 | 1284 | 0000 | 9800 | Y | 0.00 | Y |
| 787 | 00/16-35-095-02W5/0 | 1988/03/17 | 254.1 | 1398.7 | 0000 | 9800 | Y | 0.18 | Y |
| 788 | 00/16-36-026-15W4/0 | 1988/06/23 | 1250 | 1983.4 | 6600 | 7700 | N | 0.63 | |
| 789 | 00/16-36-041-15W4/0 | 1984/01/07 | 1350 | 1808.5 | 7200 | 9000 | Y | 0.75 | |
| 790 | 00/16-36-041-23W4/0 | 1984/04/27 | 890 | 2289 | 1600 | 9999 | Y | 0.39 | Y |
| 791 | 02/01-10-055-22W4/0 | 1995/03/09 | 219 | 1911 | 0000 | 8040 | N | 0.11 | |
| 792 | 02/01-35-089-04W5/0 | 1994/12/21 | 10 | 1484 | 0000 | 7880 | N | 0.01 | |
| 793 | 02/02-10-055-22W4/0 | 1985/08/20 | 900 | 1932.5 | 2480 | 8040 | N | 0.47 | |
| 794 | 02/03-31-100-22W4/0 | | 762 | 1265.5 | 7520 | 9800 | Y | 0.60 | |
| 795 | 02/03-36-092-05W5/0 | 1986/08/25 | 20 | 1346 | 0000 | 9999 | Y | 0.01 | Y |
| 796 | 02/04-18-072-03W5/0 | 1989/10/02 | 289 | 1684.7 | 0000 | 7820 | N | 0.17 | |
| 797 | 02/05-17-089-03W5/0 | 1988/10/05 | 25 | 1523.6 | 0000 | 9800 | Y | 0.02 | |
| 798 | 02/06-01-019-07W4/0 | | 640.1 | 1783.1 | 0000 | 9160 | Y | 0.36 | |
| 799 | 02/06-07-019-08W4/0 | | 975.4 | 1780.6 | 2480 | 9040 | Y | 0.55 | |
| 800 | 02/06-11-015-06W4/0 | | 929.3 | 1703.8 | 6420 | 9160 | Y | 0.55 | |
| 801 | 02/06-15-045-15W4/0 | 1983/11/12 | 251.5 | 1737 | 0000 | 7960 | N | 0.14 | |
| 802 | 02/06-17-094-04W5/0 | 1985/02/28 | 382 | 1325 | 0000 | 9800 | Y | 0.29 | |
| 803 | 02/06-18-046-06W4/0 | | 487.7 | 1389.9 | 0000 | 8500 | Y | 0.35 | Y |
| 804 | 02/06-26-015-07W4/0 | | 956.8 | 1677.9 | 6420 | 9160 | Y | 0.57 | Y |
| 805 | 02/06-30-018-08W4/0 | | 1040.3 | 2261.6 | 6420 | 9800 | Y | 0.46 | |
| 806 | 02/06-30-019-07W4/0 | | 1005.8 | 2265.9 | 3500 | 9480 | Y | 0.44 | |
| 807 | 02/07-10-055-22W4/0 | | 1642 | 1858.7 | 7700 | 8010 | N | 0.88 | |
| 808 | 02/07-21-087-02W5/0 | 1987/02/04 | 1113.7 | 1532 | 7440 | 9800 | Y | 0.73 | |
| 809 | 02/07-29-065-01W5/0 | | 205 | 2113 | 0000 | 9000 | Y | 0.10 | |
| 810 | 02/08-01-090-03W5/0 | 1985/10/20 | 130 | 1508.5 | 0000 | 9999 | Y | 0.09 | |
| 811 | 02/08-14-090-03W5/0 | 1992/12/14 | 963 | 1427.6 | 0000 | 7880 | N | 0.67 | |
| 812 | 02/08-24-025-15W4/0 | 1986/08/06 | 362 | 2054.1 | 0000 | 9000 | Y | 0.18 | |
| 813 | 02/08-34-055-20W4/0 | 1991/02/14 | 238 | 1760 | 0000 | 8040 | N | 0.14 | |
| 814 | 02/09-03-055-22W4/0 | 1986/05/30 | 209.5 | 1918 | 0000 | 8020 | N | 0.11 | |
| 815 | 02/09-10-055-22W4/0 | | 1813.6 | 1878.2 | 7700 | 7700 | N | 0.97 | |
| 816 | 02/10-10-055-22W4/0 | | 1641 | 1882.1 | 7720 | 8040 | N | 0.87 | |
| 817 | 02/10-10-093-01W5/0 | | 944.9 | 1333.5 | 7540 | 9800 | Y | 0.71 | |

**Table C.1: Bulk density log data available in the expanded study area for the Elk Point Group (source: AEUB well database)**

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top and Bottom Coverage in Elk Point Group | Fraction of Unknown Bulk Density Data from Surface to Bottom Log Interval | Wells Proposed for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| 818 | 02/10-14-033-24W4/0 | 1988/02/26 | 397 | 2530 | 0000 | 7777 | N | 0.16 | |
| 819 | 02/10-19-091-04W5/0 | 1990/03/17 | 1002 | 1384 | 7440 | 7940 | N | 0.72 | |
| 820 | 02/11-32-094-03W5/0 | 1996/07/05 | 15 | 1293.4 | 0000 | 7880 | N | 0.01 | |
| 821 | 02/12-01-072-04W5/0 | | 1743 | 1793.8 | 7580 | 7820 | N | 0.97 | |
| 822 | 02/12-25-073-05W5/0 | 1989/06/05 | 1156.3 | 1675.8 | 6960 | 7820 | N | 0.69 | |
| 823 | 02/12-27-069-03W5/0 | | 175 | 1710 | 0000 | 7820 | N | 0.10 | |
| 824 | 02/12-35-092-04W5/0 | 1994/01/27 | 796 | 1302.7 | 7170 | 7940 | N | 0.61 | |
| 825 | 02/13-01-091-05W5/0 | 1987/07/08 | 1027 | 1408.5 | 7440 | 9800 | Y | 0.73 | |
| 826 | 02/13-02-055-22W4/0 | 1988/05/28 | 212 | 1946 | 0000 | 8040 | N | 0.11 | |
| 827 | 02/13-08-089-03W5/0 | 1987/01/06 | 1049.7 | 1527 | 7170 | 9760 | Y | 0.69 | |
| 828 | 02/13-08-089-03W5/2 | 1987/01/06 | 1049.7 | 1527 | 7170 | 9760 | Y | 0.69 | |
| 829 | 02/13-11-055-22W4/0 | 1985/07/05 | 209 | 1903.1 | 0000 | 8020 | N | 0.11 | |
| 830 | 02/13-13-055-22W4/0 | 1990/11/28 | 214.5 | 1898.7 | 0000 | 8040 | N | 0.11 | |
| 831 | 02/13-23-089-03W5/0 | 1990/03/24 | 10 | 1520.2 | 0000 | 7880 | N | 0.01 | |
| 832 | 02/14-13-055-22W4/0 | 1990/01/30 | 213.2 | 1889.2 | 0000 | 8040 | N | 0.11 | |
| 833 | 02/14-13-090-03W5/0 | 1986/03/13 | 20 | 1403 | 0000 | 9800 | Y | 0.01 | |
| 834 | 02/15-15-089-04W5/0 | 1989/05/18 | 35 | 1521.9 | 0000 | 9800 | Y | 0.02 | |
| 835 | 02/16-03-055-22W4/0 | 1986/01/24 | 10 | 1907.5 | 0000 | 8040 | N | 0.01 | |
| 836 | 02/16-07-072-03W5/0 | 1991/07/19 | 1450 | 1719.2 | 7100 | 7820 | N | 0.84 | |
| 837 | 02/16-14-055-22W4/0 | 1994/12/18 | 216 | 1837.6 | 0004 | 7960 | N | 0.12 | |
| 838 | 03/07-10-055-22W4/0 | 1985/11/26 | 219 | 1898.4 | 0000 | 8020 | N | 0.12 | |
| 839 | 03/07-10-055-22W4/2 | 1985/11/26 | 219 | 1898.4 | 0000 | 8020 | N | 0.12 | |
| 840 | 03/10-10-055-22W4/0 | | 1643.8 | 1863.2 | 0000 | 8010 | N | 0.88 | |
| 841 | 03/14-13-055-22W4/0 | 1990/03/06 | 180 | 1901.6 | 0000 | 8040 | N | 0.09 | |
| 842 | 03/15-22-094-04W5/0 | 1987/12/07 | 400 | 1333.3 | 0000 | 9800 | Y | 0.30 | |
| 843 | 04/07-10-055-22W4/0 | 1985/10/29 | 220.5 | 1902 | 0000 | 8020 | N | 0.12 | |
| 844 | 04/07-10-055-22W4/2 | 1985/10/29 | 220.5 | 1902 | 0000 | 8020 | N | 0.12 | |
| 845 | 04/07-34-055-21W4/0 | 1991/03/30 | 859.7 | 1868 | 3000 | 9999 | Y | 0.46 | Y |
| 846 | 04/13-13-055-22W4/0 | 1990/12/26 | 217.5 | 1882.7 | 0000 | 8040 | N | 0.12 | |
| 847 | 04/14-13-055-22W4/0 | 1990/04/10 | 190 | 1882.9 | 0000 | 8040 | N | 0.10 | |
| 848 | 04/15-10-055-22W4/0 | 1985/04/18 | 10 | 1964 | 0000 | 8040 | N | 0.01 | |
| 849 | 05/14-13-055-22W4/0 | 1991/02/01 | 225 | 1870 | 0000 | 8040 | N | 0.12 | |
| 850 | 05/16-10-055-22W4/0 | 1985/06/03 | 207 | 1958.8 | 0000 | 8040 | N | 0.11 | |
| 851 | 06/14-11-055-22W4/0 | | 211.5 | 1926.3 | 0000 | 8040 | N | 0.11 | |
| 852 | D0/12-21-035-06W4/0 | 1993/06/05 | 1001.5 | 1658.6 | 6960 | 8610 | Y | 0.60 | Y |
| 853 | W0/13-12-029-11W4/0 | | 1082 | 1727.9 | 6440 | 7700 | N | 0.63 | |

## Table C.2: Dipmeter log data available in the expanded study area for the Elk Point and Beaverhill Lake Groups (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top of Beaverhill Lake Fm (m KB) | Dipmeter Log Recorded on Microfiche | All Data Needed for Breakout Analysis Present |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 00/01-11-091-05W5/0 | 1986/02/21 | 1051 | 1369 | 7440 | 9760 | 953.3 | Y | |
| 2 | 00/01-11-101-02W5/0 | 1969/03/31 | 518 | 1081 | 7440 | 9800 | 431.9 | N | |
| 3 | 00/01-23-095-05W5/0 | 1985/03/11 | 871 | 1238 | 7440 | 9800 | 751 | N | |
| 4 | 00/01-25-057-24W4/0 | 1984/11/12 | 1100 | 1633 | 6780 | 7440 | 1517.2 | N | |
| 5 | 00/01-28-089-03W5/0 | 1988/10/26 | 1412 | 1520 | 7820 | 9999 | 1072.5 | Y | Y |
| 6 | 00/01-29-101-24W4/0 | 1985/03/15 | 576 | 1067 | 7540 | 9800 | | N | |
| 7 | 00/02-01-074-05W5/0 | 1988/08/12 | 1595 | 1646 | 7440 | 7820 | 1429 | N | |
| 8 | 00/02-03-088-20W4/0 | | 346 | 573 | 7160 | 7440 | 551.7 | N | |
| 9 | 00/02-04-072-03W5/0 | | 975 | 1762 | 6960 | 7880 | 1414 | N | |
| 10 | 00/02-10-071-04W5/0 | | 1524 | 1791 | 7100 | 7820 | 1572.5 | Y | |
| 11 | 00/02-10-102-23W4/0 | 1985/02/07 | 573 | 1074 | 7540 | 9800 | | N | |
| 12 | 00/02-14-071-04W5/0 | 1964/10/30 | 1524 | 1756 | 7100 | 7820 | 1535.9 | N | |
| 13 | 00/02-15-071-04W5/0 | | 1524 | 1753 | 7100 | 7820 | 1531.9 | N | |
| 14 | 00/02-17-058-25W4/0 | 1984/09/29 | 1051 | 1799 | 3360 | 7440 | 1628.3 | N | |
| 15 | 00/02-19-073-04W5/0 | | 1585 | 1646 | 7440 | 7820 | 1414.9 | Y | |
| 16 | 00/02-20-091-02W5/0 | 1986/02/09 | 935 | 995 | 7440 | 7620 | 794 | Y | |
| 17 | 00/02-21-071-04W5/0 | | 1698 | 1772 | 7440 | 7820 | 1549.6 | Y | |
| 18 | 00/02-24-073-05W5/0 | | 1524 | 1650 | 7440 | 7820 | 1424 | Y | |
| 19 | 00/02-27-071-04W5/0 | | 1524 | 1764 | 7100 | 7820 | 1548.7 | Y | |
| 20 | 00/02-34-071-04W5/0 | | 1676 | 1786 | 7440 | 7820 | 1562.4 | N | |
| 21 | 00/03-04-031-12W4/0 | 1984/04/04 | 1200 | 1877 | 6660 | 9999 | 1585.5 | N | |
| 22 | 00/03-17-065-25W4/0 | | 1006 | 1523 | 6960 | 7500 | 1412.1 | Y | |
| 23 | 00/03-35-095-05W5/0 | 1988/03/25 | 1100 | 1300 | 7820 | 9999 | 770.5 | Y | |
| 24 | 00/04-01-039-20W4/0 | | 1325 | 1878 | 3360 | 7440 | 1857 | Y | |
| 25 | 00/04-01-045-16W4/0 | 1983/12/03 | 1600 | 1802 | 7520 | 9999 | 1440 | N | |
| 26 | 00/04-08-071-04W5/0 | | 1798 | 1891 | 7440 | 7820 | 1662.7 | Y | |
| 27 | 00/04-08-097-02W5/0 | | 625 | 1273 | 7170 | 9800 | 701 | N | |
| 28 | 00/04-22-073-05W5/0 | | 1524 | 1668 | 7440 | 7820 | 1447.8 | Y | |
| 29 | 00/04-23-073-05W5/0 | | 1602 | 1663 | 7440 | 7820 | 1437.1 | Y | |
| 30 | 00/04-24-070-04W5/0 | | 1792 | 1839 | 7440 | 7820 | 1614.8 | Y | |
| 31 | 00/04-28-035-20W4/0 | | 1495 | 2255 | 6440 | 7700 | | N | |
| 32 | 00/04-29-098-21W4/0 | 1985/02/09 | 691 | 1184 | 7540 | 9800 | | N | |
| 33 | 00/04-33-039-16W4/0 | 1984/03/27 | 1200 | 1600 | 6580 | 9999 | 1498 | N | |
| 34 | 00/04-33-070-04W5/0 | | 1798 | 1893 | 7440 | 7820 | 1663.3 | Y | |
| 35 | 00/04-35-073-05W5/0 | | 1585 | 1648 | 7440 | 7820 | 1429.5 | Y | |
| 36 | 00/04-36-092-05W5/2 | 1986/09/20 | 751 | 1409 | 0000 | 9800 | | N | |
| 37 | 00/05-08-094-04W5/0 | 1986/02/10 | 951 | 1272 | 7440 | 9800 | 615.5 | N | |
| 38 | 00/05-08-100-22W4/0 | 1985/03/29 | 651 | 1231 | 7460 | 7960 | | N | |
| 39 | 00/05-22-089-03W5/0 | 1986/02/07 | 1416 | 1517 | 7820 | 9800 | 1088.5 | N | |
| 40 | 00/06-02-052-27W4/0 | | 1463 | 2012 | 6580 | 7440 | 1984.9 | N | |
| 41 | 00/06-02-097-19W4/0 | 1986/02/26 | 755 | 950 | 7520 | 7860 | | Y | |
| 42 | 00/06-03-087-22W4/0 | 1988/03/01 | 885 | 1235 | 7540 | 9800 | | Y | |

## Table C.2: Dipmeter log data available in the expanded study area for the Elk Point and Beaverhill Lake Groups (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top of Beaverhill Lake Fm (m KB) | Dipmeter Log Recorded on Microfiche | All Data Needed for Breakout Analysis Present |
|---|---|---|---|---|---|---|---|---|---|
| 43 | 00/06-07-097-23W4/0 | | 1259 | 1438 | 7860 | 7960 | | Y | |
| 44 | 00/06-08-089-04W5/0 | 1989/04/05 | 1450 | 1530 | 7820 | 9800 | 1094 | Y | |
| 45 | 00/06-14-038-17W4/0 | | 1716 | 1718 | 7440 | 7440 | 1628 | N | |
| 46 | 00/06-18-035-20W4/0 | 1983/12/07 | 1675 | 2198 | 6660 | 7440 | 2026 | N | |
| 47 | 00/06-21-089-03W5/0 | 1987/01/26 | 1375 | 1559 | 7820 | 9999 | 1084.2 | N | |
| 48 | 00/06-35-046-15W4/0 | | 344 | 2113 | 0000 | 9800 | 1322 | N | |
| 49 | 00/07-04-062-26W4/0 | | 1010 | 1579 | 6580 | 7440 | 1517.9 | N | |
| 50 | 00/07-09-092-04W5/0 | 1986/09/21 | 981 | 1297 | 7440 | 9800 | 841 | Y | |
| 51 | 00/07-14-062-26W4/0 | | 1252 | 1557 | 7100 | 7440 | 1505.7 | N | |
| 52 | 00/08-10-089-03W5/0 | 1987/11/14 | 1080 | 1488 | 7440 | 9999 | 1076.5 | Y | Y |
| 53 | 00/08-14-038-21W4/0 | | 1185 | 1923 | 2140 | 7440 | 1873.5 | N | |
| 54 | 00/08-16-098-22W4/0 | 1985/02/23 | 751 | 1227 | 7520 | 8020 | | N | |
| 55 | 00/08-19-027-10W4/0 | 1988/10/20 | 1100 | 1550 | 6440 | 9999 | 1493 | Y | Y |
| 56 | 00/08-28-091-02W5/0 | 1984/03/19 | 900 | 1284 | 7440 | 9800 | 765 | Y | |
| 57 | 00/08-34-034-25W4/0 | 1984/05/27 | 1897 | 2471 | 6440 | 9999 | 2428 | Y | |
| 58 | 00/09-03-089-03W5/0 | 1987/03/28 | 1207 | 1463 | 7440 | 7880 | 1055 | Y | Y |
| 59 | 00/09-05-091-04W5/0 | 1986/12/26 | 1001 | 1364 | 7440 | 9999 | 932.5 | Y | Y |
| 60 | 00/09-10-088-03W5/0 | 1985/09/09 | 952 | 1492 | 7160 | 9800 | 1083.5 | N | |
| 61 | 00/09-14-090-03W5/0 | 1984/12/22 | 1051 | 1437 | 7440 | 9800 | 980.5 | N | |
| 62 | 00/09-33-052-26W4/0 | | 1676 | 1908 | 7100 | 7440 | 1863.9 | N | |
| 63 | 00/10-05-070-03W5/0 | | 1448 | 1712 | 7100 | 7820 | 1489.6 | Y | |
| 64 | 00/10-06-073-04W5/0 | | 1570 | 1650 | 7440 | 7820 | 1427.7 | N | |
| 65 | 00/10-08-071-04W5/0 | | 1773 | 1833 | 7440 | 7820 | 1614.2 | Y | |
| 66 | 00/10-14-070-04W5/0 | | 1676 | 1871 | 7440 | 7820 | 1644.4 | Y | |
| 67 | 00/10-14-100-23W4/0 | 1985/02/27 | 751 | 1247 | 7540 | 9800 | | N | |
| 68 | 00/10-16-027-08W4/0 | | 183 | 1704 | 0000 | 7700 | 1502 | N | |
| 69 | 00/10-18-039-20W4/0 | 1984/03/16 | 1500 | 2074 | 6660 | 7440 | 1938.5 | N | |
| 70 | 00/10-18-052-27W4/0 | | 1387 | 2001 | 3340 | 7440 | 1976.6 | N | |
| 71 | 00/10-20-085-21W4/0 | | 793 | 1240 | 7480 | 9800 | | Y | |
| 72 | 00/10-26-071-04W5/0 | | 1646 | 1782 | 7440 | 7820 | 1559.4 | Y | |
| 73 | 00/10-30-032-23W4/0 | 1988/09/19 | 2000 | 2550 | 6660 | 7700 | 2295 | N | |
| 74 | 00/10-32-090-04W5/0 | 1986/12/23 | 1053 | 1411 | 7440 | 9800 | 977 | Y | Y |
| 75 | 00/10-33-070-04W5/0 | | 1707 | 1872 | 7440 | 7820 | 1651.1 | Y | |
| 76 | 00/10-35-069-04W5/0 | | 1737 | 1772 | 7580 | 7780 | 1558.1 | N | |
| 77 | 00/10-36-082-22W4/0 | | 622 | 838 | 7169 | 7440 | 816.9 | N | |
| 78 | 00/11-08-095-22W4/0 | 1985/03/10 | 901 | 1383 | 7540 | 9800 | | Y | Y |
| 79 | 00/11-12-080-05W5/0 | | 762 | 1791 | 6540 | 9800 | 1329.8 | Y | Y |
| 80 | 00/11-13-098-01W5/0 | 1989/02/22 | 990 | 1210 | 7820 | 7880 | 623 | Y | |
| 81 | 00/11-15-073-24W4/0 | | 549 | 1178 | 2800 | 7440 | 1076.2 | N | |
| 82 | 00/11-16-044-16W4/0 | 1983/12/22 | 1075 | 1807 | 3360 | 7960 | 1470 | Y | Y |
| 83 | 00/11-23-071-05W5/0 | 1995/03/19 | 1850 | 1934 | 7440 | 7820 | 1771.5 | N | |
| 84 | 00/11-35-027-14W4/0 | | 884 | 1727 | 1860 | 7440 | 1693.8 | N | |

## Table C.2: Dipmeter log data available in the expanded study area for the Elk Point and Beaverhill Lake Groups (source: AEUB well database)

| No. | UWI | Run Date | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top of Beaverhill Lake Fm (m KB) | Dipmeter Log Recorded on Microfiche | All Data Needed for Breakout Analysis Present |
|---|---|---|---|---|---|---|---|---|---|
| 85 | 00/11-36-071-05W5/0 | 1985/04/09 | 1832 | 1911 | 7440 | 7820 | 1685 | N | |
| 86 | 00/12-01-073-05W5/0 | | 1555 | 1668 | 7440 | 7820 | 1439.3 | N | |
| 87 | 00/12-03-073-05W5/0 | | 1593 | 1684 | 7440 | 7820 | 1463.3 | Y | |
| 88 | 00/12-08-073-04W5/0 | | 1555 | 1650 | 7440 | 7440 | 1420.4 | Y | |
| 89 | 00/12-09-038-21W4/0 | 1984/02/08 | 389 | 2370 | 0000 | 9000 | 2012 | N | |
| 90 | 00/12-10-065-02W5/0 | | 1150 | 1600 | 6960 | 7440 | 1552 | N | |
| 91 | 00/12-13-073-05W5/0 | | 1585 | 1661 | 7440 | 7820 | 1432.6 | Y | |
| 92 | 00/12-13-089-03W5/0 | 1989/03/28 | 1170 | 1468 | 7440 | 9800 | 1021 | Y | Y |
| 93 | 00/12-18-087-03W5/0 | 1986/01/18 | 1055 | 1592 | 7100 | 9999 | 1136 | Y | Y |
| 94 | 00/12-21-058-25W4/0 | 1985/02/13 | 1116 | 1799 | 6580 | 7440 | 1690 | Y | |
| 95 | 00/12-33-071-04W5/0 | | 1761 | 1852 | 7440 | 7820 | 1632.2 | Y | |
| 96 | 00/13-01-036-21W4/0 | | 383 | 2415 | 0000 | 9040 | 2070 | N | |
| 97 | 00/13-09-086-21W4/0 | 1991/03/18 | 1050 | 1250 | 7860 | 9999 | 682.5 | Y | |
| 98 | 00/13-13-085-04W5/0 | 1982/02/19 | 1068 | 1671 | 7100 | 9800 | 1186 | Y | |
| 99 | 00/13-14-089-04W5/0 | 1989/10/16 | 950 | 1600 | 0000 | 9999 | 1098 | N | |
| 100 | 00/13-14-090-05W5/0 | 1988/03/15 | 1225 | 1523 | 7440 | 9800 | 1093 | Y | |
| 101 | 00/13-18-095-01W5/0 | 1989/02/09 | 1200 | 1409 | 7820 | 9999 | 850 | Y | |
| 102 | 00/13-20-085-02W5/0 | | 1250 | 1642 | 7540 | 9800 | | N | |
| 103 | 00/14-03-093-03W5/0 | 1986/01/22 | 1001 | 1316 | 7440 | 9800 | 846.5 | N | |
| 104 | 00/14-05-097-21W4/0 | | 823 | 1272 | 7580 | 8020 | | Y | |
| 105 | 00/14-09-092-04W5/0 | 1987/06/25 | 1101 | 1319 | 7820 | 9800 | 849 | Y | Y |
| 106 | 00/15-20-095-20W4/0 | | 793 | 1246 | 7440 | 9800 | 630.9 | N | |
| 107 | 00/15-30-034-20W4/0 | 1986/06/15 | 1640 | 2025 | 6660 | 7440 | 1993 | Y | |
| 108 | 00/15-34-093-24W4/0 | | 914 | 1347 | 7520 | 8000 | | Y | |
| 109 | 00/16-22-094-22W4/0 | 1984/03/10 | 620 | 1343 | 7170 | 9800 | | N | |
| 110 | 00/16-23-096-25W4/0 | 1984/03/17 | 725 | 1450 | 7170 | 8000 | | N | |
| 111 | 00/16-25-040-16W4/0 | 1984/09/04 | 800 | 1450 | 1860 | 9999 | 1386.5 | Y | |
| 112 | 00/16-26-051-27W4/0 | | 1715 | 2036 | 7100 | 7440 | 1988 | N | |
| 113 | 02/02-14-055-22W4/0 | | 0 | 1911 | 0000 | 8020 | 1417.6 | N | |
| 114 | 02/03-36-092-05W5/0 | 1986/08/25 | 1001 | 1346 | 7440 | 9999 | 869 | N | |
| 115 | 02/05-26-084-05W5/0 | | 1300 | 1655 | 7440 | 9999 | 1232 | N | |
| 116 | 02/10-19-091-04W5/0 | 1990/03/17 | 1075 | 1385 | 7620 | 7940 | 892 | Y | Y |
| 117 | 02/11-06-036-02W4/0 | | 850 | 1591 | 2760 | 9160 | 1188.5 | N | |
| 118 | AA/11-17-091-13W4/0 | 1997/01/08 | 48 | 175 | 0000 | 7440 | 167.5 | Y | |
| 119 | AA/11-21-091-13W4/0 | 1997/01/10 | 36 | 166 | 0000 | 7440 | 151.2 | Y | |
| 120 | AA/11-28-091-13W4/0 | 1997/01/12 | 42 | 161 | 0000 | 7440 | 149 | Y | |

## Table C.3: Bulk density log data available in the expanded Saskatchewan area for the Elk Point Group (source: AEUB well database)

| No. | UWI | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Formation Code | Bottom Formation Code | Top of Prairie Evaporite Formation (m KB) | Percent of Unknown Bulk Density Data above the Prairie Evaporite Formation | Within Prairie Evaporite Area Defined by AGS ? |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 01/01-10-066-27W3/0 | 1969 | 161.2 | 759 | | 545003 | 671.5 | 24 | N |
| 2 | 01/01-25-062-25W3/0 | 1968 | 167.6 | 1151.2 | 224002 | 900001 | 693.1 | 24 | N |
| 3 | 01/07-01-044-24W3/0 | 1972 | 579.1 | 1858.1 | 224002 | 900001 | 1069.2 | 54 | Y |
| 4 | 01/07-16-024-27W3/0 | 1969 | 609.6 | 1611.2 | 224002 | 601003 | 1491.1 | 41 | Y |
| 5 | 01/10-01-028-29W3/0 | 1968 | 666 | 2153.1 | 224002 | 900001 | 1511.8 | 44 | Y |
| 6 | 01/10-09-050-24W3/0 | 1971 | 426.7 | 1032.1 | 224002 | 703003 | 830.6 | 51 | Y |
| 7 | 01/12-28-045-22W3/0 | 1967 | 145.1 | 1168.6 | | 601105 | 938.5 | 15 | Y |
| 8 | 01/15-08-035-27W3/0 | 1976 | 139.3 | 1551.4 | | 511505 | 1414.3 | 10 | Y |
| 9 | 01/15-34-034-27W3/0 | 1980 | 256.9 | 2095.8 | | 801005 | 1389.9 | 18 | Y |
| 10 | 01/16-36-036-25W3/0 | 1980 | 191.1 | 1998 | | 900001 | 1292.4 | 15 | Y |
| 11 | 11/01-05-035-26W3/0 | 1997 | 250 | 2114.5 | | 900001 | 1398 | 18 | Y |
| 12 | 11/02-11-075-23W3/0 | 1997 | 177 | 566.3 | 231107 | 551003 | 490 | 36 | N |
| 13 | 11/06-15-035-27W3/0 | 1998 | 260 | 2104.5 | | 900001 | 1392.3 | 19 | Y |
| 14 | 11/11-29-035-26W3/0 | 1997 | 301.1 | 2084.1 | | 531003 | 1355 | 22 | Y |
| 15 | 11/11-29-068-23W3/0 | 1993 | 97.4 | 988.5 | | 900001 | 583 | 17 | Y |
| 16 | 11/15-13-060-24W3/0 | 1984 | 123.1 | 1034.5 | | 801003 | 701 | 18 | N |
| 17 | 21/07-30-036-28W3/0 | 1997 | 303.5 | 2128 | 521003 | 900001 | 1355 | | Y |
| 18 | 21/07-30-049-27W3/0 | 1998 | 212.7 | 949.4 | | 541003 | 949 | 22 | Y |
| 19 | 21/09-22-062-27W3/0 | 1987 | 103 | 741.7 | 232507 | 543003 | 703.3 | 15 | Y |
| 20 | 21/12-30-049-27W3/0 | 1984 | 301.4 | 1733.7 | | 900001 | 952 | 32 | Y |
| 21 | 31/01-03-074-24W3/0 | 1997 | 180.5 | 821.5 | | 551003 | 569 | 32 | N |
| 22 | 31/05-13-030-26W3/0 | 1985 | 209 | 1497.5 | | 541003 | 1491.5 | 14 | N |
| 23 | 31/07-30-049-27W3/0 | 1996 | 232.1 | 1075 | | 541003 | 950.8 | 24 | Y |
| 24 | 31/14-17-065-26W3/0 | 1968 | 113.1 | 751.6 | | 545003 | 685.8 | 16 | N |
| 25 | 31/16-05-035-26W3/0 | 1997 | 247 | 2114 | | 900001 | 1394.1 | 18 | Y |
| 26 | 31/16-10-034-22W3/0 | 1980 | 497.4 | 2033.9 | | 900001 | 1303.9 | 38 | Y |
| 27 | 41/03-09-040-22W3/0 | 1995 | 131 | 1256 | | 541003 | 1130.5 | 12 | Y |
| 28 | 41/03-18-036-25W3/0 | 1997 | 244 | 2047.8 | | 900001 | 1319.1 | 18 | Y |
| 29 | 41/04-05-035-26W3/0 | 1997 | 247.5 | 2127.2 | | 900001 | 1404.8 | 18 | Y |
| 30 | 91/05-34-033-22W3/0 | 1999 | 158 | 1363.5 | | 541003 | 1358 | 12 | Y |

## Table C.4: Dipmeter log data available in the expanded Saskatchewan area for Paleozoic age formations (source: AEUB well database)

| No. | UWI | Top Formation Code | Bottom Formation Code | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Paleozoic Formation | Paleozoic Formation Top (m KB) | Amount of coverage in Palezoic (m) | Dipmeter Log Recorded on Microfiche | All Data Needed for Breakout Analysis Available on Microfiche |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 41/04-33-035-25W3/0 | 224002 | 521003 | 609.6 | 836.1 | Madison Group | 734.0 | 102.1 | N | N |
| 2 | 11/03-04-030-28W3/2 | 227304 | 511105 | 728.0 | 862.0 | Madison Group | 798.3 | 63.7 | Y | Y |
| 3 | 41/07-07-010-23W3/0 | 511105 | 521003 | 1572.0 | 1631.5 | Torquay Fm | 1574.0 | 57.5 | Y | Y |
| 4 | 01/10-04-041-24W3/0 | 224002 | 525003 | 468.2 | 732.7 | Duperow Fm | 678.2 | 54.5 | N | N |
| 5 | 01/09-06-035-26W3/0 | 438003 | 511505 | 820.8 | 874.8 | Bakken Fm | 829.1 | 45.7 | Y | N |
| 6 | 11/10-17-040-24W3/0 | n/a | 525003 | 238.0 | 712.0 | Bird Bear Fm | 671.0 | 41.0 | Y | Y |
| 7 | 11/07-19-031-24W3/0 | 224002 | 511105 | 600.2 | 835.2 | Madison Group | 794.6 | 40.6 | Y | Y |
| 8 | 01/13-21-035-25W3/0 | 219505 | 511505 | 536.8 | 788.2 | Bakken Fm | 758.3 | 29.9 | N | N |
| 9 | 01/02-16-036-28W3/0 | 226108 | 511505 | 651.1 | 848.9 | Torquay Fm | 826.0 | 22.9 | Y | N |
| 10 | 01/10-07-039-25W3/0 | n/a | 521003 | 127.1 | 737.9 | Bird Bear Fm | 718.0 | 19.9 | Y | N |
| 11 | 11/13-19-052-23W3/0 | n/a | 525003 | 123.1 | 669.0 | Duperow Fm | 650.0 | 19.0 | Y | N |
| 12 | 11/10-22-046-22W3/0 | n/a | 525003 | 125.9 | 612.0 | Duperow Fm | 597.4 | 14.6 | Y | N |
| 13 | 01/06-07-043-24W3/0 | 219003 | 525003 | 441.0 | 752.9 | Duperow Fm | 741.0 | 11.9 | Y | N |
| 14 | 11/02-21-040-26W3/0 | 219176 | 525003 | 399.9 | 815.0 | Duperow Fm | 803.5 | 11.5 | Y | N |
| 15 | 11/11-24-047-27W3/0 | 224002 | 525003 | 475.8 | 686.4 | Duperow Fm | 675.1 | 11.3 | Y | N |
| 16 | 11/11-18-048-21W3/0 | 224002 | 525003 | 349.9 | 593.1 | Duperow Fm | 581.9 | 11.2 | Y | N |
| 17 | 20/07-21-009-29W3/0 | 224002 | 430002 | 914.4 | 1332.0 | Madison Group | 1324.1 | 7.9 | Y | N |
| 18 | 11/09-24-047-27W3/0 | 231107 | 525003 | 499.9 | 675.1 | Duperow Fm | 667.5 | 7.6 | Y | N |
| 19 | 11/13-01-052-27W3/0 | n/a | 525003 | 125.9 | 602.6 | Duperow Fm | 595.0 | 7.6 | Y | N |
| 20 | 11/07-03-054-25W3/0 | 224002 | 525003 | 326.1 | 660.5 | Duperow Fm | 653.5 | 7.0 | Y | N |
| 21 | 11/06-23-052-25W3/0 | 224002 | 525003 | 250.5 | 531.9 | Duperow Fm | 525.2 | 6.7 | Y | Y |
| 22 | 11/13-24-052-25W3/0 | 226408 | 525003 | 369.0 | 579.0 | Duperow Fm | 572.5 | 6.5 | Y | N |
| 23 | 11/01-26-052-25W3/0 | 226408 | 525003 | 367.6 | 583.4 | Duperow Fm | 578.5 | 4.9 | Y | Y |
| 24 | 11/03-23-052-25W3/0 | 231307 | 525003 | 399.9 | 545.0 | Duperow Fm | 540.5 | 4.5 | Y | N |
| 25 | 11/09-29-042-25W3/0 | 234107 | 525003 | 630.0 | 684.0 | Duperow Fm | 679.9 | 4.1 | Y | N |

* Area bounded by 49.5-56.0 deg Latitude N and 109-110 deg Longitude W

** 71 total number of dipmeters in area

# APPENDIX D

## DATA ANALYSIS RESULTS FOR ORIGINAL STUDY AREA

## Table D.1: Vertical Stress for the Elk Point Group determined from bulk density data

| No. | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Elk Point Group (m KB) | Vertical Stress at Top of Elk Point Group (MPa) | Normalized Vertical Stress Gradient at Top of Elk Point Group (kPa/m) | Top Prairie Evaporite Fm (m KB) | Vertical Stress at Top of Prairie Evaporite Fm (MPa) | Normalized Vertical Stress Gradient at Top of Prairie Evaporite Fm (kPa/m) | Top Basal Red Beds Fm (m KB) | Vertical Stress at Top of Basal Red Beds Fm (MPa) | Normalized Vertical Stress Gradient at Top of Basal Red Beds Fm (kPa/m) | Bulk Density Log Quality | Stress Magnitude Difference b/w Prairie Evaporite and Basal Red Beds (MPa) | Stress Gradient Difference b/w Prairie Evaporite and Basal Red Beds (kPa/m) | % of Unknown Bulk Density Data above Prairie Evaporite Fm | % of Unknown Bulk Density Data above Basal Red Beds Fm | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | HUSKY D.H. WILDMERE 6-5-48-6 | 1970 | 610.0 | 975.0 | 1180.8 | | | 1194.8 | | | | | | poor | | | | | bulk density data does not reach top of Elk Point Grp. |
| 2 | VOYAGER PLAIN 6-1-52-13 | 1978 | 750.0 | 2100.0 | 1340.0 | 31.3 | 23.3 | 1356.0 | 31.7 | 23.4 | 1683.0 | 39.1 | 23.2 | fair | 7.4 | -0.1 | 55 | 44 | |
| 3 | HUSKY 2C FROG LAKE 2-19-53-1 | 1996 | 132.0 | 1134.0 | 842.9 | 19.3 | 22.9 | 856.5 | 19.7 | 23.0 | 1080.5 | 25.5 | 23.6 | very good | 5.8 | 0.6 | 15 | 12 | |
| 4 | HUSKY 8B MARWAYNE 8-9-53-3 | 1996 | 132.0 | 1393.2 | 869.0 | 19.9 | 22.9 | 883.0 | 20.3 | 22.9 | 1106.0 | 25.1 | 22.7 | very good | 4.9 | -0.2 | 14 | 12 | |
| 5 | STERLING ET AL DEWBERRY 6-12-53-4 | 1988 | 425.0 | 605.0 | 898.8 | | | 913.3 | | | | | | very good | | | | | bulk density data does not reach top of Elk Point Grp. |
| 6 | HUSKY DH ETHELWYN 10D-17-54-5 | 1971 | 365.8 | 964.2 | 948.1 | | | 964.1 | | | | | | poor | | | | | this well has incorrect digital data |
| 7 | AMOCO INJ LINDBERGH 14-28-55-6 | 1991 | 671.0 | 1289.3 | 969.0 | 21.6 | 22.3 | 989.0 | 22.1 | 22.3 | | | | very good | | | 67 | | Lotsberg Fm at TD |
| 8 | CHEMCELL DUVERNAY NACL 16-27-55-12 | 1969 | 186.5 | 1448.4 | 1065.9 | 24.2 | 22.7 | 1081.7 | 24.6 | 22.7 | 1441.7 | 32.7 | 22.7 | poor | 8.1 | -0.1 | 17 | 13 | |
| 9 | WESTMIN HAIRY 2-13-55-13 | 1983 | 335.0 | 1745.0 | 1158.0 | 26.5 | 22.9 | 1170.0 | 26.8 | 22.9 | 1532.5 | 34.8 | 22.7 | fair | 8.0 | -0.2 | 28 | 22 | |
| 10 | CANSALT L-2 NACL LIND 16-23-56-5 | 1989 | 155.0 | 1219.0 | 822.4 | 18.2 | 22.2 | 838.4 | 18.7 | 22.3 | | | | very good | | | 18 | | Lotsberg Fm at TD |
| 11 | MURPHY SWD 5 LIND 15-13-58-5 | 1987 | 586.0 | 1546.0 | 869.9 | 19.5 | 22.4 | 886.0 | 19.9 | 22.5 | 1323.3 | 29.5 | 22.3 | very good | 9.6 | -0.2 | 66 | 44 | |
| 12 | SASKOIL SUGDEN 8-1-62-11 | 1991 | 296.0 | 1635.0 | 935.6 | 21.2 | 22.7 | 952.0 | 21.6 | 22.7 | 1469.2 | 32.5 | 22.2 | good | 10.9 | -0.6 | 31 | 20 | |
| 13 | RENAISSANCE COLD LAKE 1-28-63-2 | 1989 | 170.0 | 799.6 | 614.0 | 13.0 | 21.1 | 634.5 | 13.5 | 21.3 | | | | good | | | 26 | | Winnipegosis FM at TD, some washed out zones |
| 14 | CON BEACON PARA COLDLK 8-26-63-3 | 1992 | 195.0 | 924.8 | 589.0 | 13.0 | 22.1 | 605.6 | 13.5 | 22.2 | | | | very good | | | 32 | | bulk density data does not reach top of Basal Red Beds |
| 15 | CDNOXY SWD 2 SUGDEN 6-13-63-8 | 1986 | 270.0 | 1459.6 | 783.0 | 17.7 | 22.6 | 797.5 | 18.1 | 22.7 | 1337.0 | 29.8 | 22.3 | good | 11.7 | -0.4 | 33 | 20 | |
| 16 | ESSO MARIE OV 15-20-64-2 | 1979 | 21.0 | 1207.0 | 652.0 | 14.4 | 22.1 | 669.2 | 14.8 | 22.1 | 1092.5 | 24.0 | 22.0 | fair | 9.2 | -0.1 | 3 | 2 | |
| 17 | ESSO 79 SWD COLDLK 7-18-64-3 | 1979 | 20.2 | 1294.6 | 666.2 | 14.9 | 22.4 | 680.3 | 15.3 | 22.4 | 1171.0 | 26.2 | 22.4 | fair | 10.9 | -0.1 | 2 | 1 | |
| 18 | ESSO 85 SWD ETHELLK 1-19-64-3 | 1985 | 250.0 | 1229.6 | 656.9 | 14.5 | 22.1 | 671.3 | 14.9 | 22.2 | 1177.2 | 26.0 | 22.1 | fair | 11.1 | -0.2 | 37 | 21 | |
| 19 | ESSO 83 SWD ETHELLK 11-22-64-3 | 1983 | 253.4 | 1277.0 | 654.0 | 14.4 | 22.1 | 668.7 | 14.8 | 22.1 | 1164.4 | 26.0 | 22.3 | fair | 11.2 | 0.2 | 37 | 21 | |
| 20 | ESSO 81 SWD ETHELLK 3-29-64-3 | 1981 | 20.0 | 1310.0 | 671.7 | 14.7 | 21.9 | 686.4 | 15.1 | 21.9 | 1190.6 | 26.0 | 21.8 | fair | 10.9 | -0.1 | 2 | 1 | |
| 21 | ESSO 83 INJ ETHELLK 8-33-64-3 | 1983 | 257.0 | 1317.0 | 705.0 | 15.2 | 21.6 | 720.0 | 15.6 | 21.6 | 1210.0 | 26.3 | 21.7 | fair | 10.7 | 0.1 | 35 | 21 | |
| 22 | MOBIL GARTH 5-6-64-6 | 1988 | 270.0 | 1405.0 | 736.0 | 16.4 | 22.2 | 752.5 | 16.8 | 22.3 | 1252.5 | 27.6 | 22.0 | good | 10.8 | -0.3 | 35 | 21 | |
| 23 | MOBIL GARTH 12-6-64-6 | 1985 | 271.0 | 1414.0 | 741.0 | 16.6 | 22.4 | 758.4 | 17.0 | 22.4 | 1280.0 | 28.3 | 22.1 | good | 11.3 | -0.3 | 35 | 21 | |
| 24 | ESSO 83 SWD ETHELLK 2-3-65-3 | 1984 | 256.0 | 1314.0 | 696.0 | 15.1 | 21.7 | 712.0 | 15.5 | 21.8 | 1213.8 | 26.5 | 21.8 | fair | 10.9 | 0.0 | 35 | 21 | |
| 25 | ESSO SWD LEMING ETHELLK 3-4-65-3 | 1978 | 396.4 | 1320.0 | 690.0 | 14.6 | 21.2 | 707.0 | 15.1 | 21.3 | 1204.4 | 25.7 | 21.3 | fair | 10.6 | 0.0 | 56 | 33 | |
| 26 | ESSO 81 ETHELLK OV 9-20-65-3 | 1981 | 20.0 | 1264.6 | 624.5 | 13.5 | 21.6 | 640.4 | 13.9 | 21.7 | 1173.0 | 25.4 | 21.7 | poor | 11.5 | 0.0 | 2 | 1 | |
| 27 | ESSO MEDLEY OV 6-8-66-2 | 1979 | 20.0 | 1214.6 | 672.6 | 15.0 | 22.3 | 690.0 | 15.4 | 22.3 | 1141.0 | 25.5 | 22.3 | fair | 10.1 | 0.0 | 2 | 1 | |
| 28 | ESSO MEDLEY OV 14-28-66-3 | 1979 | 20.0 | 1254.6 | 644.0 | 14.2 | 22.1 | 660.2 | 14.6 | 22.1 | 1184.0 | 26.3 | 22.2 | fair | 11.7 | 0.1 | 2 | 1 | |
| 29 | BP PCI MARGLK 10-8-66-5 | 1984 | 15.0 | 1353.0 | 708.0 | 15.6 | 22.0 | 720.2 | 15.9 | 22.1 | 1262.4 | 27.3 | 21.6 | fair | 11.4 | -0.5 | 1 | 1 | |
| 30 | BP LEMING 10-10-66-6 | 1981 | 156.0 | 1363.0 | 720.1 | 15.9 | 22.1 | 735.0 | 16.3 | 22.2 | 1273.3 | 28.1 | 22.1 | fair | 11.8 | -0.1 | 21 | 12 | |
| 31 | AMOCO 10B4 MOORE 10-5-67-4 | 1983 | 165.0 | 1339.6 | 693.5 | 14.8 | 21.4 | 707.4 | 15.2 | 21.4 | 1257.8 | 27.1 | 21.6 | poor | 12.0 | 0.1 | 23 | 13 | |
| 32 | ESSO AEC 85 FISHCK 7-11-67-6 | 1985 | 250.0 | 1344.6 | 700.6 | 15.6 | 22.2 | 717.0 | 16.0 | 22.3 | 1261.0 | 27.7 | 22.0 | fair | 11.7 | -0.3 | 34 | 20 | |
| 33 | ESSO AEC 85 FISHCK 12-31-67-7 | 1985 | 248.0 | 1333.0 | 698.0 | 15.5 | 22.3 | 716.0 | 16.0 | 22.4 | 1257.5 | 27.8 | 22.1 | good | 11.7 | -0.3 | 34 | 19 | |
| 34 | ESSO AEC 85 FISHCK 7-34-67-8 | 1985 | 250.0 | 1389.6 | 753.0 | 16.8 | 22.3 | 769.0 | 17.2 | 22.4 | 1312.0 | 29.1 | 22.2 | fair | 11.9 | -0.2 | 32 | 19 | |
| 35 | ESSO AEC 85 FISHCK 11-19-68-6 | 1985 | 250.0 | 1339.6 | 715.0 | 15.8 | 22.1 | 729.8 | 16.2 | 22.2 | 1276.0 | 28.1 | 22.0 | good | 11.9 | -0.2 | 34 | 19 | |
| 36 | AECOG (NE) FISHER 8D-12-69-5 | 1990 | 196.0 | 915.0 | 664.9 | 14.1 | 21.2 | 680.0 | 14.5 | 21.3 | | | | fair | | | 28 | | Contact Rapids Fm at TD |
| 37 | ARCO HEART LAKE 11-26-69-10 | 1967 | 189.0 | 1435.3 | 831.5 | 18.8 | 22.6 | 847.0 | 19.2 | 22.6 | 1370.7 | 30.7 | 22.4 | fair | 11.5 | -0.3 | 22 | 13 | |
| 38 | AEC ET AL SCHELTENS 16-13-71-1 | 1985 | 184.0 | 825.0 | 750.4 | 16.3 | 21.8 | | | | | | | good | | | | | Elk Point Fm at TD |
| 39 | AEC ET AL FOSTERCK 16-36-72-1 | 1985 | 199.0 | 770.8 | 657.0 | 14.2 | 21.6 | | | | | | | fair | | | | | Contact Rapids Fm at TD |
| 40 | AMOCO AEC KIRBY 5-21-71-4 | 1980 | 153.9 | 1150.9 | 591.0 | 12.8 | 21.6 | 606.0 | 13.2 | 21.7 | 1142.5 | 25.0 | 21.9 | fair | 11.9 | 0.2 | 25 | 13 | |
| 41 | AMOCO AEC IPIATIK 6-30-71-5 | 1980 | 285.0 | 1214.9 | 648.1 | 14.1 | 21.8 | 662.3 | 13.5 | 21.9 | 1190.3 | 26.1 | 21.9 | fair | 11.6 | 0.0 | 42 | 24 | |
| 42 | AMOCO AEC IPIATIK GRIST 10-17-71-6 | 1980 | 156.0 | 1224.8 | 647.0 | 14.6 | 22.5 | 662.0 | 14.9 | 22.6 | 1189.9 | 26.5 | 22.3 | fair | 11.6 | -0.3 | 23 | 13 | |
| 43 | AEC PHILLIPS WIAU 10-26-71-7 | 1980 | 230.0 | 1229.6 | 671.5 | 14.8 | 22.0 | 688.0 | 15.2 | 22.1 | 1208.6 | 26.7 | 22.1 | fair | 11.5 | 0.0 | 33 | 19 | |
| 44 | RAX ET AL MILLS 7-12-71-11 | 1978 | 313.9 | 1376.5 | 798.6 | 18.1 | 22.7 | 814.1 | 18.5 | 22.7 | 1330.0 | 30.3 | 22.7 | fair | 11.7 | 0.0 | 38 | 23 | |
| 45 | AEC FOSTER CREEK 7-7-72-3 | 1996 | 169.7 | 837.6 | 600.7 | 13.0 | 21.6 | 624.3 | 13.5 | 21.7 | | | | very good | | | 26 | | Contact Rapids Fm at TD |
| 46 | AMOCO AEC IPIATIK 11-18-72-4 | 1979 | 285.0 | 1187.0 | 609.0 | 13.3 | 21.8 | 627.0 | 13.7 | 21.9 | 1153.0 | 25.3 | 22.0 | fair | 11.6 | 0.1 | 45 | 24 | |
| 47 | AMOCO KIRBY 10-22-72-6 | 1980 | 300.0 | 1208.8 | 671.5 | 14.7 | 21.8 | 689.0 | 15.1 | 22.0 | 1205.0 | 26.6 | 22.0 | fair | 11.4 | 0.1 | 43 | 25 | |

## Table D.1: Vertical Stress for the Elk Point Group determined from bulk density data

| No. | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Elk Point Group (m KB) | Vertical Stress at Top of Elk Point Group (MPa) | Normalized Vertical Stress Gradient at Top of Elk Point Group (kPa/m) | Top Prairie Evaporite Fm (m KB) | Vertical Stress at Top of Prairie Evaporite Fm (MPa) | Normalized Vertical Stress Gradient at Top of Prairie Evaporite Fm (kPa/m) | Top Basal Red Beds Fm (m KB) | Vertical Stress at Top of Basal Red Beds Fm (MPa) | Normalized Vertical Stress Gradient at Top of Basal Red Beds Fm (kPa/m) | Bulk Density Log Quality | Stress Magnitude Difference b/w Prairie Evaporite and Basal Red Beds (MPa) | Stress Gradient Difference b/w Prairie Evaporite and Basal Red Beds (kPa/m) | % of Unknown Bulk Density Data above Prairie Evaporite Fm | % of Unknown Bulk Density Data above Basal Red Beds Fm | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 48 | AEC PHILLIPS WIAU 11-14-72-8 | 1980 | 150.0 | 1279.6 | 721.0 | 16.0 | 22.2 | 737.6 | 16.5 | 22.3 | 1253.8 | 27.9 | 22.2 | fair | 11.4 | -0.1 | 20 | 12 | |
| 49 | AEC PHILLIPS WIAU 10-33-72-8 | 1980 | 160.0 | 1290.0 | 745.0 | 16.7 | 22.4 | 760.0 | 17.1 | 22.5 | 1271.0 | 28.4 | 22.3 | fair | 11.3 | -0.2 | 21 | 12 | |
| 50 | PAN AM A-1 BEHAN 6-26-72-11 | 1969 | 426.7 | 1044.2 | 799.8 | 18.1 | 22.6 | 815.3 | 18.4 | 22.6 | | | | poor | | | 52 | | Contact Rapids Fm at TD |
| 51 | AEC FOSTER CREEK 6-25-73-3 | 1997 | 148.0 | 825.0 | 663.3 | 14.3 | 21.6 | 684.6 | 14.9 | 21.7 | | | | very good | | | 21 | | Prairie Evaporite Fm at TD, * |
| 52 | AMOCO AEC IPIATIK KIRBY 10-14-73-5 | 1979 | 281.9 | 1119.7 | 599.9 | 13.0 | 21.7 | 616.8 | 13.5 | 21.8 | | | | fair | | | 45 | | Lotsberg Fm at TD |
| 53 | AMOCO KIRBY 9-25-73-5 | 1980 | 224.0 | 839.9 | 588.0 | 12.7 | 21.7 | 602.0 | 13.1 | 21.8 | | | | fair | | | 37 | | Contact Rapids Fm at TD |
| 54 | AMOCO KIRBY 11-30-74-5 | 1977 | 187.5 | 1107.9 | 605.9 | 13.3 | 21.9 | 621.6 | 13.7 | 22.0 | 1070.0 | 23.7 | 22.2 | poor | 10.0 | 0.1 | 30 | 17 | some bulk density data logged through cased hole |
| 55 | AMOCO KIRBY 10-9-74-6 | 1977 | 187.8 | 1094.7 | 583.4 | 12.9 | 22.2 | 602.3 | 13.4 | 22.3 | 1042.5 | 23.2 | 22.3 | fair | 9.8 | 0.0 | 31 | 18 | Top of Granite Wash used for bottom of Lotsberg |
| 56 | AMOCO KIRBY 6-24-74-7 | 1977 | 189.9 | 1142.4 | 632.2 | 14.0 | 22.1 | 650.1 | 14.4 | 22.2 | 1094.0 | 24.3 | 22.2 | fair | 9.9 | 0.0 | 29 | 17 | Top of Granite Wash used for bottom of Lotsberg |
| 57 | HOME LEISMER A10-1-77-7 | 1975 | 190.8 | 951.0 | 479.5 | 10.6 | 22.2 | 495.3 | 11.0 | 22.3 | 919.6 | 20.5 | 22.3 | fair | 9.4 | 0.0 | 38 | 20 | |
| 58 | HOME LEISMER 3-7-77-7 | 1980 | 128.0 | 788.0 | 520.4 | 11.7 | 22.5 | 534.8 | 12.1 | 22.6 | | | | poor | | | 23 | | Contact Rapids Fm at TD |
| 59 | NORCEN POR LEISMER 2-8-77-8 | 1982 | 167.0 | 782.0 | 568.0 | 12.7 | 22.4 | 583.1 | 13.1 | 22.5 | | | | fair | | | 28 | | Winnipegosis Fm at TD |
| 60 | ALTANA HUBER CHRISTINA 10-28-77-8 | 1971 | 118.3 | 787.9 | 523.0 | 11.7 | 22.3 | 539.3 | 12.1 | 22.5 | | | | fair | | | 21 | | Winnipegosis Fm at TD |
| 61 | LAKEWOOD ET AL CHARD 14-29-79-5 | 1991 | 128.0 | 605.0 | 405.0 | 8.8 | 21.7 | 426.7 | 9.3 | 21.9 | | | | very good | | | 29 | | Contact Rapids Fm at TD |
| 62 | HOME WINNEFRED LAKE 10-5-80-2 | 1967 | 116.1 | 557.9 | 479.1 | 10.3 | 21.6 | 505.7 | 11.0 | 21.7 | | | | poor | | | 22 | | density profile looks different, Contacts Rapids Fm at TD, * |
| 63 | HOMESTEAD CANOXY COWPAR 11-32-80-4 | 1976 | 61.8 | 364.8 | 393.9 | | | 410.0 | | | | | | fair | | | | | bulk density data does not reach Elk Pt. Group |
| 64 | GULF RESDELN 7-8-82-6 | 1981 | 370.0 | 654.0 | 419.0 | 9.0 | 21.4 | 444.2 | 9.7 | 21.7 | 624.6 | 14.2 | 22.8 | poor | 4.6 | 1.1 | 83 | 59 | Top of Granite Wash used for bottom of Lotsberg |
| 65 | HUSKY ET AL DIVIDE 10-29-82-12 | 1988 | 201.0 | 964.0 | 689.0 | 15.6 | 22.6 | 703.0 | 15.9 | 22.7 | | | | very good | | | 28 | | Contact Rapids Fm at TD |
| 66 | GULF RESDELN 10-8-83-6 | 1981 | 120.0 | 624.0 | 477.5 | 10.6 | 22.2 | 500.1 | 11.2 | 22.4 | | | | fair | | | 23 | | Winnipegosis Fm at TD |
| 67 | TEXCAN COTTONWOOD 1-14-83-6 | 1969 | 113.0 | 685.8 | 432.8 | 9.6 | 22.3 | | | | 673.4 | 15.4 | 22.9 | fair | | | | | No Prairie Evaporite, Granite Wash used for bottom of Lotsberg |
| 68 | NORTHSTAR ET AL SURMONT 7-32-83-6 | 1980 | 125.0 | 704.0 | 446.0 | 9.8 | 22.0 | 453.0 | 10.0 | 22.0 | 665.4 | 15.1 | 22.7 | fair | 5.1 | 0.7 | 27 | 18 | Edge of Prairie Evaporite Fm |
| 69 | JACOS WD HANGST 15-14-84-11 | 1990 | 181.0 | 883.0 | 521.6 | 11.7 | 22.4 | 529.0 | 11.9 | 22.4 | 852.0 | 19.2 | 22.5 | good | 7.3 | 0.1 | 33 | 21 | Top of Granite Wash used for bottom of Lotsberg |
| 70 | PCI PCEJ HANGST 9-27-84-11 | 1988 | 183.6 | 860.9 | 499.0 | 11.4 | 22.8 | 505.7 | 11.5 | 22.8 | 833.5 | 19.1 | 22.9 | fair | 7.5 | 0.1 | 35 | 21 | Top of Granite Wash used for bottom of Lotsberg |
| 71 | RAX NEWBY 14-24-85-6 | 1988 | 119.0 | 470.0 | 336.0 | 7.4 | 21.9 | 343.0 | 7.5 | 22.0 | | | | good | | | | | Contact Rapids Fm at TD* |
| 72 | TEXCAN CS HORSE 16-27-85-11 | 1969 | 181.7 | 779.7 | 417.6 | 9.7 | 23.1 | 425.8 | 9.9 | 23.2 | 756.5 | 17.4 | 22.9 | fair | 7.5 | -0.2 | 42 | 24 | Top of Granite Wash used for bottom of Lotsberg |
| 73 | CIGOL ET AL HORSE 11-10-85-13 | 1970 | 96.6 | 875.9 | 526.0 | 12.6 | 23.9 | 534.0 | 12.8 | 24.0 | | | | fair | | | | | |
| 74 | SUNCOR CLARKE 2-32PREV-89-12 | 1981 | 86.0 | 717.0 | 397.8 | 9.1 | 22.8 | 406.5 | 9.3 | 22.9 | | | | fair | | | | | |
| 75 | AOSTRA WDW1 ATHABASCA 6-18-93-12 | 1991 | 179.0 | 599.0 | 314.3 | 7.2 | 22.9 | 323.5 | 7.4 | 22.9 | 576.5 | 13.5 | 23.5 | very good | 6.1 | 0.6 | 54 | 30 | |
| 76 | CHEVRON STEEPBANK EX 8-22-94-7 | 1981 | 11.0 | 414.6 | 328.5 | 7.3 | 22.2 | | | | | | | fair | | | | | Elk Pt Fm at TD |
| 77 | CHEVRON STEEPBANK 6-23-94-7 | 1992 | 188.0 | 424.0 | | | | | | | | | | very good | | | | | no picks for Watt Mtn or Elk Pt Group |
| 78 | CHEVRON WDW STEEPBANK 13-23-94-7 | 1991 | 180.0 | 396.0 | 284.0 | 5.9 | 20.9 | | | | | | | very good | | | | | Winnipegosis Fm at TD |
| 79 | CDCOG TENN MUSKEGR 1-3-95-7 | 1980 | 119.0 | 410.0 | 286.6 | 6.1 | 21.2 | | | | | | | fair | | | | | Well Renamed: HUSKY TENN MUSKEGR 1-3-95-7 |
| 80 | HUSKY TENN NOVA 3-14-95-7 | 1981 | 44.0 | 405.0 | 275.0 | 6.0 | 21.9 | | | | | | | fair | | | | | |
| 81 | HUSKY TENN NOVA 3-15-95-7 | 1981 | 43.0 | 391.0 | 260.7 | 5.6 | 21.6 | | | | | | | fair | | | | | |
| 82 | HUSKY TENN MUSKEGR 1-20-95-7 | 1980 | 104.0 | 339.0 | 224.4 | 4.8 | 21.4 | | | | | | | fair | | | | | |
| 83 | HUSKY TENN NOVA 4-22-95-7 | 1981 | 45.0 | 385.0 | 251.7 | 5.7 | 22.5 | | | | | | | fair | | | | | density seems way to high over Elk Pt. Gp. |
| 84 | CDCOG TENN MUSKEGR 1-24-95-7 | 1980 | 129.0 | 413.0 | 283.0 | 6.1 | 21.5 | | | | | | | fair | | | | | |
| 85 | ESSO 90PC OSLO 12-7-95-8 | 1990 | 143.0 | 311.0 | 183.5 | 3.9 | 21.4 | | | | | | | fair | | | | | density to low, not analyzed, Casing@143 m KB |
| 86 | GULF FIREBAG 15-8-96-1 | 1976 | 12.1 | 134.0 | 129.6 | 2.9 | 22.2 | | | | | | | poor | | | | | |
| 87 | GULF FIREBAG 14-11-96-1 | 1976 | 9.1 | 131.7 | 130.2 | 2.7 | 20.8 | | | | | | | fair | | | | | |
| 88 | GULF FIREBAG 6-26-96-1 | 1976 | 14.0 | 162.5 | 162.4 | 3.5 | 21.5 | | | | | | | fair | | | | | |
| 89 | GULF FIREBAG 7-29-96-1 | 1976 | 11.0 | 113.3 | 112.6 | 2.4 | 21.1 | | | | | | | fair | | | | | |
| 90 | GULF FIREBAG 2-8-97-1 | 1976 | 6.0 | 125.0 | 169.8 | | | | | | | | | fair | | | | | bulk density data does not reach top of Elk Point Grp. |
| 91 | GULF FIREBAG 2-11-97-1 | 1976 | 12.8 | 173.6 | 172.5 | 3.7 | 21.5 | | | | | | | fair | | | | | |
| 92 | GULF FIREBAG 13-12-97-2 | 1976 | 7.3 | 126.0 | 143.3 | | | | | | | | | fair | | | | | bulk density data does not reach top of Elk Point Grp. |

* These wells have tops picked for the Prairie Evaporite Formation but are outside the Prairie Evaporite Formation area as outlined by AGS. They have not been included in the contour plots.

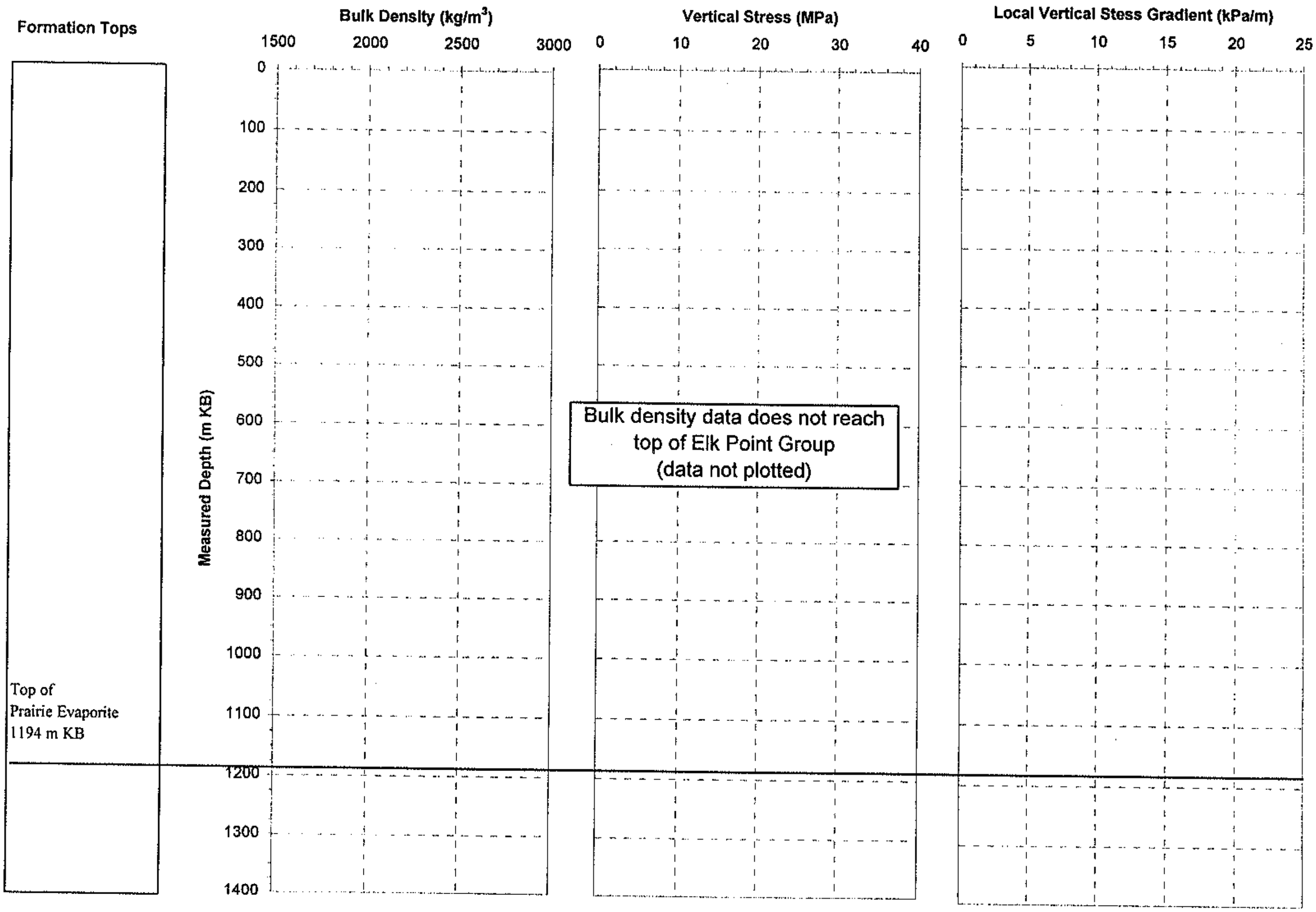


**Figure D.1.1: Calculated vertical stress and vertical stress gradients for Husky D.H. Wildmere 6-5-48-6.**

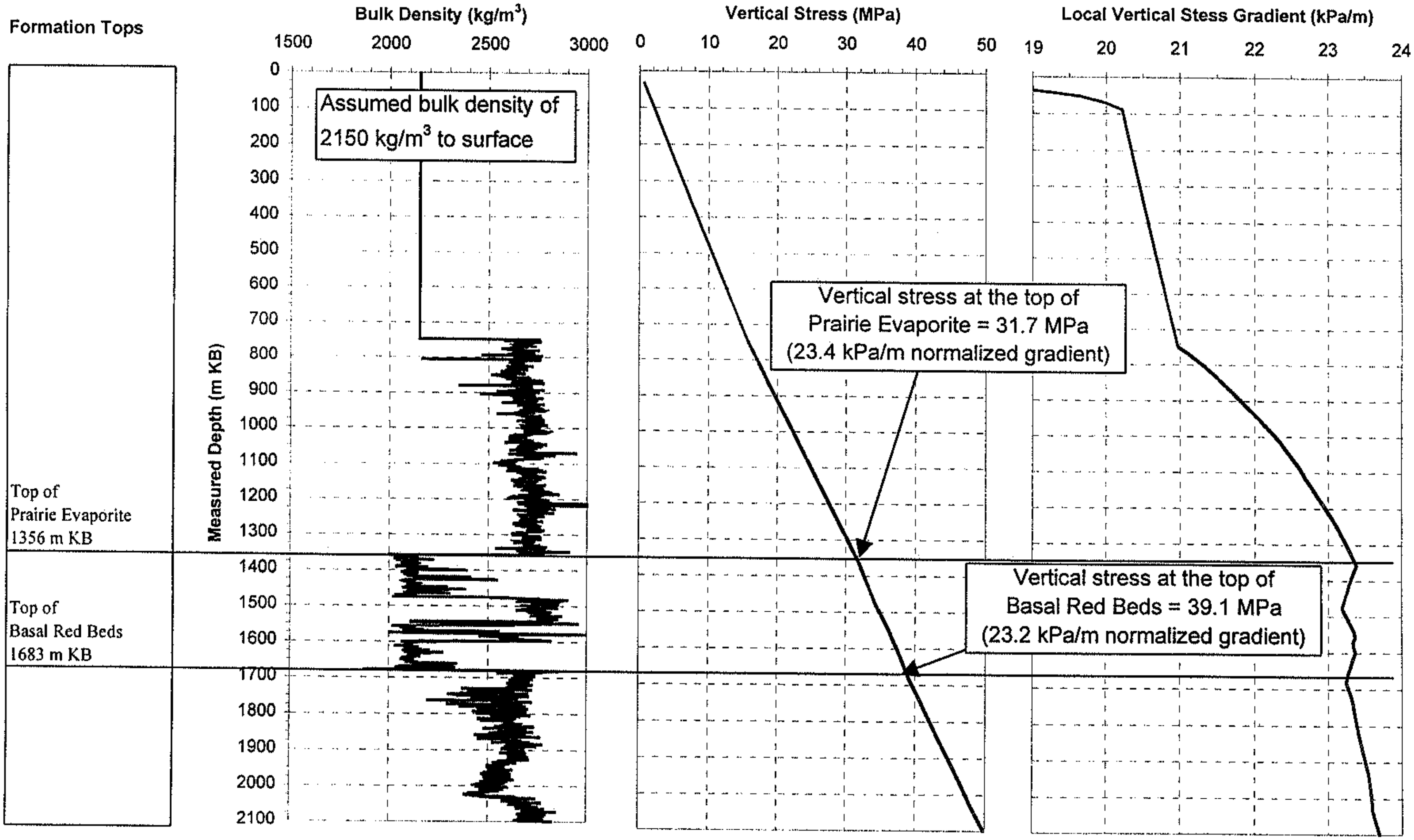


**Figure D.1.2: Calculated vertical stress and vertical stress gradients for Voyager Plain 6-1-52-13.**

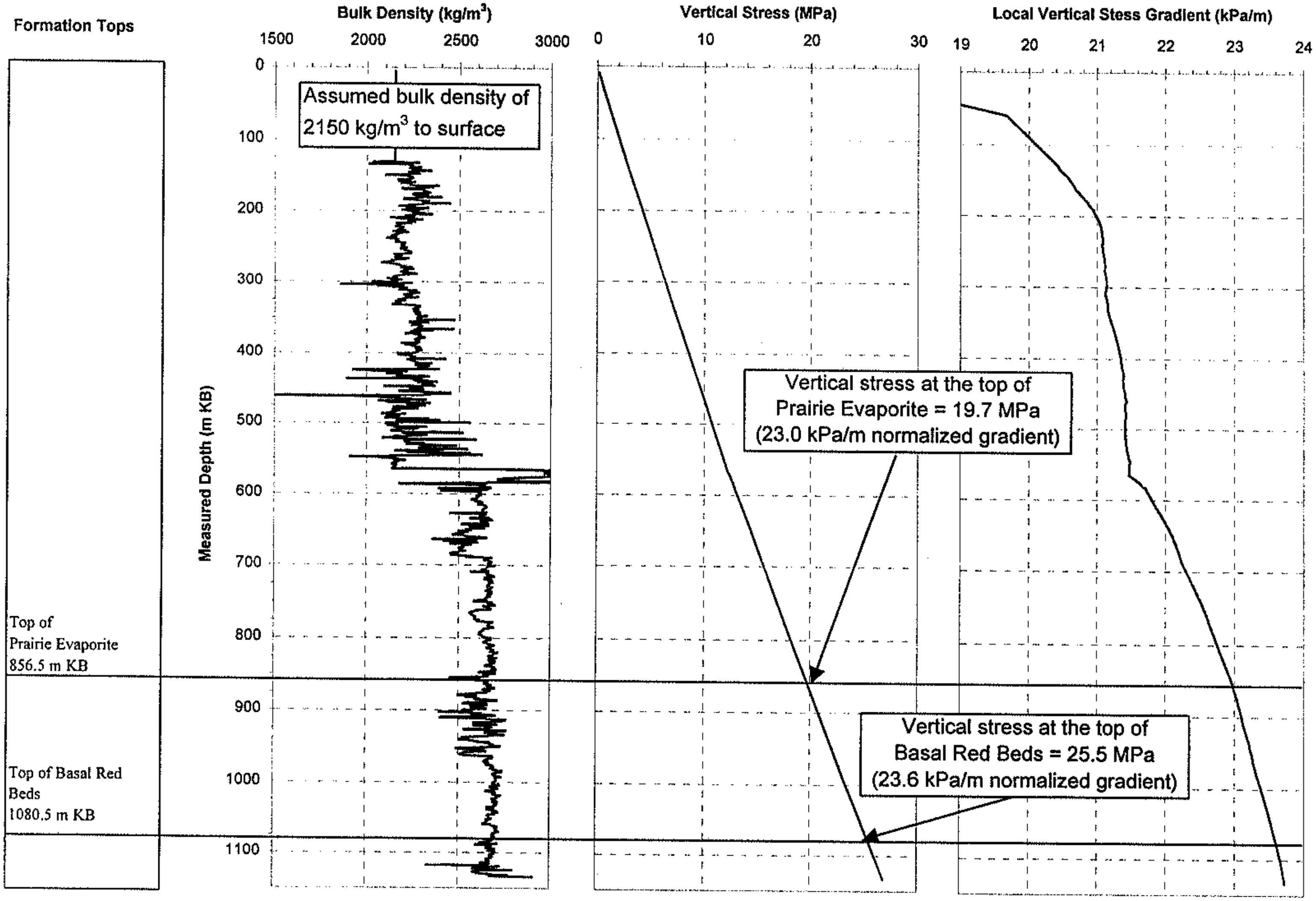


**Figure D.1.3: Calculated vertical stress and vertical stress gradients for Husky 2C Frog Lake 2-19-53-1.**

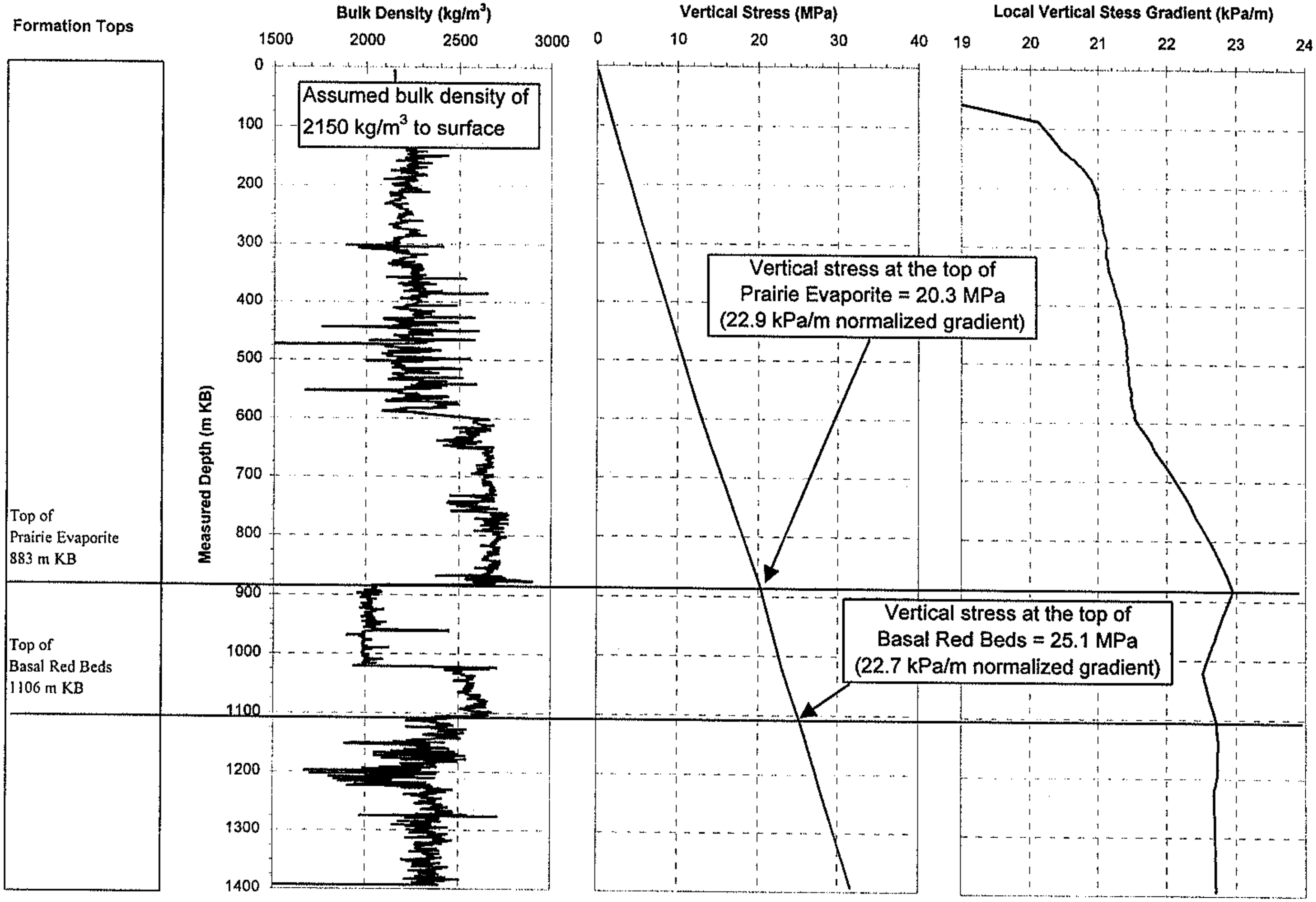


**Figure D.1.4: Calculated vertical stress and vertical stress gradients for Husky 8B Marwayne 8-9-53-3.**

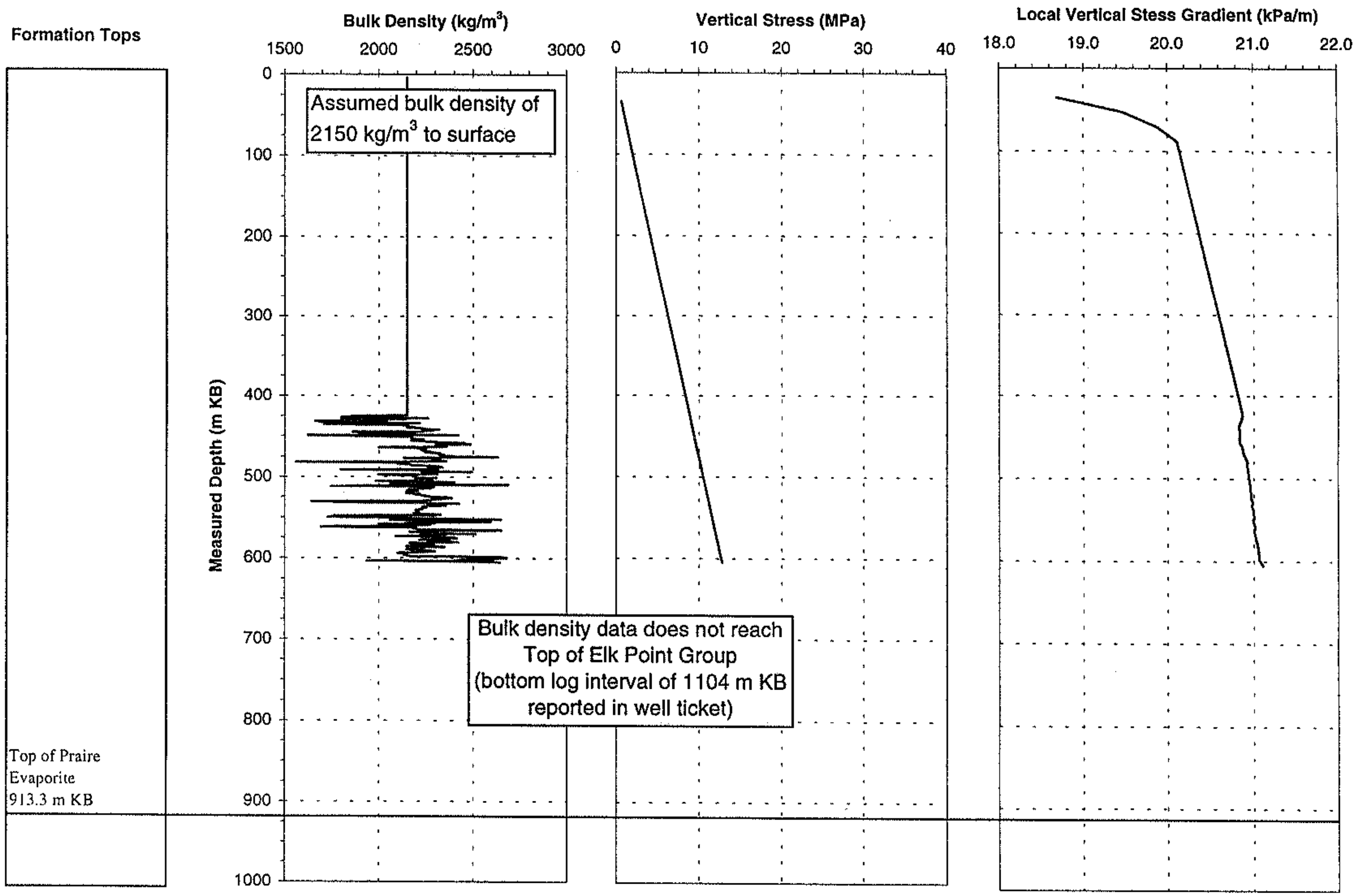


**Figure D.1.5: Calculated vertical stress and vertical stress gradients for Sterling et al Dewberry 6-12-53-4.**

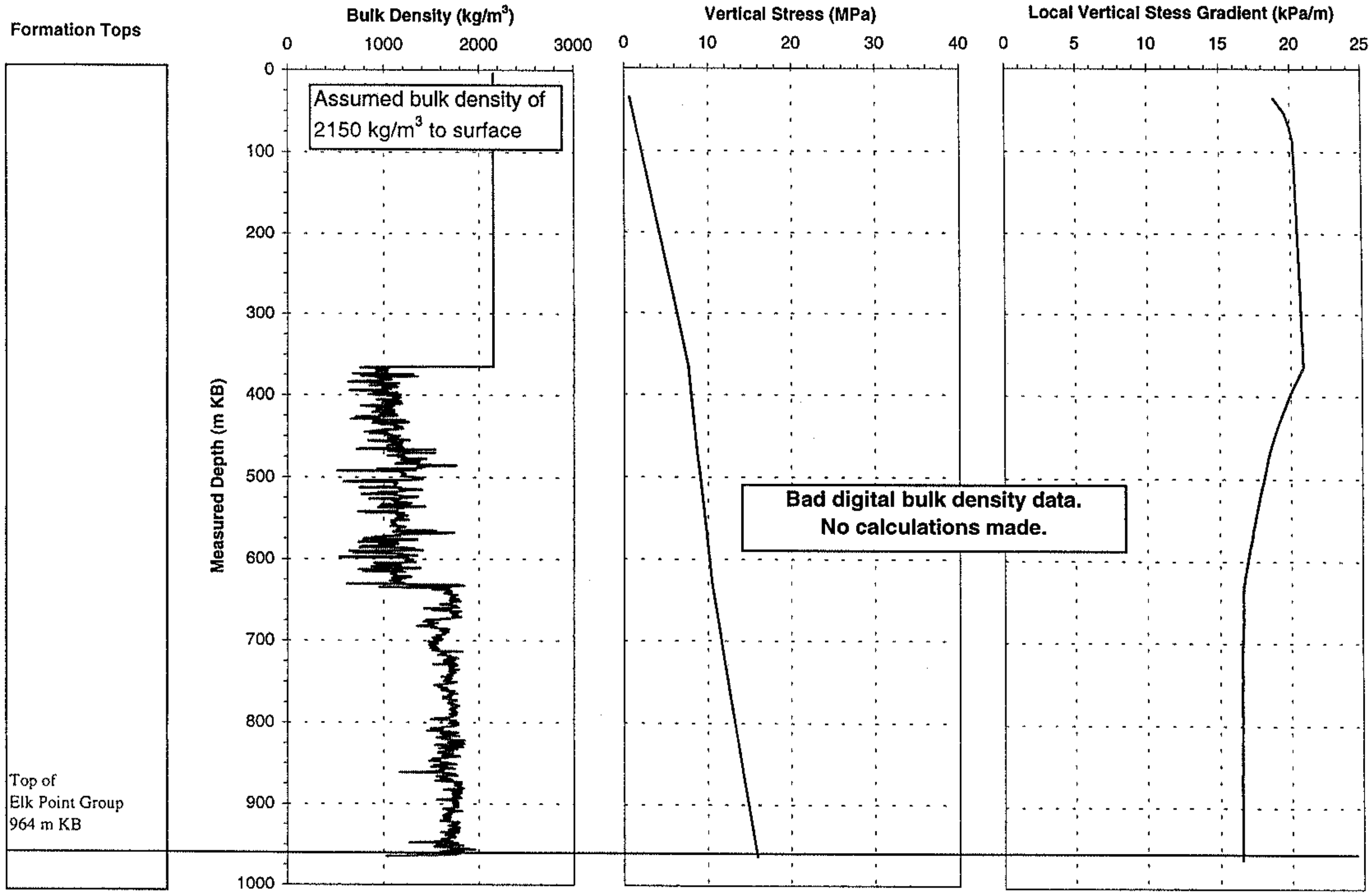


**Figure D.1.6: Calculated vertical stress and vertical stress gradients for Husky DH Ethelwyn 10D-17-54-5.**

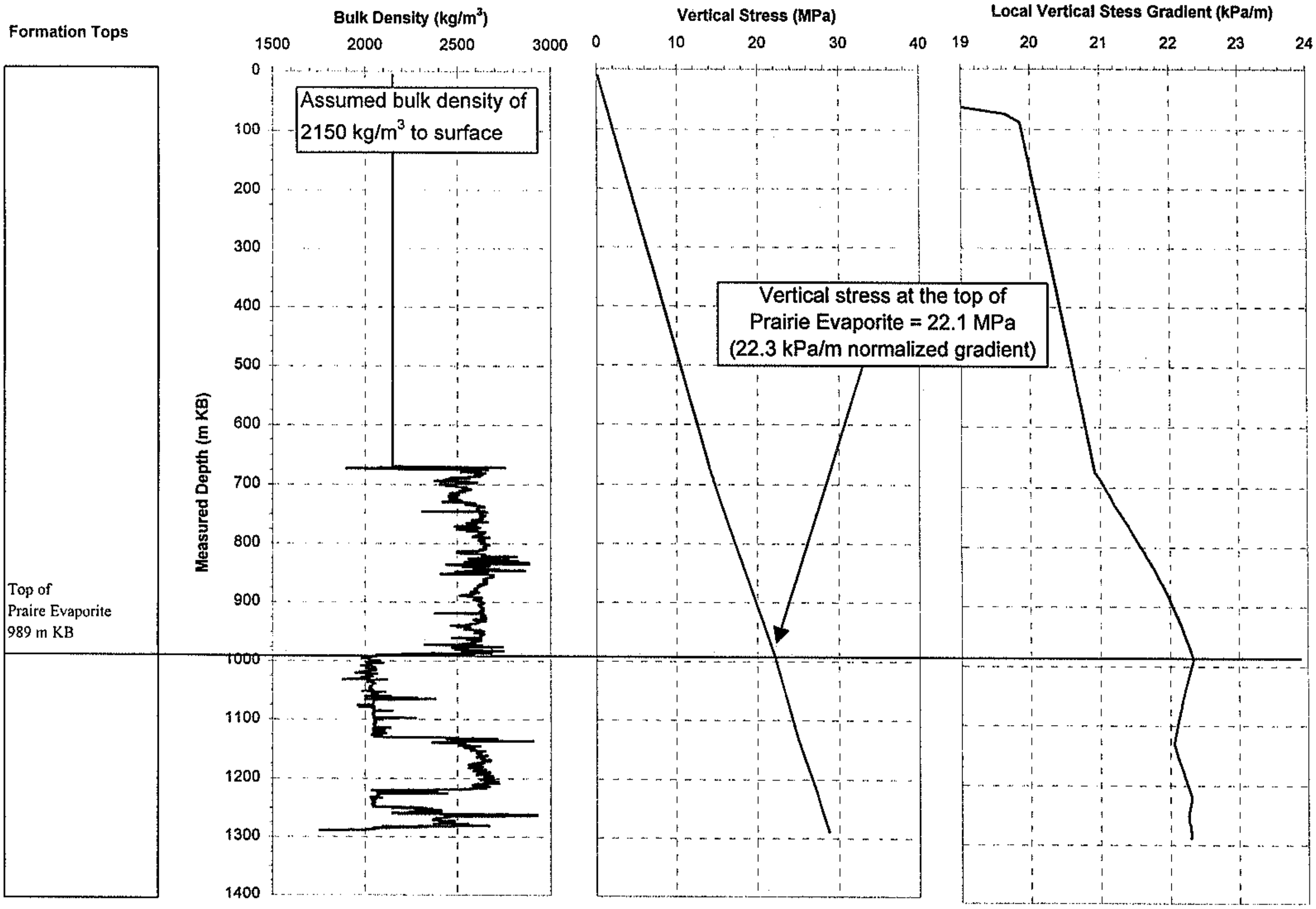


**Figure D.1.7: Calculated vertical stress and vertical stress gradients for Amoco INJ Lindbergh 14-28-55-6.**

ADVANCED GEOTECHNOLOGY

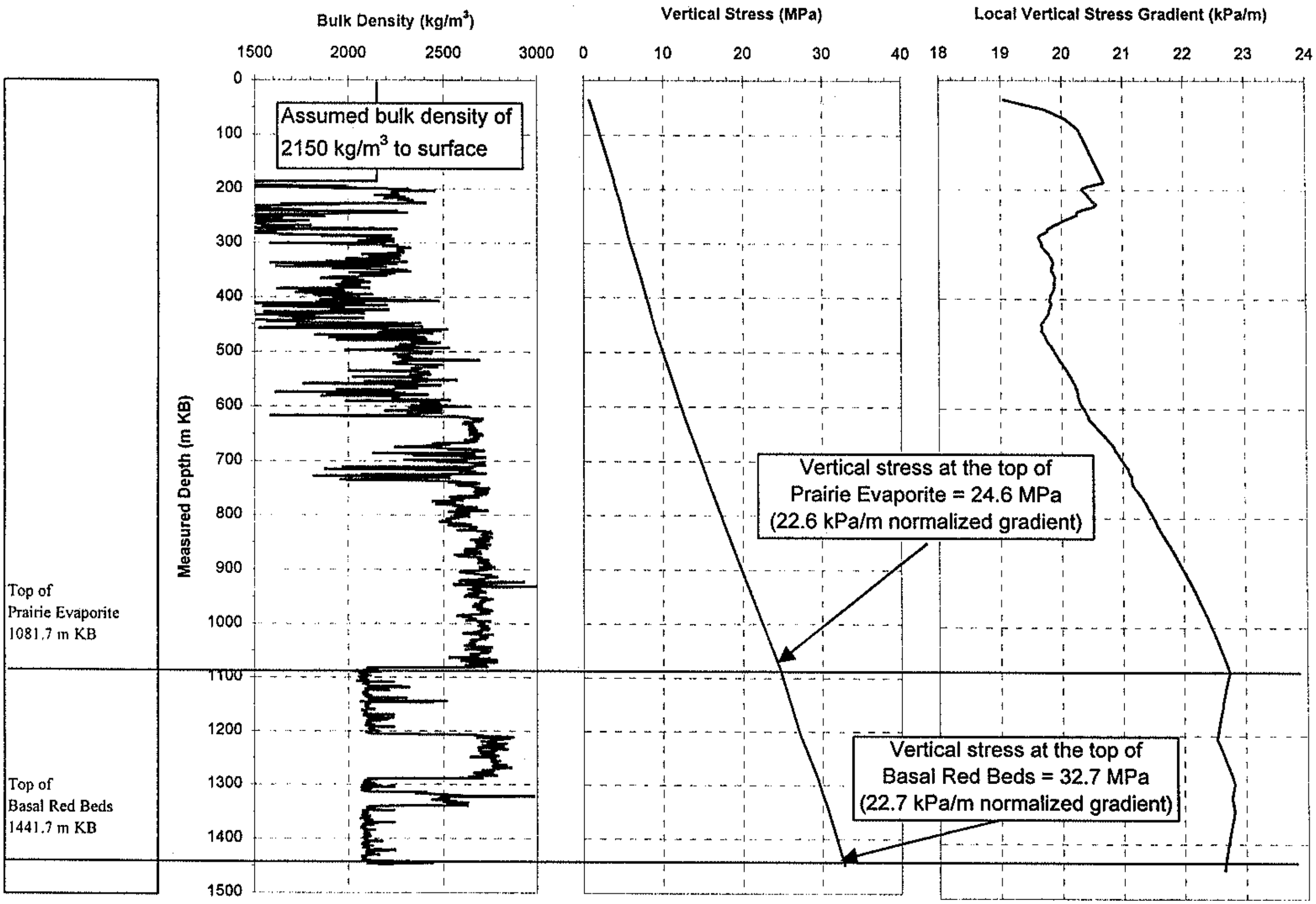


**Figure D.1.8: Calculated vertical stress and vertical stress gradients for Chemcell Duvernay NaCl 16-27-55-12 .**

ADVANCED GEOTECHNOLOGY

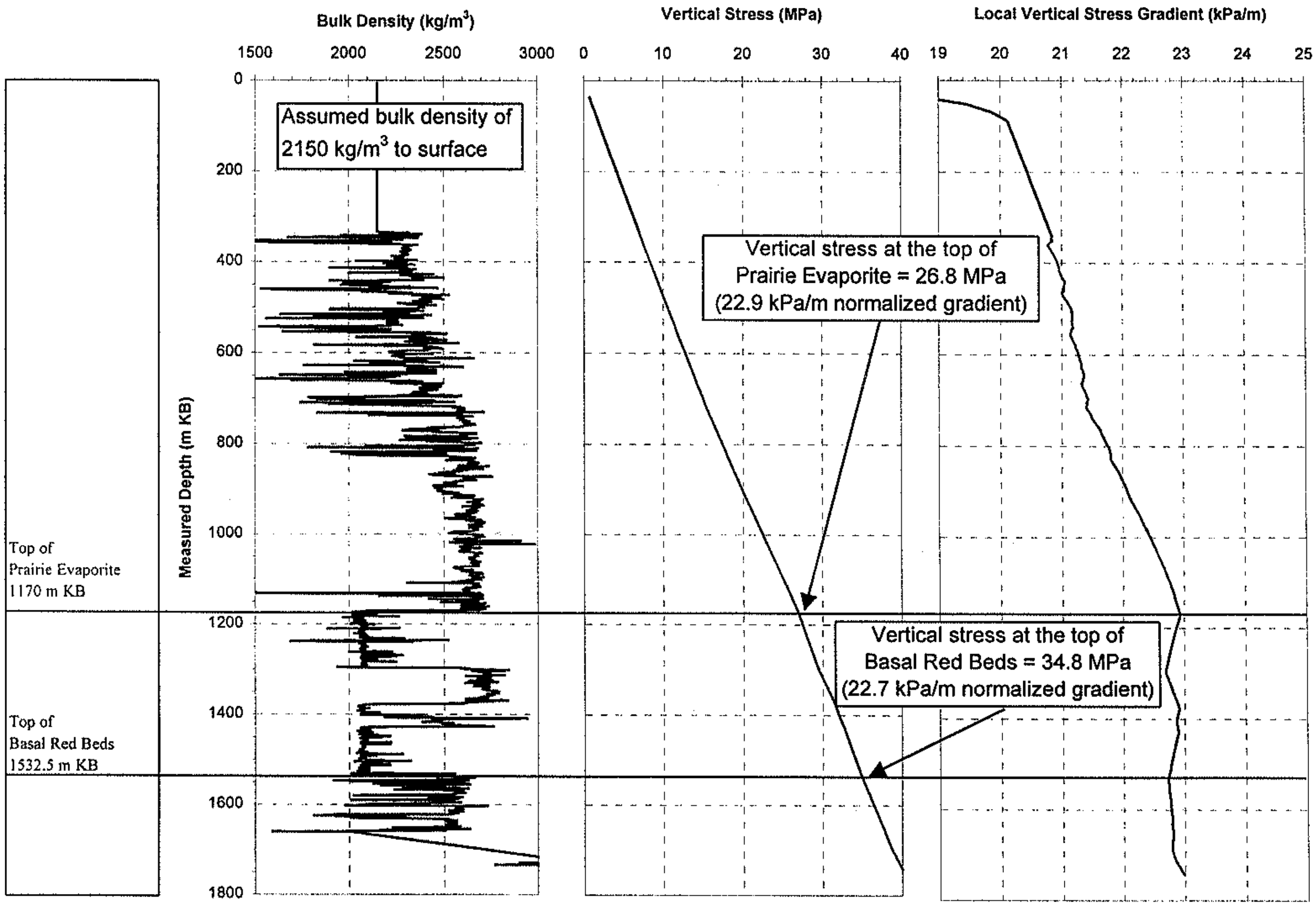


**Figure D.1.9: Calculated vertical stress and vertical stress gradients for Westmin Hairy 2-13-55-13 .**

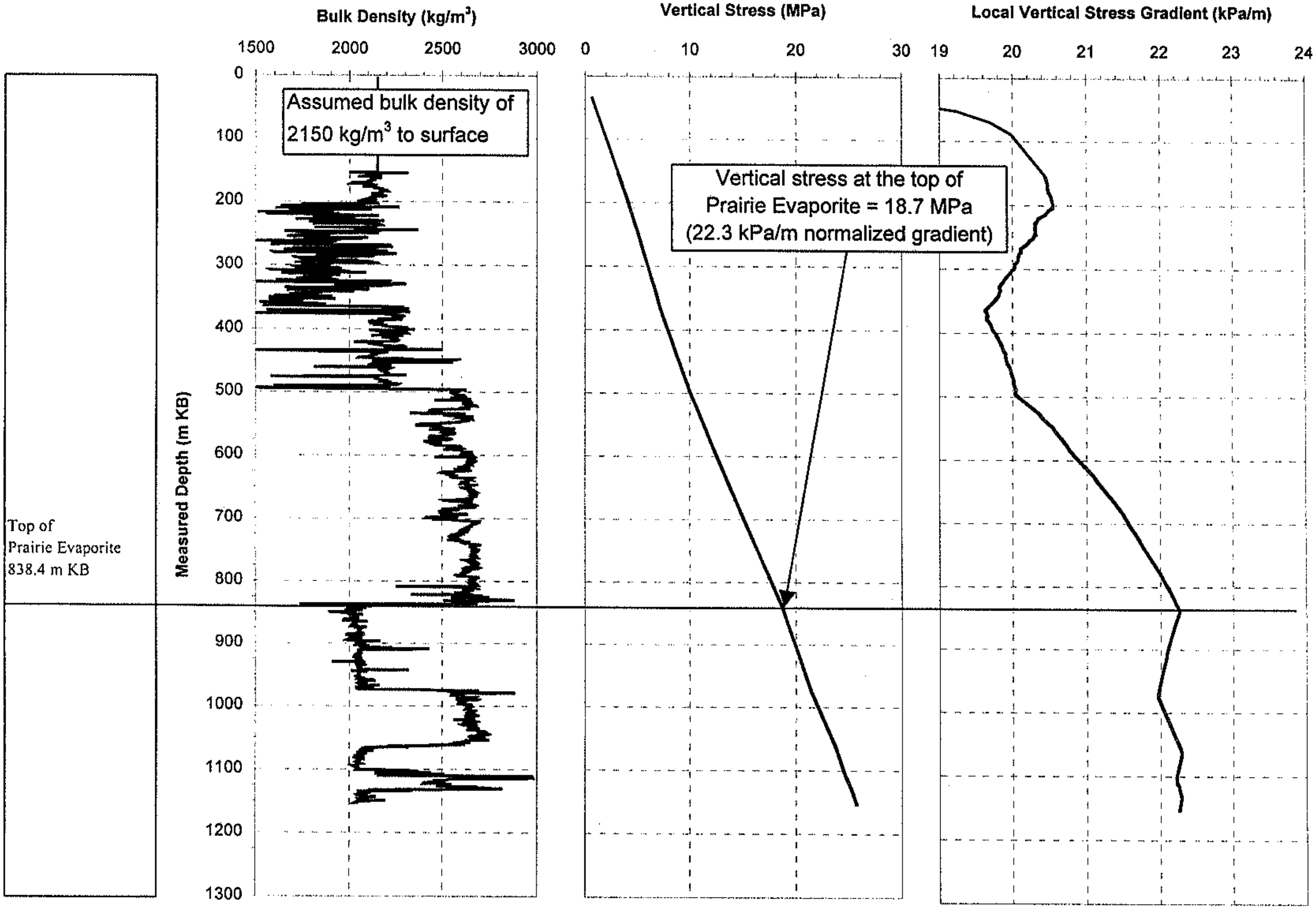


**Figure D.1.10: Calculated vertical stress and vertical stress gradients for Cansalt L-2 NaCl Lind 16-23-56-5 .**

ADVANCED GEOTECHNOLOGY

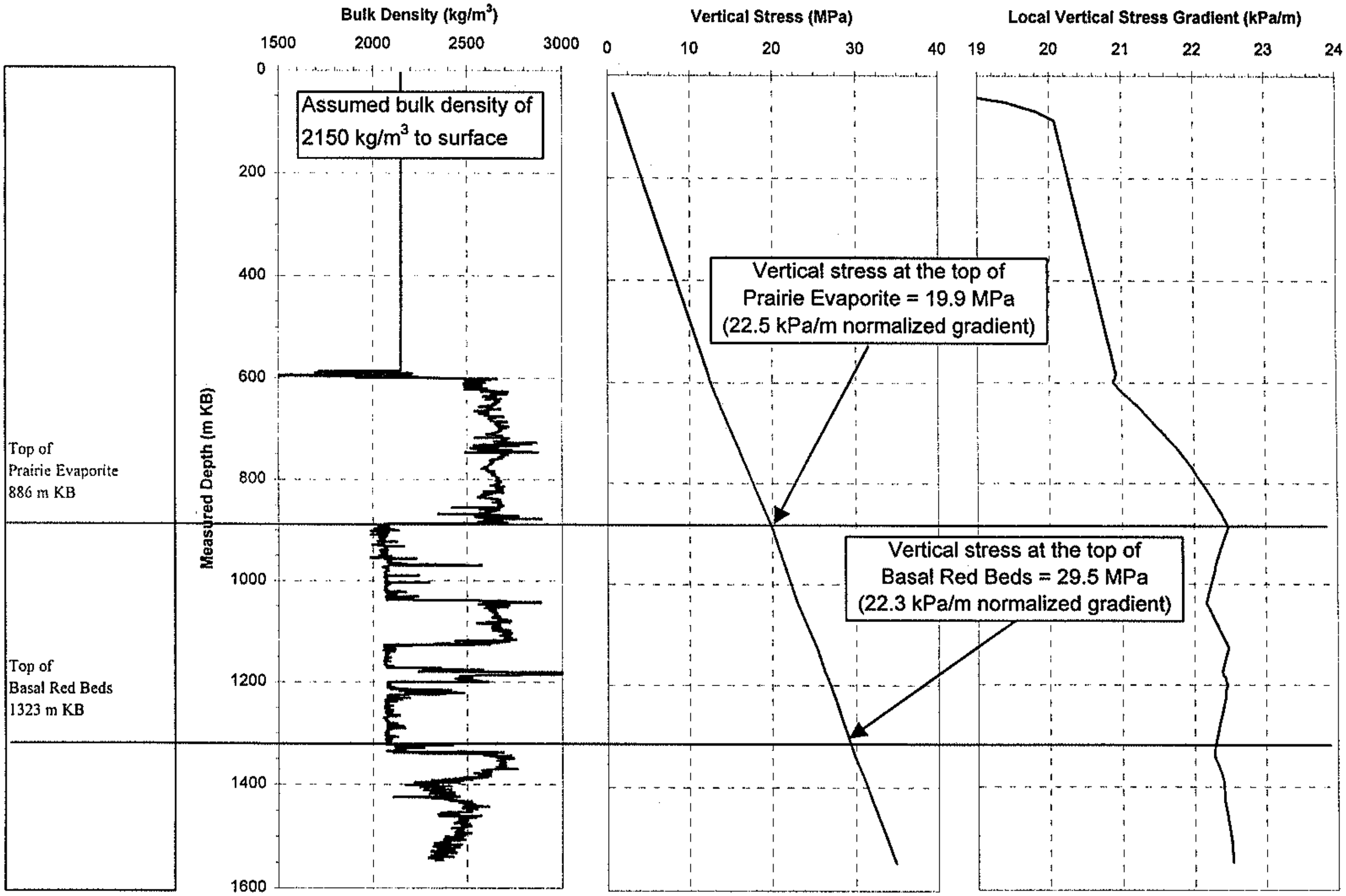


**Figure D.1.11: Calculated vertical stress and vertical stress gradients for Murphy SWD 5 Lind 15-13-58-5.**

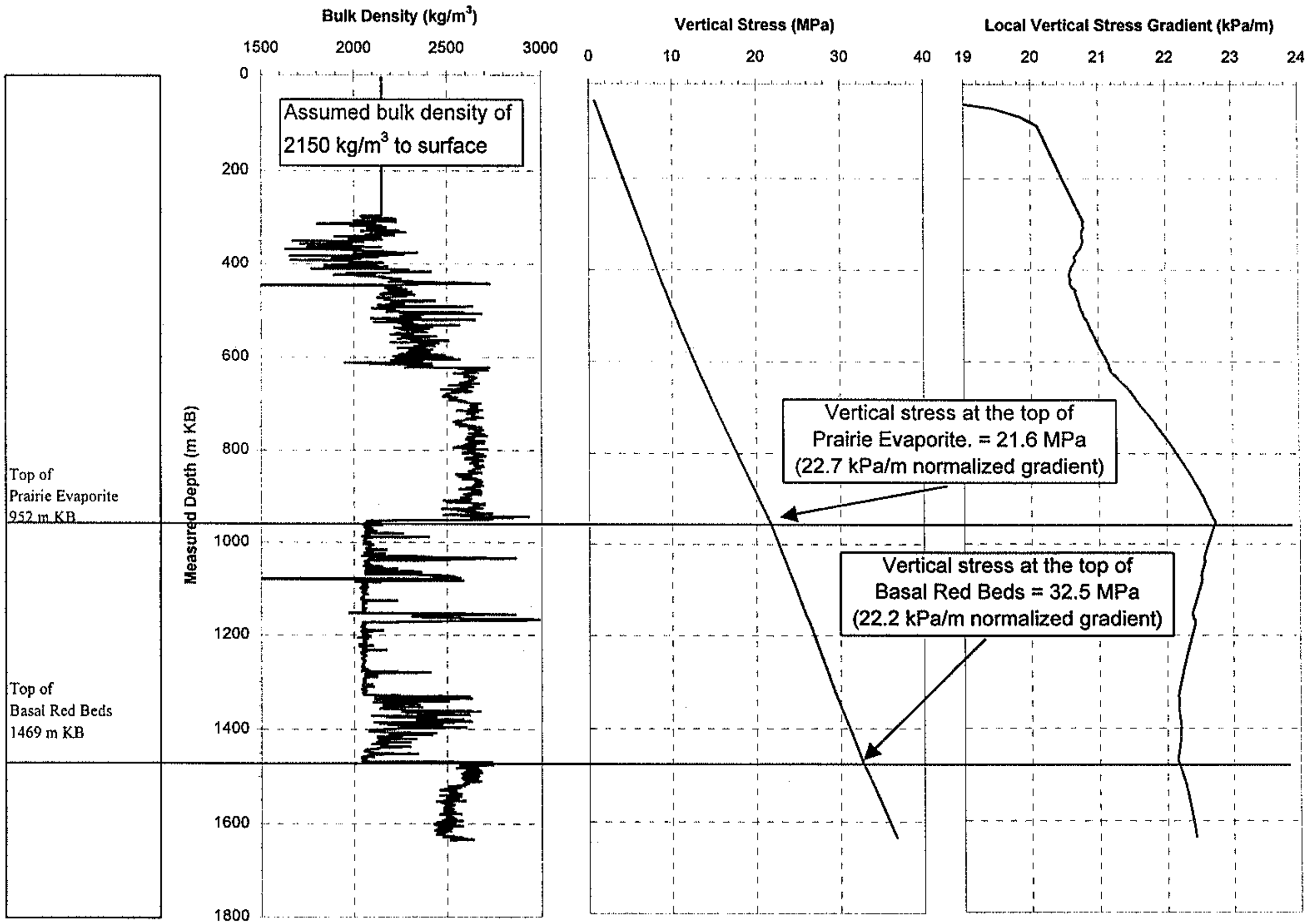


**Figure D.1.12: Calculated vertical stress and vertical stress gradients for Saskoil Sugden 8-1-62-11.**

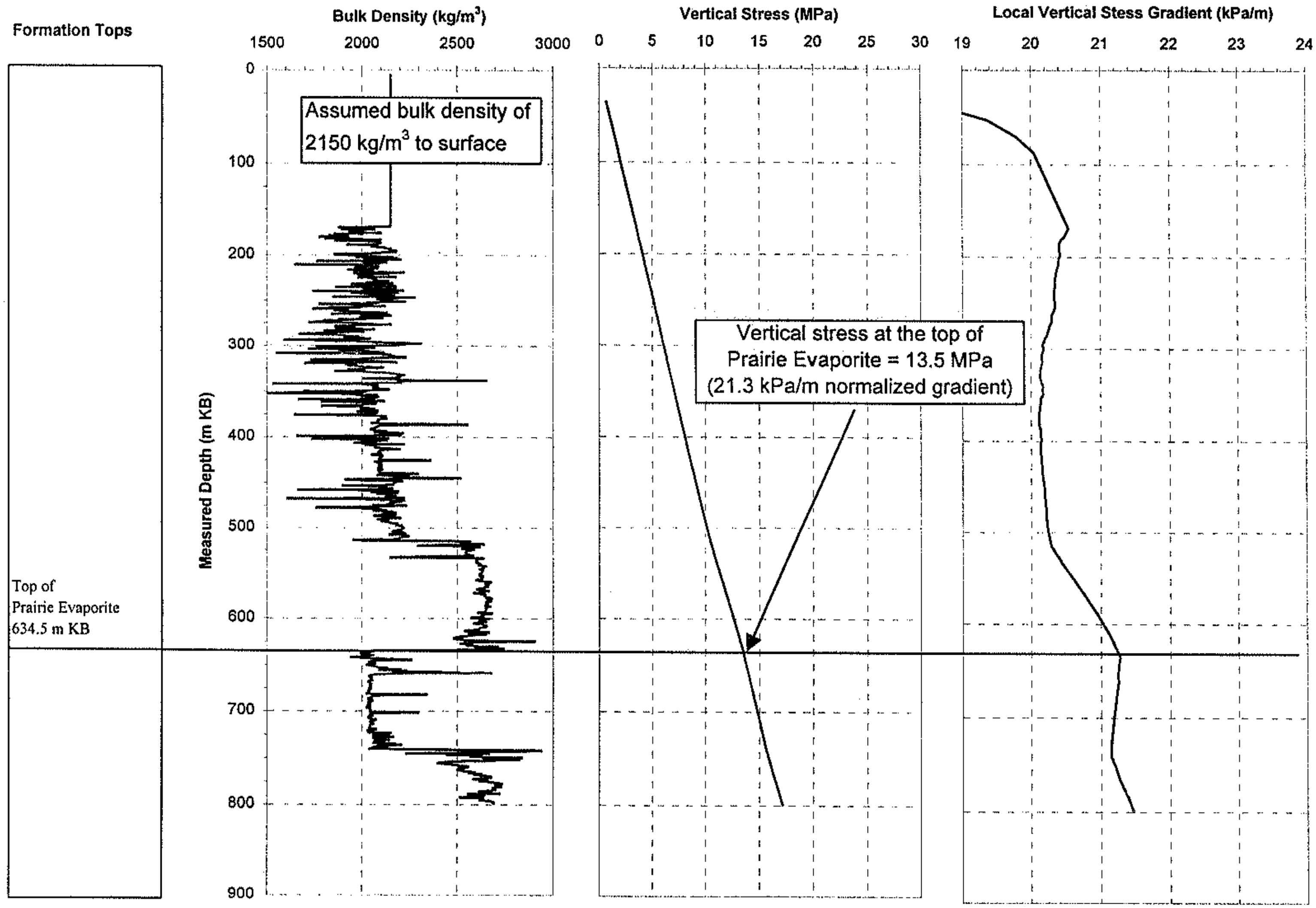


**Figure D.1.13: Calculated vertical stress and vertical stress gradients for Renaissance Cold Lake 1-28-63-2.**

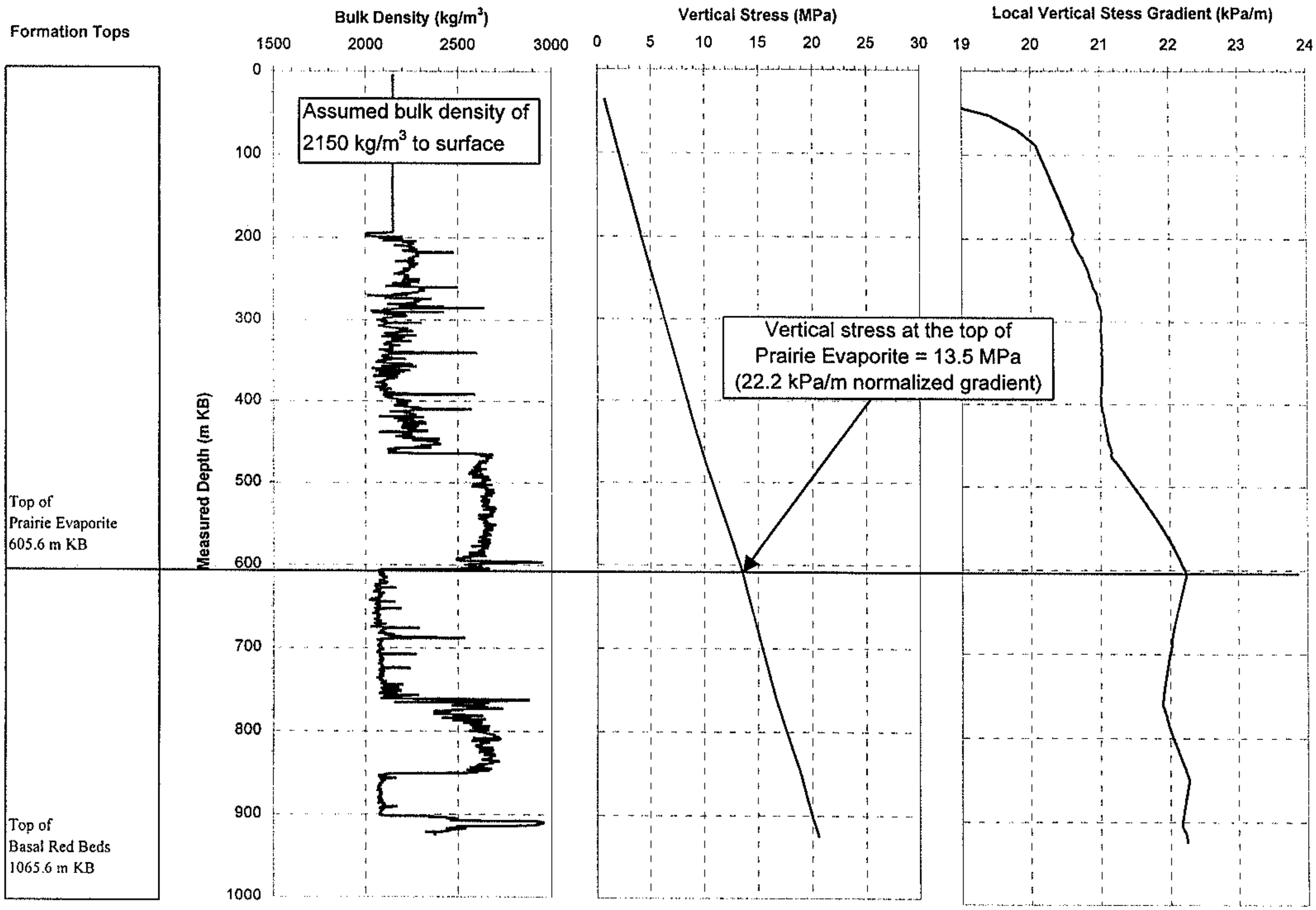


**Figure D.1.14: Calculated vertical stress and vertical stress gradients for Con Beacon Para Coldlk 8-26-63-3.**

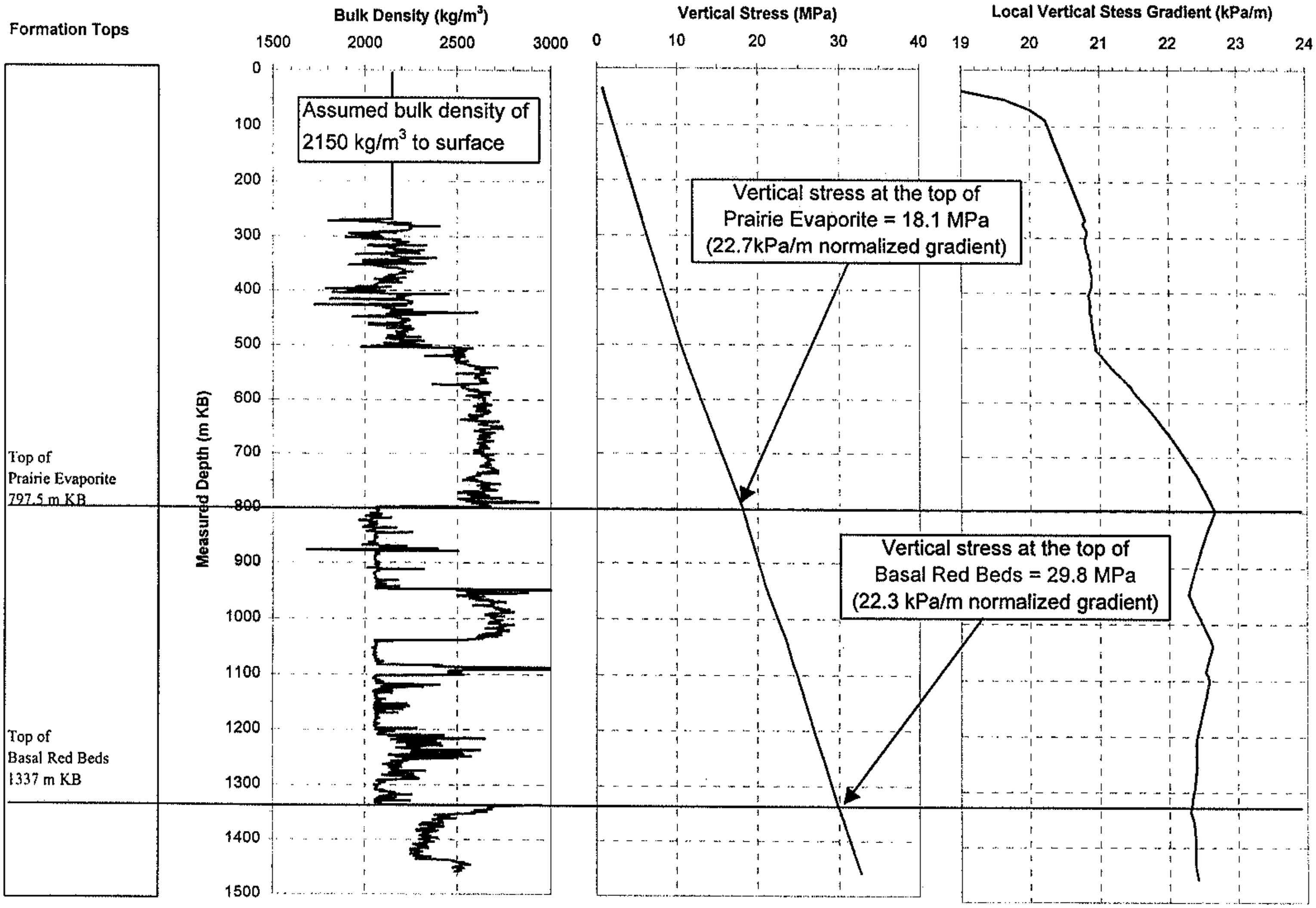


**Figure D.1.15: Calculated vertical stress and vertical stress gradients for Cdnoxy SWD 2 Sugden 6-13-63-8.**

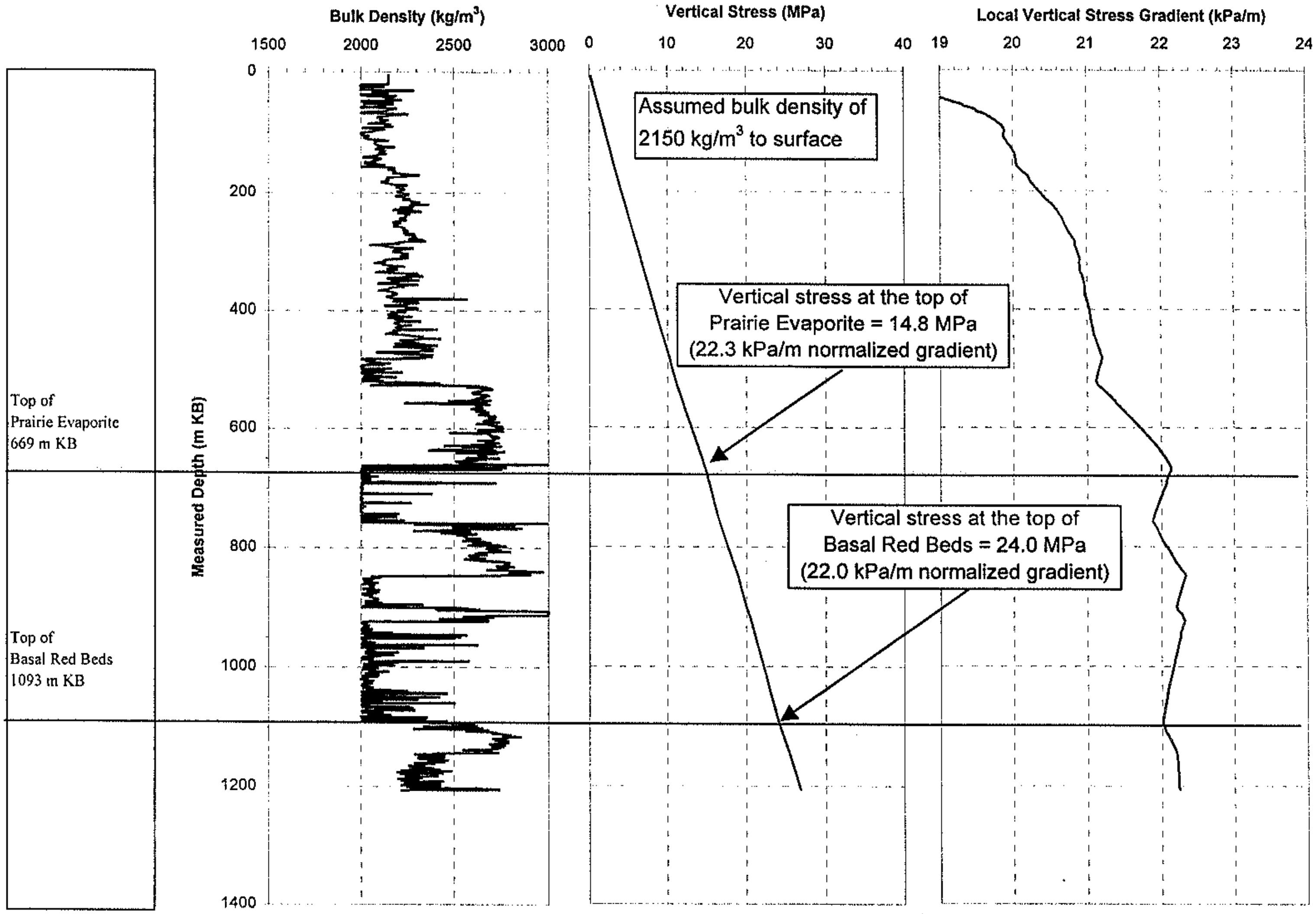


**Figure D.1.16: Calculated vertical stress and vertical stress gradients for Esso Marie OV 15-20-64-2.**

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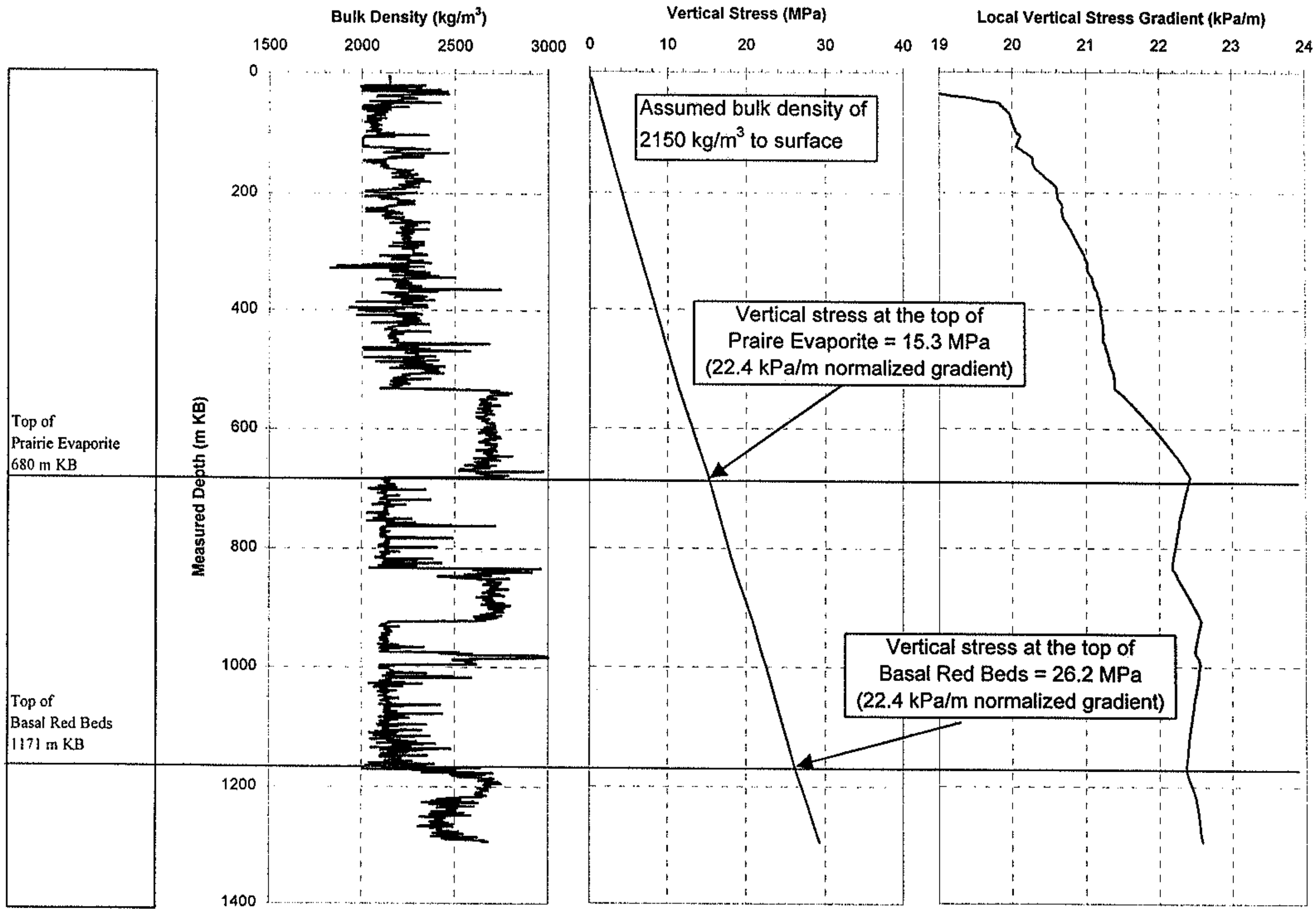


**Figure D.1.17: Calculated vertical stress and vertical stress gradients for Esso 79 SWD 7-18-64-3.**

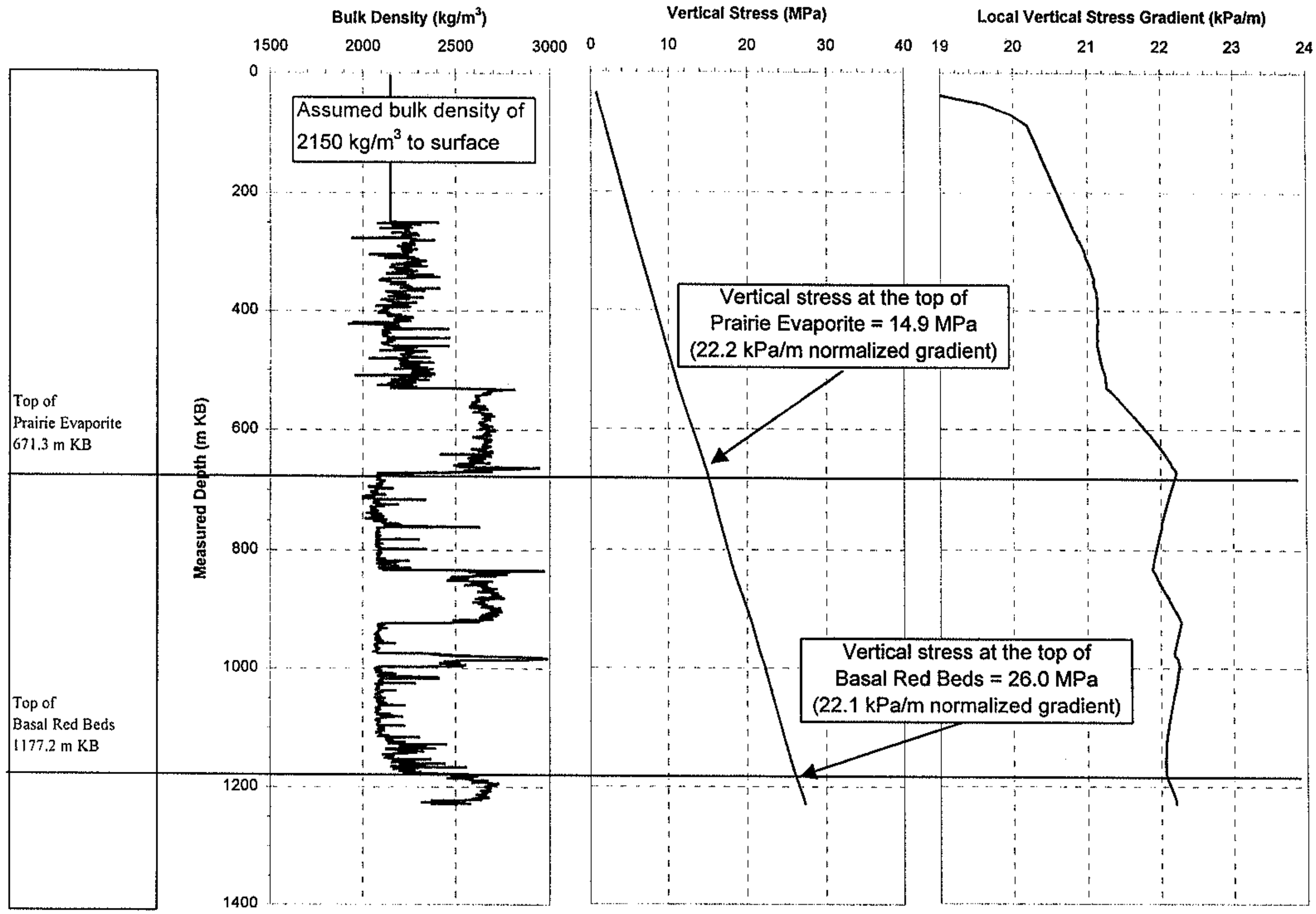


**Figure D.1.18: Calculated vertical stress and vertical stress gradients for Esso 85 SWS Ethellk 1-19-64-3.**

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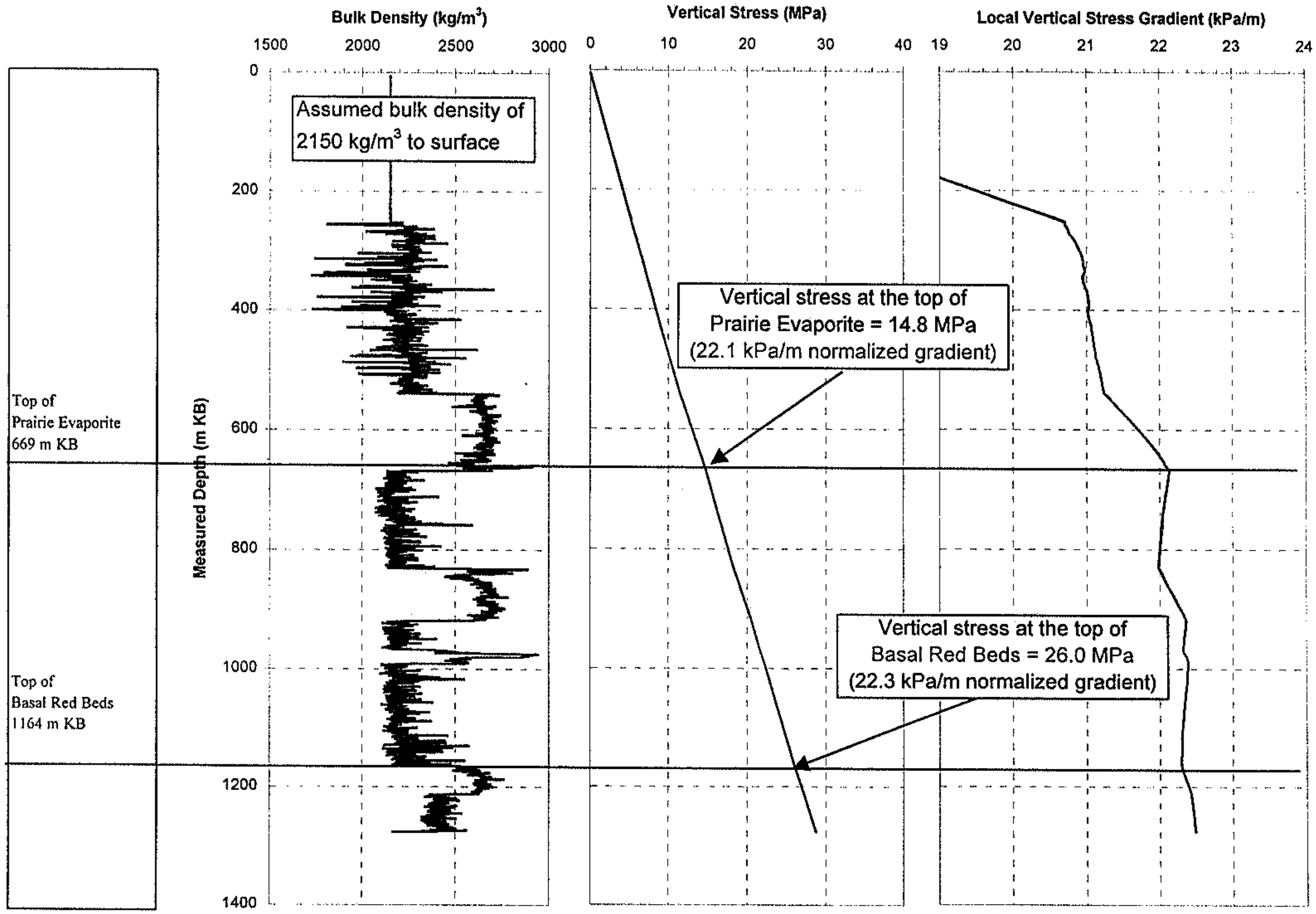


**Figure D.1.19: Calculated vertical stress and vertical stress gradients for Esso 83 SWD Ethellk 11-22-64-3.**

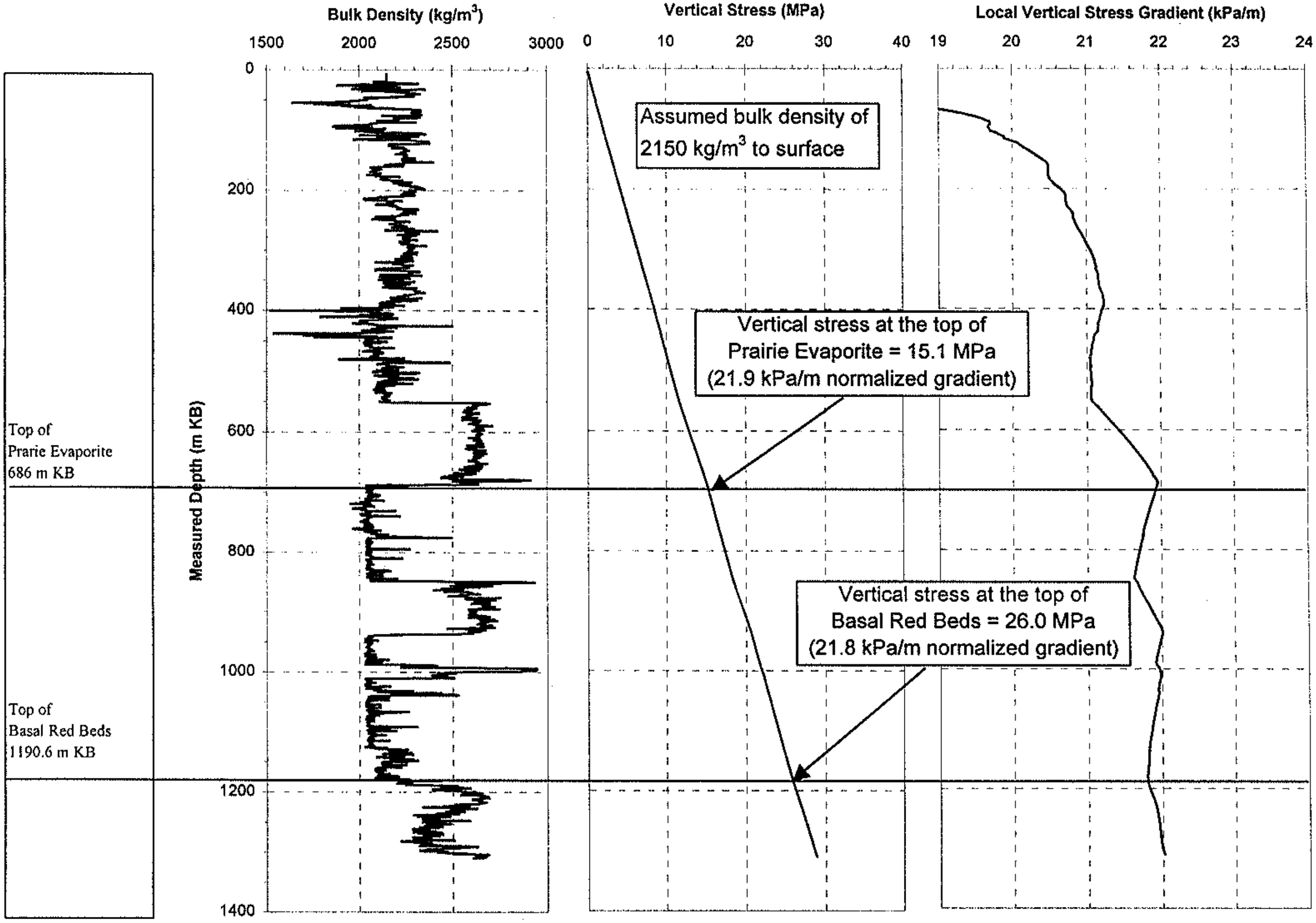


**Figure D.1.20: Calculated vertical stress and vertical stress gradients for Esso 81 SWD Ethellk 3-29-64-3.**

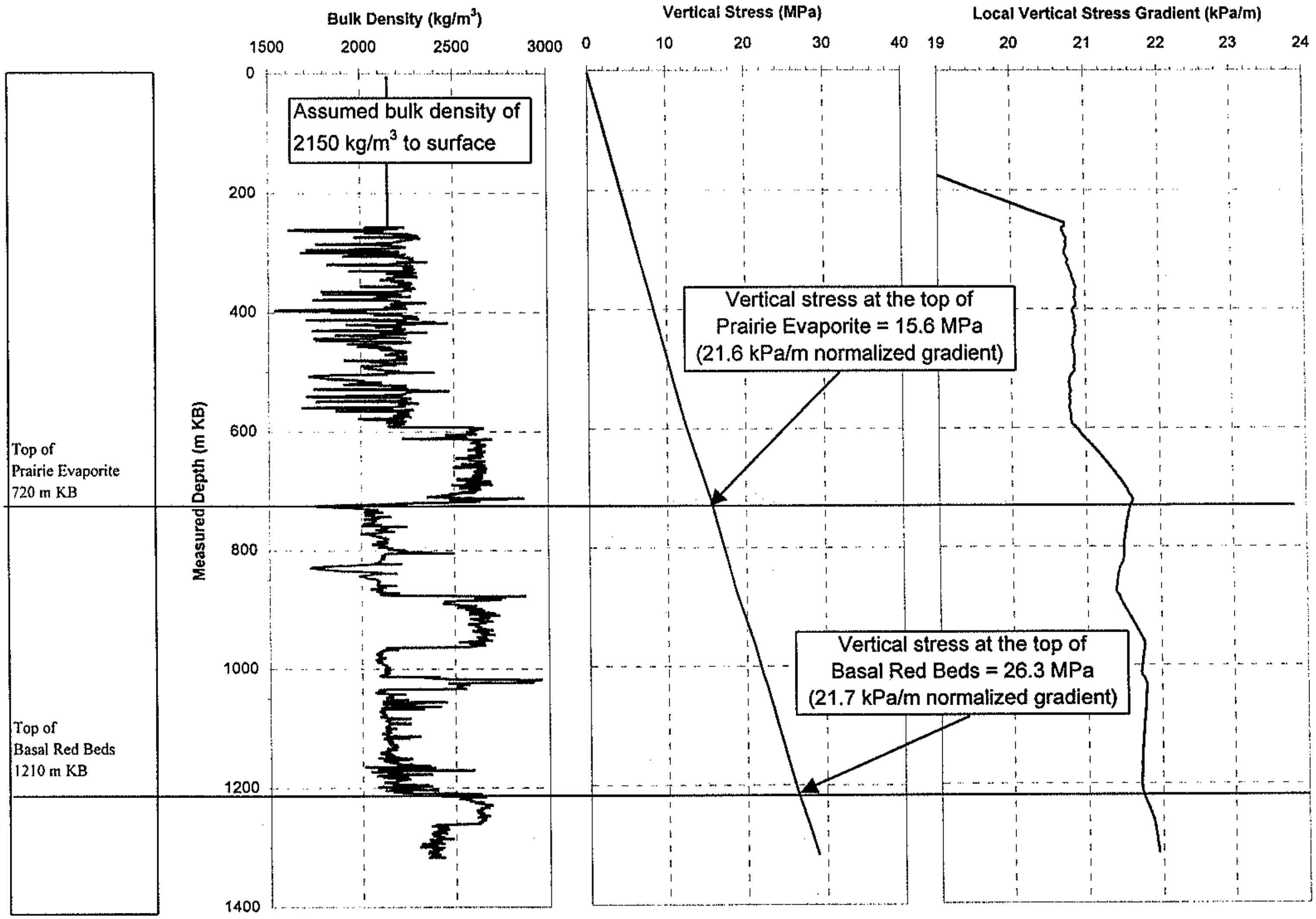


**Figure D.1.21: Calculated vertical stress and vertical stress gradients for Esso 83 INJ Ethellk 8-33-64-3.**

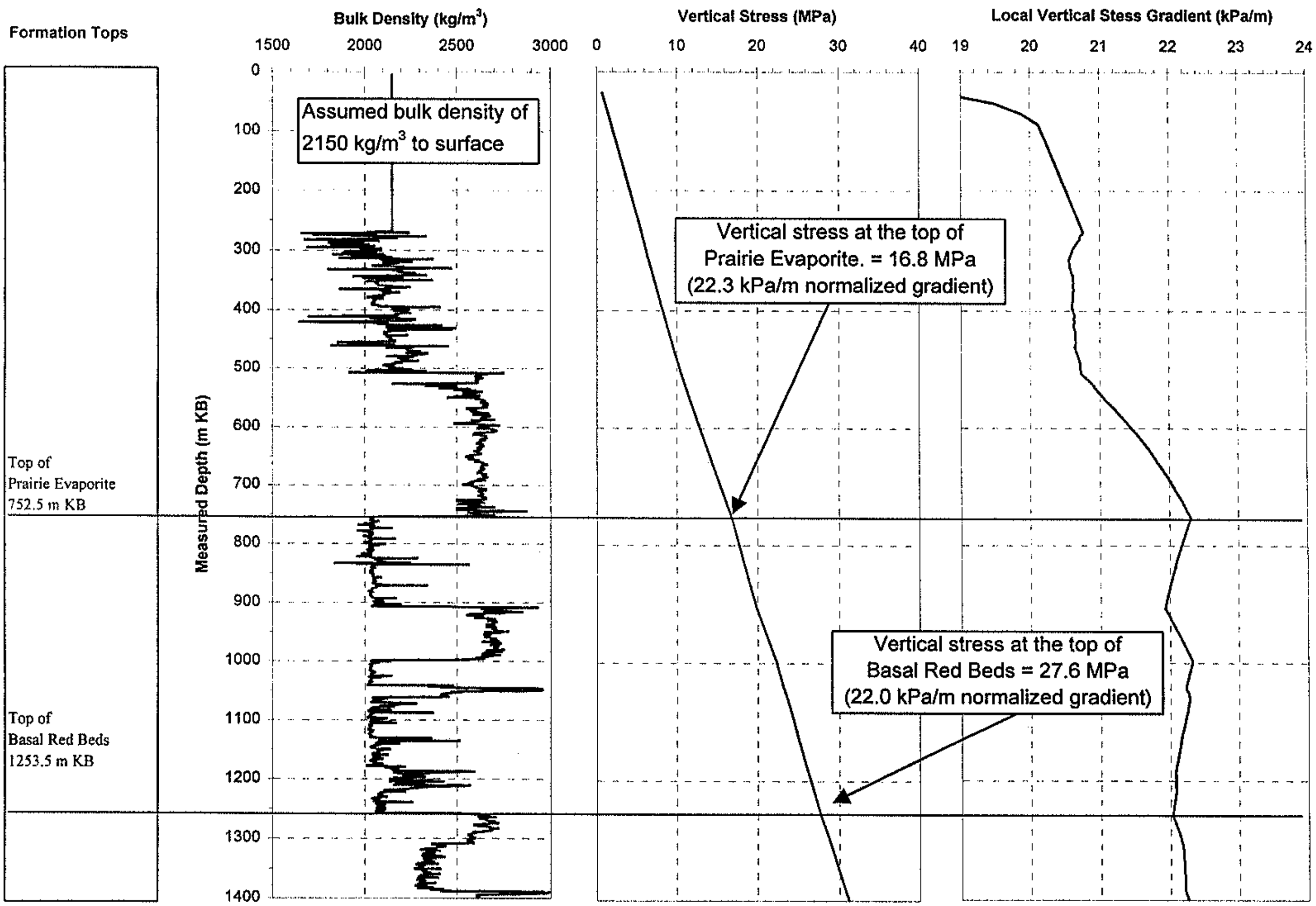


**Figure D.1.22: Calculated vertical stress and vertical stress gradients for Mobil Garth 5-6-64-6.**

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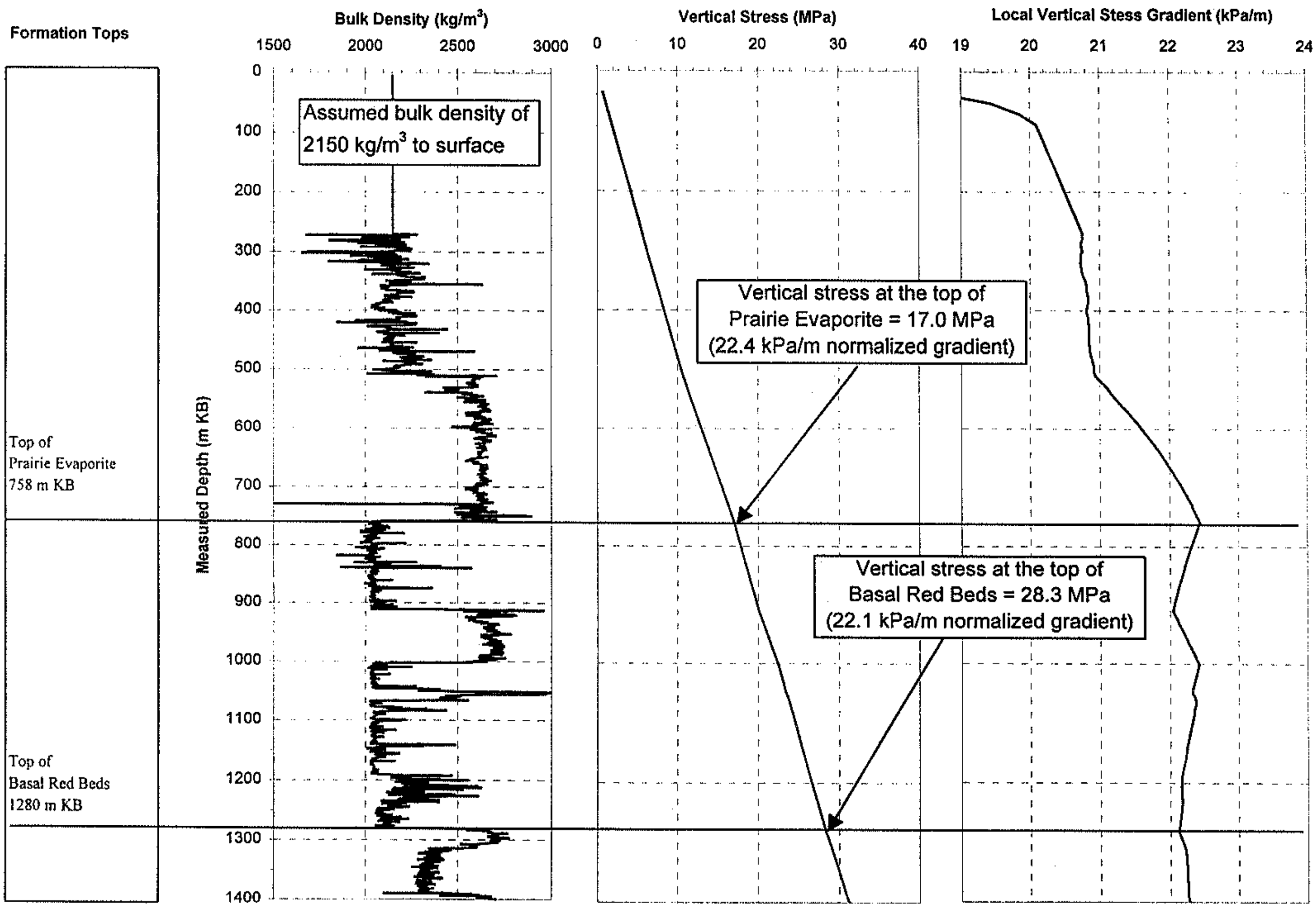


**Figure D.1.23: Calculated vertical stress and vertical stress gradients for Mobil Garth 12-6-64-6.**

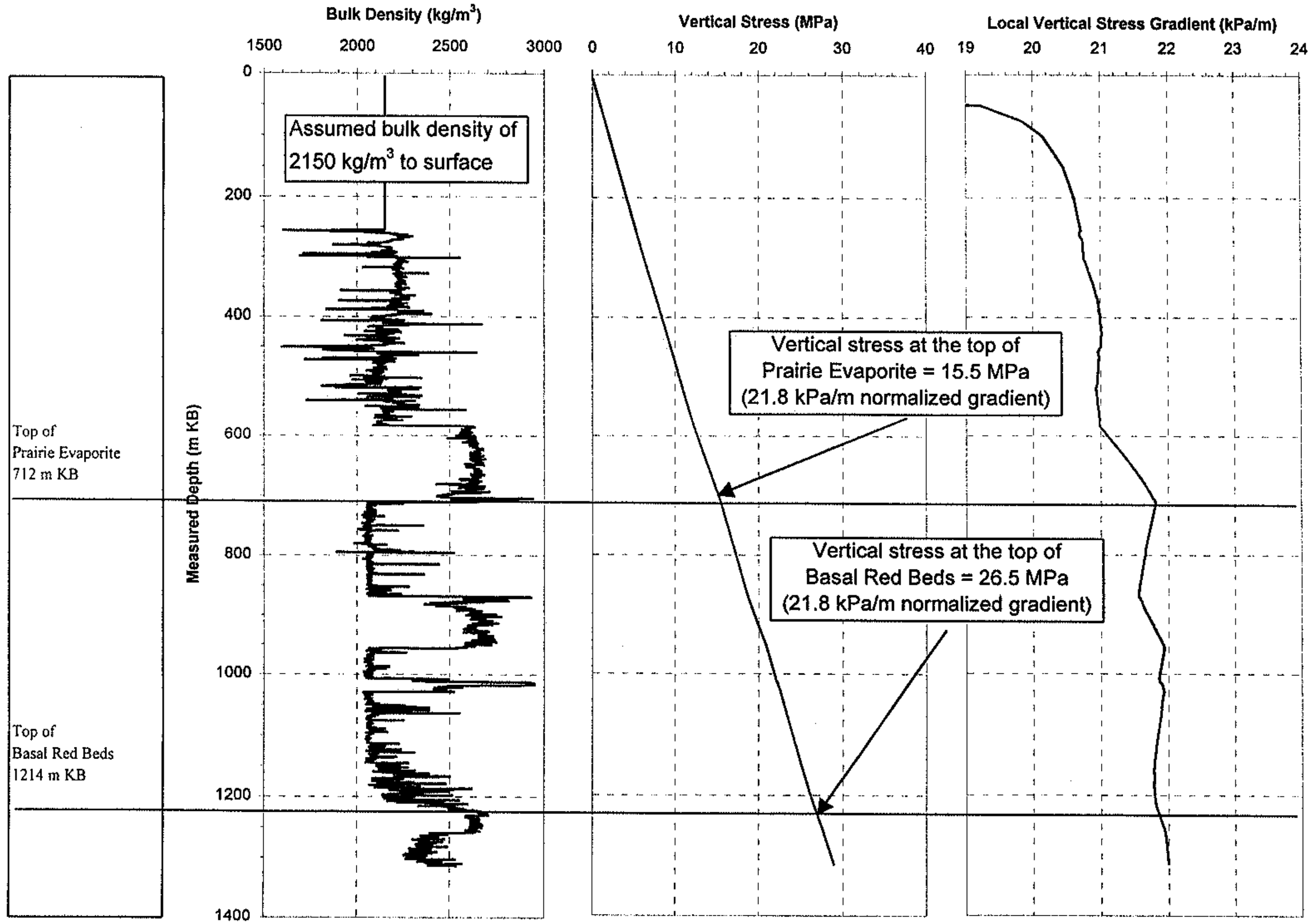


**Figure D.1.24: Calculated vertical stress and vertical stress gradients for ESSO 83 SWD Ethellk 2-3-65-3.**

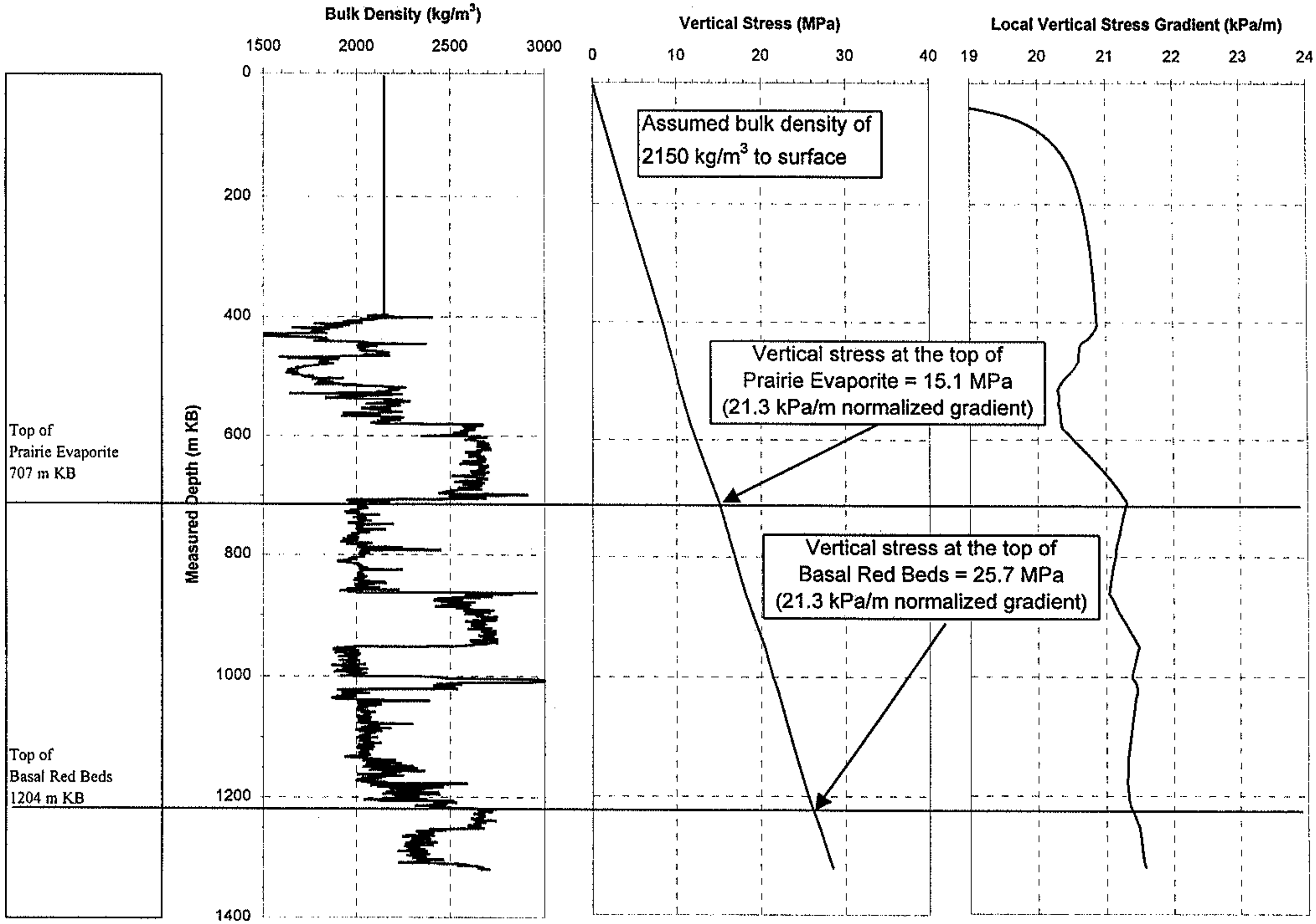


**Figure D.1.25: Calculated vertical stress and vertical stress gradients for ESSO SWD Ethellk 3-4-65-3.**

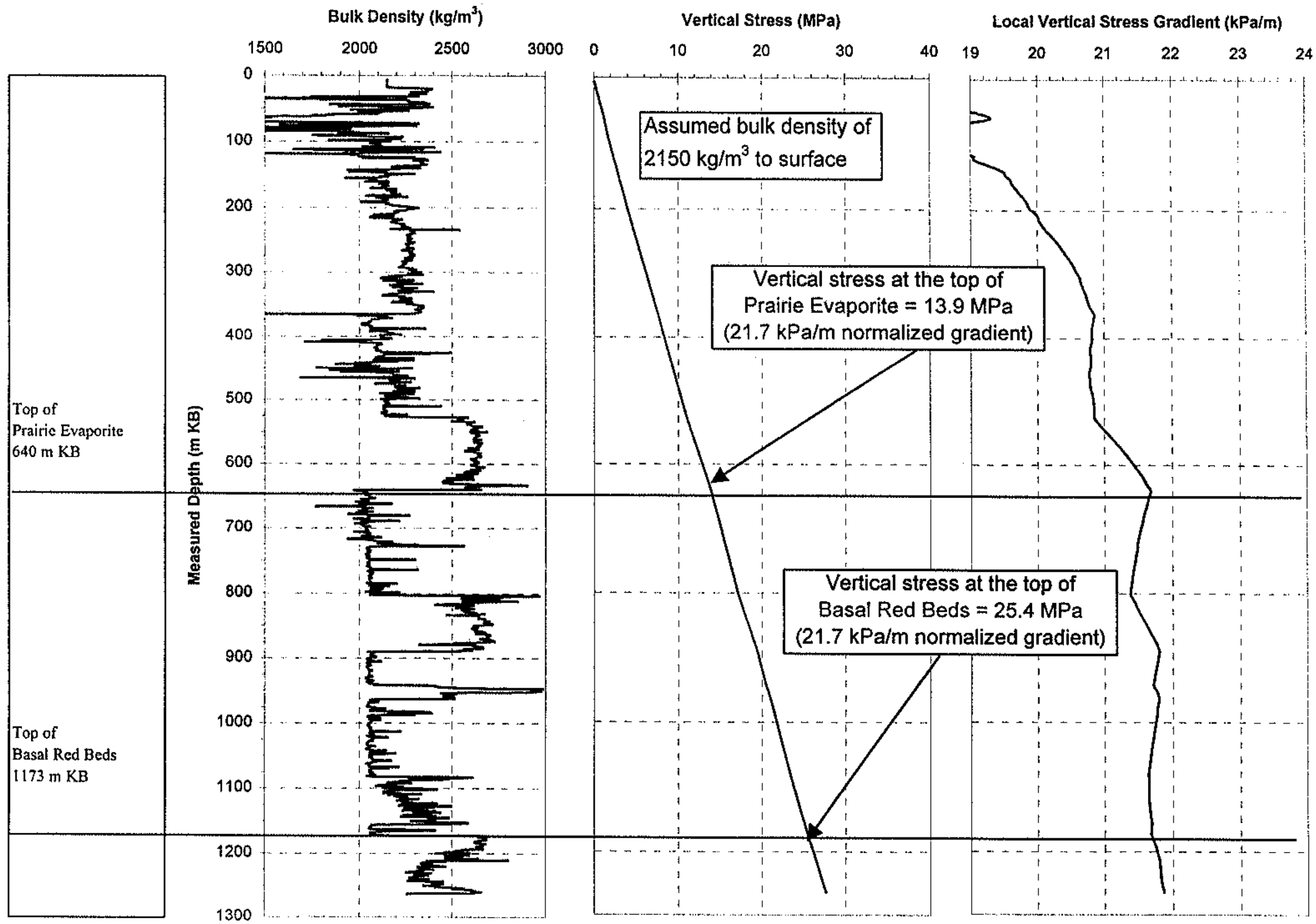


**Figure D.1.26: Calculated vertical stress and vertical stress gradients for ESSO 81 Ethellk OV 9-20-65-3.**

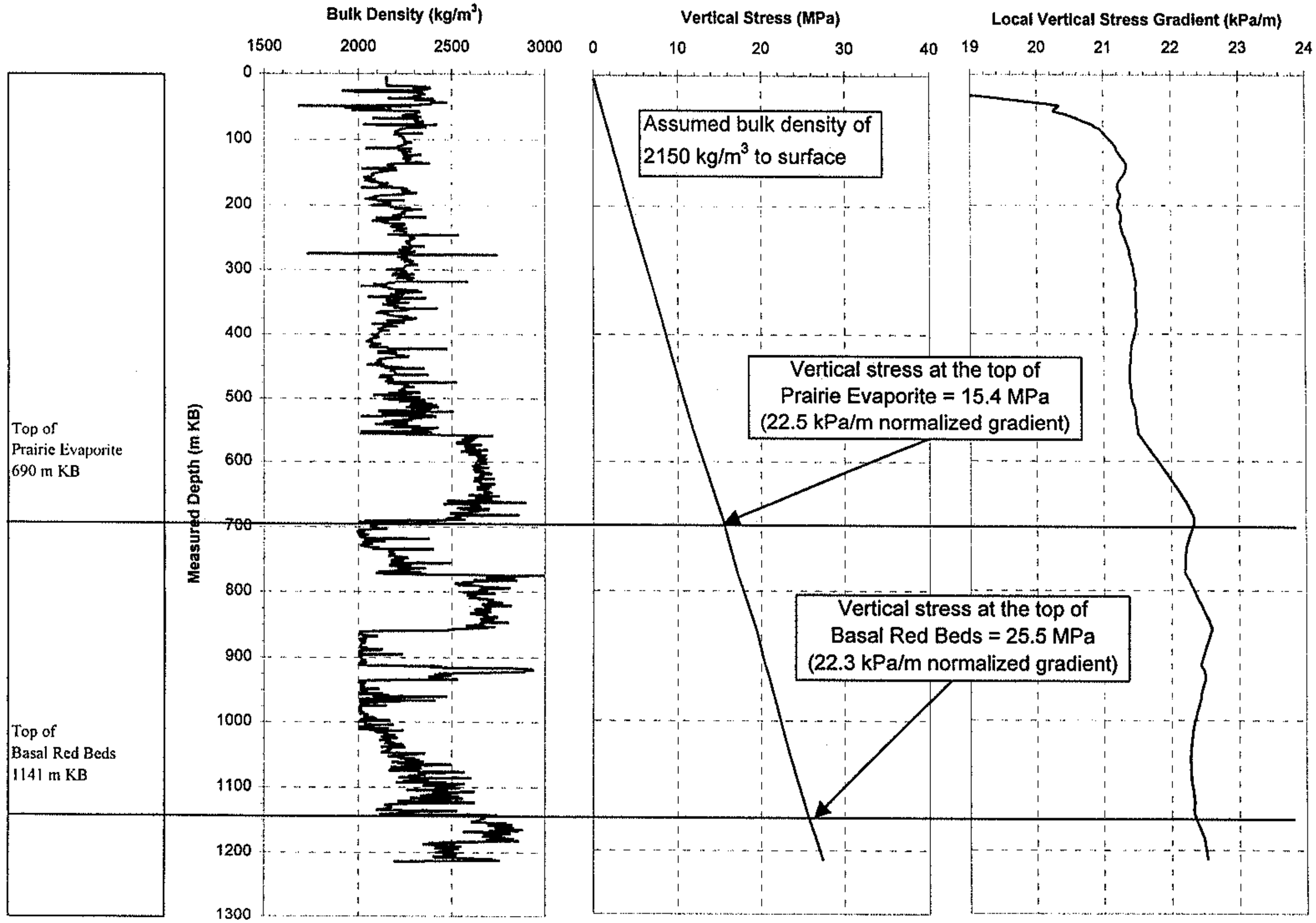


**Figure D.1.27: Calculated vertical stress and vertical stress gradients for ESSO Medley OV 6-8-66-2.**

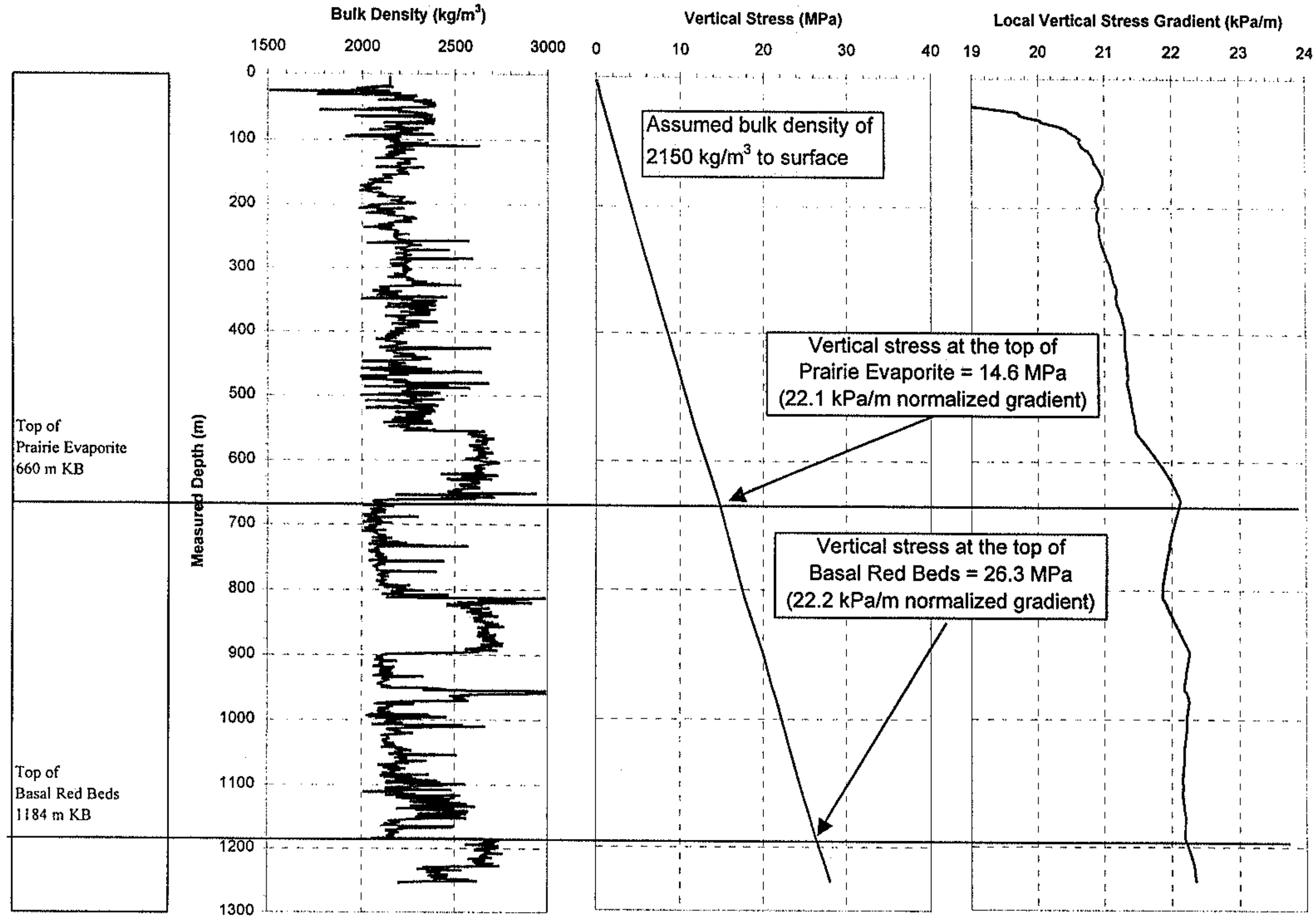


**Figure D.1.28: Calculated vertical stress and vertical stress gradients for ESSO Medley OV 14-28-66-3.**

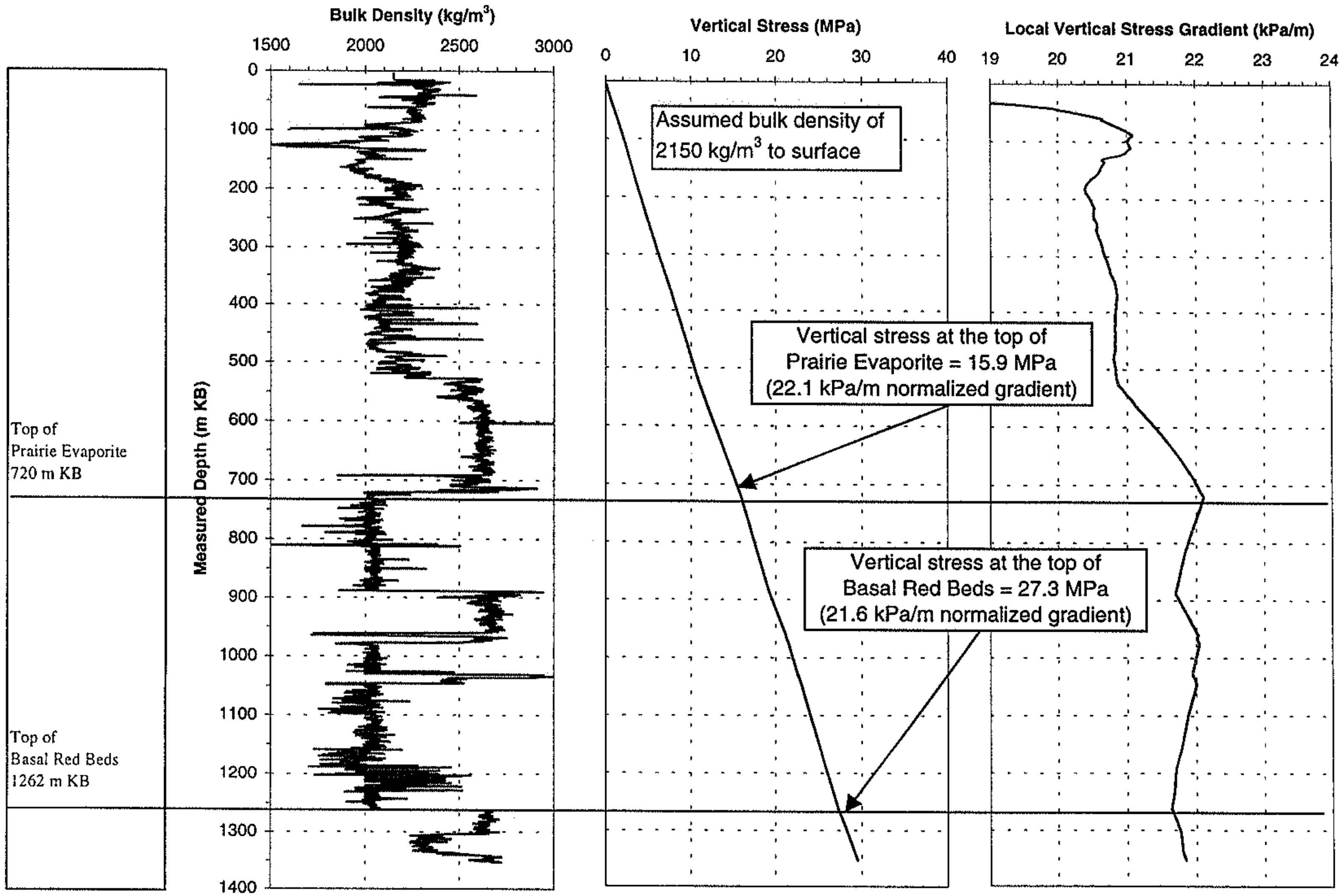


**Figure D.1.29: Calculated vertical stress and vertical stress gradients for BP PCI Marglk 10-8-66-5.**

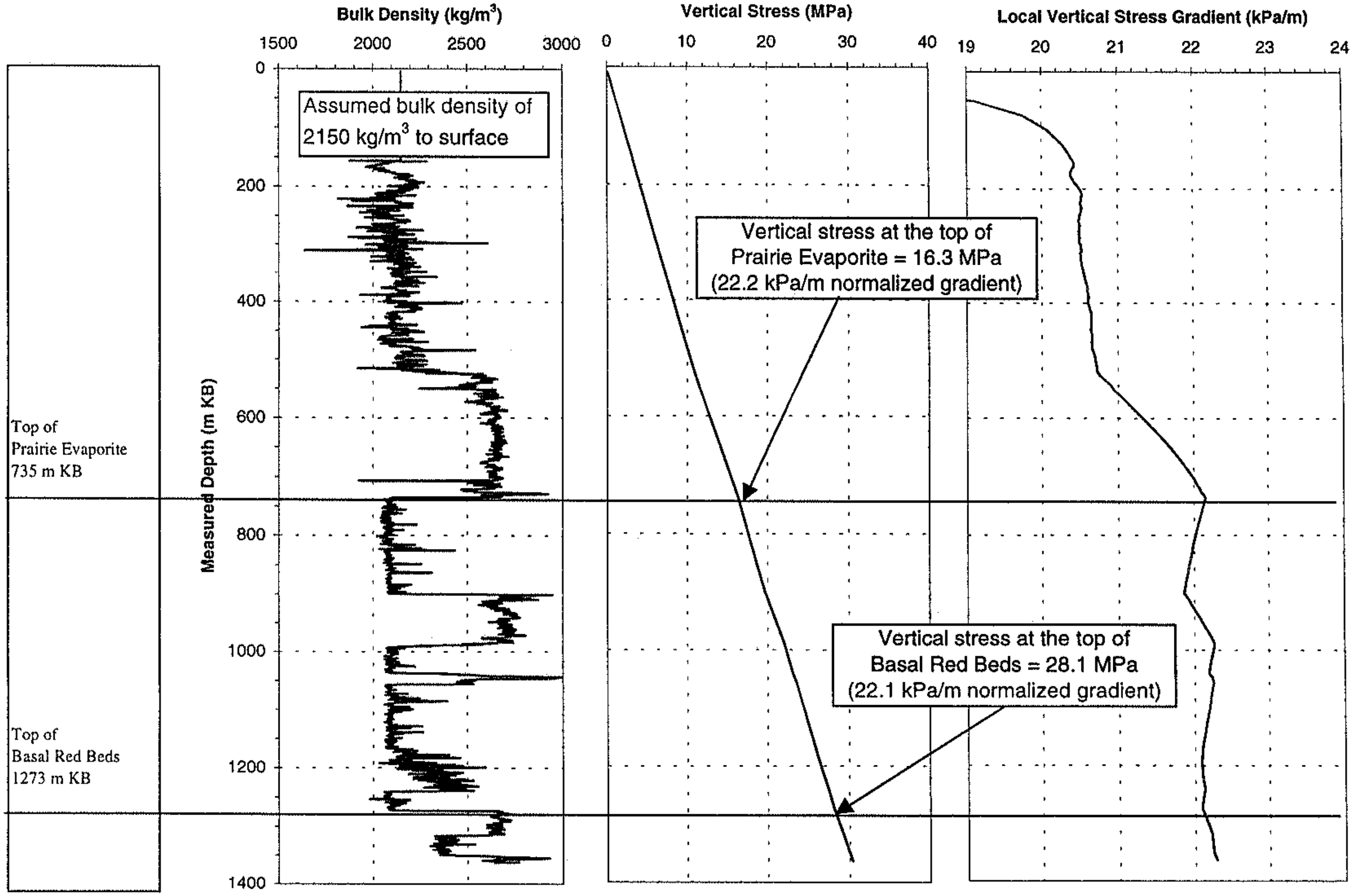


**Figure D.1.30: Calculated vertical stress and vertical stress gradients for BP Leming 10-10-66-6.**

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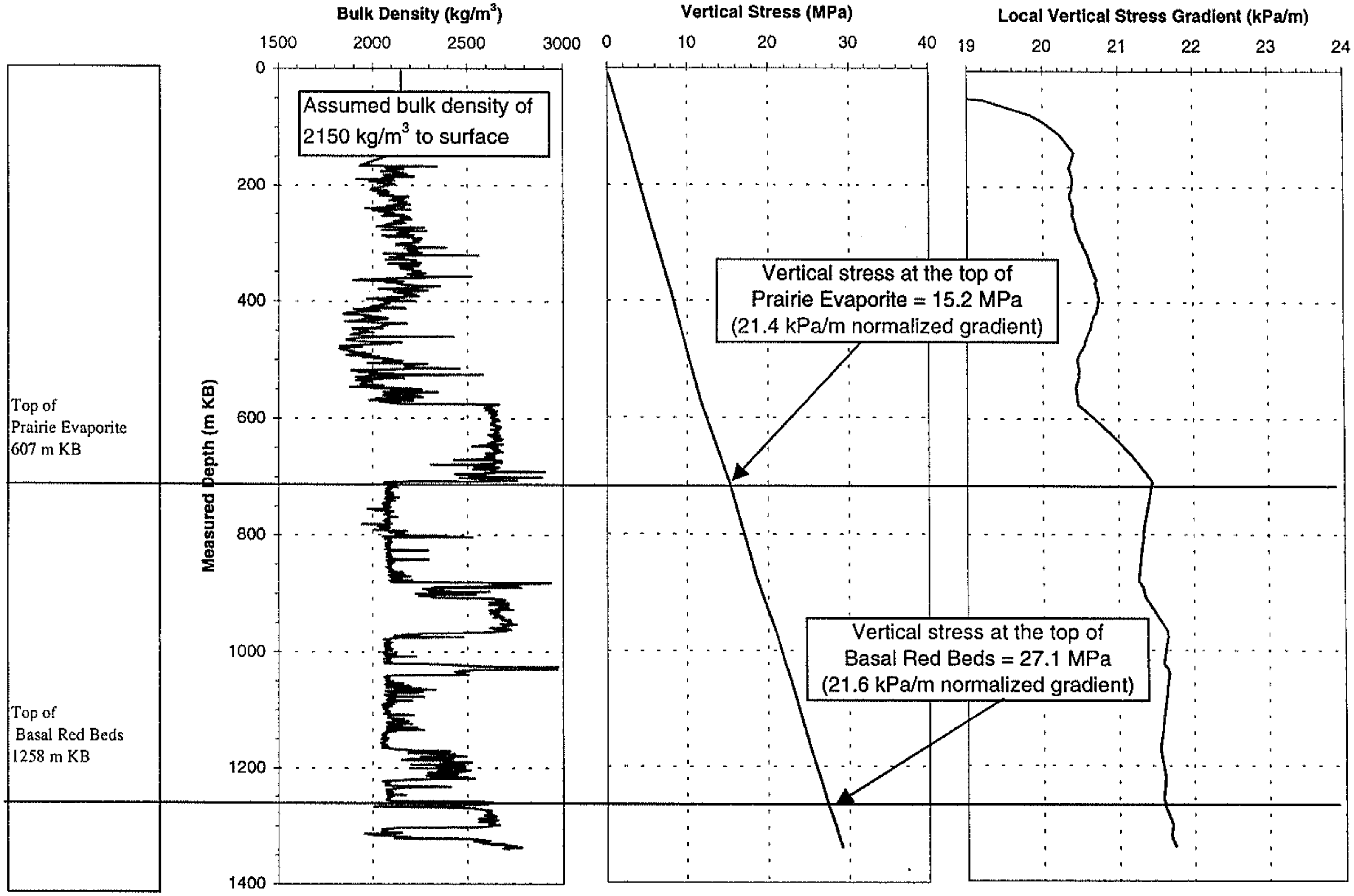
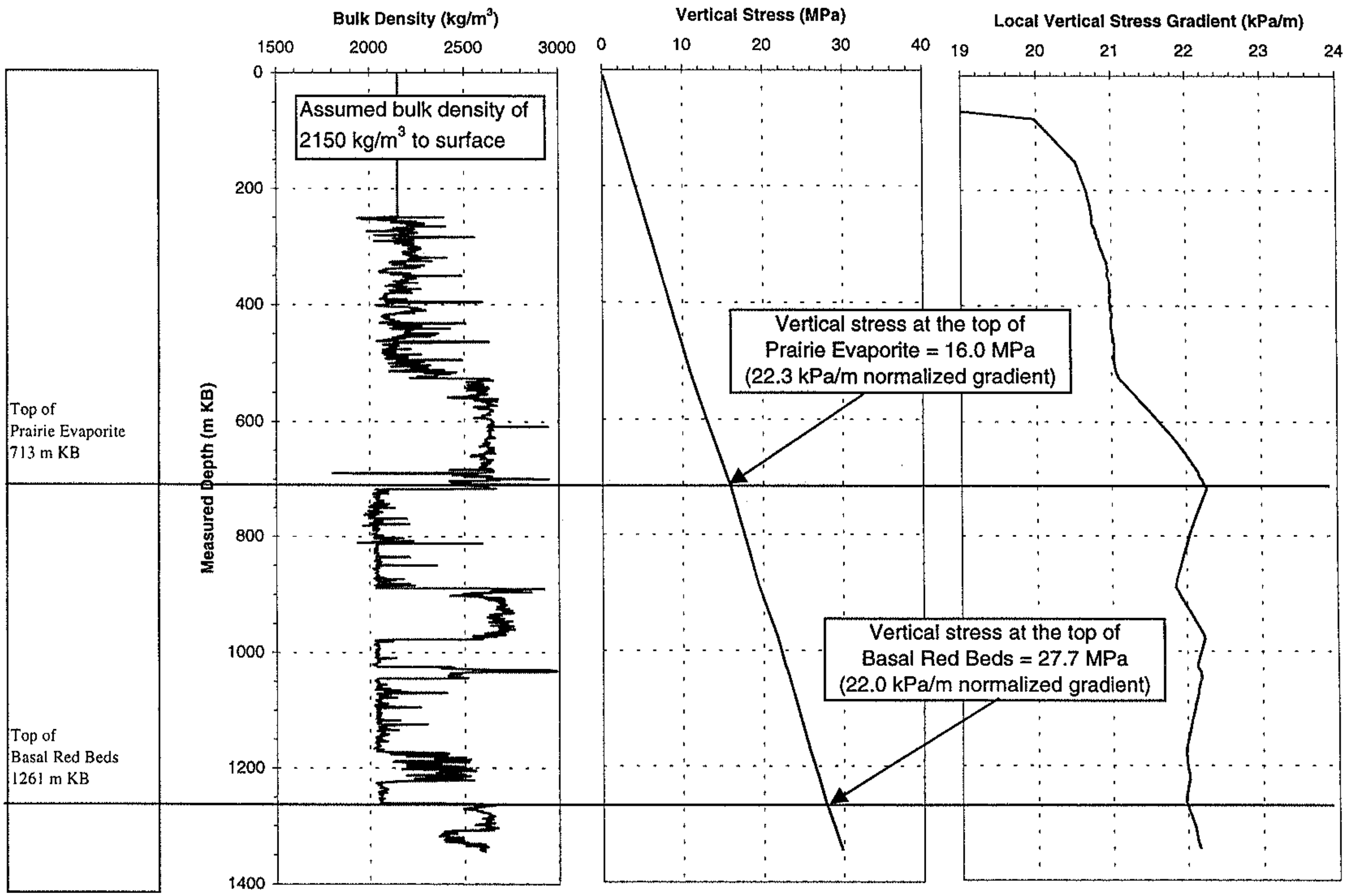



**Figure D.1.31: Calculated vertical stress and vertical stress gradients for Amoco 10B4 Moore 10-5-67-4.**




**Fugure D.1.32: Calculated vertical stress and vertical stress gradients for Esso AEC 85 Fishck 7-11-67-6.**

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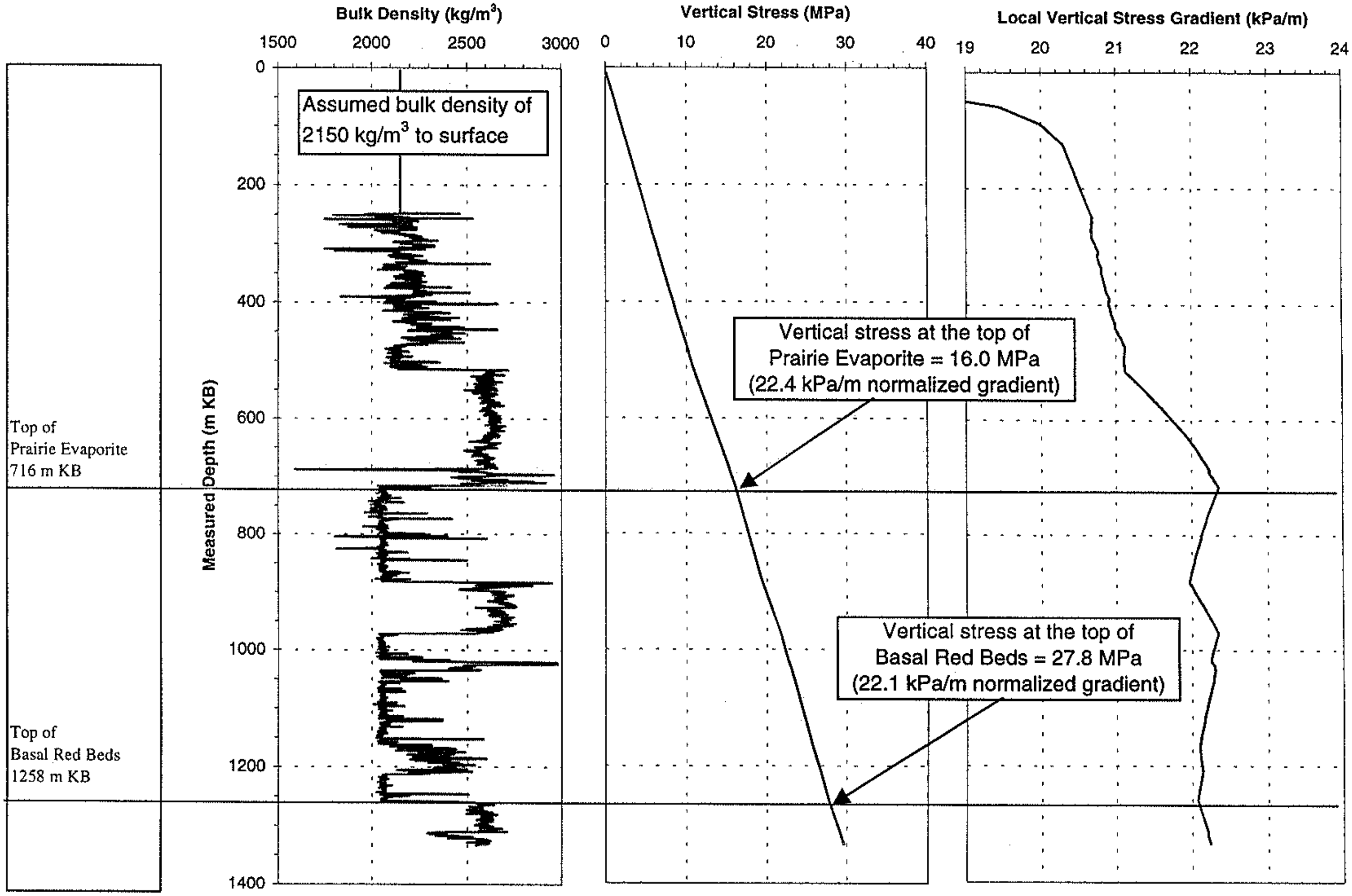


**Figure D.1.33: Calculated vertical stress and vertical stress gradients for Esso AEC 85 Fishck 12-31-67-7.**

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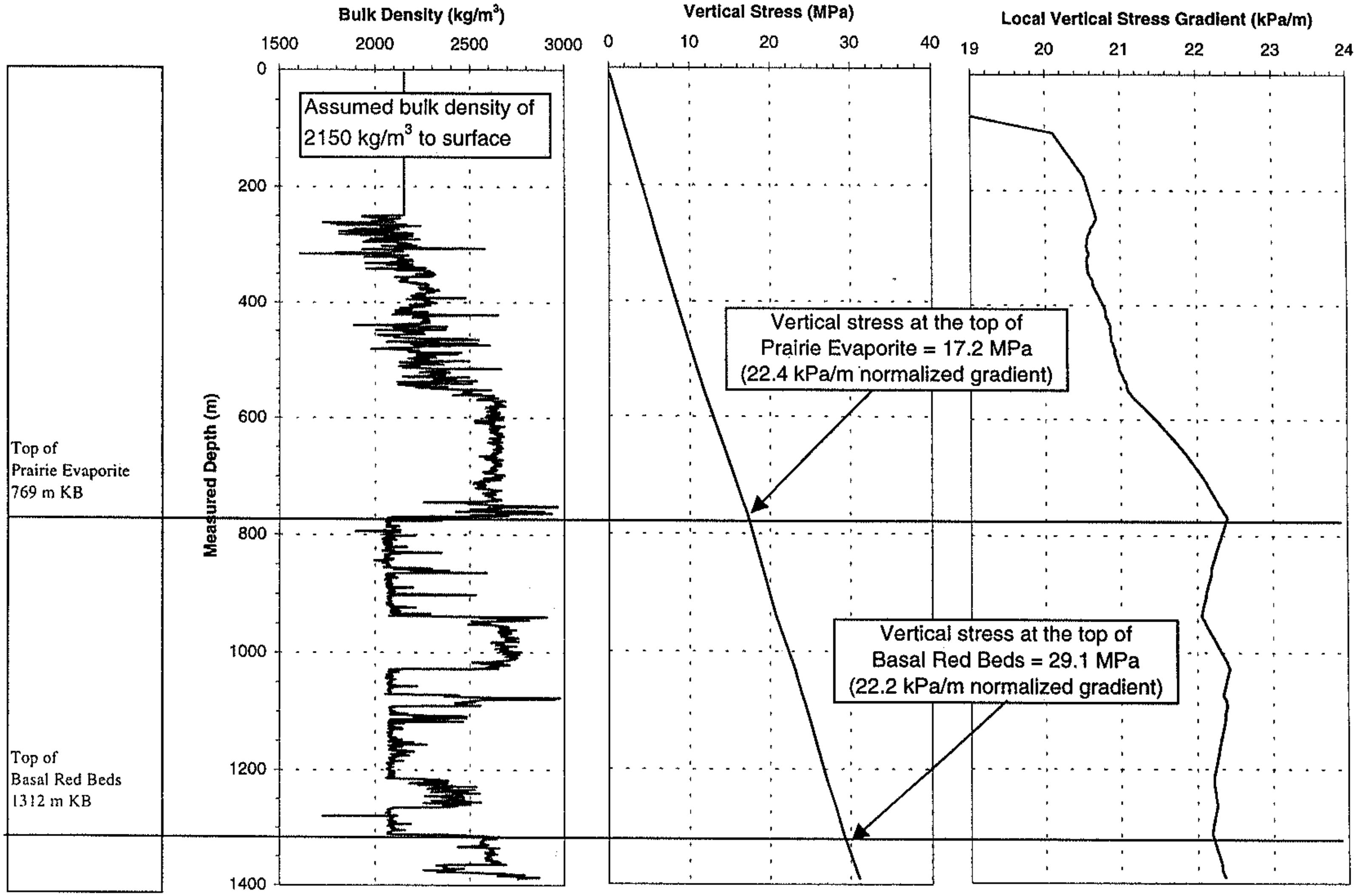


**Figure D.1.34: Calculated vertical stress and vertical stress gradients for Esso AEC 85 Fishck 7-34-67-8.**

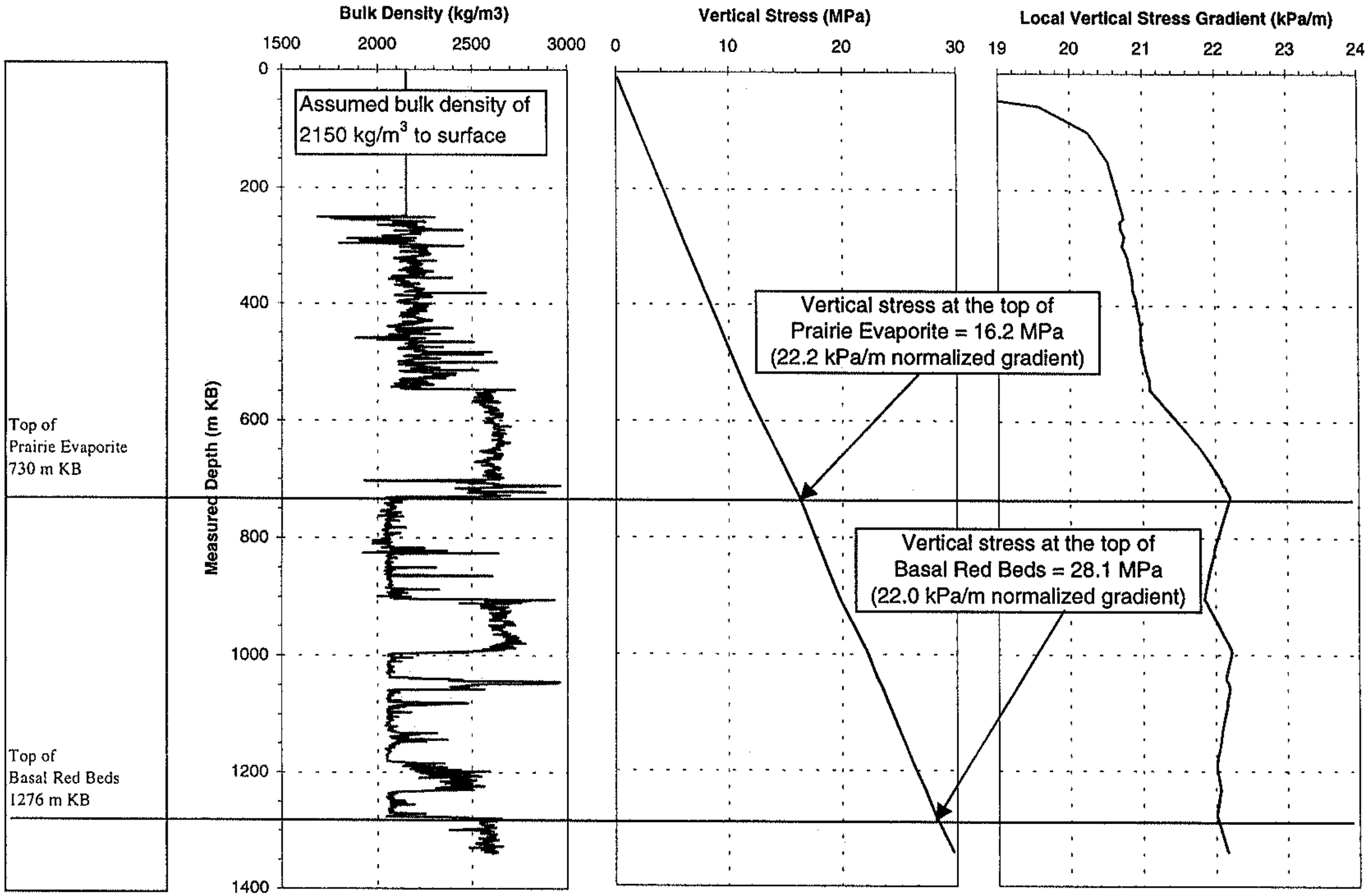


**Figure D.1.35: Calculated vertical stress and vertical stress gradients for ESSO AEC 85 FISHCK 11-19-68-6.**

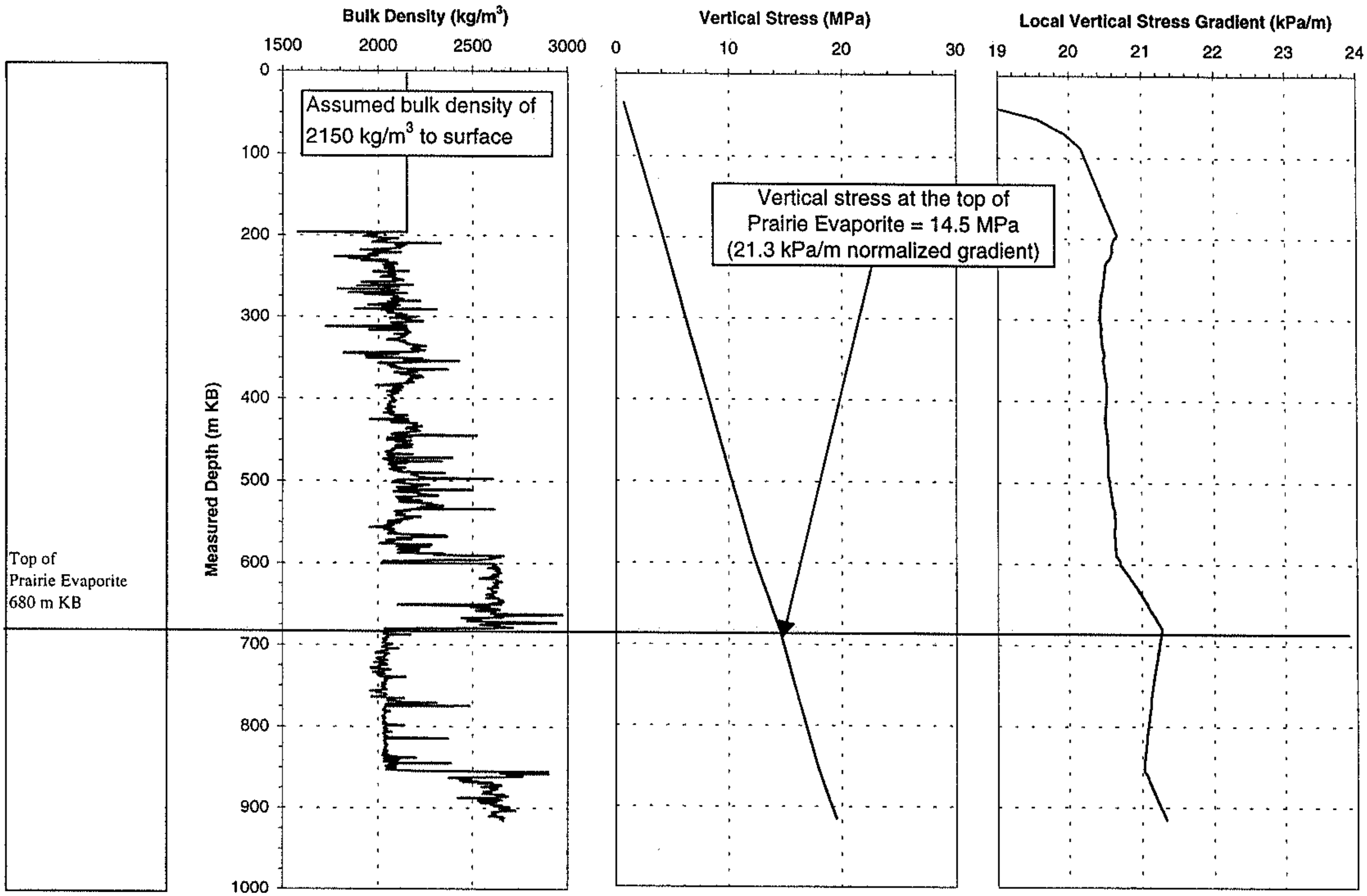


**Figure D.1.36: Calculated vertical stress and vertical stress gradients for AECOG (NE) Fisher 8D-12-69-5.**

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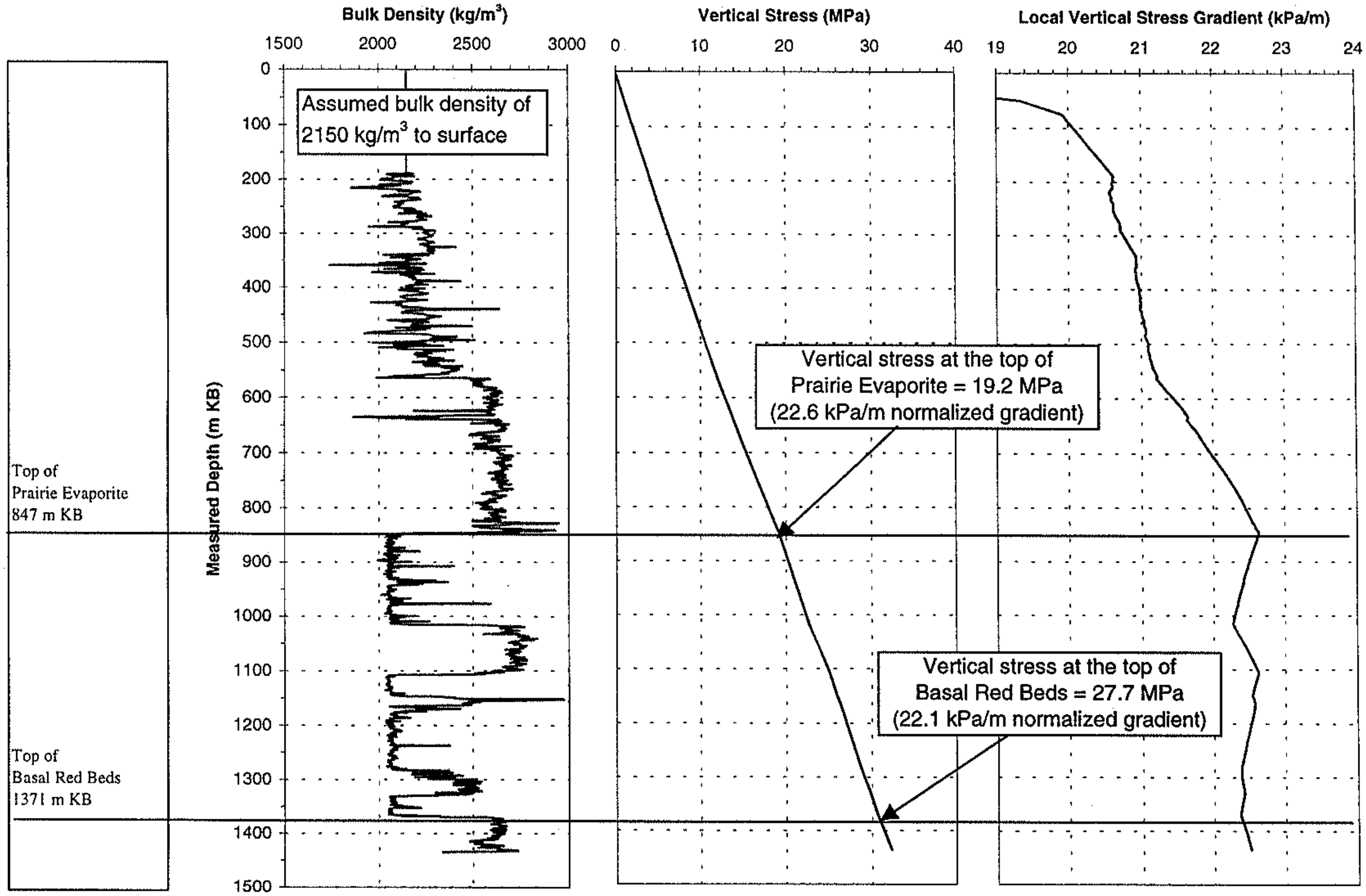


**Figure D.1.37: Calculated vertical stress and vertical stress gradients for Arco Heart Lake 11-26-69-10.**

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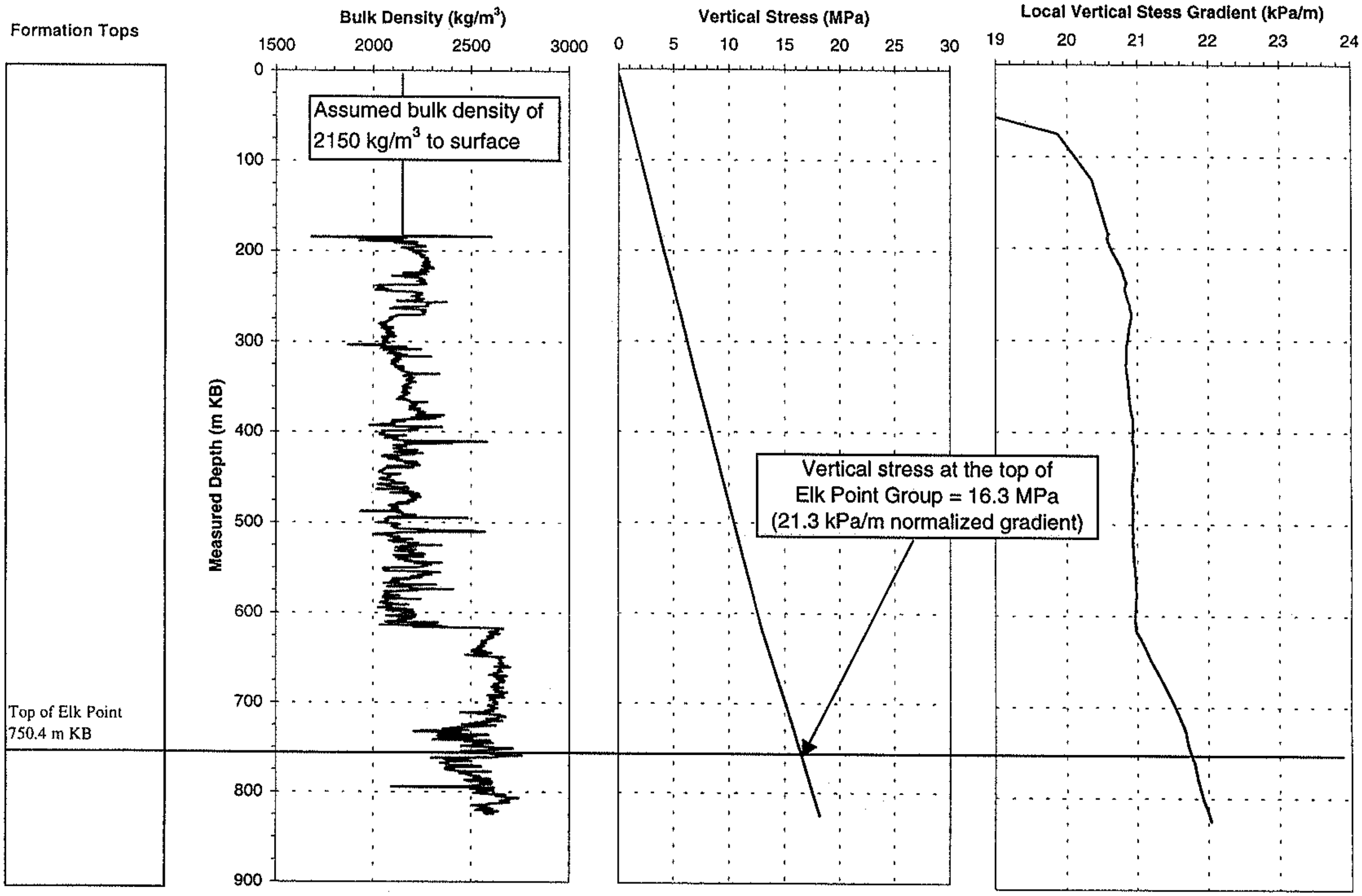


**Figure D.1.38: Calculated vertical stress and vertical stress gradients for AEC et al Scheltens 16-13-71-1.**

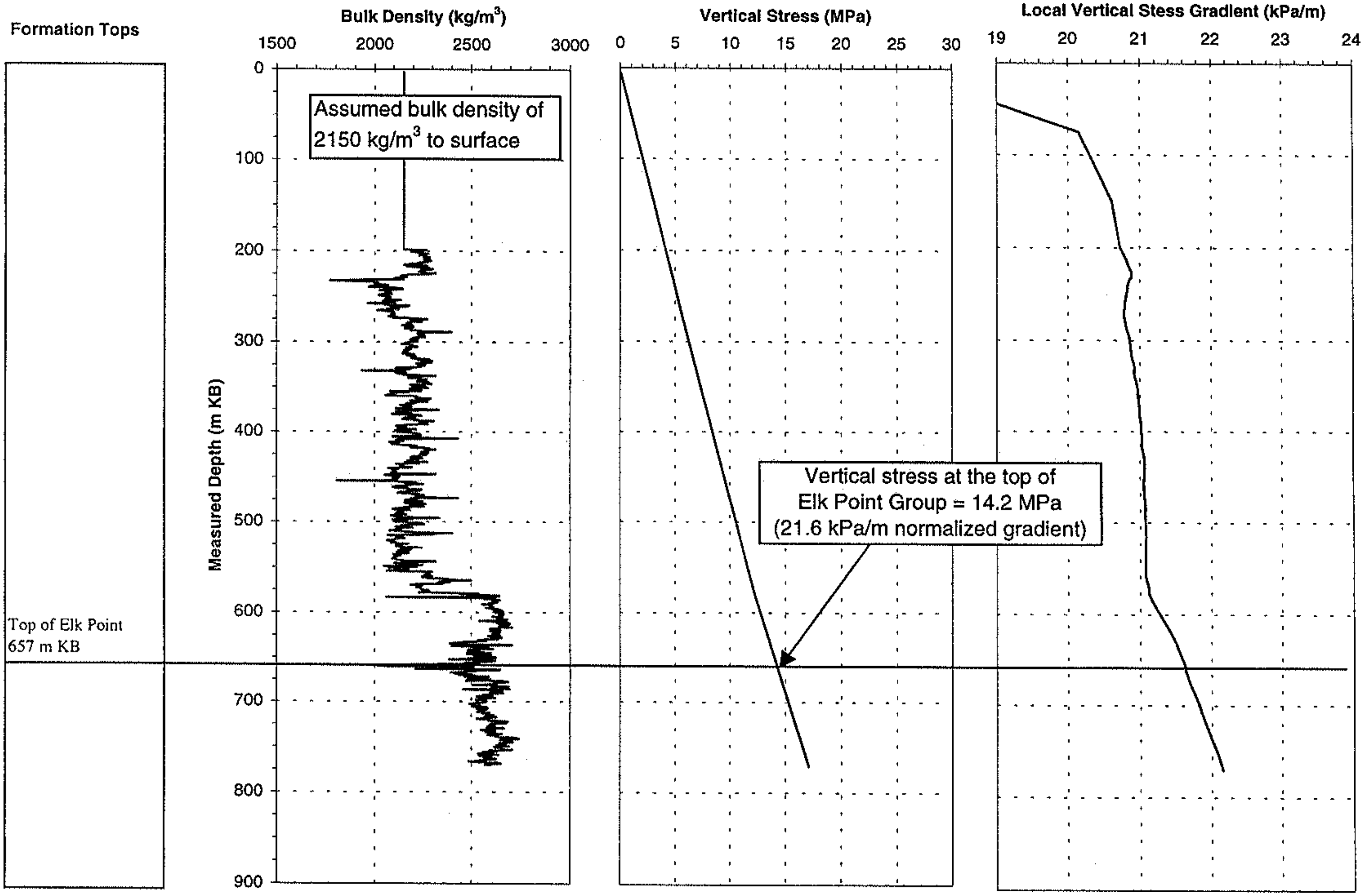


**Figure D.1.39: Calculated vertical stress and vertical stress gradients for AEC Foster Creek 16-36-72-1.**

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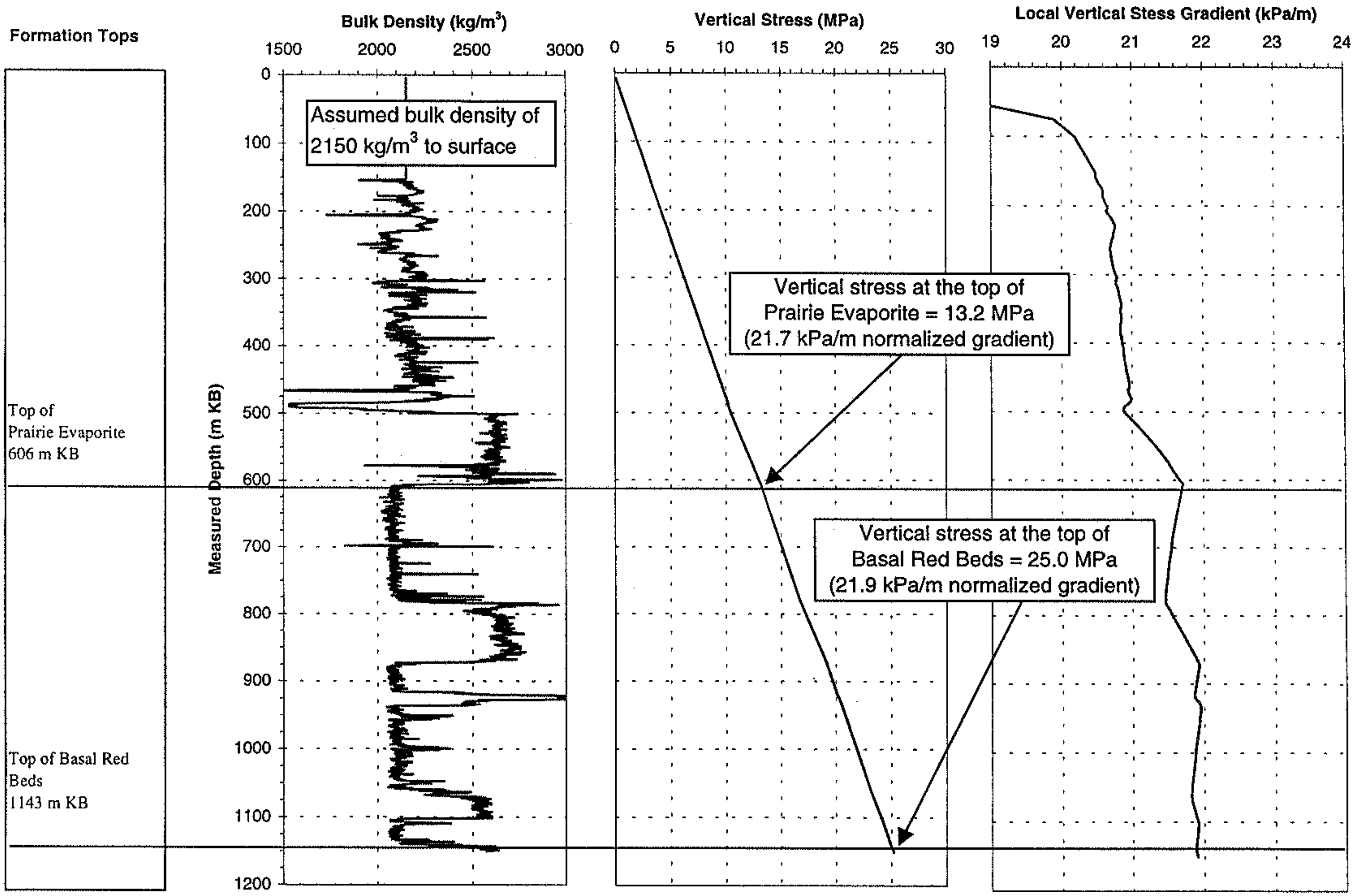


**Figure D.1.40: Calculated vertical stress and vertical stress gradients for Amoco AEC Kirby 5-21-71-4.**

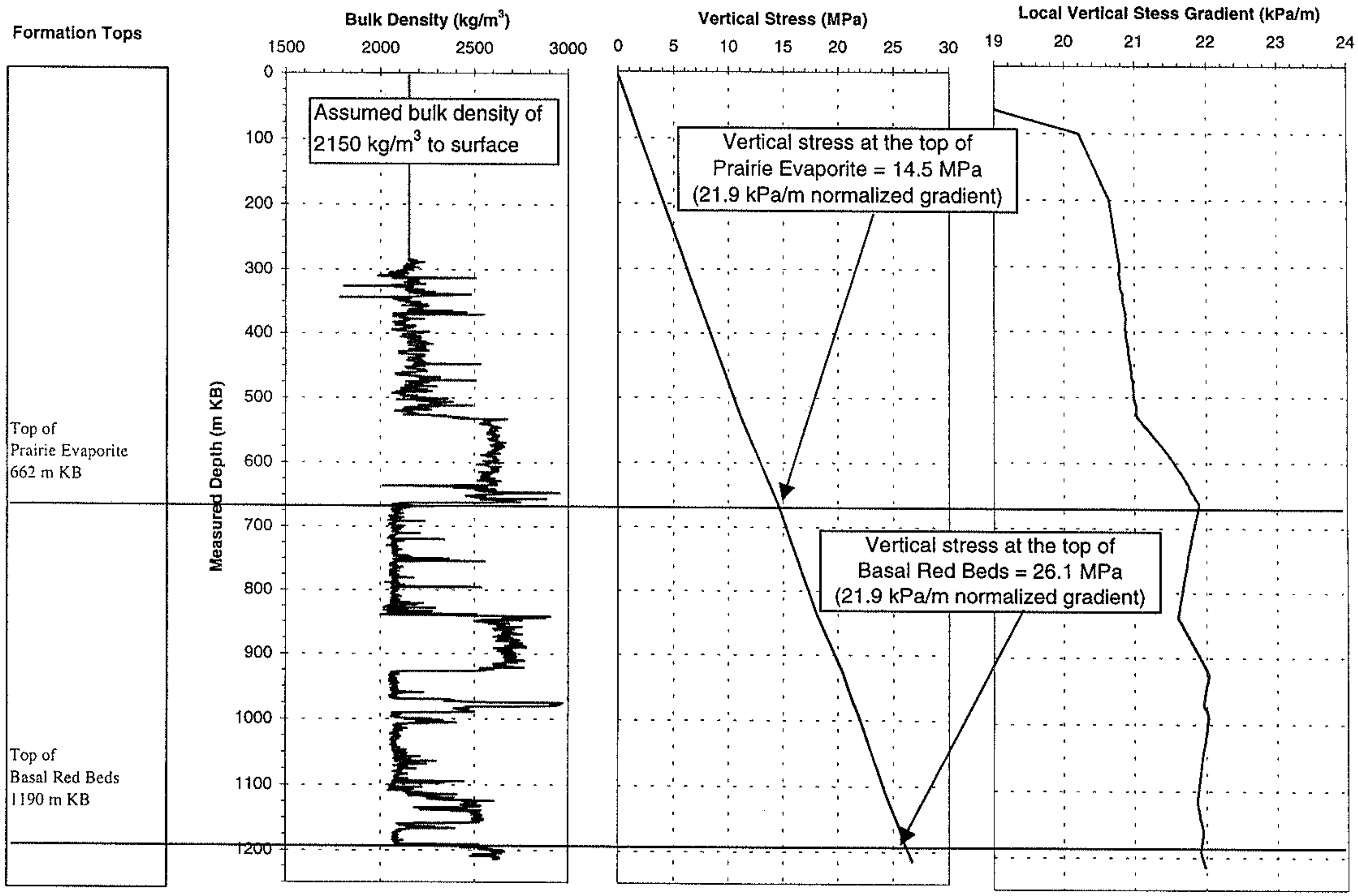


**Figure D.1.41: Calculated vertical stress and vertical stress gradients for Amoco AEC Ipiatik 6-30-71-5.**

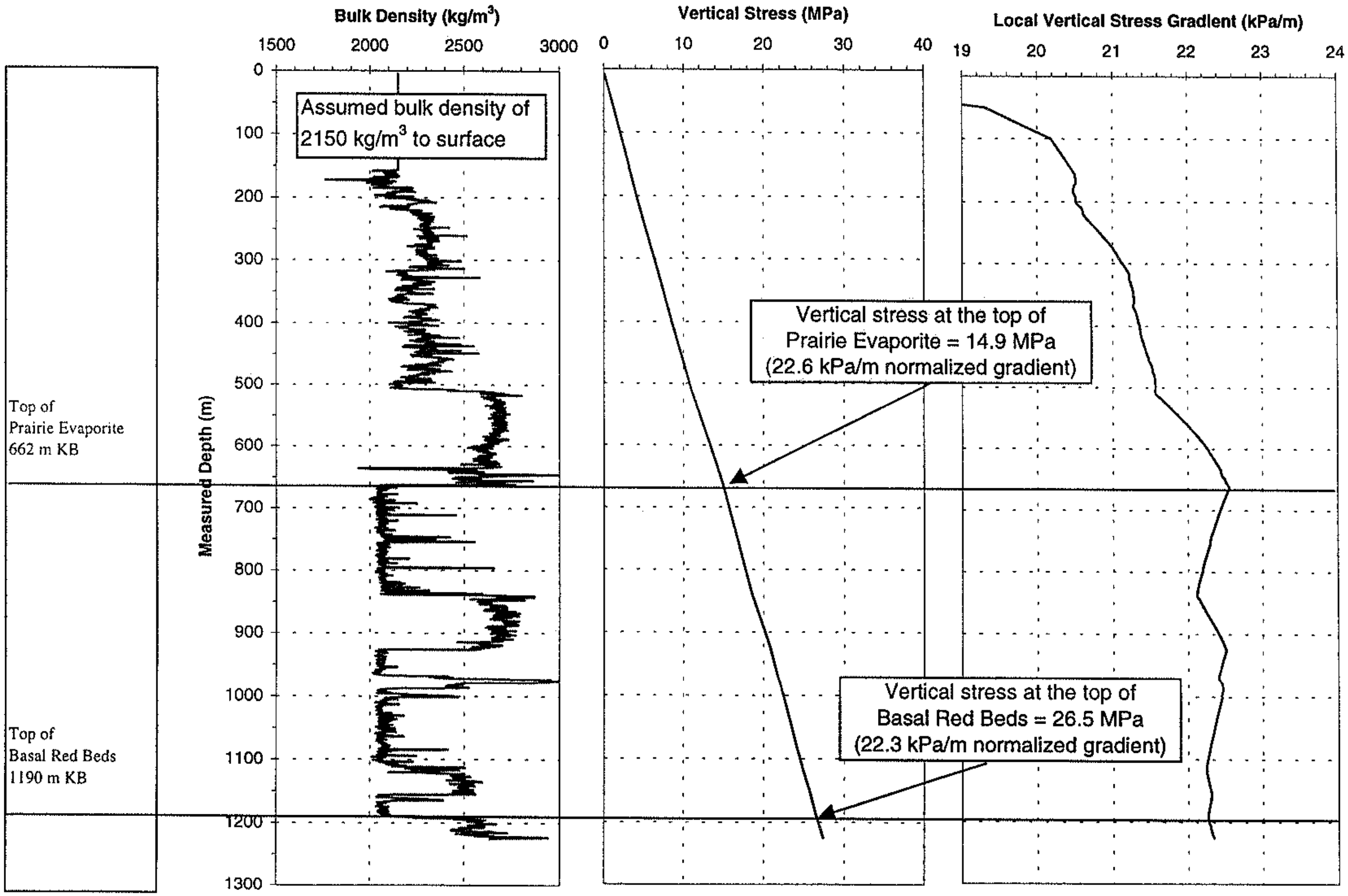


**Figure D.1.42: Calculated vertical stress and vertical stress gradients for Amoco AEC Ipiatik Grist 10-17-71-6.**

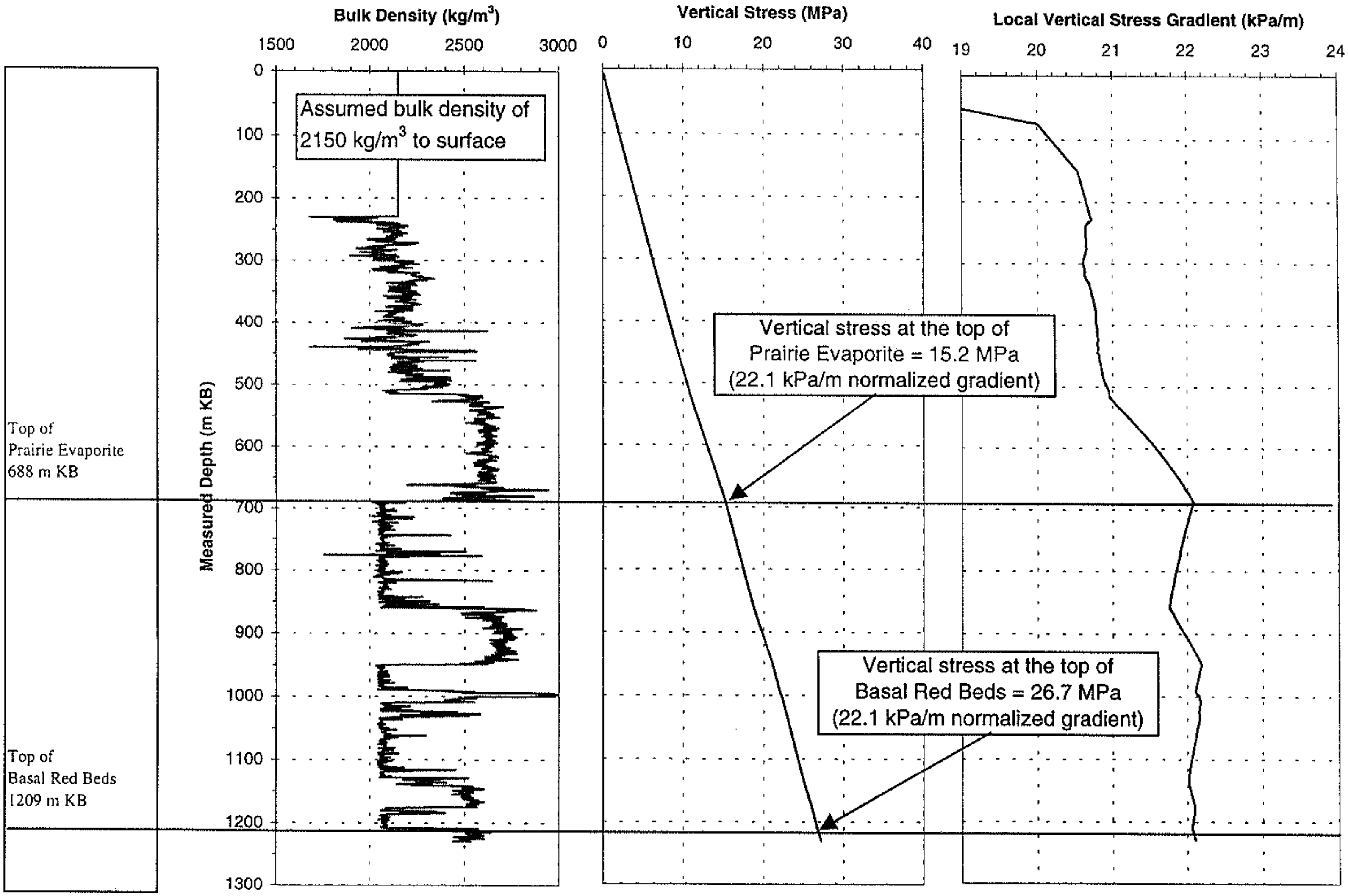


**Figure D.1.43: Calculated vertical stress and vertical stress gradients for AEC Phillips Wiau 10-26-71-7.**

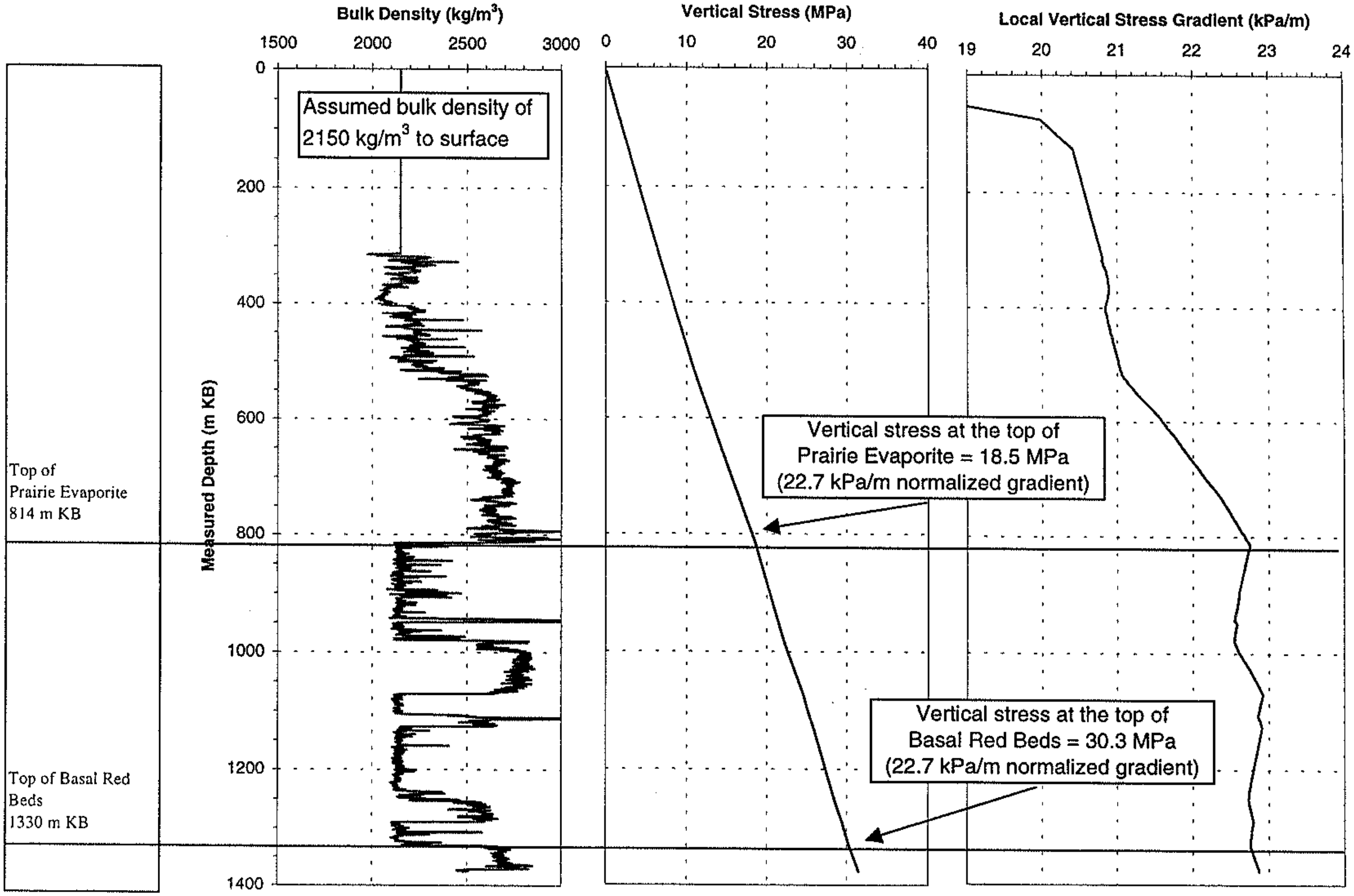


**Figure D.1.44: Calculated vertical stress and vertical stress gradients for Rax et al Mills 7-12-71-11.**

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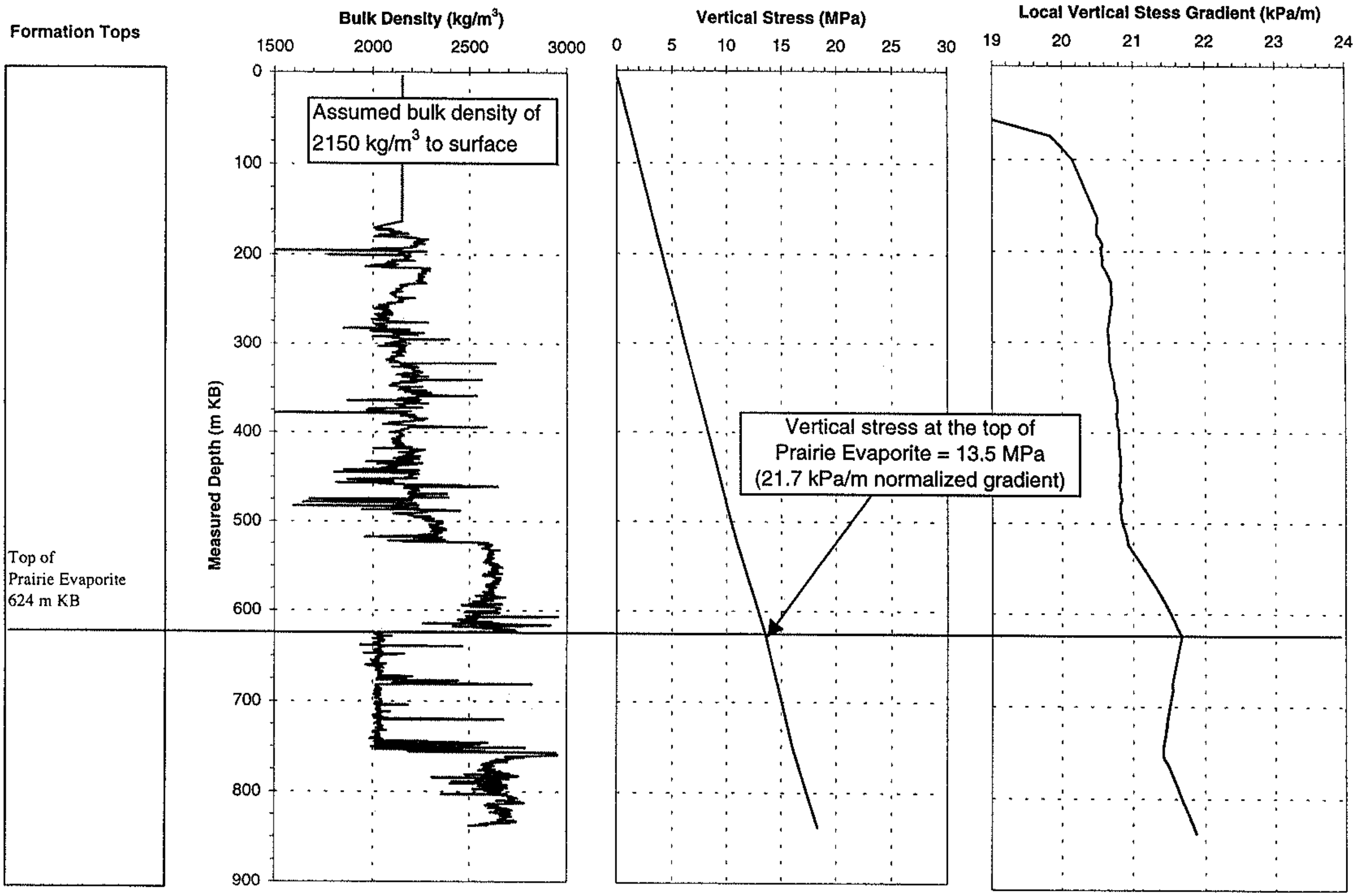


**Figure D.1.45: Calculated vertical stress and vertical stress gradients for AEC Foster Creek 7-7-72-3.**

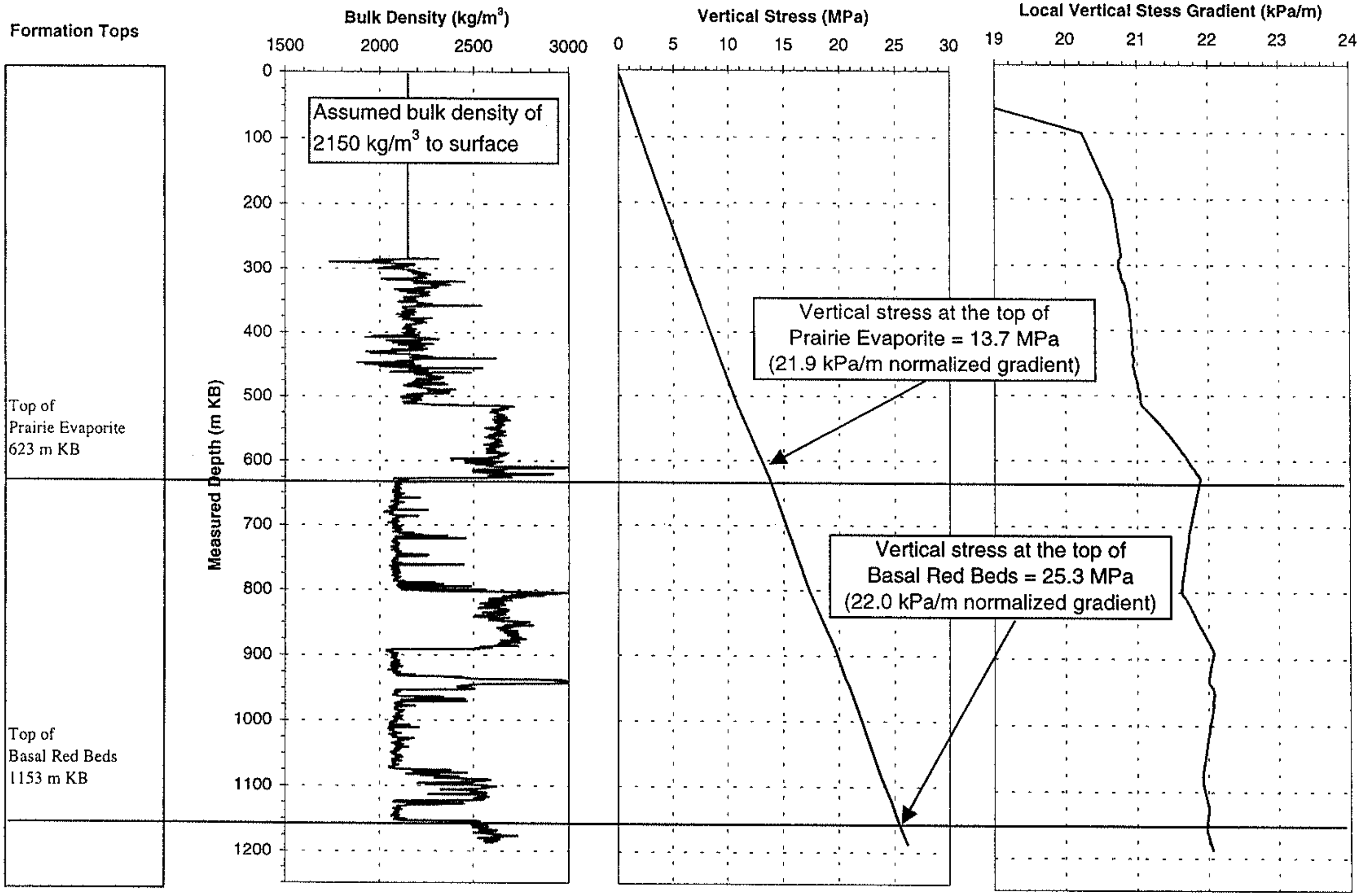


**Figure D.1.46: Calculated vertical stress and vertical stress gradients for Amoco AEC Ipiatik 11-18-72-4.**

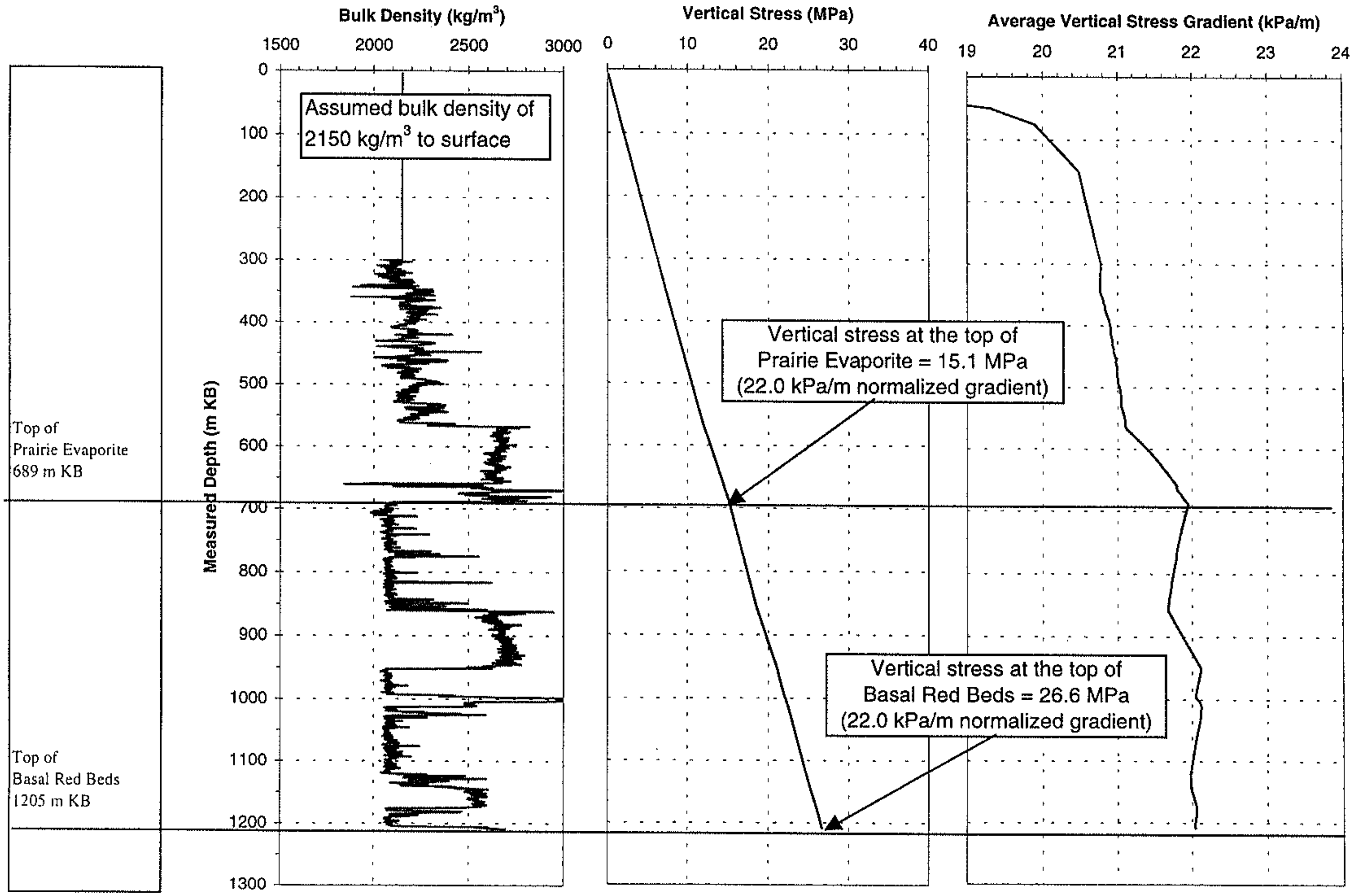


**Figure D.1.47: Calculated vertical stress and vertical stress gradients for AMOCO Kirby 10-22-72-6.**

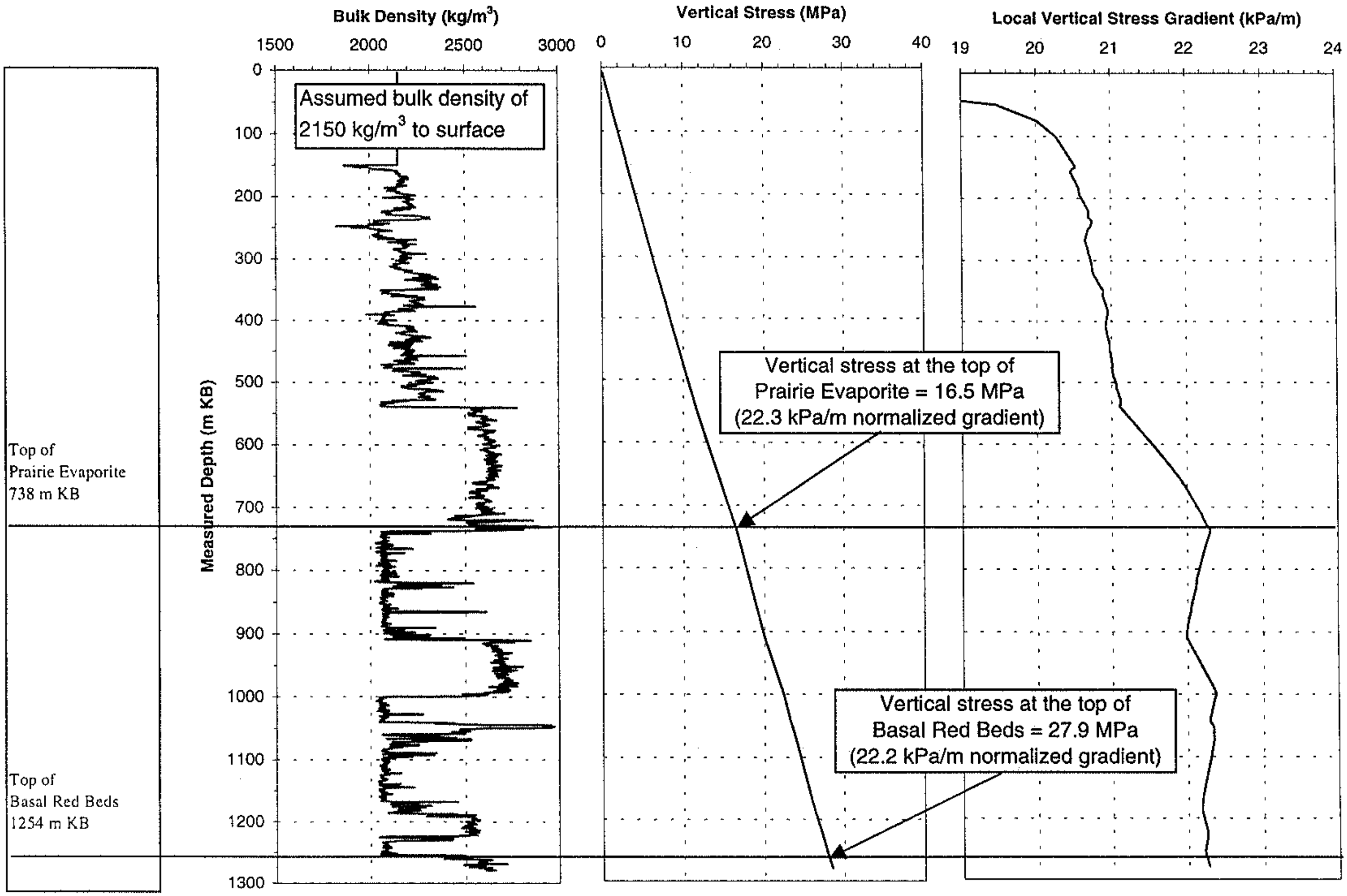


**Figure D.1.48: Calculated vertical stress and vertical stress gradients for AEC Phillips Wiau 11-14-72-8.**

ADVANCED GEOTECHNOLOGY

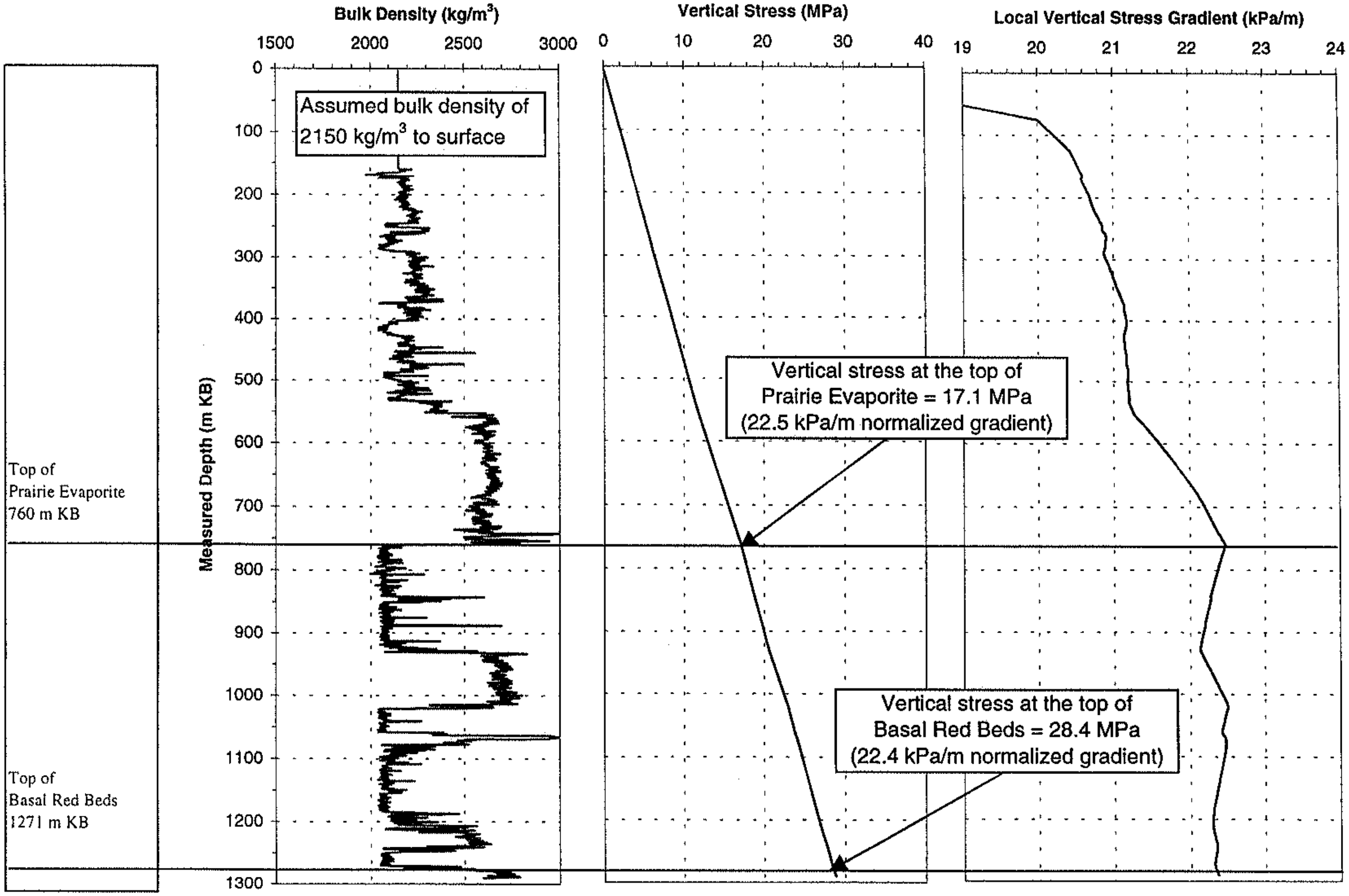


**Figure D.1.49: Calculated vertical stress and vertical stress gradients for AEC Phillips Wiau 10-33-72-8.**

ADVANCED GEOTECHNOLOGY

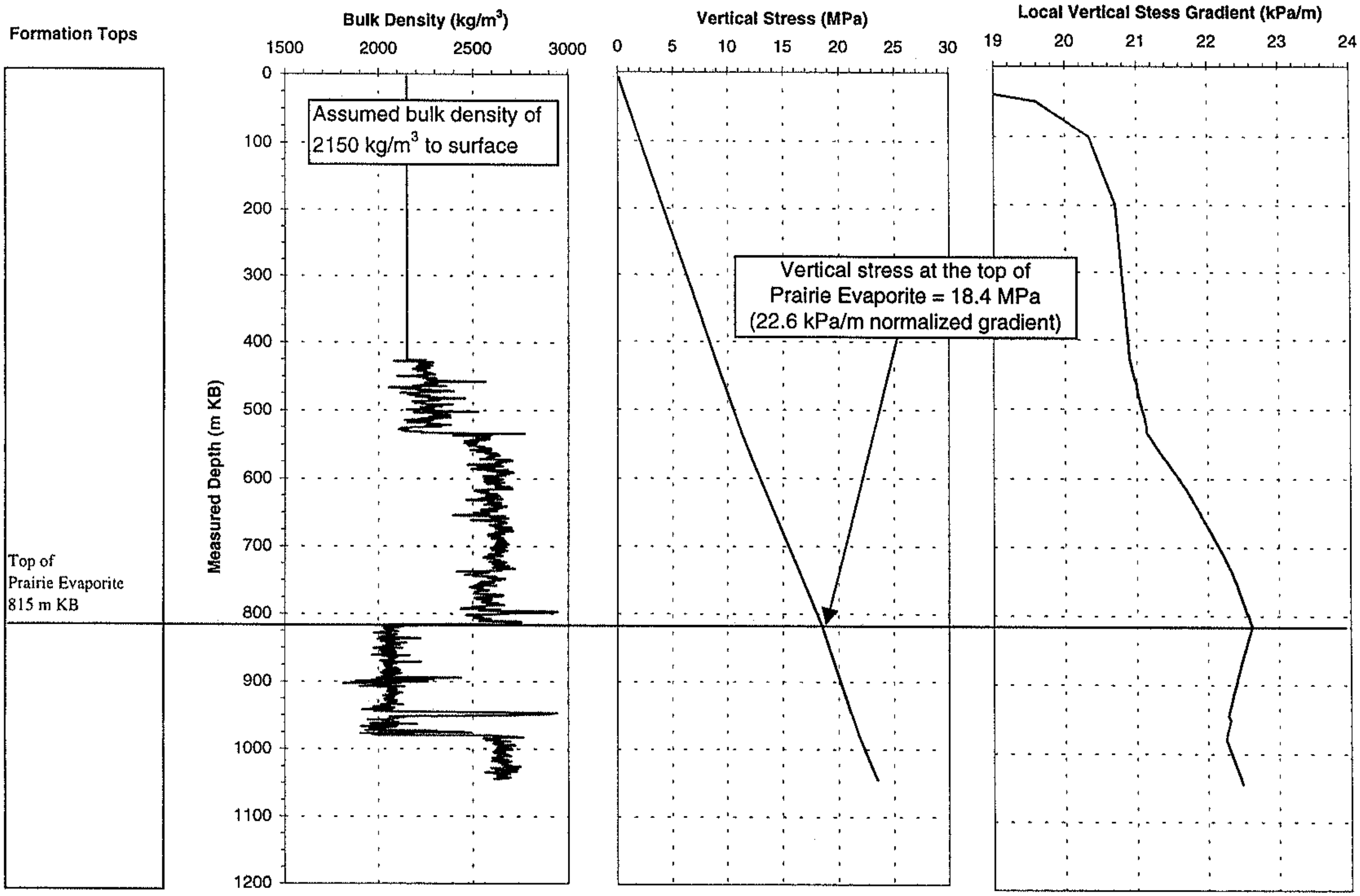


**Figure D.1.50: Calculated vertical stress and vertical stress gradients for Pam Am A-1 Behan 6-26-72-11**

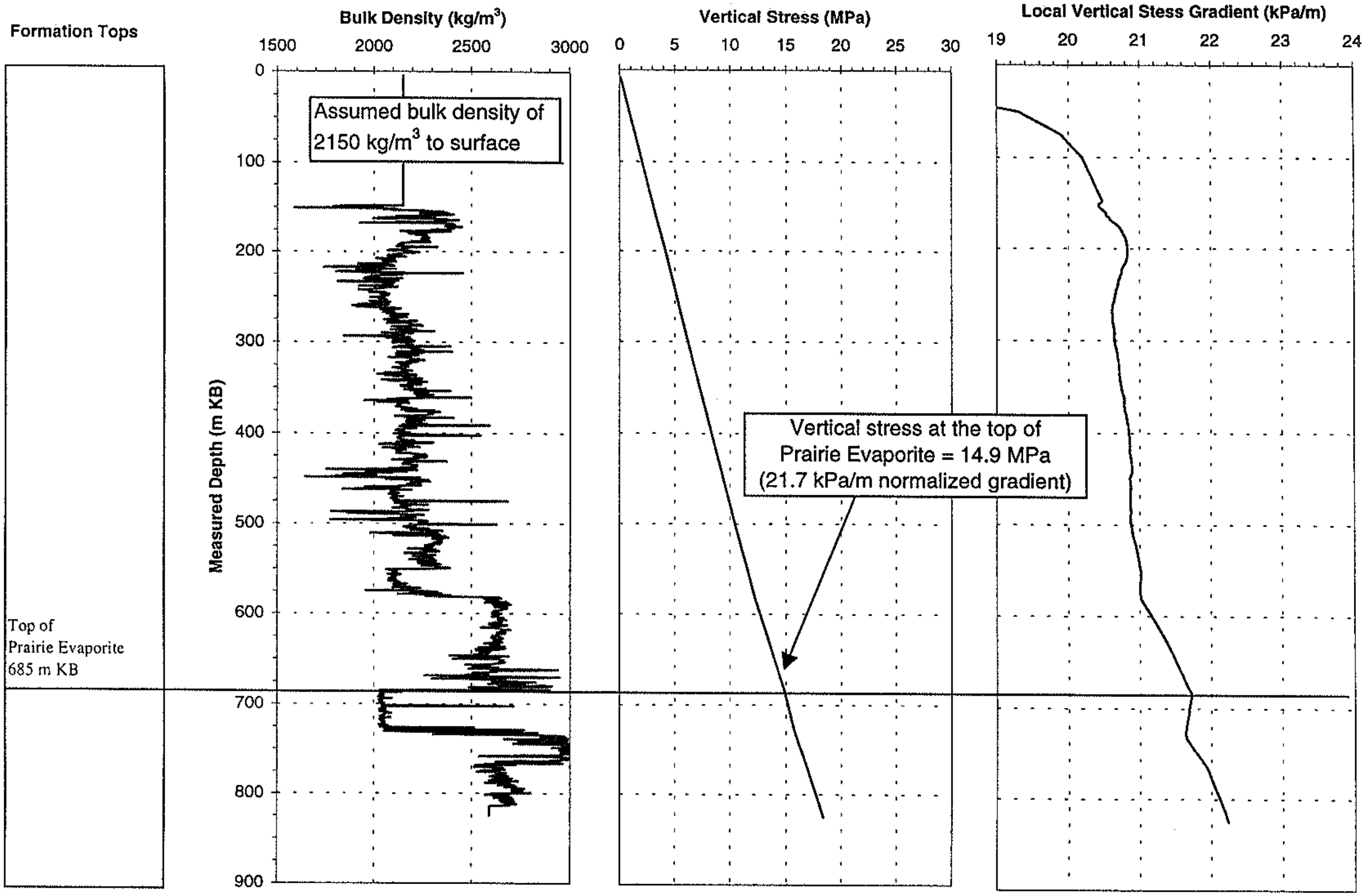


Figure D.1.51: Calculated vertical stress and vertical stress gradients for AEC Foster Creek 6-25-73-3.

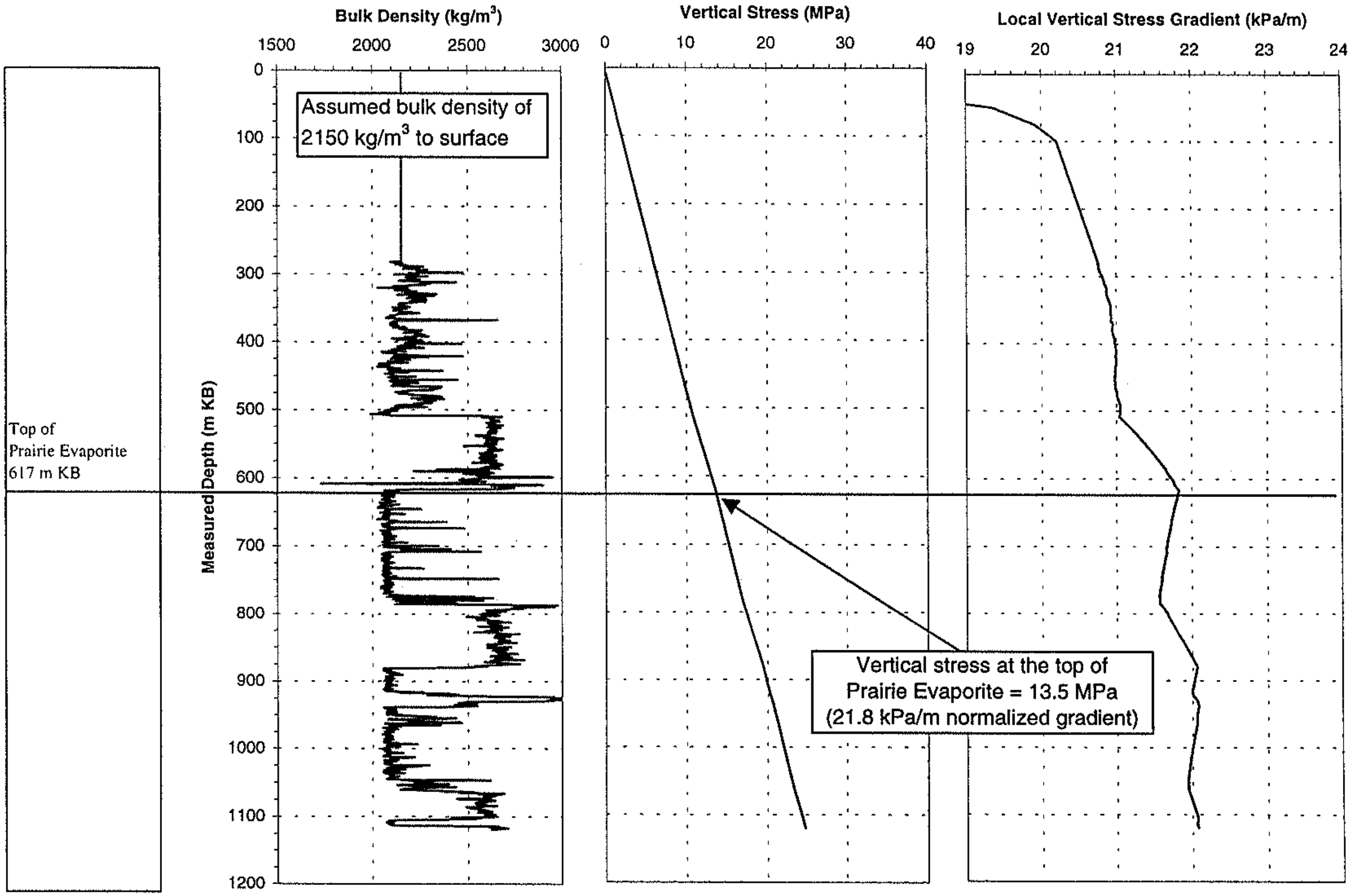


**Figure D.1.52: Calculated vertical stress and vertical stress gradients for Amoco AEC Ipiatik Kirby 10-14-73-5.**

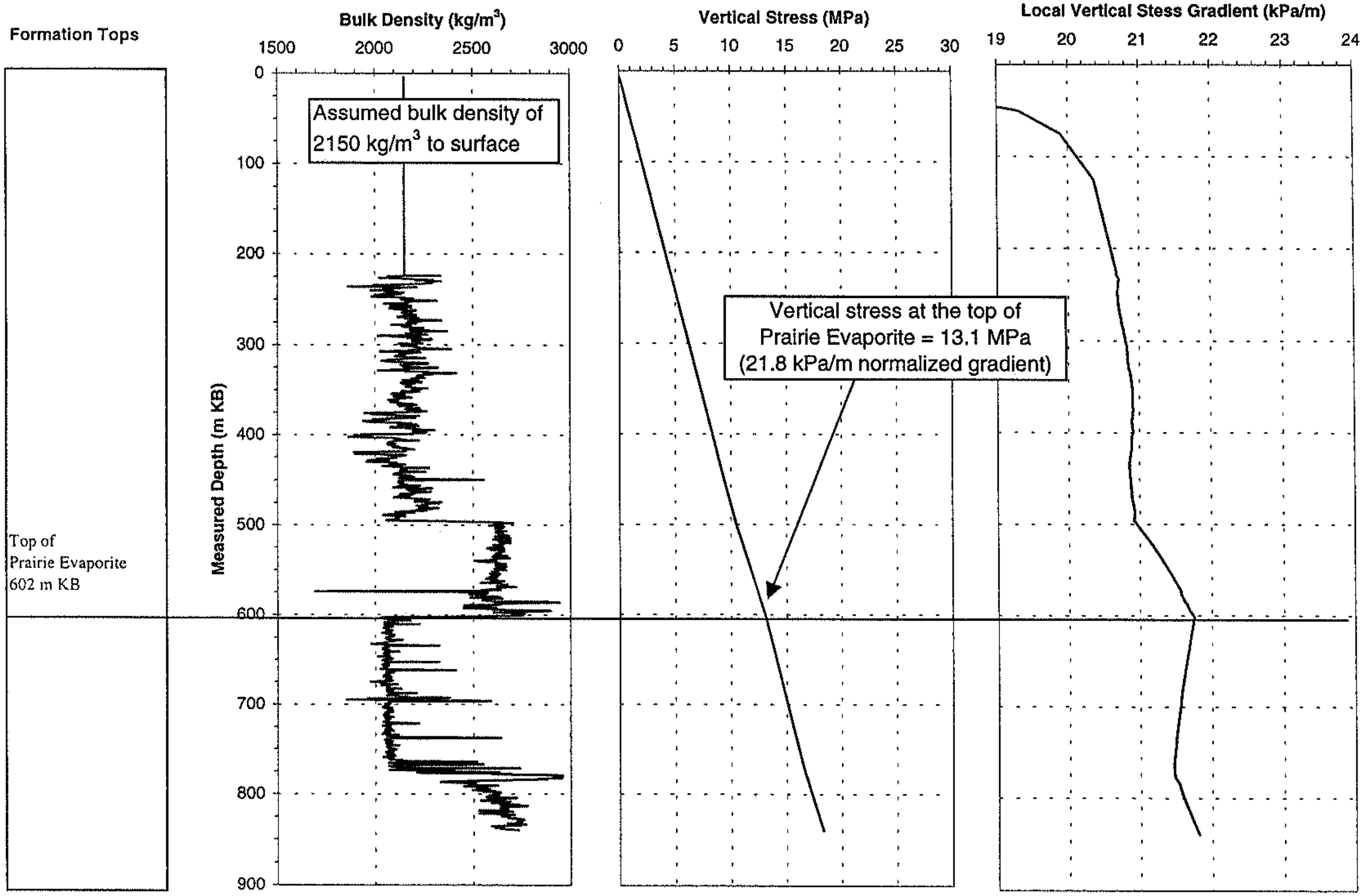


**Figure D.1.53: Calculated vertical stress and vertical stress gradients for Amoco Kirby 9-25-73-5.**

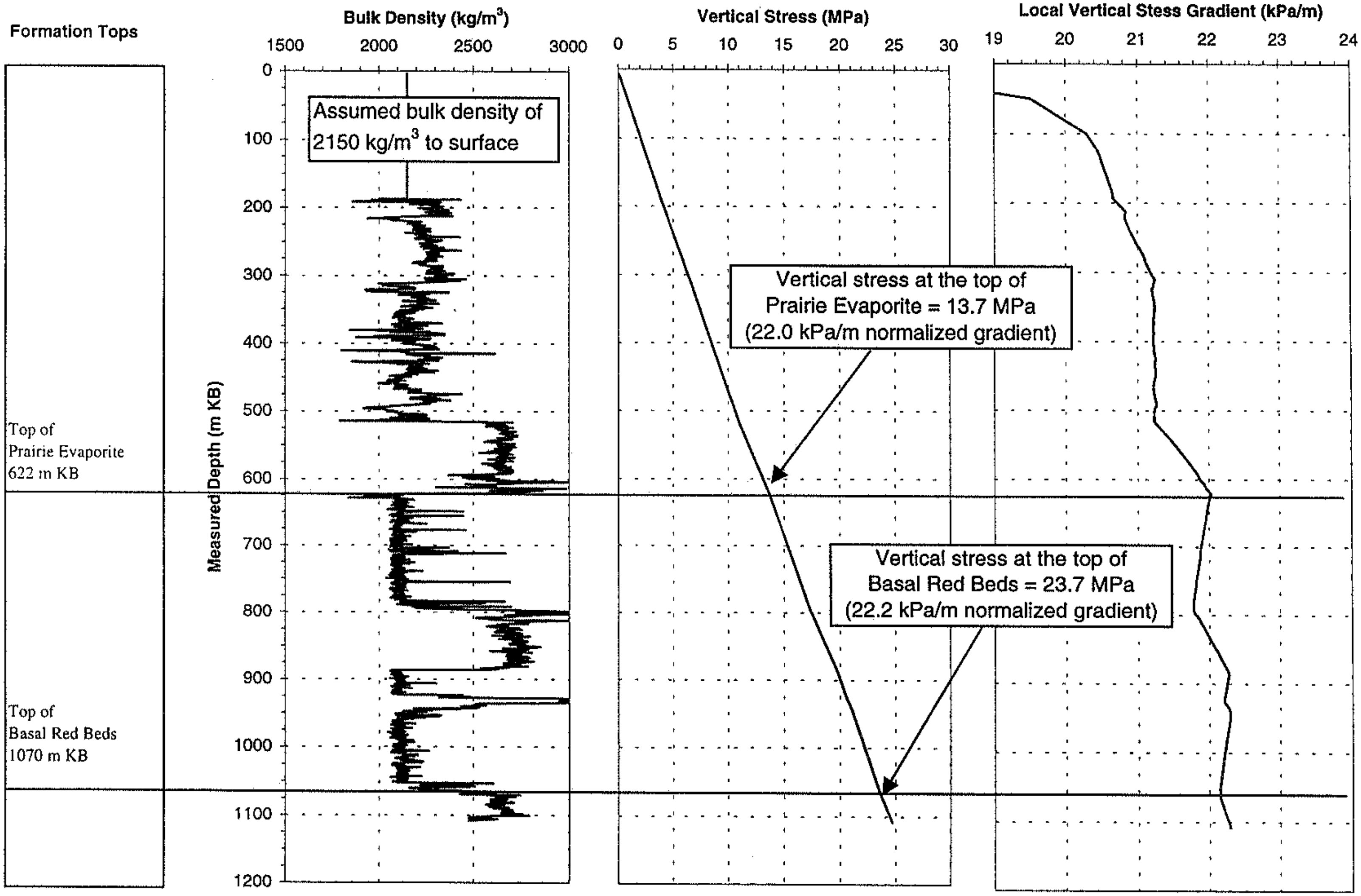


**Figure D.1.54: Calculated vertical stress and vertical stress gradients for Amoco Kirby 11-30-74-5.**

 

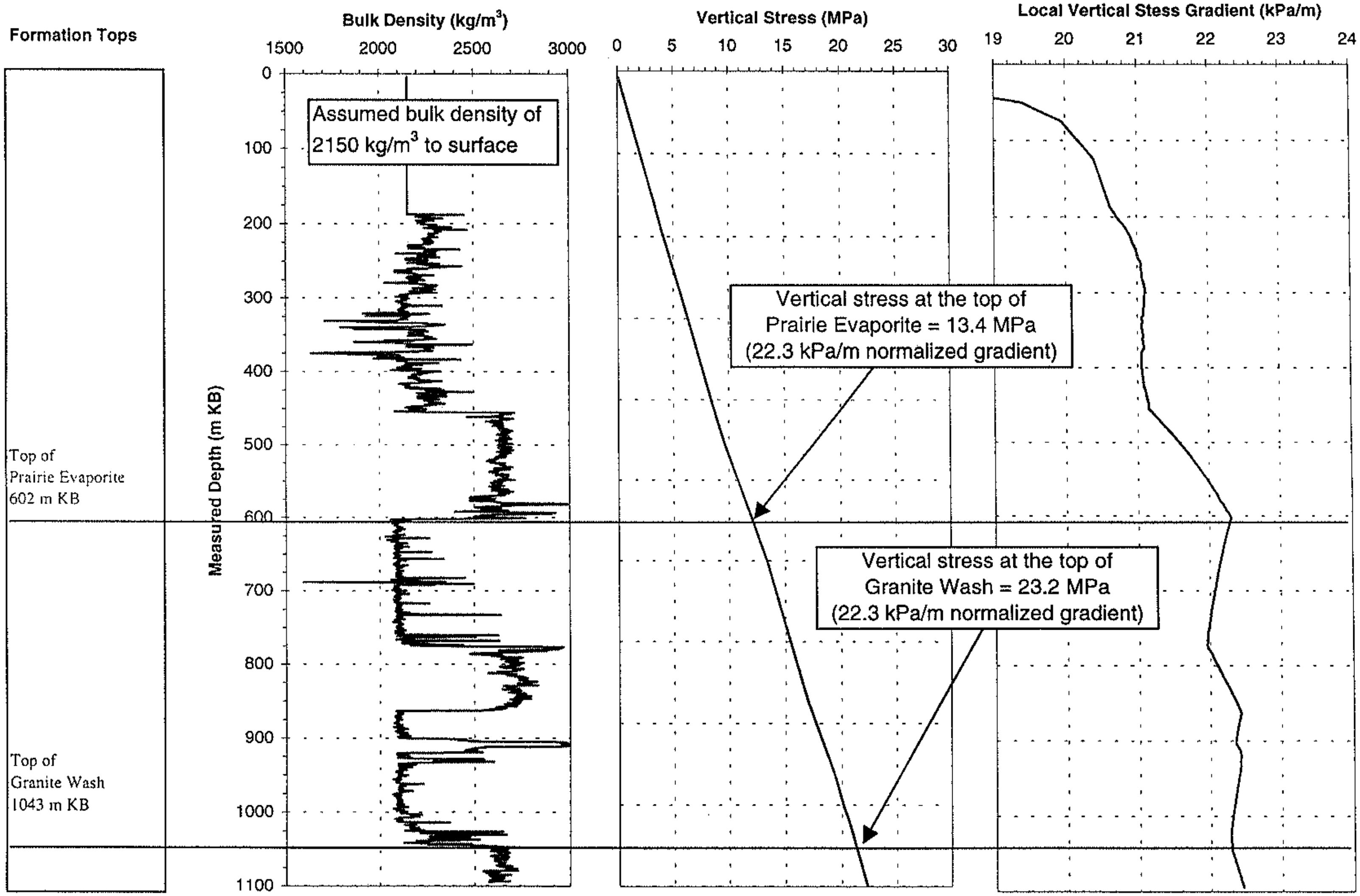


**Figure D.1.55: Calculated vertical stress and vertical stress gradients for Amoco Kirby 10-9-74-6.**

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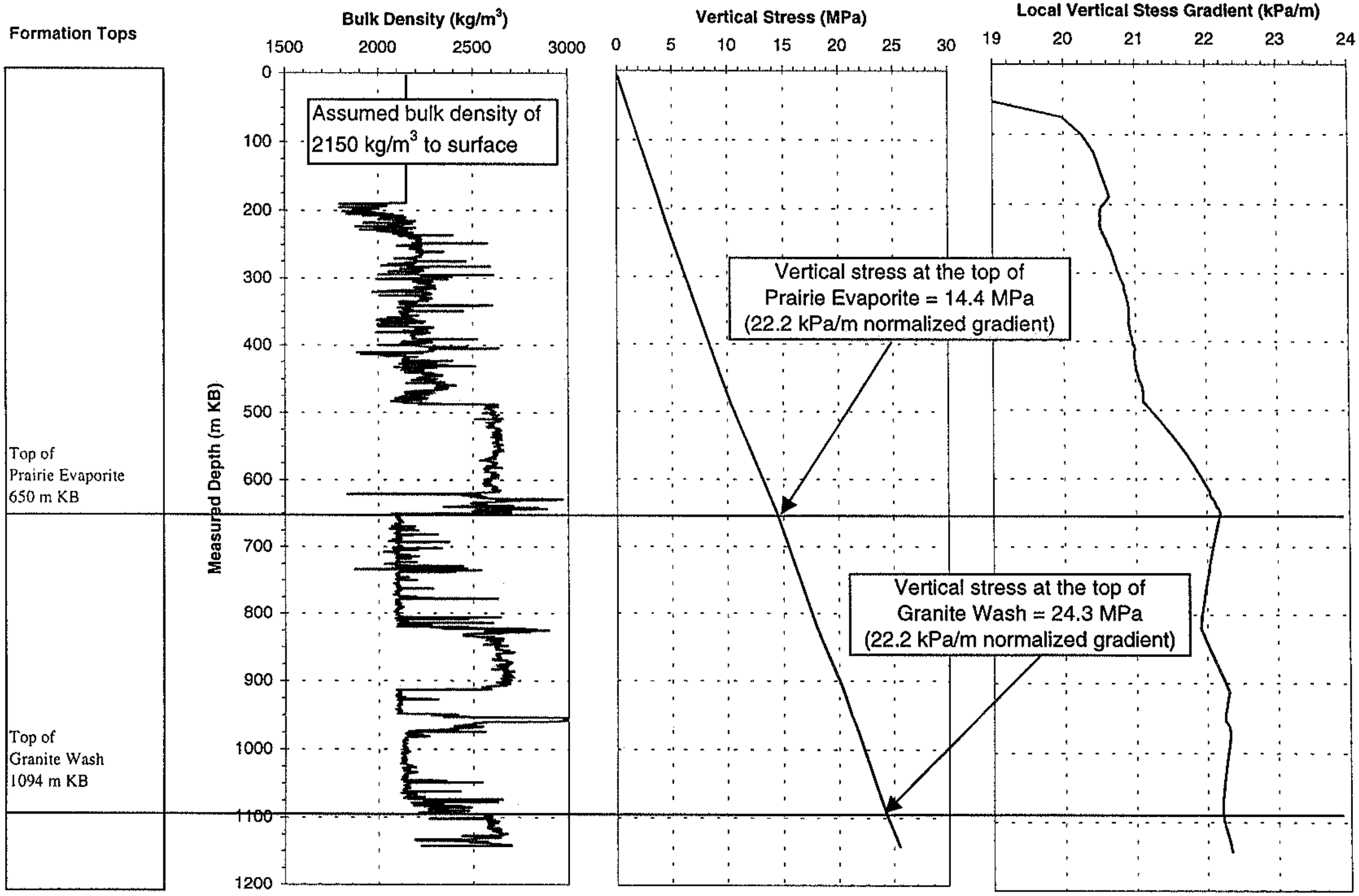


**Figure D.1.56: Calculated vertical stress and vertical stress gradients for Amoco Kirby 6-24-74-7.**

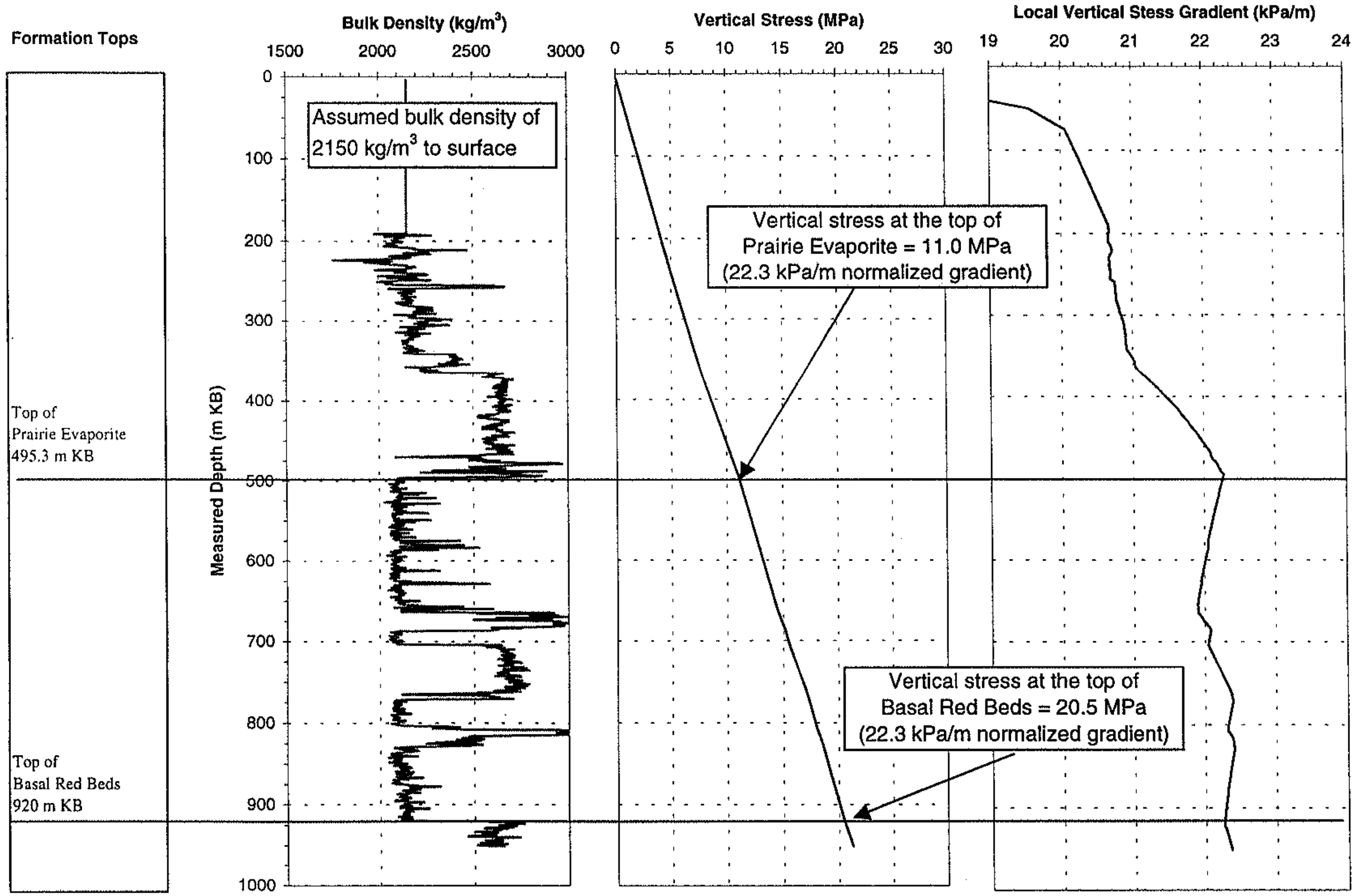


**Figure D.1.57: Calculated vertical stress and vertical stress gradients for Home Leismer A10-1-77-7.**

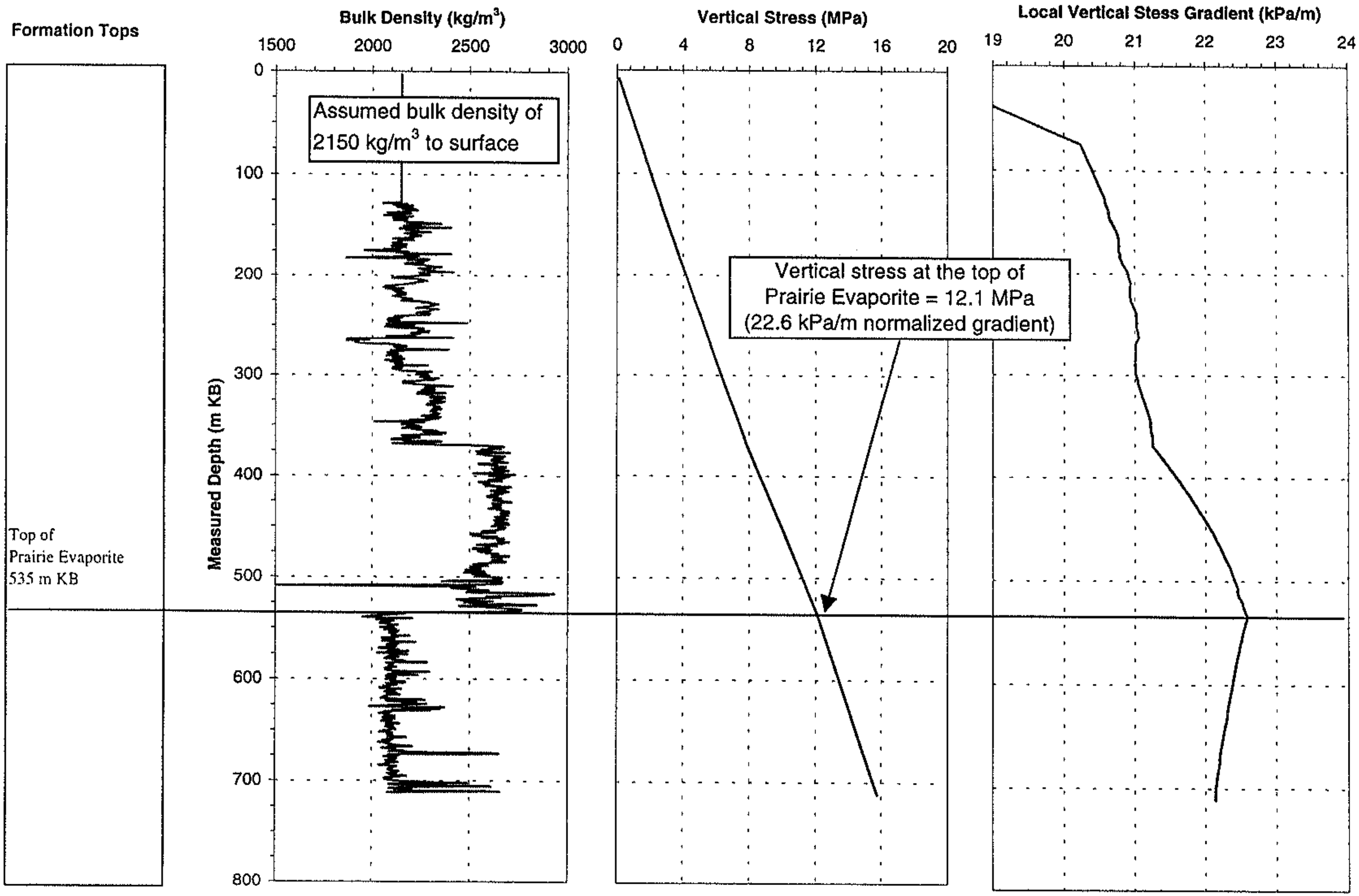


**Figure D.1.58: Calculated vertical stress and vertical stress gradients for Home Leismer 3-7-77-7.**

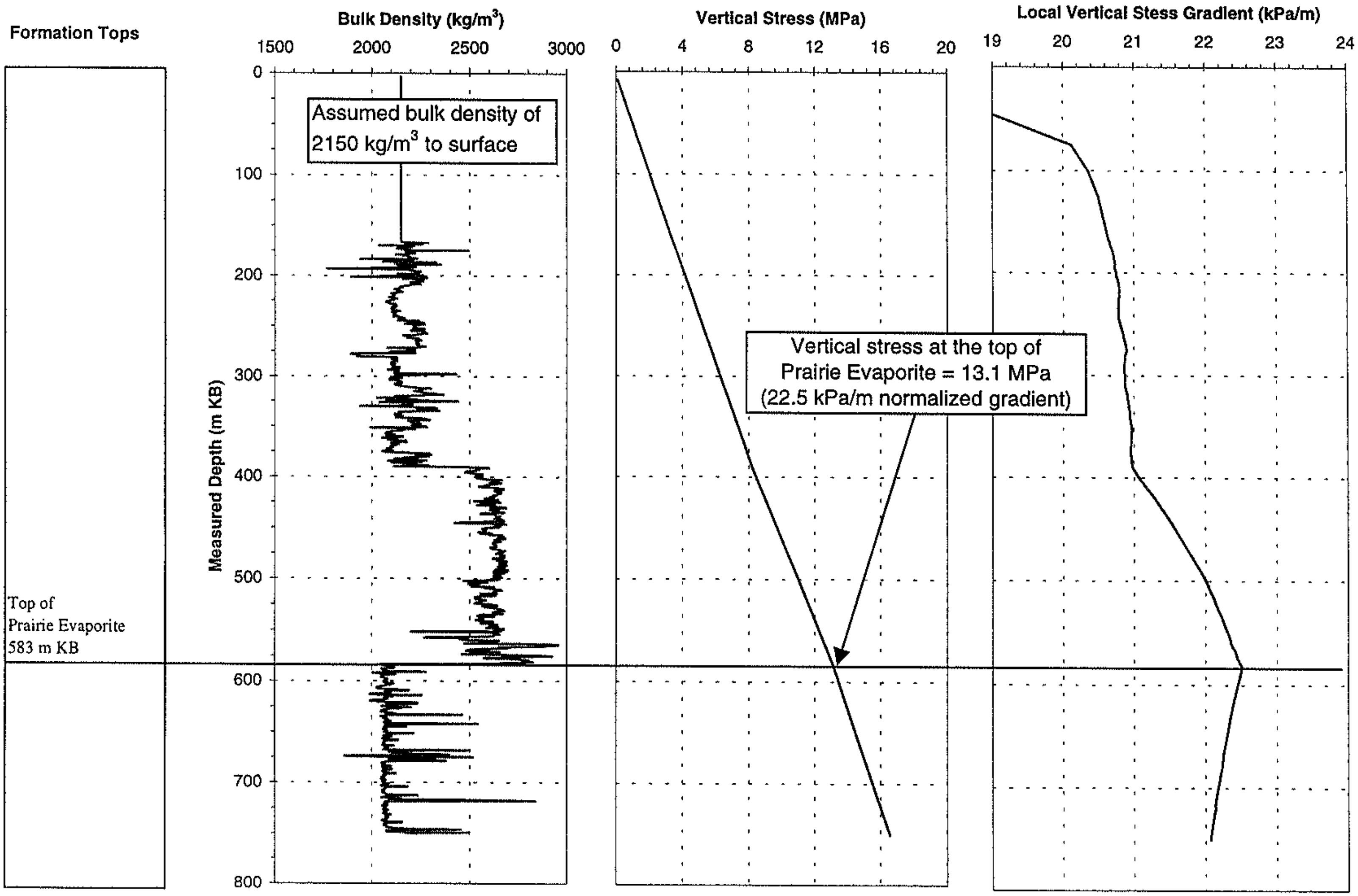


**Figure D.1.59: Calculated vertical stress and vertical stress gradients for Norcen Por Leismer 2-8-77-8.**

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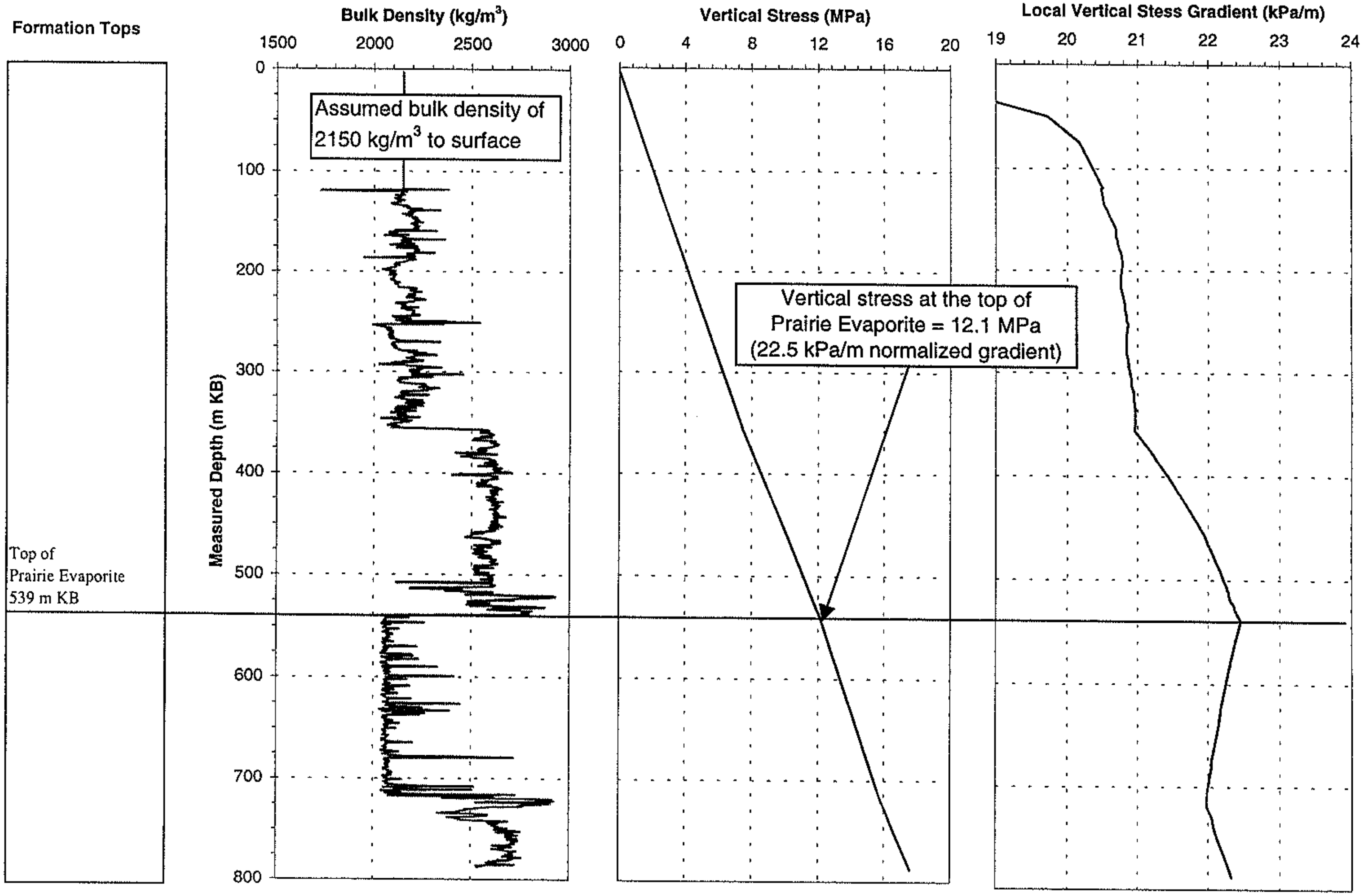


**Figure D.1.60: Calculated vertical stress and vertical stress gradients for Altana Huber Christina 10-28-77-8.**

ADVANCED GEOTECHNOLOGY

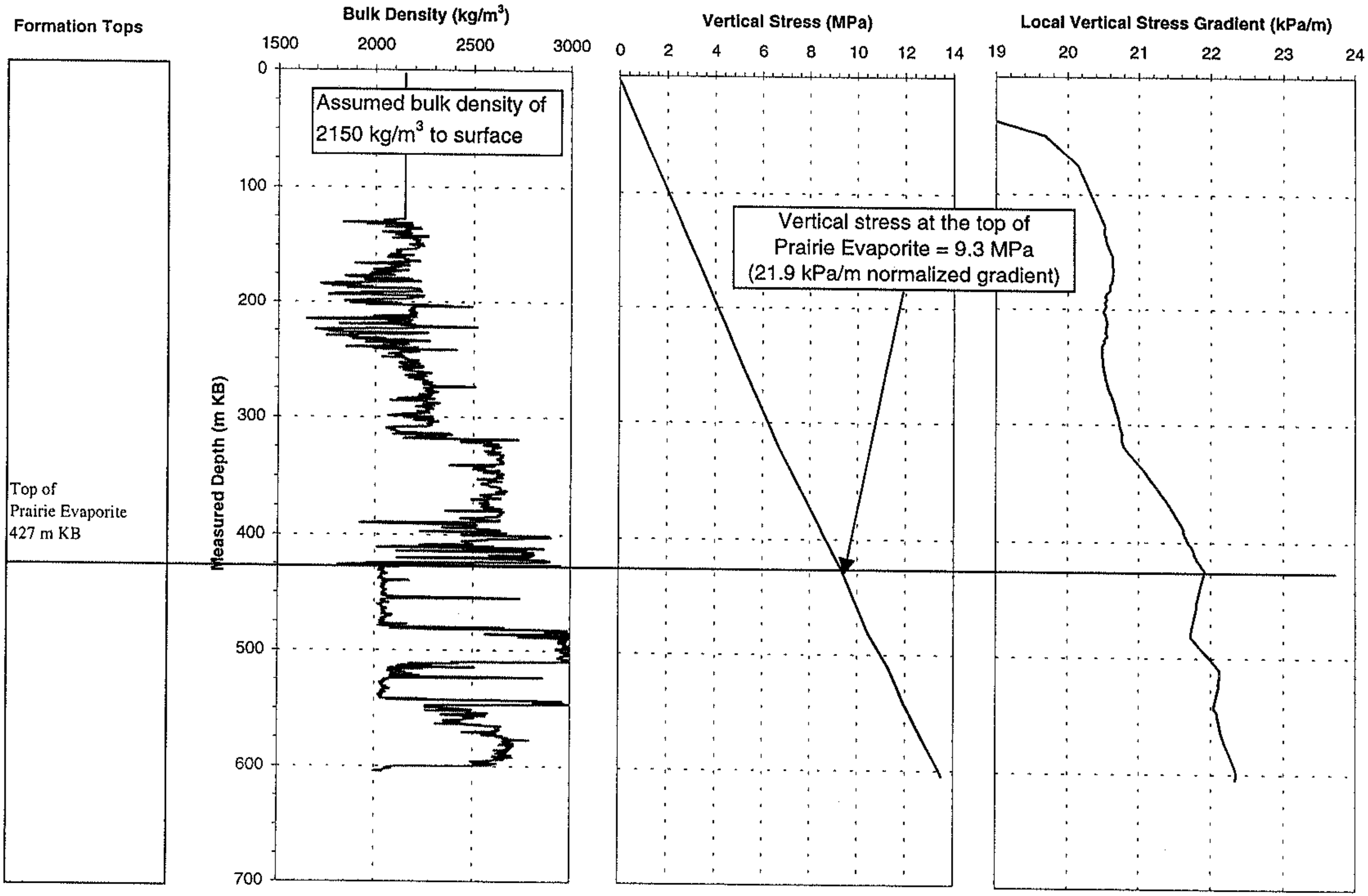


**Figure D.1.61: Calculated vertical stress and vertical stress gradients for Lakewood et al Chard 14-29-79-5.**

ADVANCED GEOTECHNOLOGY

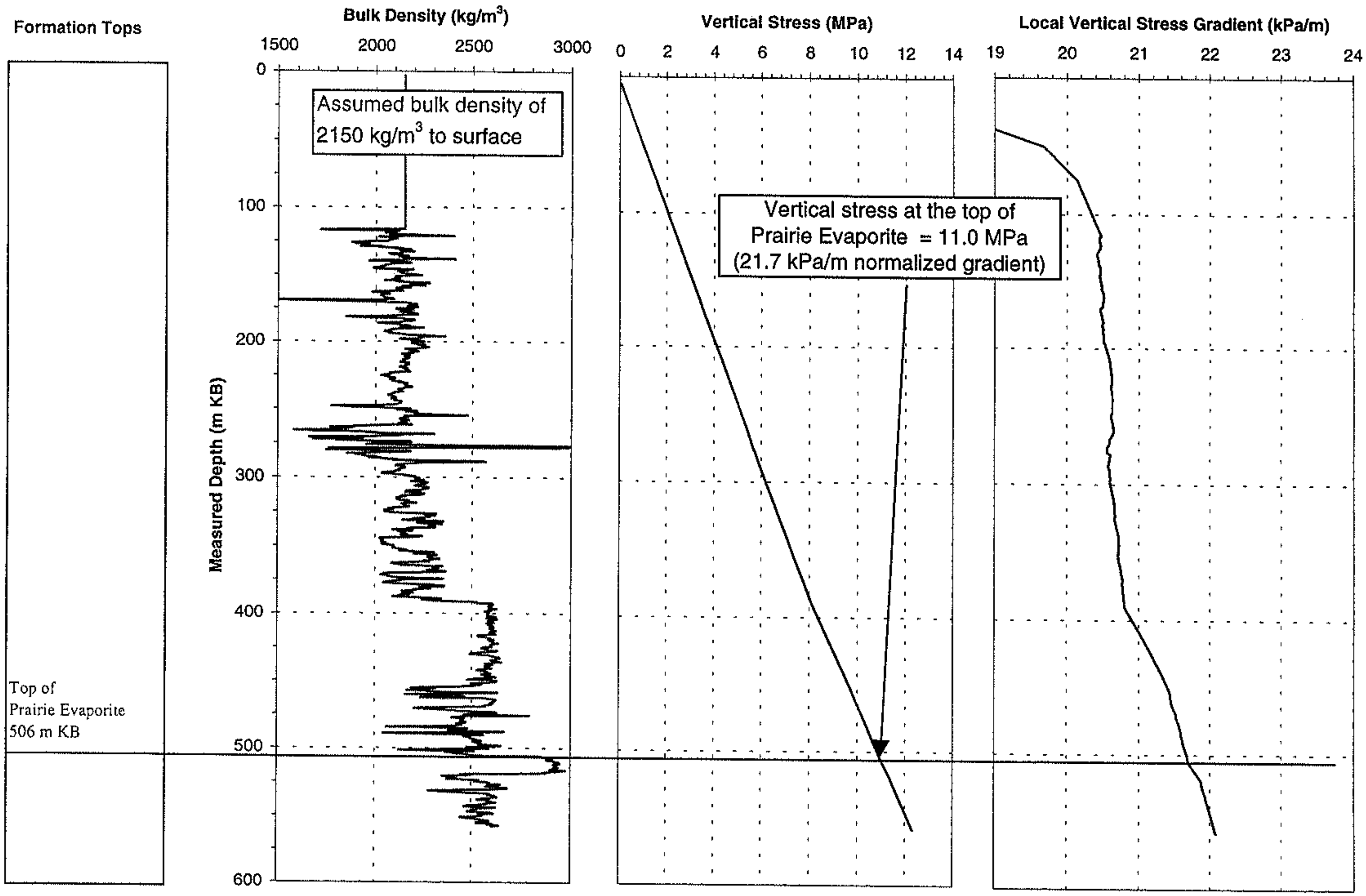


**Figure D.1.62: Calculated vertical stress and vertical stress gradients for Home WinneFred Lake 10-5-80-2.**

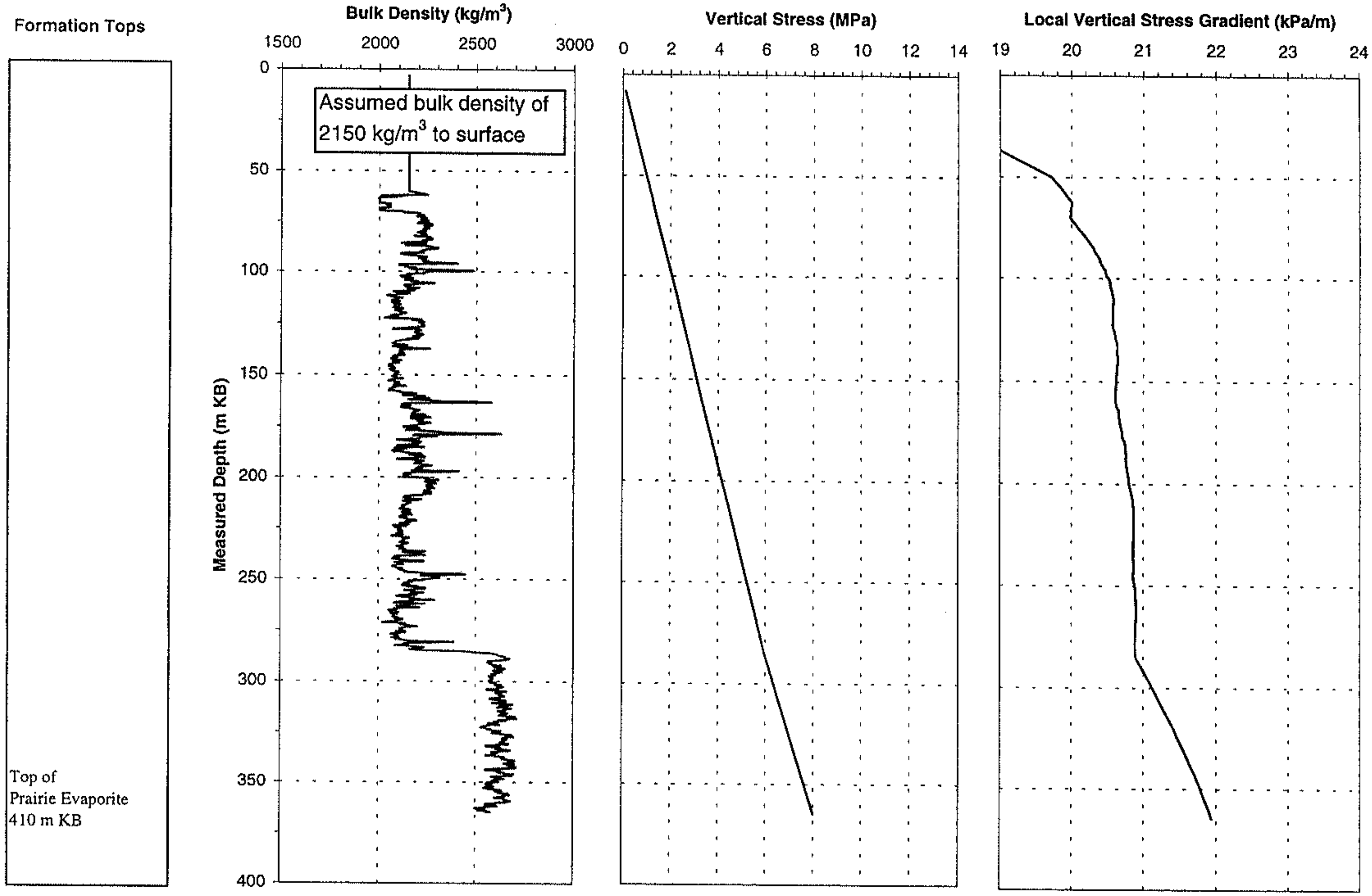


**Figure D.1.63: Calculated vertical stress and vertical stress gradients for Homestead Canoxy Cowpar 11-32-80-4.**

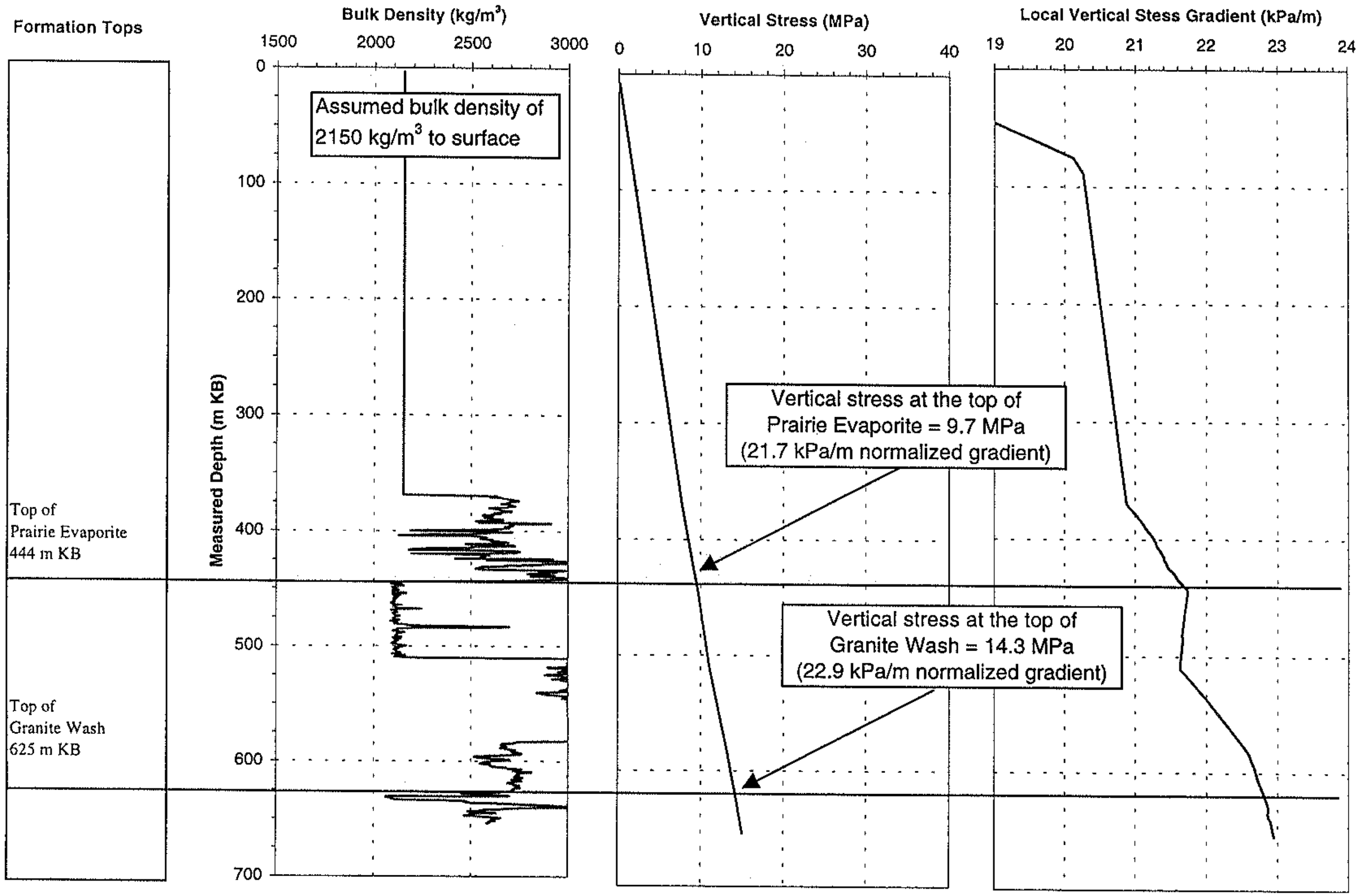


**Figure D.1.64: Calculated vertical stress and vertical stress gradients for Gulf Resdeln 7-8-82-6.**

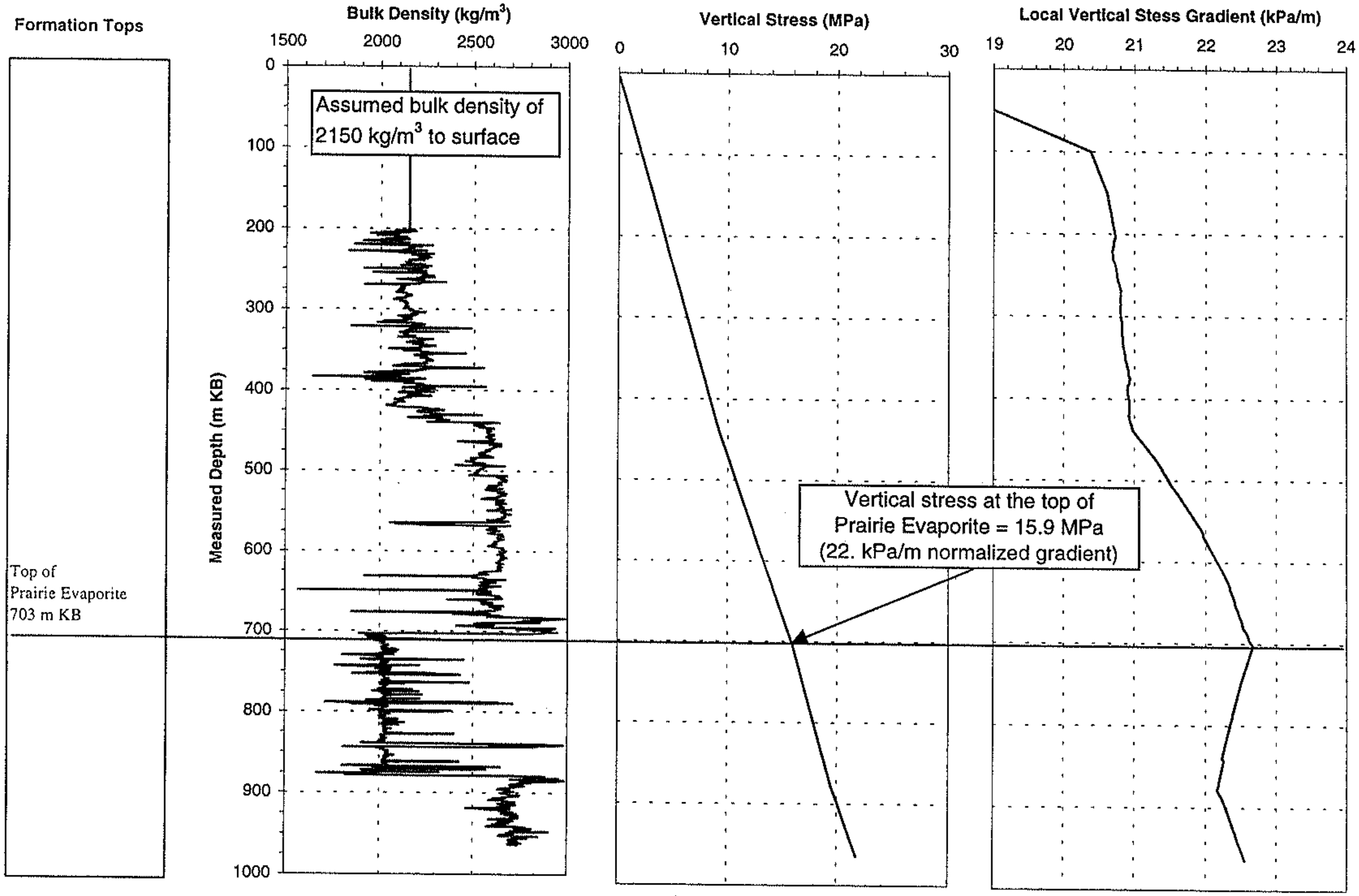


**Figure D.1.65: Calculated vertical stress and vertical stress gradients for Husky et al Divide 10-29-82-12.**

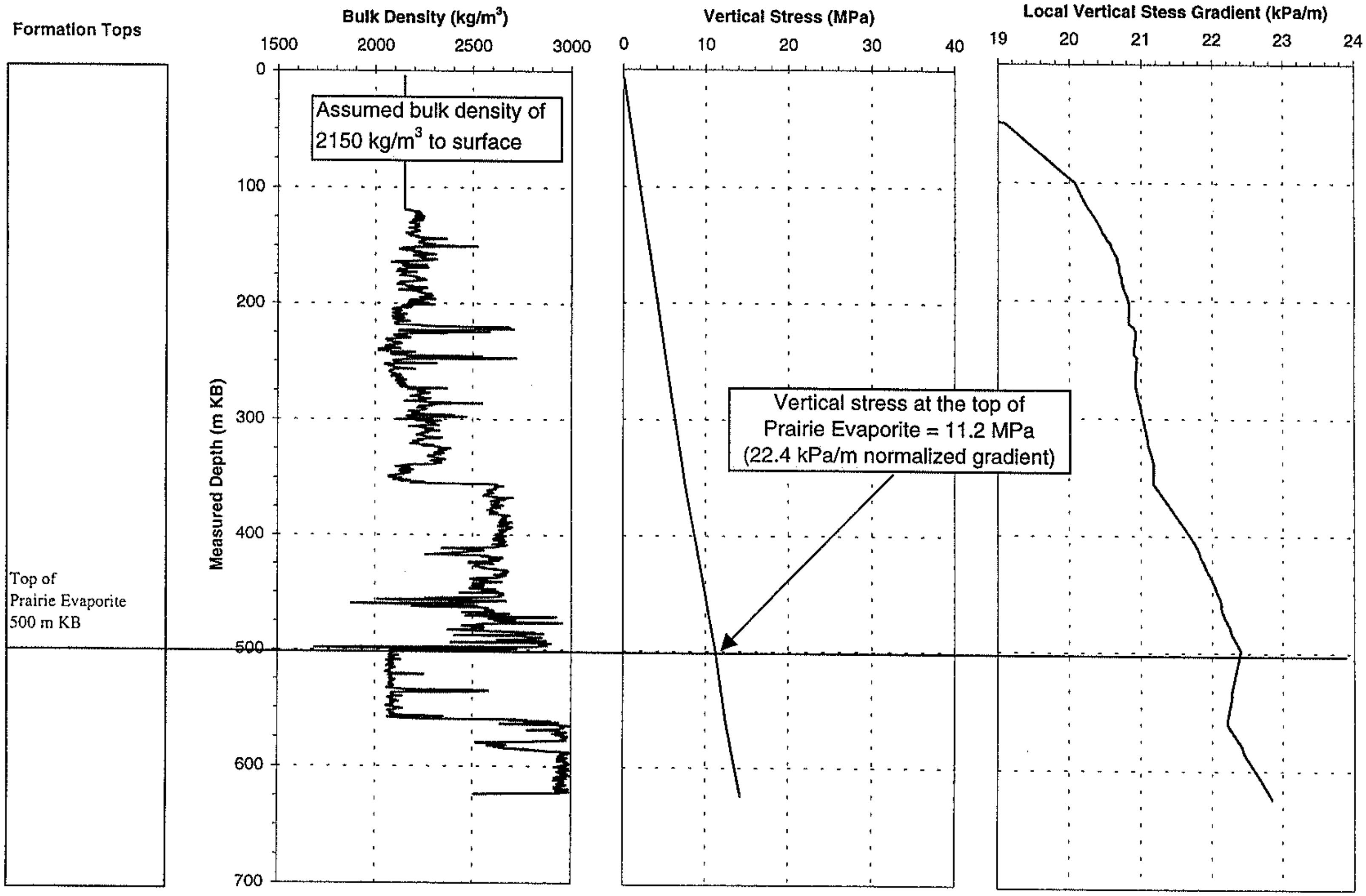


Figure D.1.66: Calculated vertical stress and vertical stress gradients for Gulf Resdeln 10-8-83-6.

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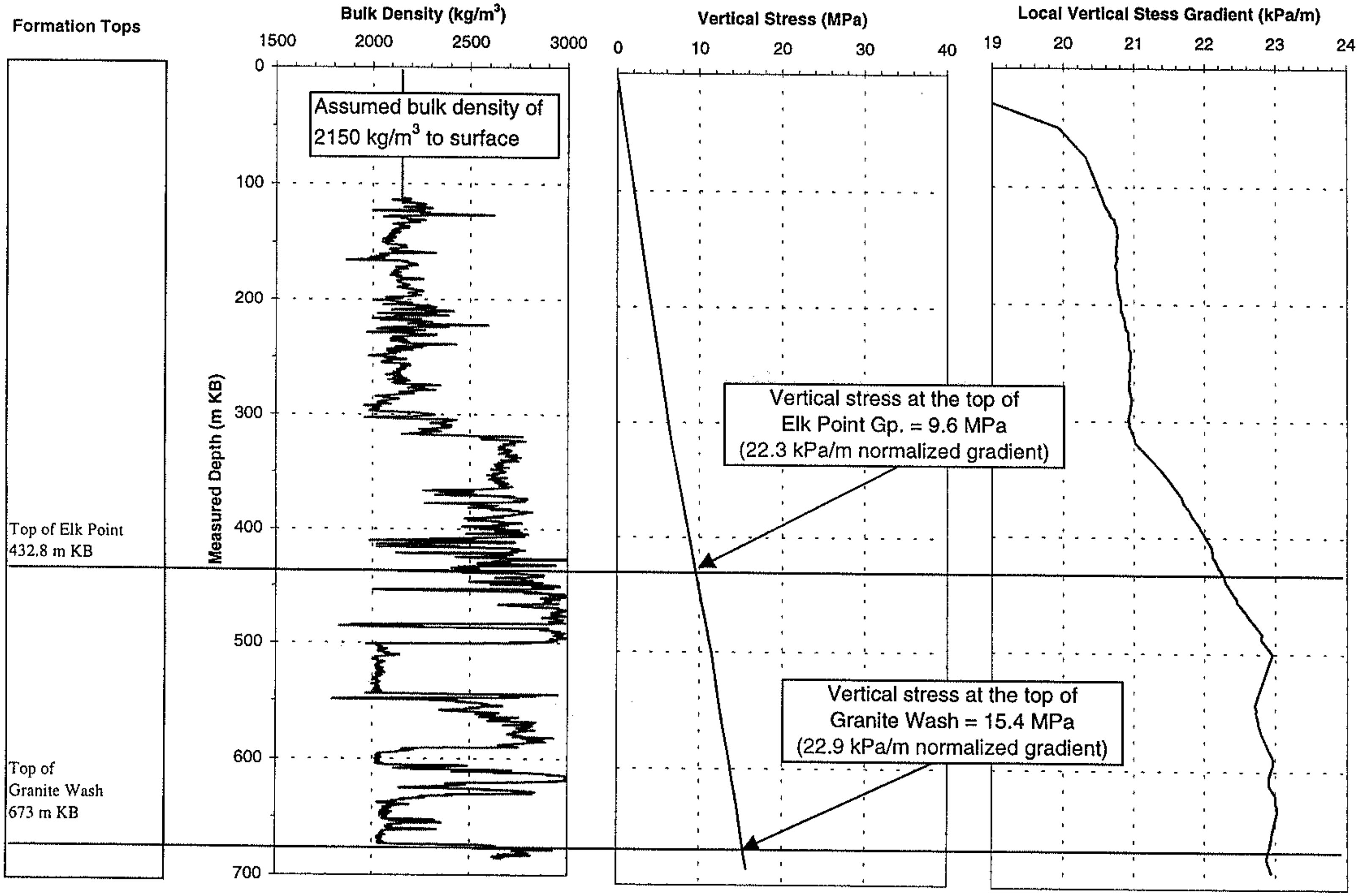



**Figure D.1.67: Calculated vertical stress and vertical stress gradients for Texcan Cottonwood 1-14-83-6.**

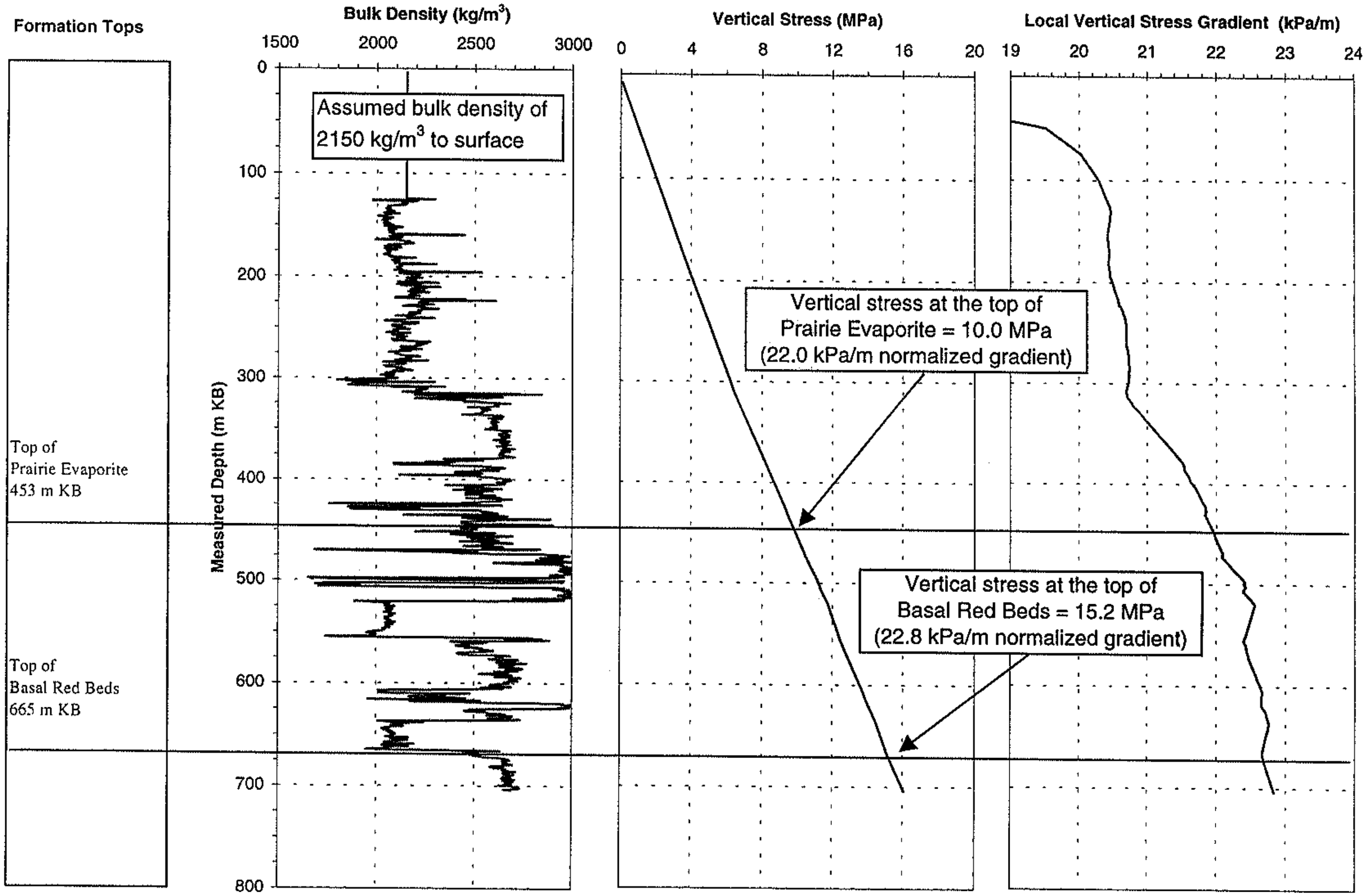



**Figure D.1.68: Calculated vertical stress and vertical stress gradients for Northstar et al Surmont 7-32-83-6.**

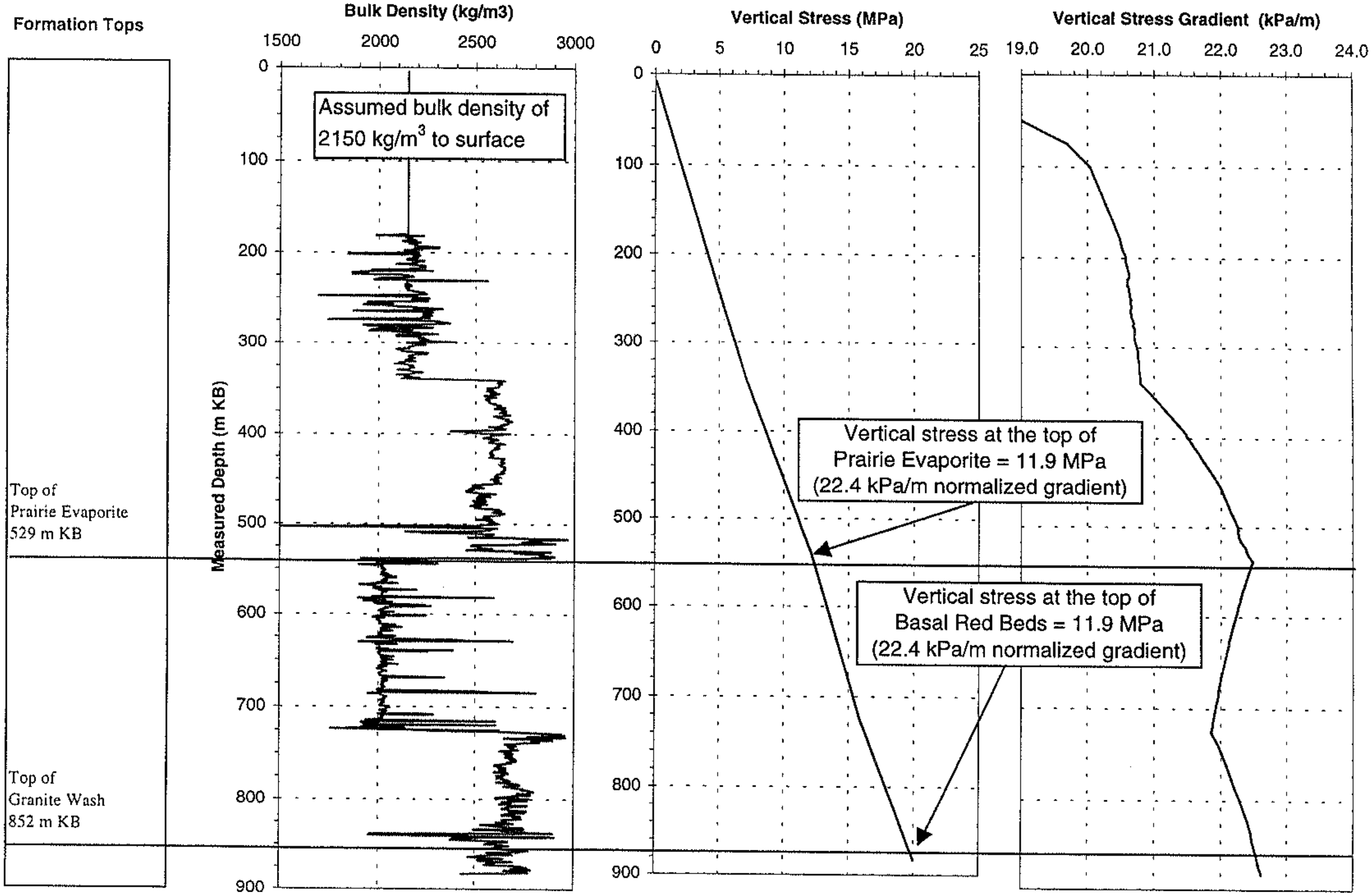



**Figure D.1.69: Calculated vertical stress and vertical stress gradients for JACOS WD HANGST 15-14-84-11.**

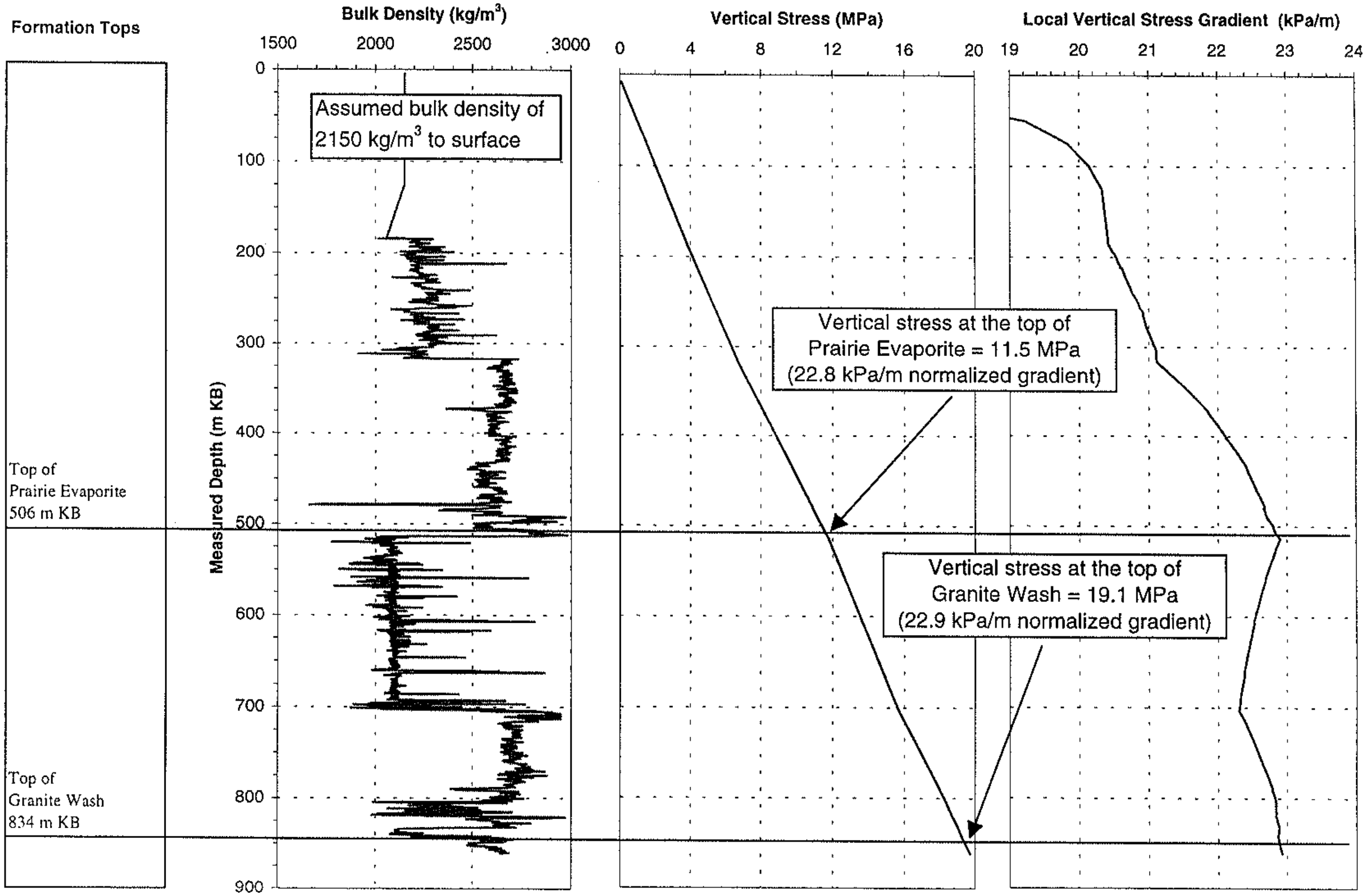



**Figure D.1.70: Calculated vertical stress and vertical stress gradients for PCI PCEJ Hangst 9-27-84-11.**

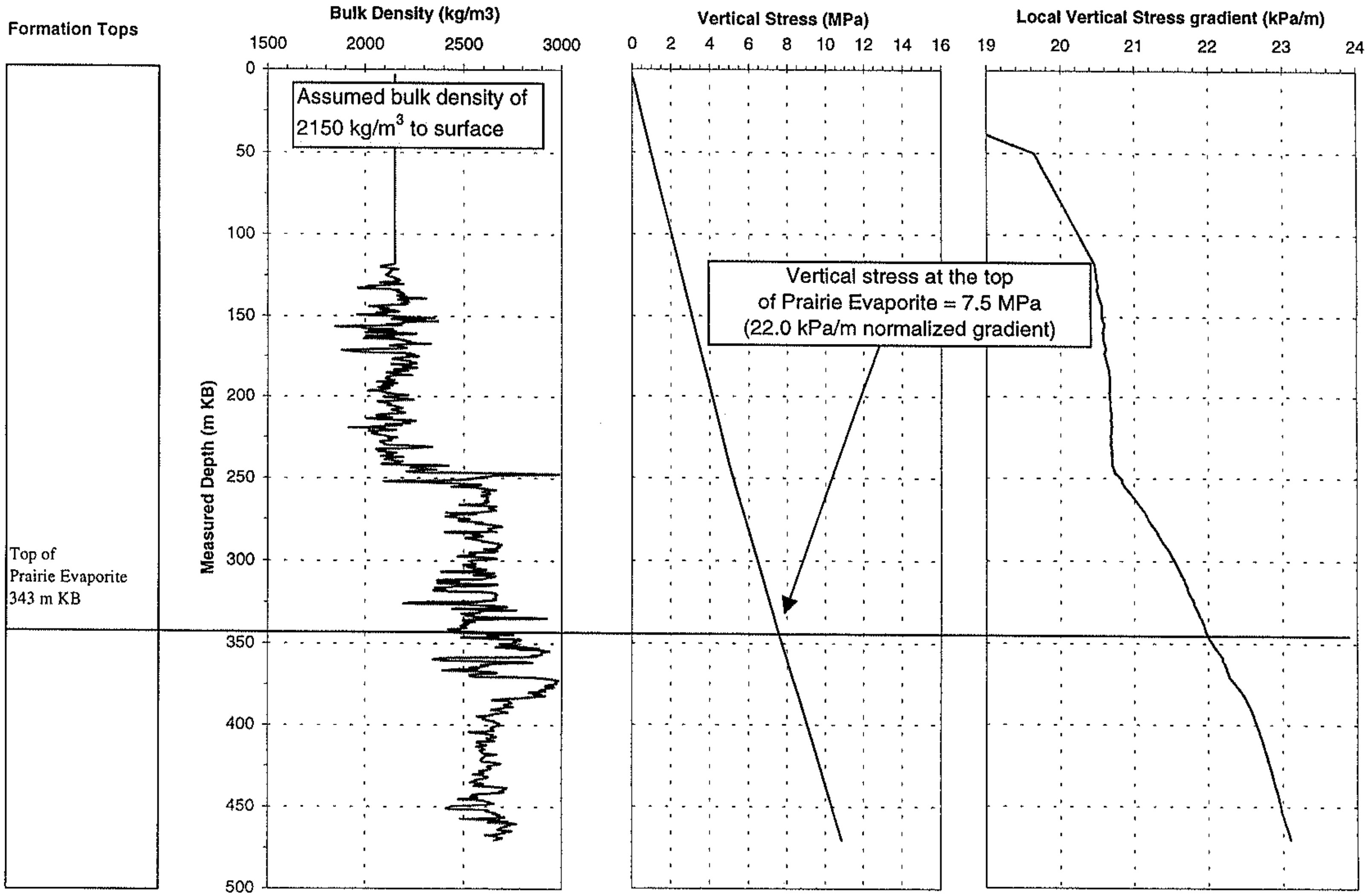



**Figure D.1.71: Calculated vertical stress and vertical stress gradients for Rax Newby 14-24-85-6.**

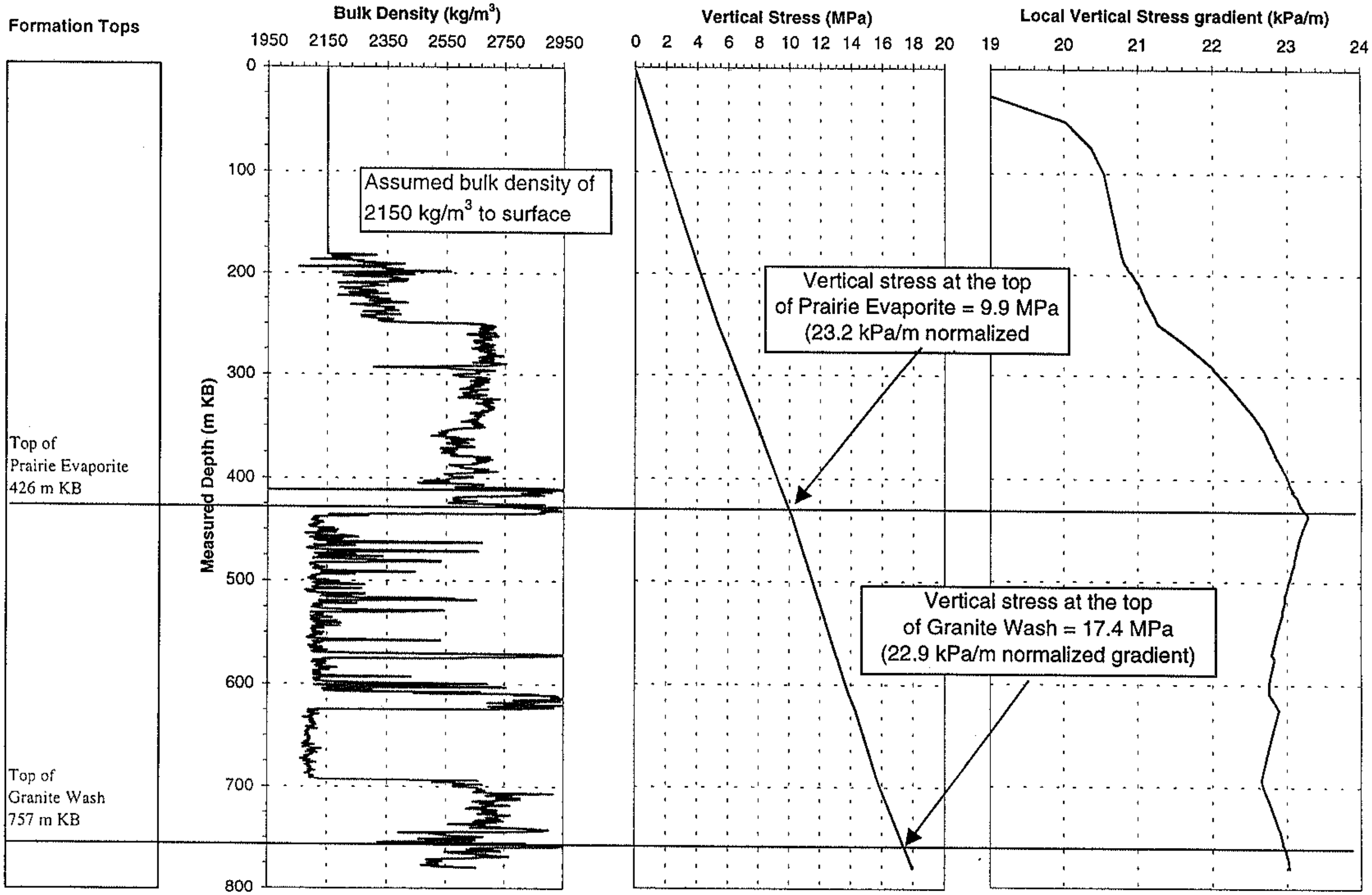



**Figure D.1.72: Calculated vertical stress and vertical stress gradients for Texcan CS Horse 16-27-85-11.**

ADVANCED GEOTECHNOLOGY

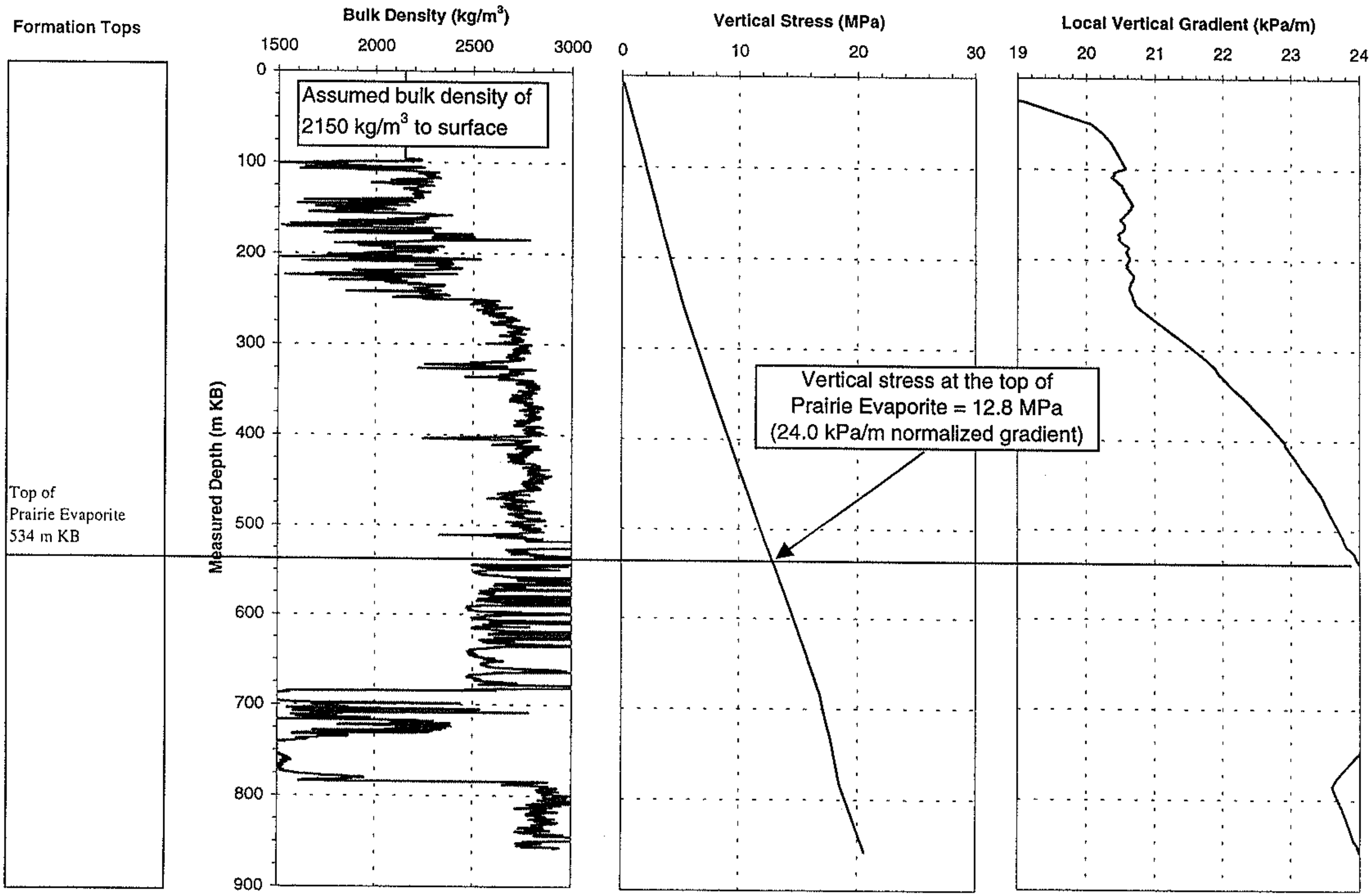



**Figure D.1.73: Calculated vertical stress and vertical stress gradients for Cigol et al Horse 11-10-85-13.**

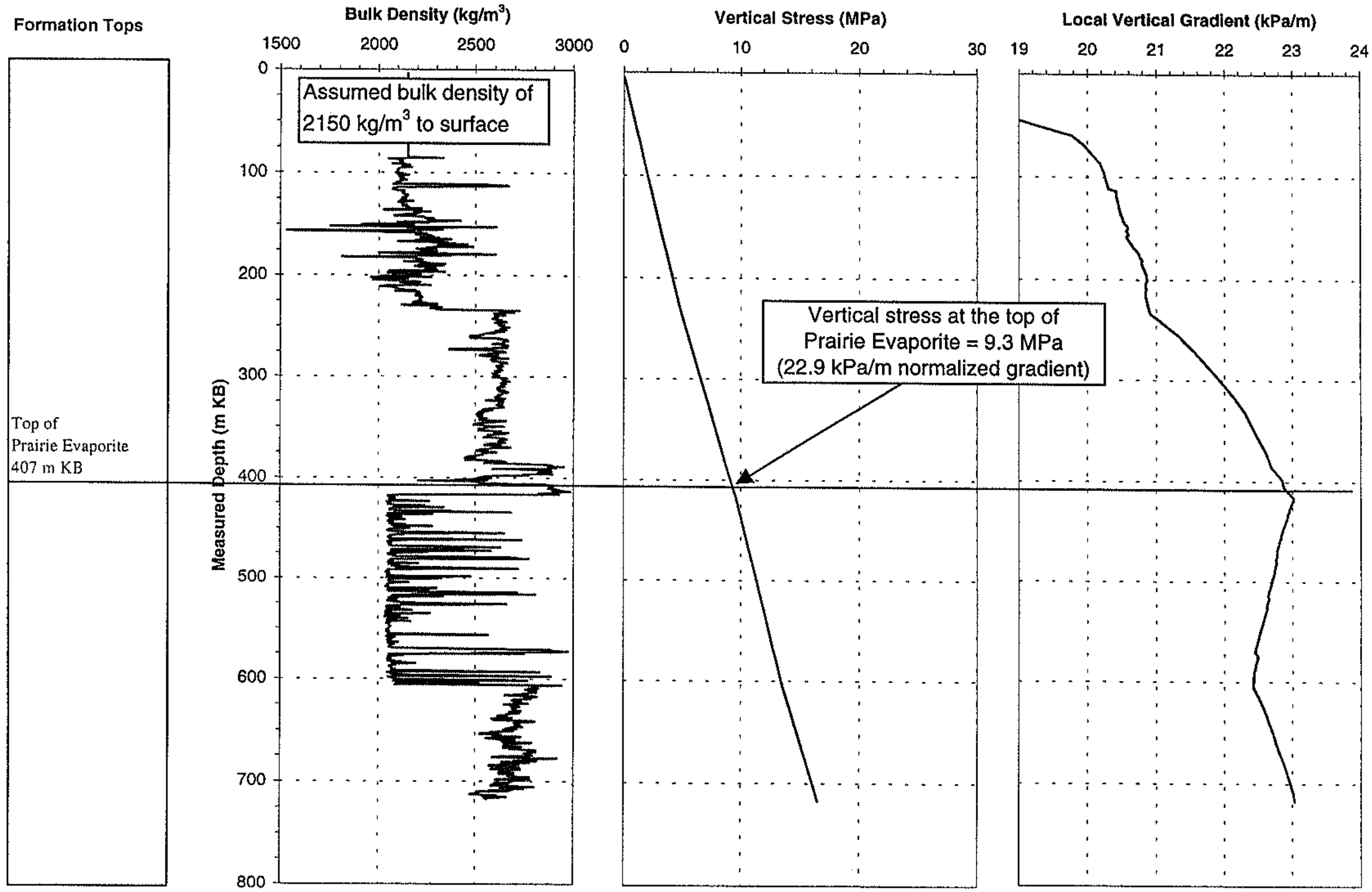



**Figure D.1.74: Calculated vertical stress and vertical stress gradients for Suncor Clarke 2-32prev-89-12.**

ADVANCED GEOTECHNOLOGY

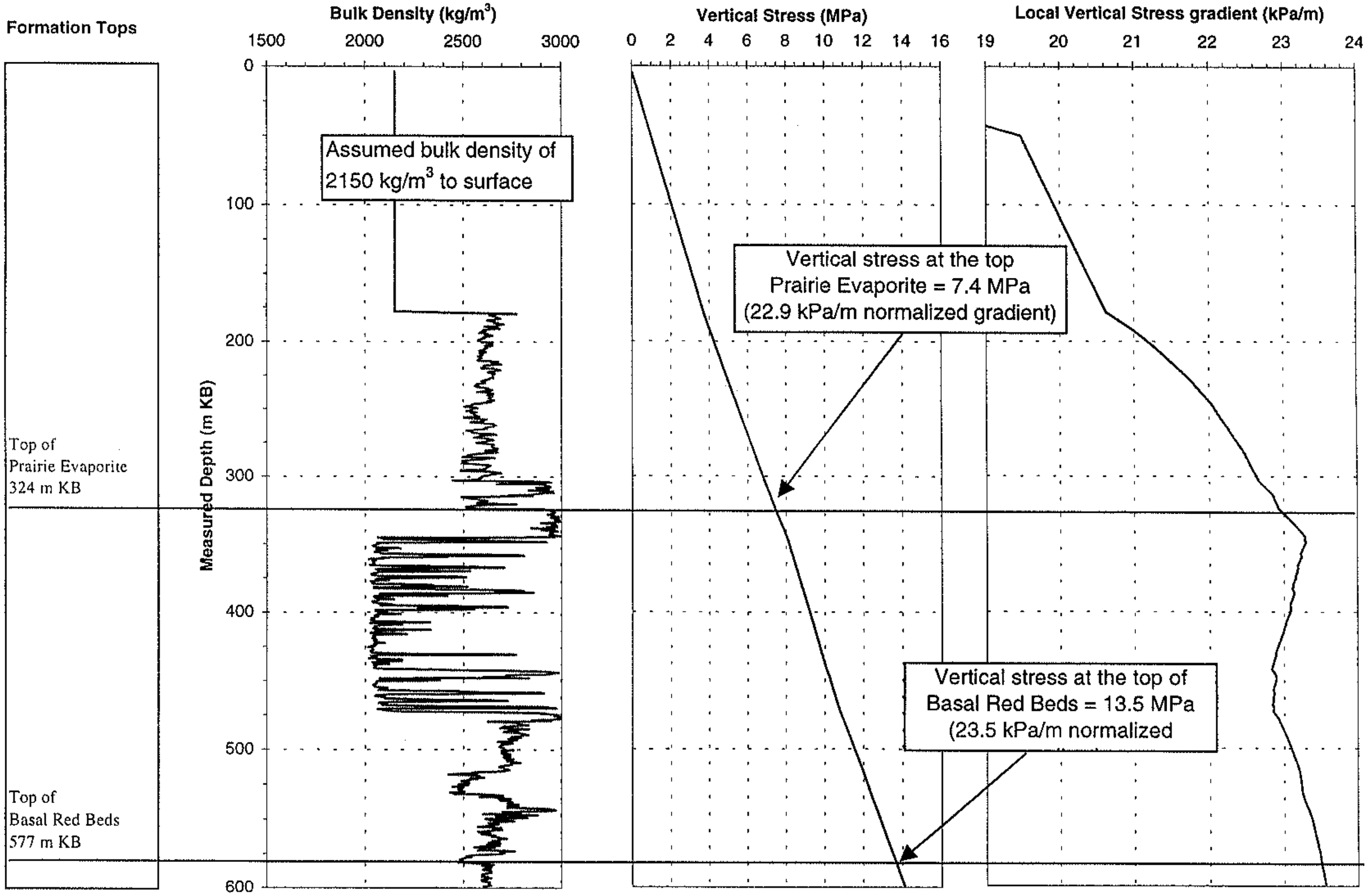



**Figure D.1.75: Calculated vertical stress and vertical stress gradients for AOSTRA WDW1 Athasbasca 6-18-93-12.**

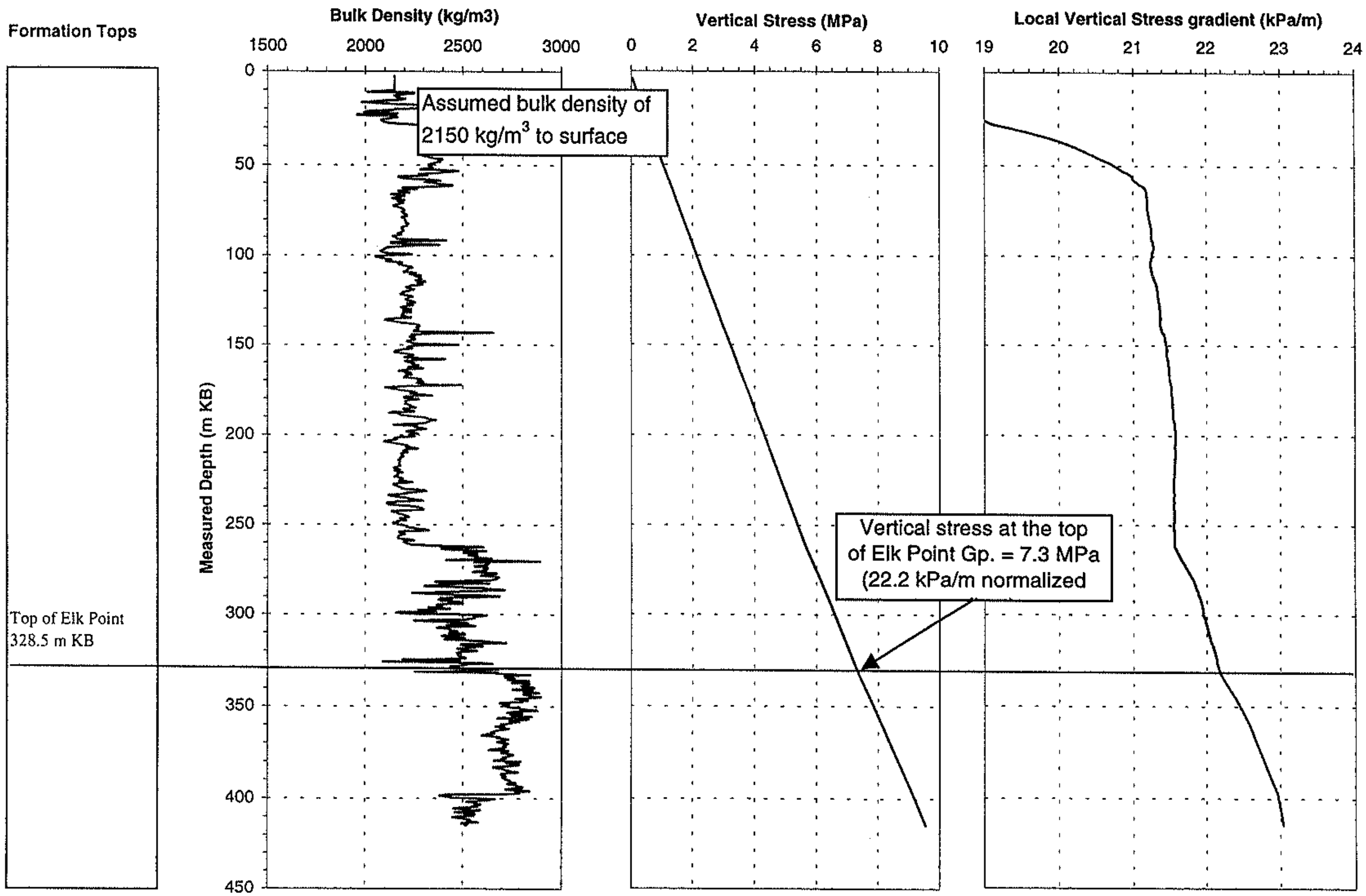



Figure D.1.76: Calculated vertical stress and vertical stress gradients for Chevron Steepbank EX 8-22-94-7.

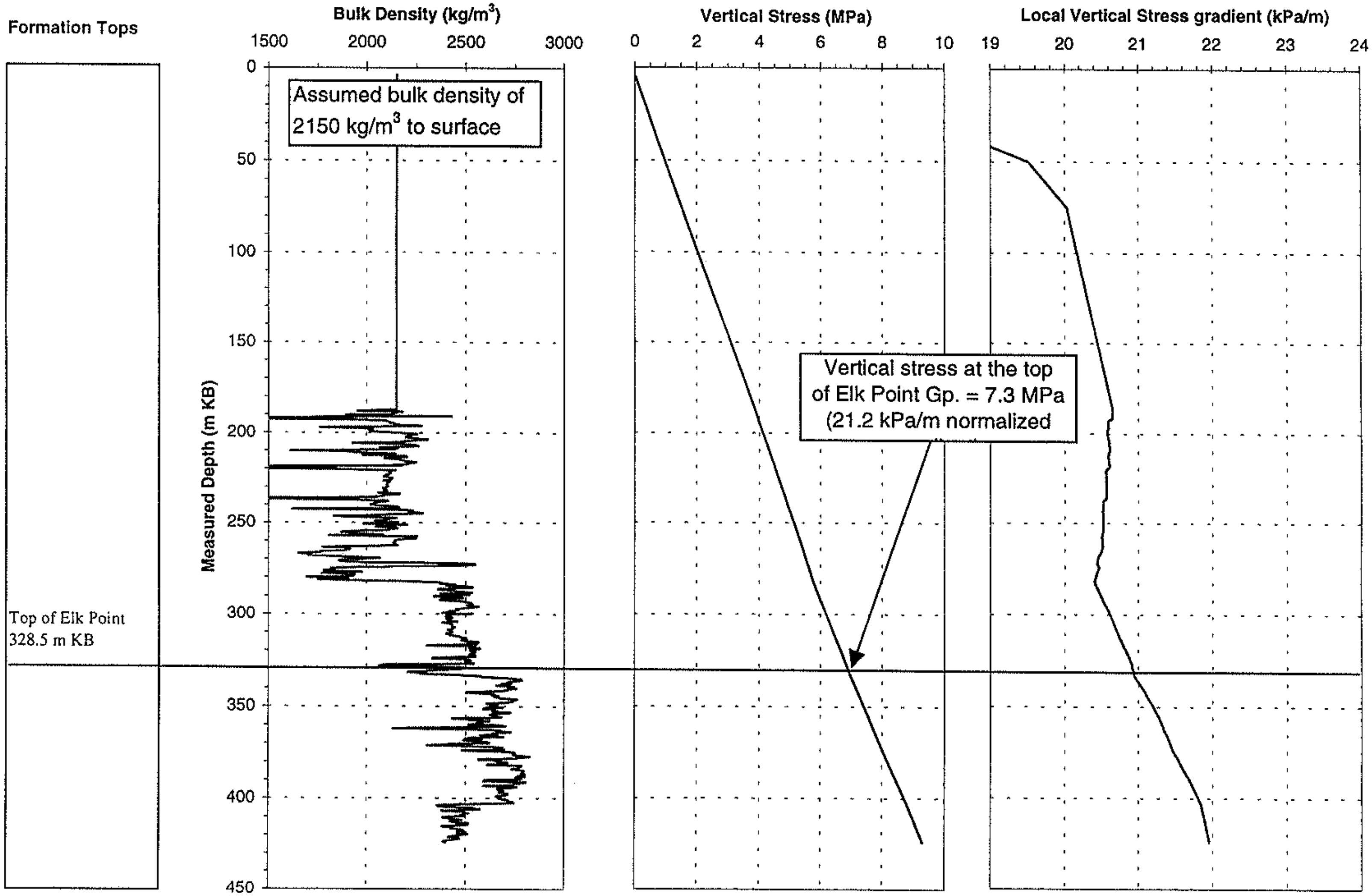



**Figure D.1.77: Calculated vertical stress and vertical stress gradients for Chevron Steepbank 6-23-94-7.**

ADVANCED GEOTECHNOLOGY

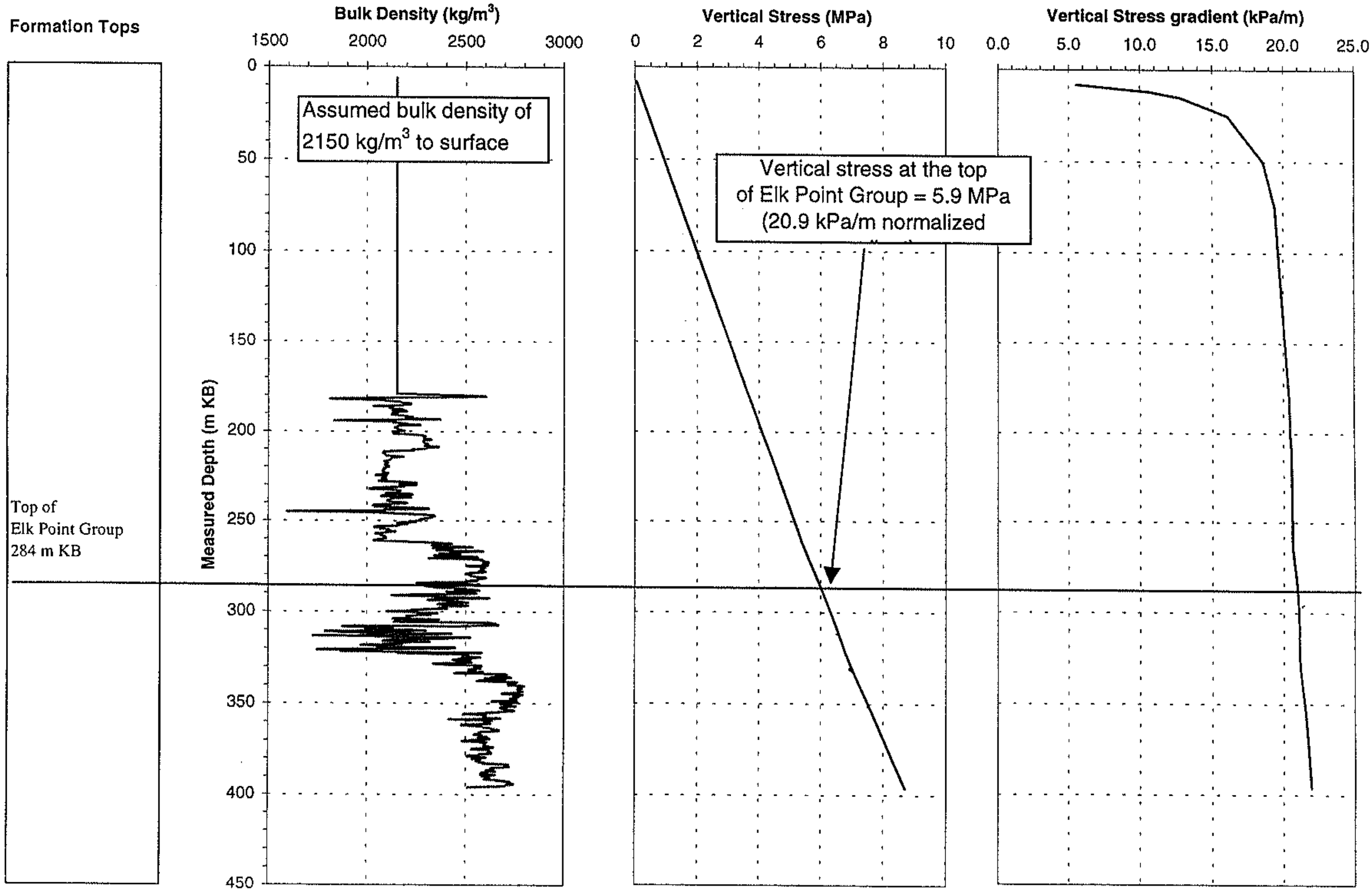



**Figure D.1.78: Calculated vertical stress and vertical stress gradients for Chevron Steepbank 13-23-94-7.**

ADVANCED GEOTECHNOLOGY

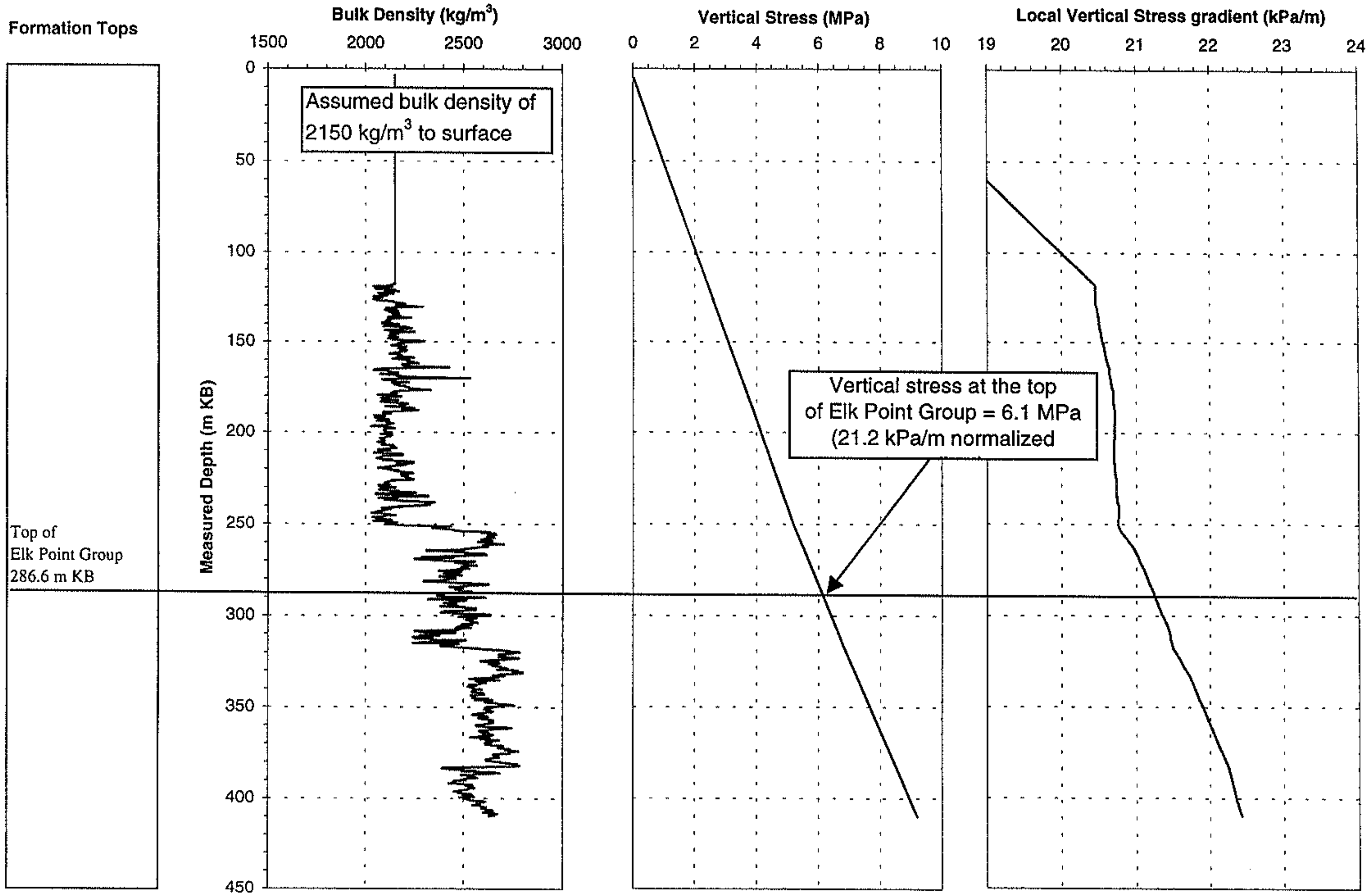



**Figure D.1.79: Calculated vertical stress and vertical stress gradients for CDCOG Tenn Muskegr 1-3-95-7.**

ADVANCED GEOTECHNOLOGY

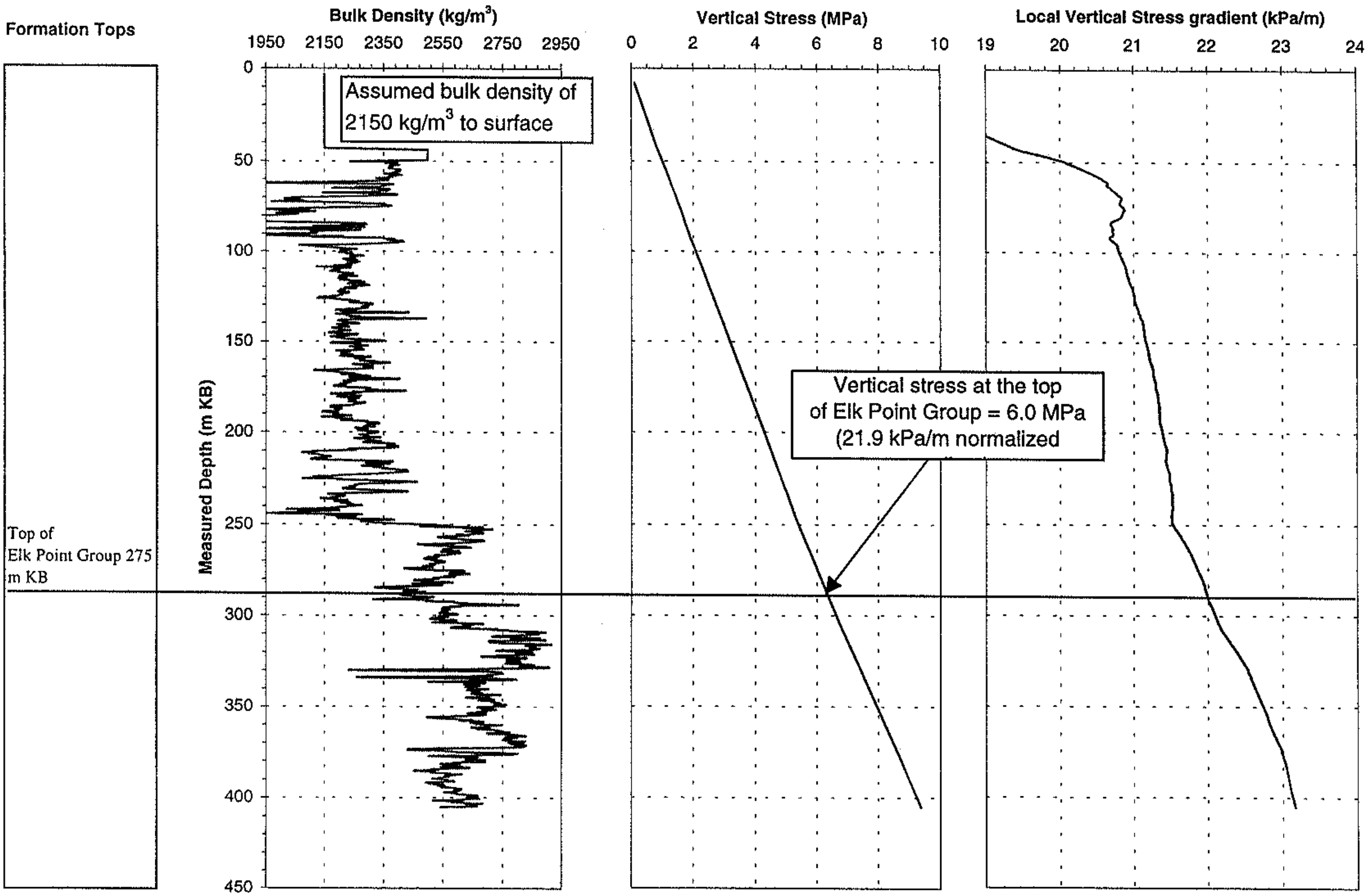



**Figure D.1.80: Calculated vertical stress and vertical stress gradients for Husky Tenn Nova 3-14-95-7.**

ADVANCED GEOTECHNOLOGY

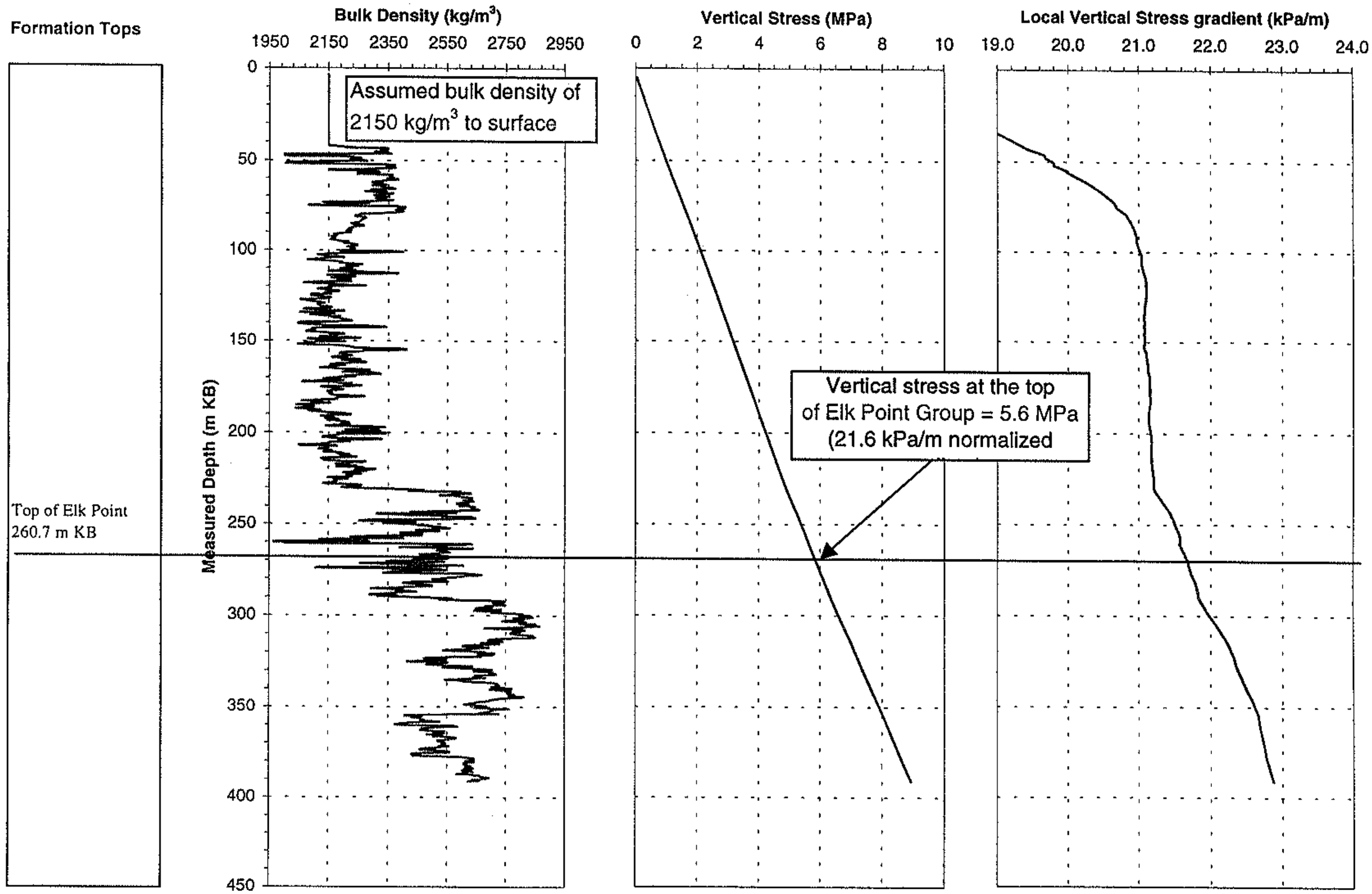



**Figure D.1.81: Calculated vertical stress and vertical stress gradients for Husky Tenn Nova 3-15-95-7.**

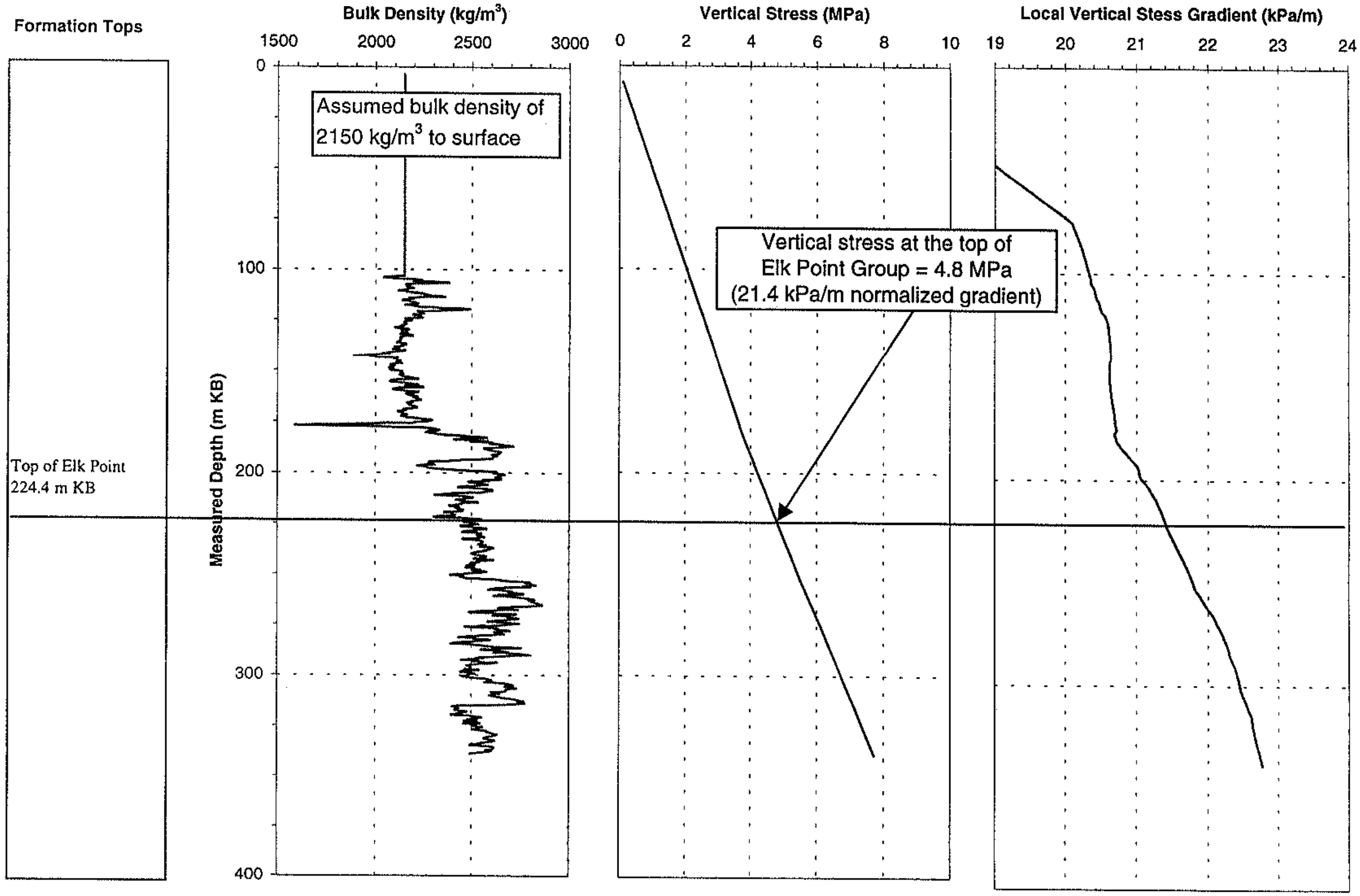



**Figure D.1.82: Calculated vertical stress and vertical stress gradients for Husky Tenn Muskegr 1-20-95-7.**

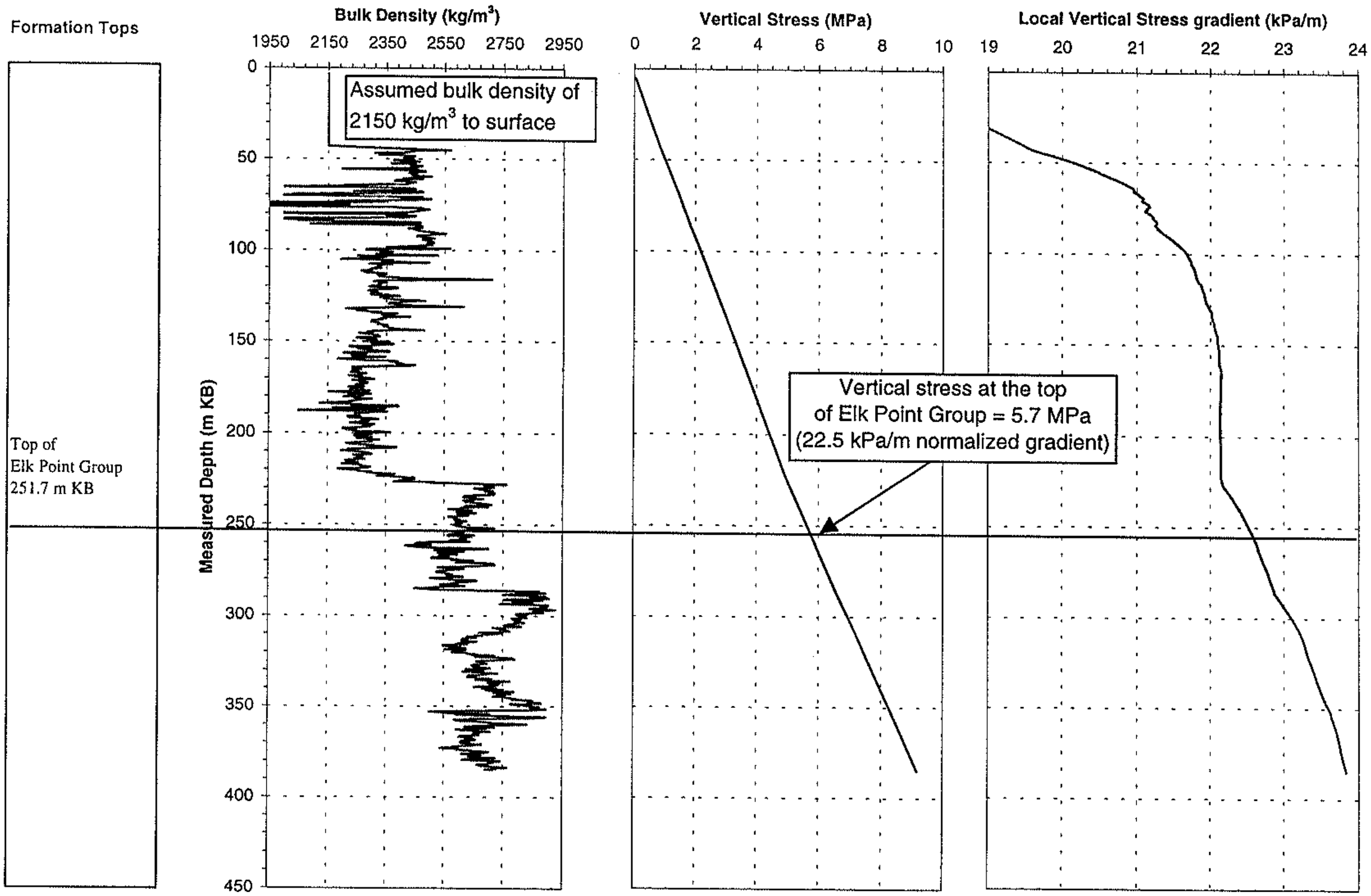



**Figure D.1.83: Calculated vertical stress and vertical stress gradients for Husky Tenn Nova 4-22-95-7.**

ADVANCED GEOTECHNOLOGY

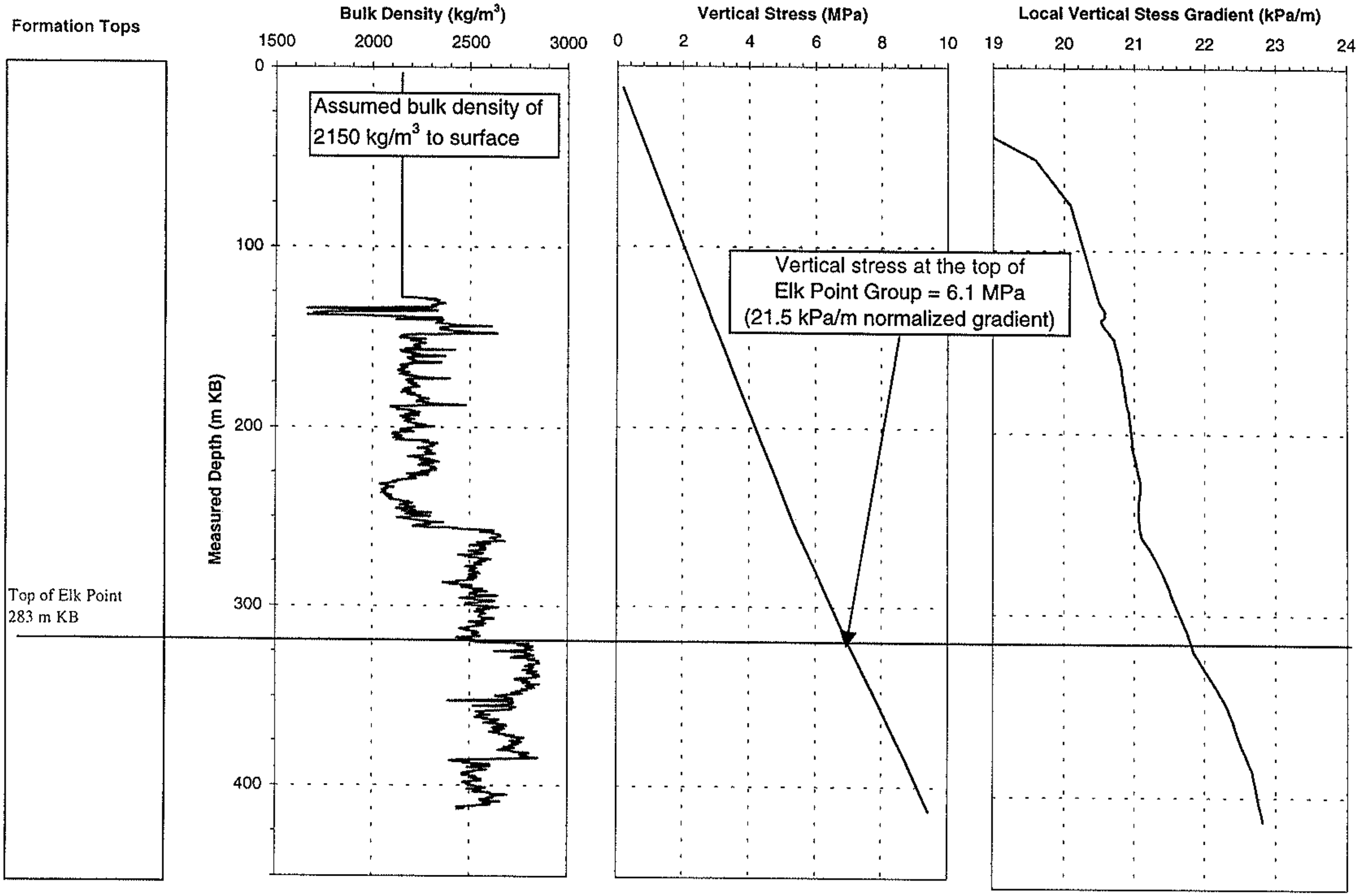



**Figure D.1.84: Calculated vertical stress and vertical stress gradients for CDCOG Tenn Muskegr 1-24-95-7.**

ADVANCED GEOTECHNOLOGY

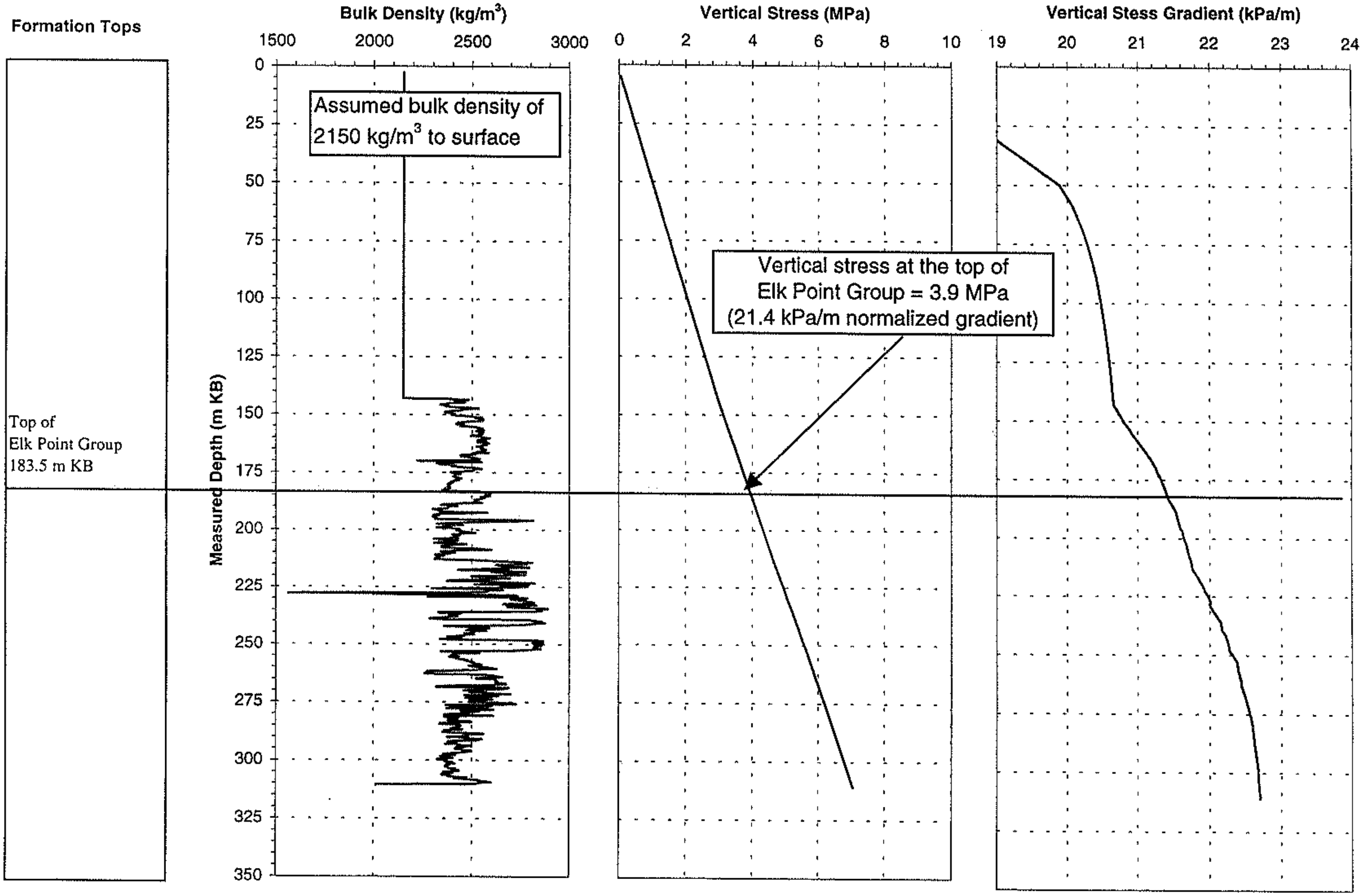



Figure D.1.85: Calculated vertical stress and vertical stress gradients for Esso 90PC Oslo 12-7-95-8.

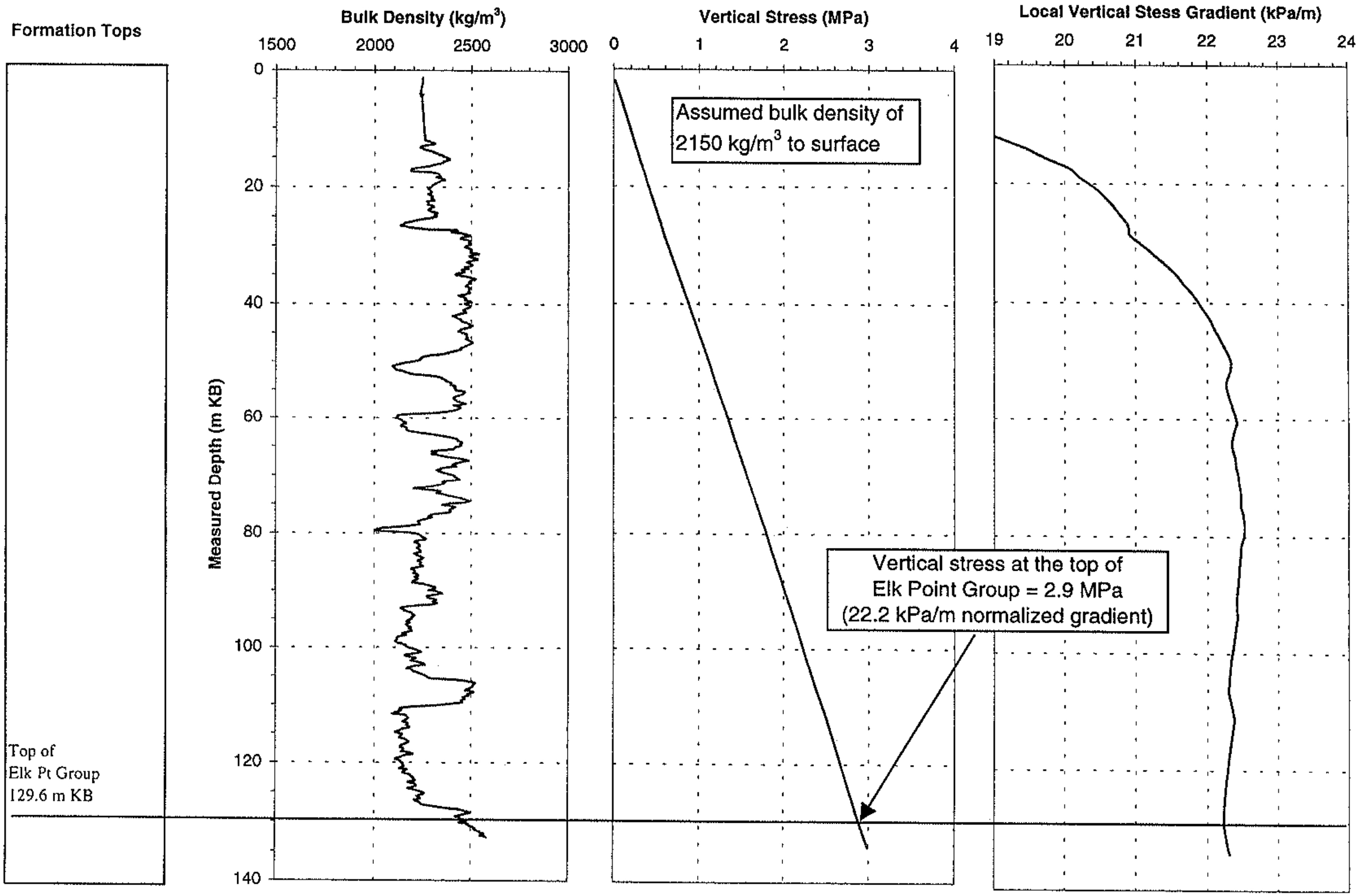



**Figure D.1.86: Calculated vertical stress and vertical stress gradients for Gulf Firebag 15-8-96-1.**

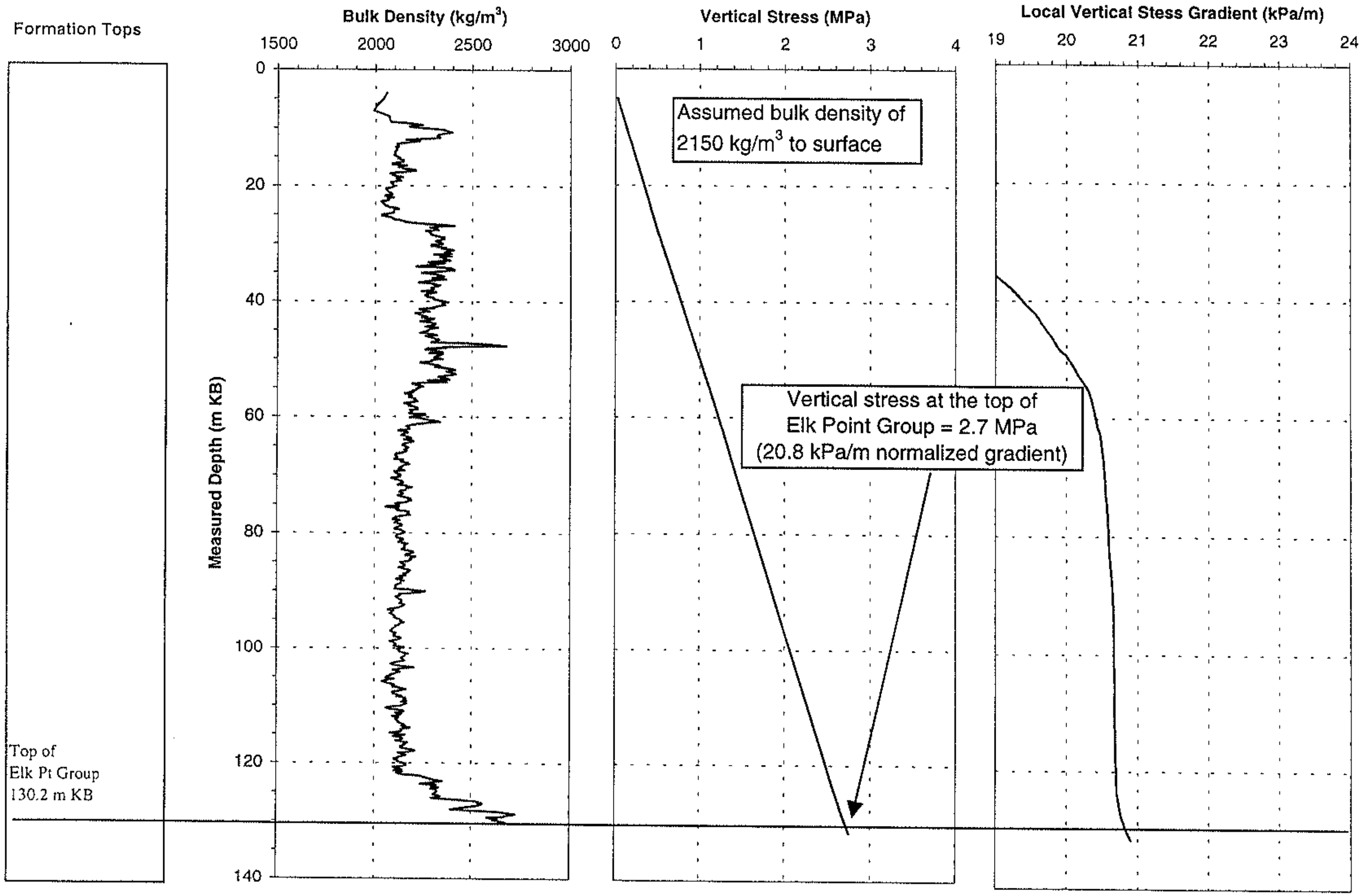



**Figure D.1.87: Calculated vertical stress and vertical stress gradients for Gulf Firebag 14-11-96-1.**

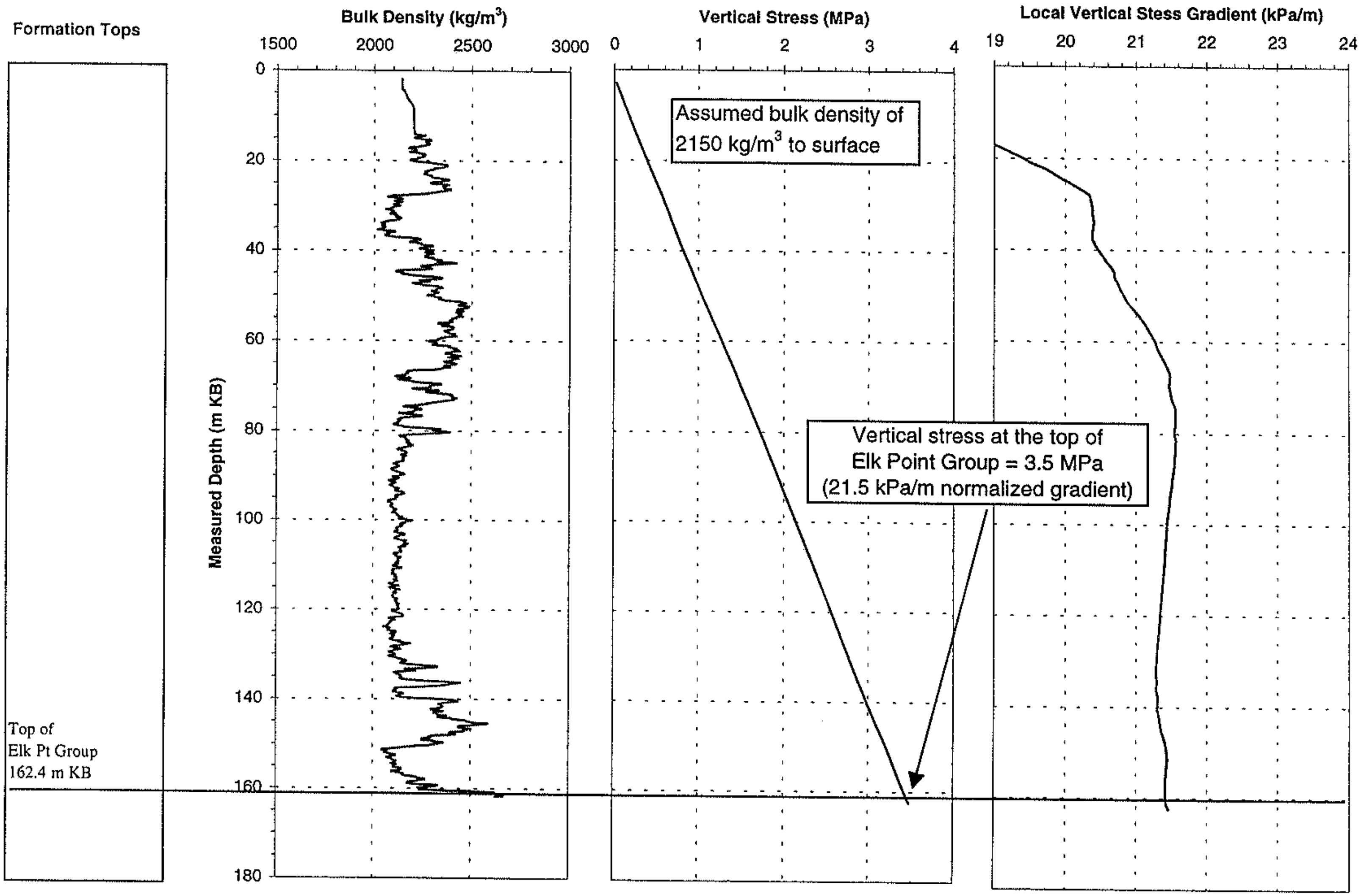



**Figure D.1.88: Calculated vertical stress and vertical stress gradients for Gulf Firebag 6-26-96-1.**

ADVANCED GEOTECHNOLOGY

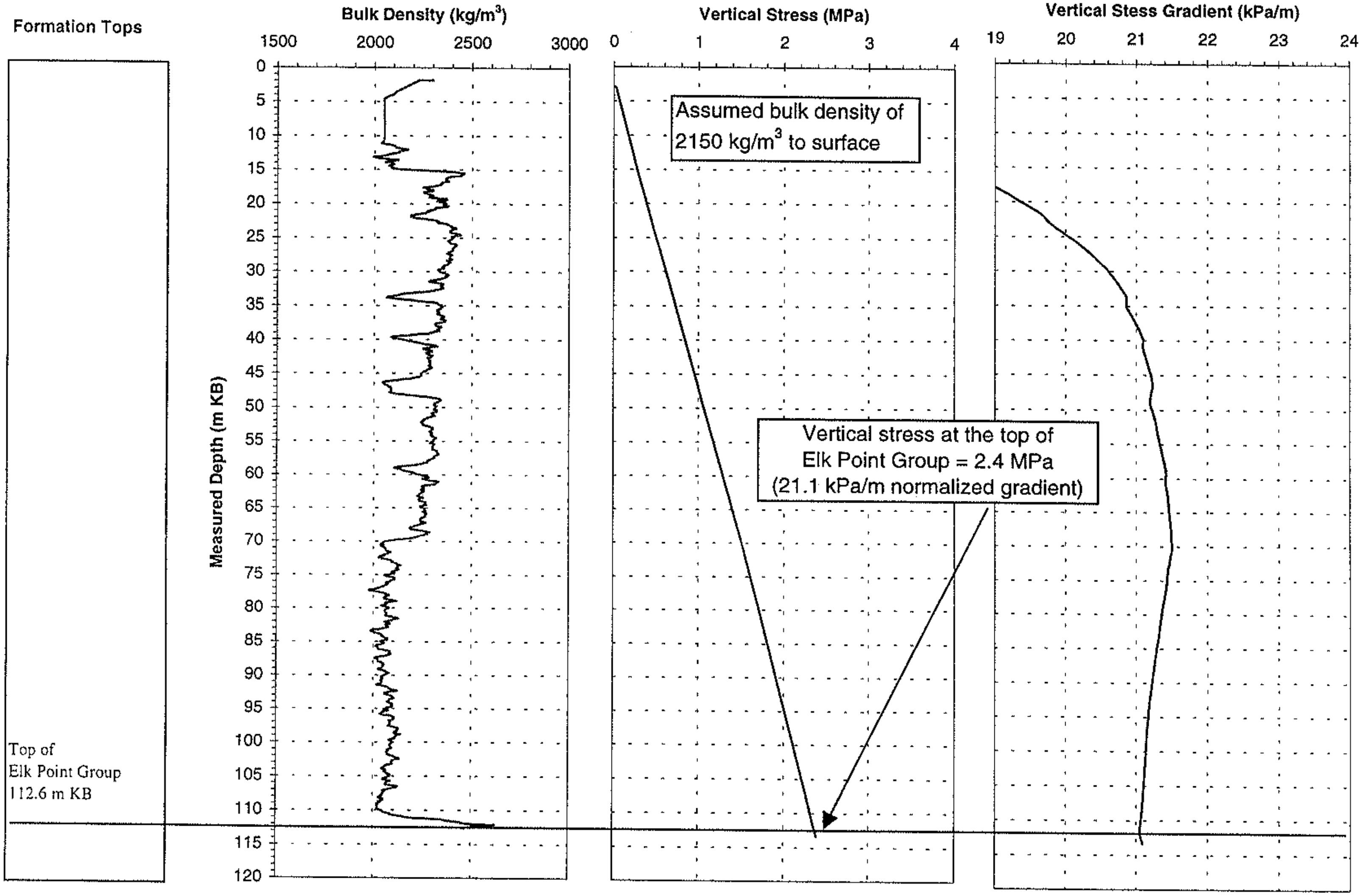



**Figure D.1.89: Calculated vertical stress and vertical stress gradients for Gulf Firebag 7-29-96-1.**

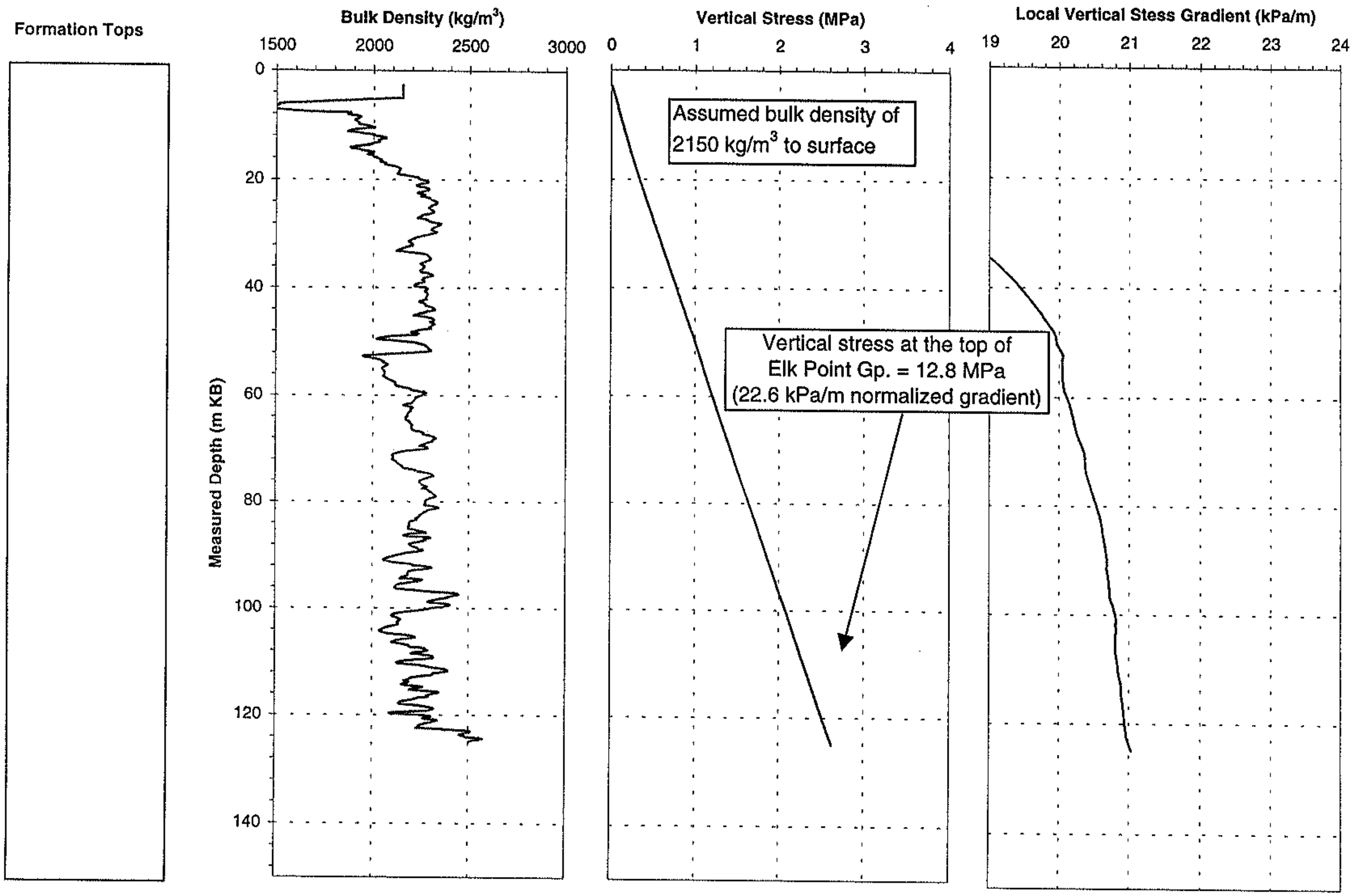



**Figure D.1.90: Calculated vertical stress and vertical stress gradients for Gulf Firebag 2-8-97-1.**

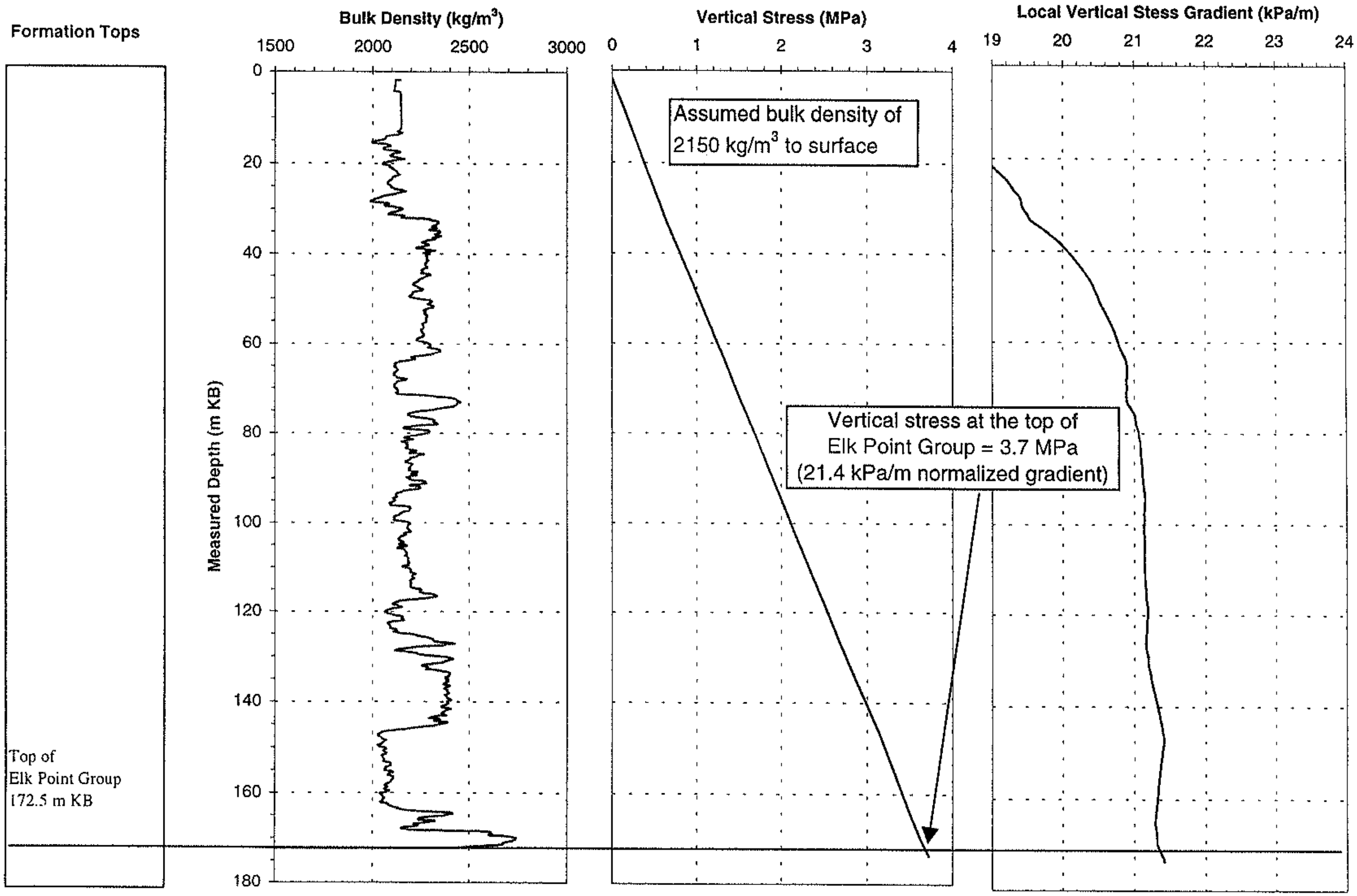



**Figure D.1.91: Calculated vertical stress and vertical stress gradients for Gulf Firebag 2-11-97-1.**

ADVANCED GEOTECHNOLOGY

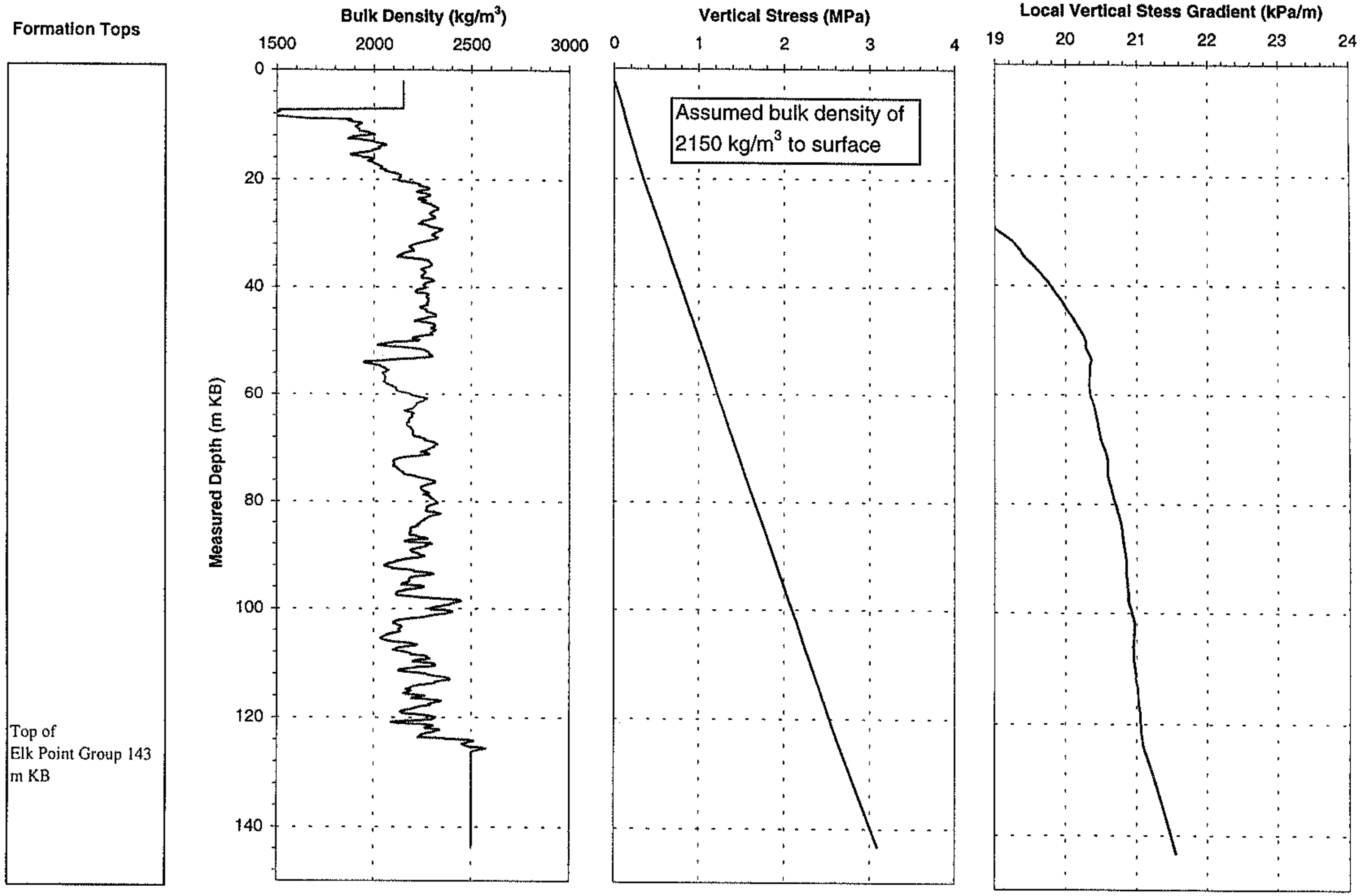



**Figure D.1.92: Calculated vertical stress and vertical stress gradients for Gulf Firebag 13-12-97-2.**

ADVANCED GEOTECHNOLOGY

## Table D.2: Detailed summary of breakout data in the Beaverhill Lake and Elk Point Groups

top: top of interval (m log depth)
bottom: bottom of interval (m log depth)
thickness: thickness of interval (m)
P1AZ: azimuth of C1 caliper (degrees)
P1AZc: azimuth of C1 caliper corrected to true north
Cmax Az wrt true North: Breakout azimuth corrected to true north
C1: C1-C3 caliper measurement (mm)
C2: C2-C4 caliper measurement (mm)
% enlarge % difference between C1 and C2 readings
% gauge % difference between smaller caliper reading and hole gauge
quality: quality of breakout
formation formation that breakout occurs within

Well Name: **Voyager et al Bruce 6-14-48-14 (100/06-14-048-14W4/00)**
Borehole Diameter: 159 mm
Correction to True North: 20 (1982, Lat: 53, Long 112 = correction 20 deg E)

| top (m KB) | bottom (m KB) | thickness (m) | P1AZ (deg) | CMAX Az (deg) | CMAX Az wrt true N (deg) | C1 (mm) | C2 (mm) | % enlarge | % gauge | quality | formation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1475 | 1476 | 1 | 230 | 230 | 250 | 181.25 | 161 | 12.58% | 1.26% | v good | Watt Mtn |
| 1474 | 1475 | 1 | 230 | 230 | 250 | 173 | 156 | 10.90% | -1.89% | v good | Watt Mtn |
| 1473 | 1474 | 1 | 225 | 225 | 245 | 171 | 153 | 11.76% | -3.77% | good | Watt Mtn |
| 1472 | 1473 | 1 | 240 | 240 | 260 | 175 | 156 | 12.18% | -1.89% | good | Watt Mtn |
| 1471 | 1472 | 1 | 235 | 235 | 255 | 173 | 159 | 8.81% | 0.00% | good | Watt Mtn |
| 1470 | 1471 | 1 | 235 | 235 | 255 | 169 | 153 | 10.46% | -3.77% | good | Watt Mtn |
| 1469 | 1470 | 1 | 232 | 232 | 252 | 165 | 153 | 7.84% | -3.77% | good | Watt Mtn |
| 1468 | 1469 | 1 | 230 | 230 | 250 | 165 | 153 | 7.84% | -3.77% | good | Watt Mtn |
| 1467 | 1468 | 1 | 235 | 235 | 255 | 161 | 153 | 5.23% | -3.77% | good | Watt Mtn |
| 1466 | 1467 | 1 | 238 | 238 | 258 | 160 | 153 | 4.58% | -3.77% | good | Watt Mtn |
| 1465 | 1466 | 1 | 238 | 238 | 258 | 160 | 153 | 4.58% | -3.77% | good | Watt Mtn |
| 1464 | 1465 | 1 | 238 | 238 | 258 | 160 | 153 | 4.58% | -3.77% | good | Watt Mtn |
| 1463 | 1464 | 1 | 240 | 240 | 260 | 159 | 153 | 3.92% | -3.77% | good | Watt Mtn |
| 1462 | 1463 | 1 | 240 | 240 | 260 | 159 | 153 | 3.92% | -3.77% | good | Watt Mtn |
| 1461 | 1462 | 1 | 240 | 240 | 260 | 158 | 153 | 3.27% | -3.77% | fair | Watt Mtn |
| 1460 | 1461 | 1 | 240 | 240 | 260 | 157 | 153 | 2.61% | -3.77% | fair | Watt Mtn |
| 1459 | 1460 | 1 | 242 | 242 | 262 | 156 | 153 | 1.96% | -3.77% | fair | Watt Mtn |

## Table D.2: Detailed summary of breakout data in the Beaverhill Lake and Elk Point Groups

Well Name: **AEC D1 Fisher 1-21-70-4 (104/01-21-070-04W4/00)**
Borehole Diameter: 311 mm
Correction to True North: 0 (corrected 18 deg E on log)

| top (m KB) | bottom (m KB) | thickness (m) | P1AZ (deg) | CMAX Az (deg) | CMAX Az wrt true N (deg) | C1 (mm) | C2 (mm) | % enlarge | % gauge | quality | formation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 510 | 511 | 1 | 145 | 145 | 145 | 320 | 311 | 2.89% | 0.00% | poor | BH LK |
| 511 | 512 | 1 | 145 | 145 | 145 | 320 | 311 | 2.89% | 0.00% | poor | BH LK |
| 512 | 513 | 1 | 145 | 145 | 145 | 315 | 311 | 1.29% | 0.00% | poor | BH LK |
| 513 | 514 | 1 | 145 | 145 | 145 | 320 | 311 | 2.89% | 0.00% | poor | BH LK |
| 514 | 515 | 1 | 145 | 145 | 145 | 320 | 311 | 2.89% | 0.00% | poor | BH LK |
| 515 | 516 | 1 | 145 | 145 | 145 | 320 | 311 | 2.89% | 0.00% | poor | BH LK |

Well Name: **AEC A8 Fisher 8-21-70-4 (100/08-21-070-04W4/00)**
Borehole Diameter: 200 mm
Correction to True North: 0 (corrected 18.3 deg E on log)
Comments: Dipmeter logged 09-Oct-96 while other logs ran 12-Feb-97
Comments: No P1AZ trace (tadpoles within breakout zone)

| top (m KB) | bottom (m KB) | thickness (m) | P1AZ (deg) | CMAX Az (deg) | CMAX Az wrt true N (deg) | C1 (mm) | C2 (mm) | % enlarge | % gauge | quality | formation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 520 | 521 | 1 | 285 | 285 | 285 | 209 | 200 | 4.50% | 0.00% | fair | BH LK |
| 521 | 522 | 1 | 285 | 285 | 285 | 209 | 198 | 5.56% | -1.00% | fair | BH LK |
| 522 | 523 | 1 | 285 | 285 | 285 | 213 | 198 | 7.58% | -1.00% | fair | BH LK |
| 523 | 524 | 1 | 285 | 285 | 285 | 217 | 198 | 9.60% | -1.00% | fair | BH LK |
| 524 | 525 | 1 | 285 | 285 | 285 | 211 | 198 | 6.57% | -1.00% | fair | BH LK |
| 525 | 526 | 1 | 280 | 280 | 280 | 209 | 196 | 6.63% | -2.00% | fair | BH LK |
| 526 | 527 | 1 | 280 | 280 | 280 | 209 | 196 | 6.63% | -2.00% | fair | BH LK |
| 527 | 528 | 1 | 280 | 280 | 280 | 209 | 196 | 6.63% | -2.00% | fair | BH LK |
| 528 | 529 | 1 | 280 | 280 | 280 | 208 | 196 | 6.12% | -2.00% | fair | BH LK |
| 529 | 530 | 1 | 280 | 280 | 280 | 209 | 196 | 6.63% | -2.00% | fair | BH LK |
| 530 | 531 | 1 | 280 | 280 | 280 | 211 | 200 | 5.50% | 0.00% | fair | BH LK |
| 531 | 532 | 1 | 280 | 280 | 280 | 208 | 196 | 6.12% | -2.00% | fair | BH LK |
| 532 | 533 | 1 | 280 | 280 | 280 | 206 | 196 | 5.10% | -2.00% | fair | BH LK |
| 533 | 534 | 1 | 275 | 275 | 275 | 203 | 200 | 1.50% | 0.00% | fair | BH LK |
| 534 | 535 | 1 | 275 | 275 | 275 | 200 | 200 | 0.00% | 0.00% | fair | BH LK |

**Table D.2: Detailed summary of breakout data in the Beaverhill Lake and Elk Point Groups**

Well Name: **AEC B3 Fisher 3-22-70-4 (100/03-22-070-04W4/00)**
Borehole Diameter: 159 mm
Correction to True North: 0 (corrected 18.2 deg E on log)
Comments:

| top (m KB) | bottom (m KB) | thickness (m) | P1AZ (deg) | CMAX Az (deg) | CMAX Az wrt true N (deg) | C1 (mm) | C2 (mm) | % enlarge | % gauge | quality | formation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 496 | 497 | 1 | 115 | 115 | 115 | 167 | 162 | 3.09% | 1.89% | poor | BH LK |
| 497 | 498 | 1 | 115 | 115 | 115 | 167 | 159 | 5.03% | 0.00% | poor | BH LK |
| 498 | 499 | 1 | 115 | 115 | 115 | 171 | 162 | 5.56% | 1.89% | poor | BH LK |
| 499 | 500 | 1 | 115 | 115 | 115 | 173 | 159 | 8.81% | 0.00% | poor | BH LK |
| 500 | 501 | 1 | 115 | 115 | 115 | 173 | 159 | 8.81% | 0.00% | poor | BH LK |
| 501 | 502 | 1 | 115 | 115 | 115 | 173 | 159 | 8.81% | 0.00% | poor | BH LK |

Well Name: **AEC Fisher 6-33-70-4 (100/06-33-070-04W4/00)**
Borehole Diameter: 159 mm
Correction to True North: 0 (corrected 18.2 deg E on log)
Comments:

| top | bottom | thickness | P1AZ | CMAX Az | CMAX Az wrt true N | C1 | C2 | % enlarge | % gauge | quality | formation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 495 | 496 | 1 | 140 | 140 | 140 | 167 | 159 | 5.03% | 0.00% | fair | BH LK |
| 496 | 497 | 1 | 140 | 140 | 140 | 167 | 159 | 5.03% | 0.00% | fair | BH LK |
| 497 | 498 | 1 | 140 | 140 | 140 | 171 | 159 | 7.55% | 0.00% | fair | BH LK |
| 498 | 499 | 1 | 140 | 140 | 140 | 167 | 159 | 5.03% | 0.00% | fair | BH LK |
| 499 | 500 | 1 | 140 | 140 | 140 | 165 | 159 | 3.77% | 0.00% | fair | BH LK |
| 500 | 501 | 1 | 140 | 140 | 140 | 165 | 159 | 3.77% | 0.00% | fair | BH LK |

## Table D.2: Detailed summary of breakout data in the Beaverhill Lake and Elk Point Groups

**SD of corrected CMAX Az data from all wells: 53°**

top: top of interval (m log depth)
bottom: bottom of interval (m log depth)
thickness: thickness of interval (m)
P1AZ: azimuth of C1 caliper (degrees)
P1AZc: azimuth of C1 caliper corrected to true north
Cmax Az wrt true North: Breakout azimuth corrected to true north
C1: C1-C3 caliper measurement (mm)
C2: C2-C4 caliper measurement (mm)
% enlarge: % difference between C1 and C2 readings
% gauge: % difference between smaller caliper reading and hole gauge
quality: quality of breakout
formation: formation that breakout occurs within

Well Name: **Voyager et al Bruce 6-14-48-14 (100/06-14-048-14W4/00)**
Borehole Diameter: 159 mm
Correction to True North: 20 (1982, Lat: 53, Long 112 = correction 20 deg E)

(Original defect on this page)

| top (m KB) | bottom (m KB) | thickness (m) | P1AZ (deg) | CMAX Az (deg) | CMAX Az wrt true N (deg) | C (m. | | | | | formation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1475 | 1476 | 1 | 230 | 230 | 250 | 181. | | | | | Watt Mtn |
| 1474 | 1475 | 1 | 230 | 230 | 250 | 17: | | | | | Watt Mtn |
| 1473 | 1474 | 1 | 225 | 225 | 245 | 171 | | | | | Watt Mtn |
| 1472 | 1473 | 1 | 240 | 240 | 260 | 175 | | | | | Vatt Mtn |
| 1471 | 1472 | 1 | 235 | 235 | 255 | 173 | | | | | att Mtn |
| 1470 | 1471 | 1 | 235 | 235 | 255 | 169 | | | | | att Mtn |
| 1469 | 1470 | 1 | 232 | 232 | 252 | 165 | | | | | att Mtn |
| 1468 | 1469 | 1 | 230 | 230 | 250 | 165 | | | | | Watt Mtn |
| 1467 | 1468 | 1 | 235 | 235 | 255 | 161 | | | -3.77% | good | Watt Mtn |
| 1466 | 1467 | 1 | 238 | 238 | 258 | 160 | | 4.58% | -3.77% | good | Watt Mtn |
| 1465 | 1466 | 1 | 238 | 238 | 258 | 160 | 153 | 4.58% | -3.77% | good | Watt Mtn |
| 1464 | 1465 | 1 | 238 | 238 | 258 | 160 | 153 | 4.58% | -3.77% | good | Watt Mtn |
| 1463 | 1464 | 1 | 240 | 240 | 260 | 159 | 153 | 3.92% | -3.77% | good | Watt Mtn |
| 1462 | 1463 | 1 | 240 | 240 | 260 | 159 | 153 | 3.92% | -3.77% | good | Watt Mtn |
| 1461 | 1462 | 1 | 240 | 240 | 260 | 158 | 153 | 3.27% | -3.77% | fair | Watt Mtn |
| 1460 | 1461 | 1 | 240 | 240 | 260 | 157 | 153 | 2.61% | -3.77% | fair | Watt Mtn |
| 1459 | 1460 | 1 | 242 | 242 | 262 | 156 | 153 | 1.96% | -3.77% | fair | Watt Mtn |

**SD of corrected CMAX Az data: 9**

## Table D.2: Detailed summary of breakout data in the Beaverhill Lake and Elk Point Groups

Well Name: **AEC D1 Fisher 1-21-70-4 (104/01-21-070-04W4/00)**
Borehole Diameter: 311 mm
Correction to True North: 0 (corrected 18 deg E on log)

| top (m KB) | bottom (m KB) | thickness (m) | P1AZ (deg) | CMAX Az (deg) | CMAX Az wrt true N (deg) | C1 (mm) | C2 (mm) | % enlarge | % gauge | quality | formation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 510 | 511 | 1 | 145 | 145 | 145 | 320 | 311 | 2.89% | 0.00% | poor | BH LK |
| 511 | 512 | 1 | 145 | 145 | 145 | 320 | 311 | 2.89% | 0.00% | poor | BH LK |
| 512 | 513 | 1 | 145 | 145 | 145 | 315 | 311 | 1.29% | 0.00% | poor | BH LK |
| 513 | 514 | 1 | 145 | 145 | 145 | 320 | 311 | 2.89% | 0.00% | poor | BH LK |
| 514 | 515 | 1 | 145 | 145 | 145 | 320 | 311 | 2.89% | 0.00% | poor | BH LK |
| 515 | 516 | 1 | 145 | 145 | 145 | 320 | 311 | 2.89% | 0.00% | poor | BH LK |

**SD of corrected CMAX Az data: 0**

Well Name: **AEC A8 Fisher 8-21-70-4 (100/08-21-070-04W4/00)**
Borehole Diameter: 200 mm
Correction to True North: 0 (corrected 18.3 deg E on log)
Comments: Dipmeter logged 09-Oct-96 while other logs ran 12-Feb-97
Comments: No P1AZ trace (tadpoles within breakout zone)

| top (m KB) | bottom (m KB) | thickness (m) | P1AZ (deg) | CMAX Az (deg) | CMAX Az wrt true N (deg) | C1 (mm) | C2 (mm) | % enlarge | % gauge | quality | formation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 520 | 521 | 1 | 285 | 285 | 285 | 209 | 200 | 4.50% | 0.00% | fair | BH LK |
| 521 | 522 | 1 | 285 | 285 | 285 | 209 | 198 | 5.56% | -1.00% | fair | BH LK |
| 522 | 523 | 1 | 285 | 285 | 285 | 213 | 198 | 7.58% | -1.00% | fair | BH LK |
| 523 | 524 | 1 | 285 | 285 | 285 | 217 | 198 | 9.60% | -1.00% | fair | BH LK |
| 524 | 525 | 1 | 285 | 285 | 285 | 211 | 198 | 6.57% | -1.00% | fair | BH LK |
| 525 | 526 | 1 | 280 | 280 | 280 | 209 | 196 | 6.63% | -2.00% | fair | BH LK |
| 526 | 527 | 1 | 280 | 280 | 280 | 209 | 196 | 6.63% | -2.00% | fair | BH LK |
| 527 | 528 | 1 | 280 | 280 | 280 | 209 | 196 | 6.63% | -2.00% | fair | BH LK |
| 528 | 529 | 1 | 280 | 280 | 280 | 208 | 196 | 6.12% | -2.00% | fair | BH LK |
| 529 | 530 | 1 | 280 | 280 | 280 | 209 | 196 | 6.63% | -2.00% | fair | BH LK |
| 530 | 531 | 1 | 280 | 280 | 280 | 211 | 200 | 5.50% | 0.00% | fair | BH LK |
| 531 | 532 | 1 | 280 | 280 | 280 | 208 | 196 | 6.12% | -2.00% | fair | BH LK |
| 532 | 533 | 1 | 280 | 280 | 280 | 206 | 196 | 5.10% | -2.00% | fair | BH LK |
| 533 | 534 | 1 | 275 | 275 | 275 | 203 | 200 | 1.50% | 0.00% | fair | BH LK |
| 534 | 535 | 1 | 275 | 275 | 275 | 200 | 200 | 0.00% | 0.00% | fair | BH LK |

**SD of corrected CMAX Az data: 7**

**Table D.2: Detailed summary of breakout data in the Beaverhill Lake and Elk Point Groups**

Well Name: **AEC B3 Fisher 3-22-70-4 (100/03-22-070-04W4/00)**
Borehole Diameter: 159 mm
Correction to True North: 0 (corrected 18.2 deg E on log)
Comments:

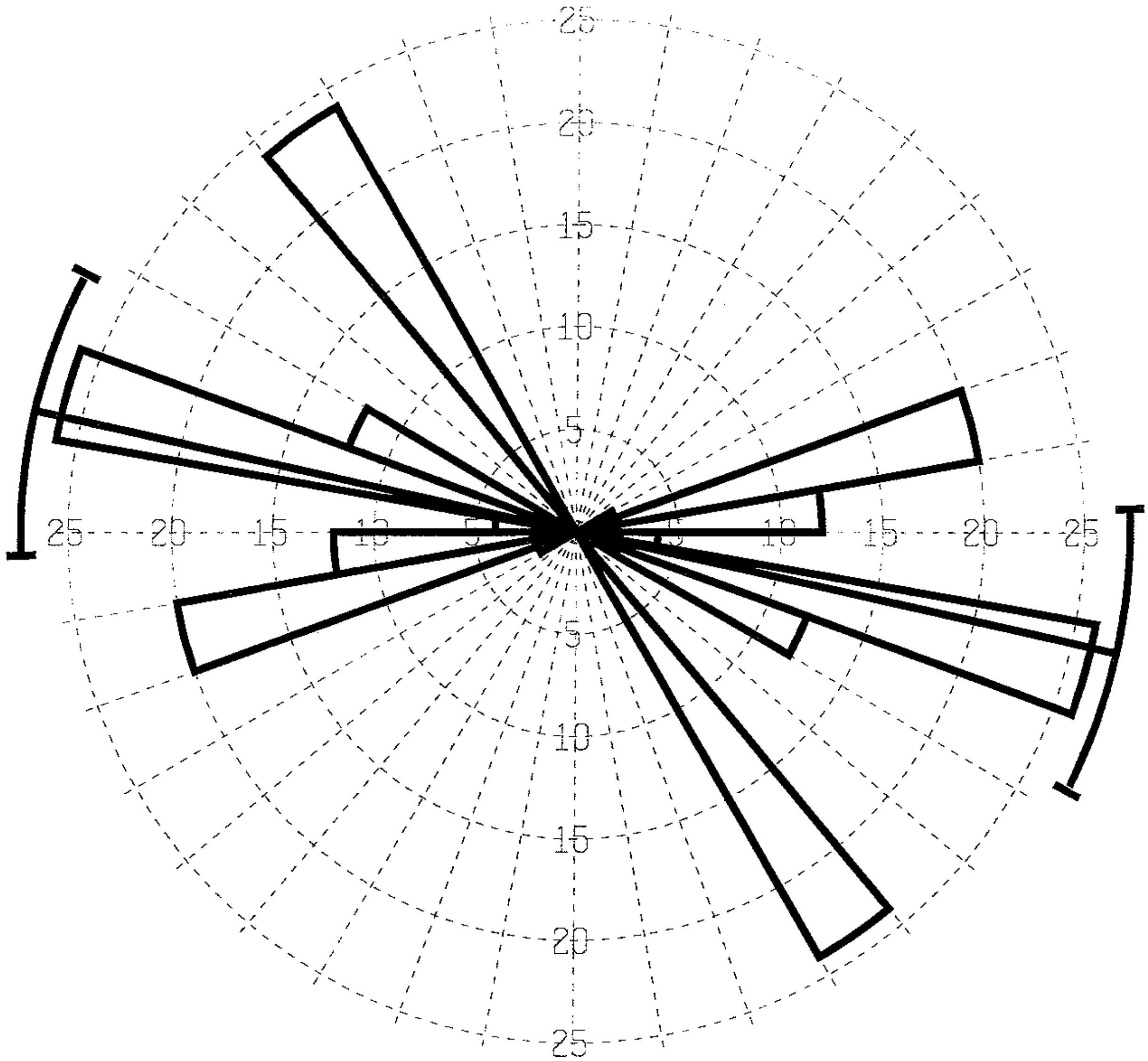
| top (m KB) | bottom (m KB) | thickness (m) | P1AZ (deg) | CMAX Az (deg) | CMAX Az wrt true N (deg) | C1 (mm) | C2 (mm) | % enlarge | % gauge | quality | formation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 496 | 497 | 1 | 115 | 115 | 115 | 167 | 162 | 3.09% | 1.89% | poor | BH LK |
| 497 | 498 | 1 | 115 | 115 | 115 | 167 | 159 | 5.03% | 0.00% | poor | BH LK |
| 498 | 499 | 1 | 115 | 115 | 115 | 171 | 162 | 5.56% | 1.89% | poor | BH LK |
| 499 | 500 | 1 | 115 | 115 | 115 | 173 | 159 | 8.81% | 0.00% | poor | BH LK |
| 500 | 501 | 1 | 115 | 115 | 115 | 173 | 159 | 8.81% | 0.00% | poor | BH LK |
| 501 | 502 | 1 | 115 | 115 | 115 | 173 | 159 | 8.81% | 0.00% | poor | BH LK |

**SD of corrected CMAX Az data: 0**

Well Name: **AEC Fisher 6-33-70-4 (100/06-33-070-04W4/00)**
Borehole Diameter: 159 mm
Correction to True North: 0 (corrected 18.2 deg E on log)
Comments:

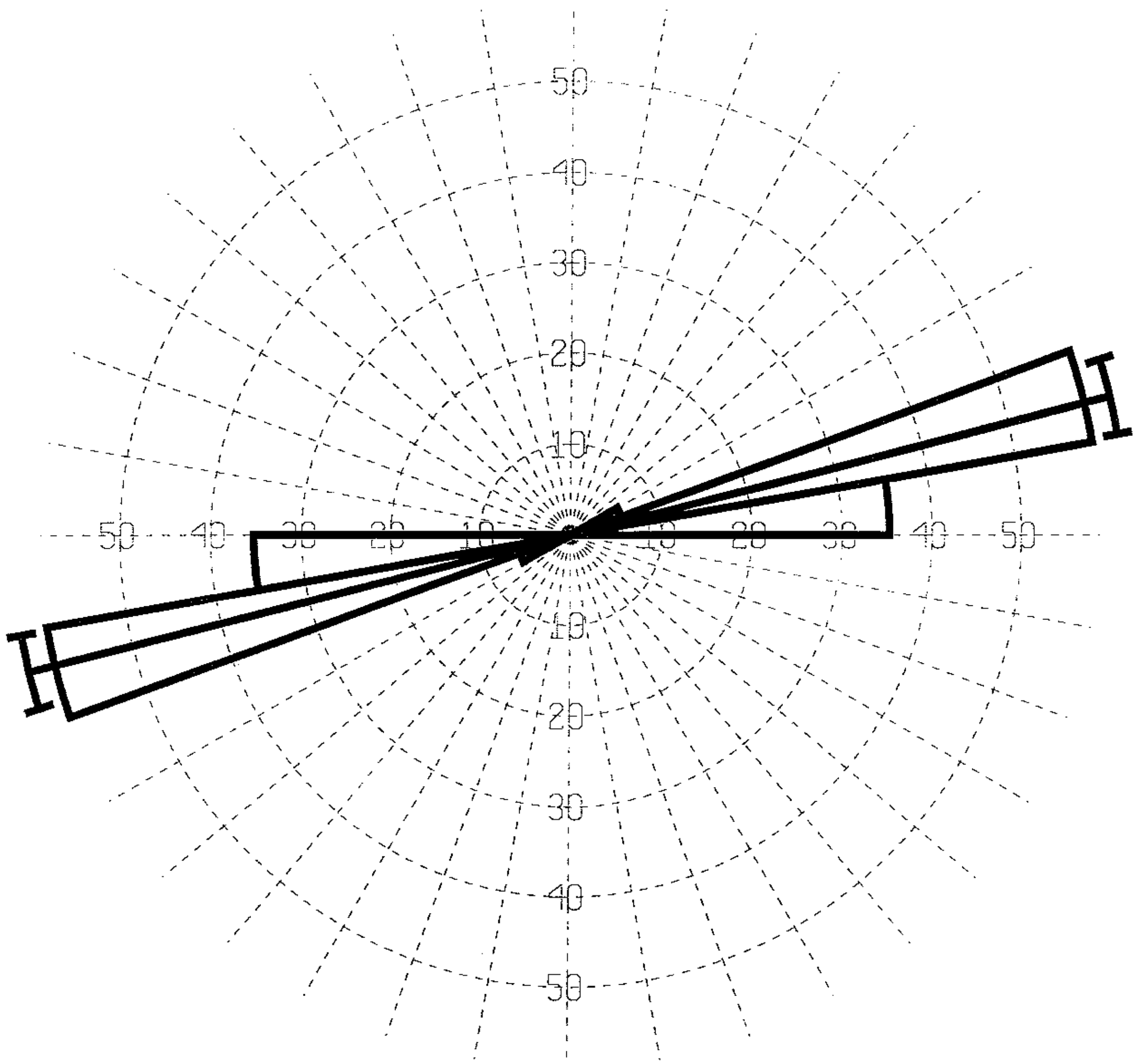
| top | bottom | thickness | P1AZ | CMAX Az | CMAX Az wrt true N | C1 | C2 | % enlarge | % gauge | quality | formation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 495 | 496 | 1 | 140 | 140 | 140 | 167 | 159 | 5.03% | 0.00% | fair | BH LK |
| 496 | 497 | 1 | 140 | 140 | 140 | 167 | 159 | 5.03% | 0.00% | fair | BH LK |
| 497 | 498 | 1 | 140 | 140 | 140 | 171 | 159 | 7.55% | 0.00% | fair | BH LK |
| 498 | 499 | 1 | 140 | 140 | 140 | 167 | 159 | 5.03% | 0.00% | fair | BH LK |
| 499 | 500 | 1 | 140 | 140 | 140 | 165 | 159 | 3.77% | 0.00% | fair | BH LK |
| 500 | 501 | 1 | 140 | 140 | 140 | 165 | 159 | 3.77% | 0.00% | fair | BH LK |

**SD of corrected CMAX Az data: 0**




Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 50
Maximum Percentage ... 26 Percent
Mean Percentage ...... 14.3 Percent
Standard Deviation ... 9.04 Percent
Vector Mean .......... 282.55 Degrees
Confidence Interval .. 14.96 Degrees
R-mag ................ 0.65

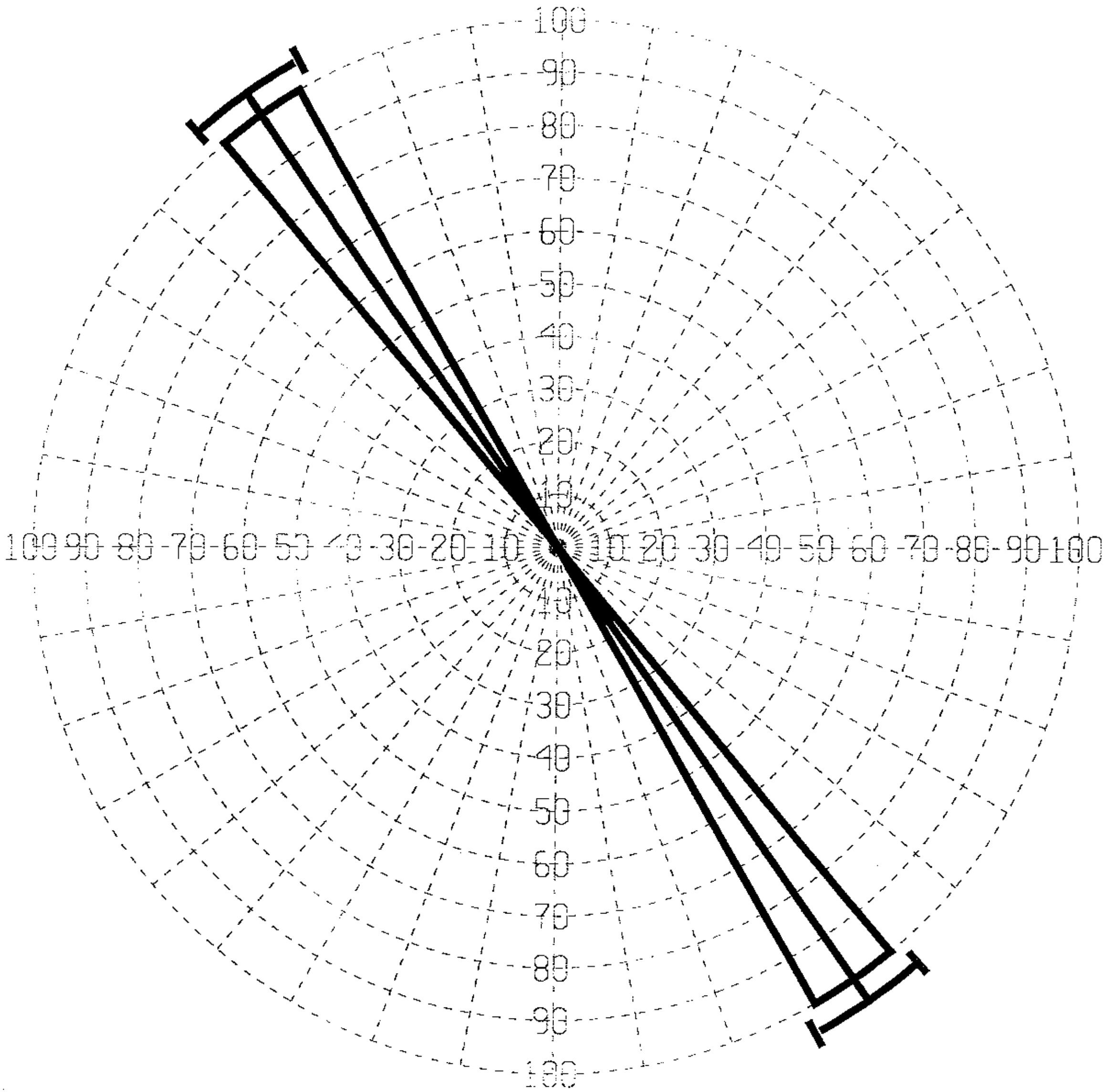
**Figure D.2.1: Combined roseplot of borehole breakout data for all wells.**




Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Deactivated
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 17
Maximum Percentage ... 58.8 Percent
Mean Percentage ...... 33.3 Percent
Standard Deviation ... 23.72 Percent
Vector Mean .......... 75.78 Degrees
Confidence Interval .. 3.87 Degrees
R-mag ................ 0.99

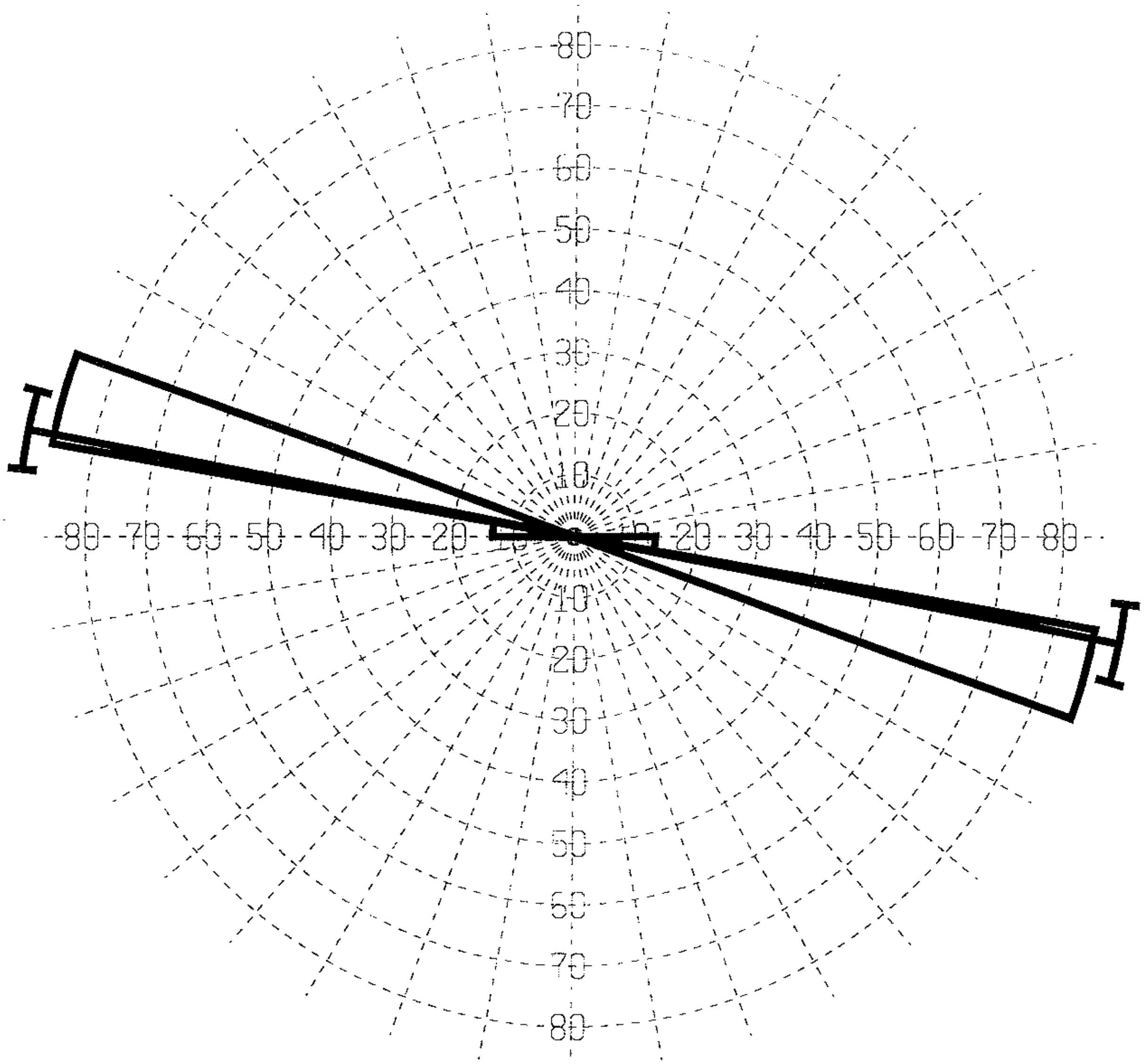
**Figure D.2.2: Roseplot of borehole breakout data for Voyager et al Bruce 6-14-048-14W4.**

ADVANCED GEOTECHNOLOGY



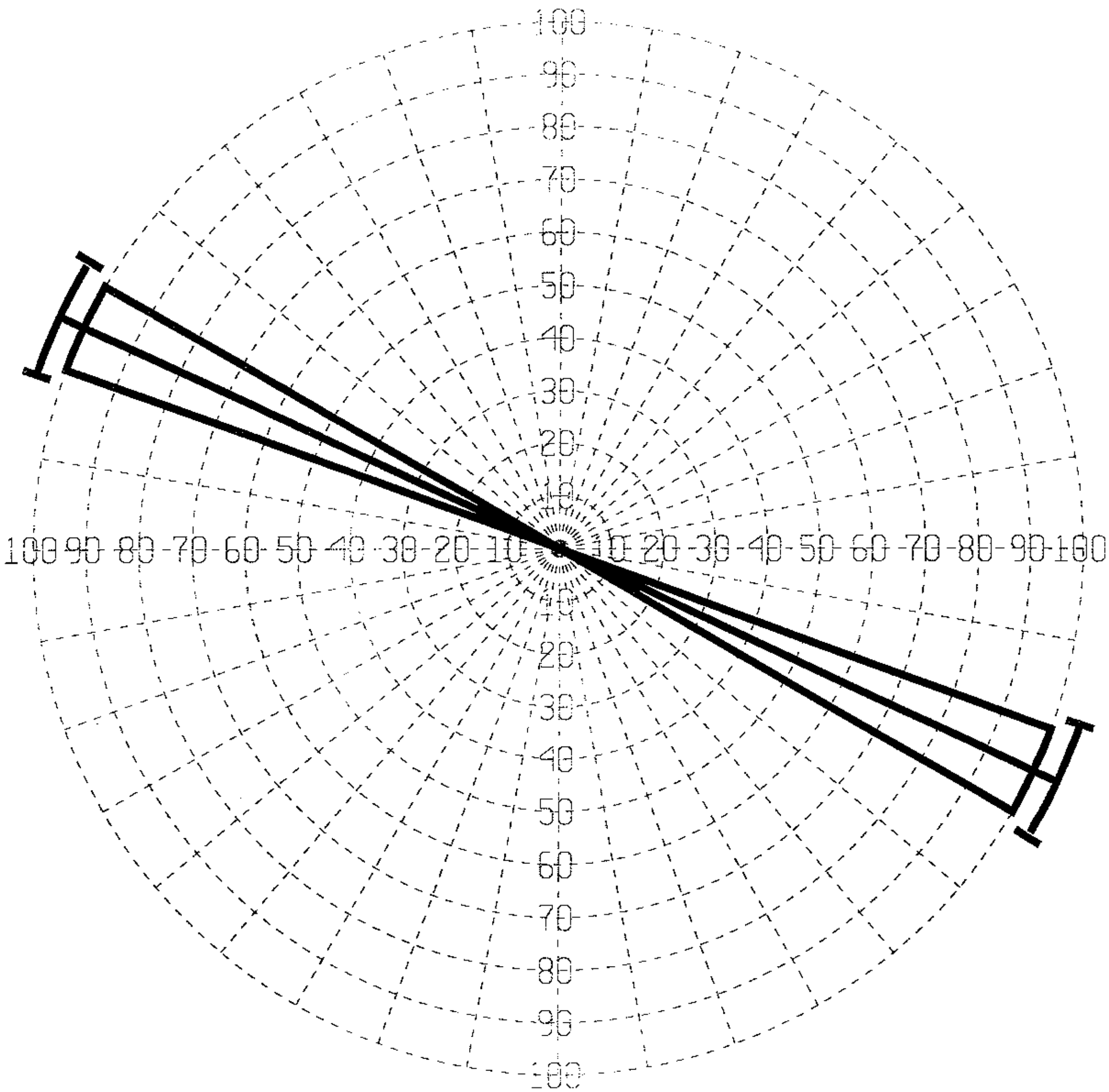

Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 6
Maximum Percentage ... 100 Percent
Mean Percentage ...... 100 Percent
Standard Deviation ... 0 Percent
Vector Mean .......... 325 Degrees
Confidence Interval .. 6.47 Degrees
R-mag ................ 1

**Figure D.2.3: Roseplot of borehole breakout data for AEC D1 Fisher 1-21-70-4W4.**



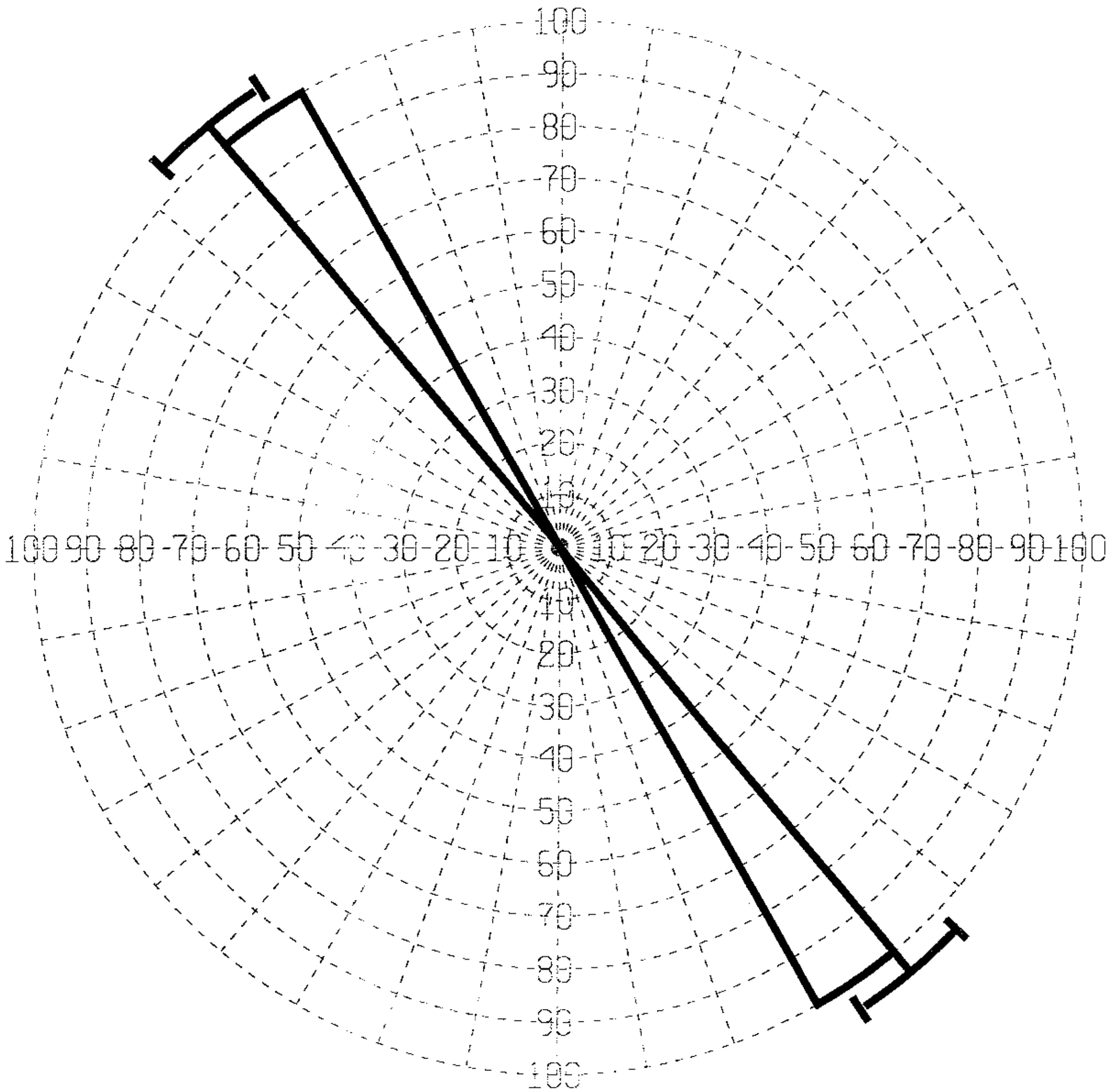

Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 15
Maximum Percentage ... 86.7 Percent
Mean Percentage ...... 50 Percent
Standard Deviation ... 42.34 Percent
Vector Mean .......... 281 Degrees
Confidence Interval .. 4.1 Degrees
R-mag ................ 0.99

**Figure D.2.4: Roseplot of borehole breakout data for AEC A8 Fisher 8-21-70-4W4.**




Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Deactivated
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 6
Maximum Percentage ... 100 Percent
Mean Percentage ...... 100 Percent
Standard Deviation ... 0 Percent
Vector Mean .......... 295 Degrees
Confidence Interval .. 6.47 Degrees
R-mag ............... 1

**Figure D.2.5: Roseplot of borehole breakout data for AEC B3 Fisher 3-22-70-4W4.**




Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Deactivated
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 6
Maximum Percentage ... 100 Percent
Mean Percentage ...... 100 Percent
Standard Deviation ... 0 Percent
Vector Mean .......... 320 Degrees
Confidence Interval .. 6.47 Degrees
R-mag ............... 1

**Figure D.2.6: Roseplot of borehole breakout data for AEC Fisher 6-33-70-4W4.**

ADVANCED GEOTECHNOLOGY

**Table D.3: Summary of breakout analysis data in the original study area for the Elk Point and Beaverhill Lake Groups**

| No. | UWI | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Dipmeter log recorded in microfiche obtained from AEUB | Dipmeter microfiche obtained from MJ | Missing data necessary for breakout analysis | Apparent breakout caused by pipe wear in deviated hole | Breakout present in Beaverhill Lake or Elk Point Groups | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00/07-14-057-06W4/0 | TEXEX ET AL ELK POINT 7-14-57-6 | 1956 | 546 | 1585 | | | | | | |
| 2 | 00/10-13-060-04W4/0 | TEXEX ET AL CHAR LAKE 10-13-60-4 | 1956 | 597 | 1433 | | | | | | |
| 3 | 02/10-30-048-10W4/0 | NUL KINSELLA 10-30-48-10 | 1978 | 579 | 937 | | | | | | |
| 4 | 00/06-14-048-14W4/0 | VOYAGER et al BRUCE 6-14-48-14 | 1982 | 891 | 2087 | Y | | | | Y | good breakout over Elk Point Group |
| 5 | 00/14-09-049-08W4/0 | PCP MANNVILLE SOUTH 14-9-49-8 | 1983 | 520 | 813 | | | | | | |
| 6 | 00/16-31-050-01W4/0 | CNRL B LLOYD 16-31-50-1 | 1981 | 534 | 705 | | | | | | |
| 7 | 00/14-22-050-11W4/0 | SIGNALTA ET AL BIRCH 14-22-50-11 | 1971 | 506 | 718 | Y | | Y | | | tadpoles but no dipmeter caliper |
| 8 | 00/11-34-051-04W4/0 | CDNOXY P9 MORGAN EX 11-34-51-4 | 1980 | 115 | 622 | | | | | | |
| 9 | 00/06-32-055-06W4/0 | AMOCO LINDBERGH 6-32-55-6 | 1996 | 450 | 681 | | | | | | |
| 10 | AR/10-11-056-01W4/0 | AMOCO AQ JOHN LAKE EX 10-11-56-1 | 1983 | 400 | 634 | Y | | | | | no breakout |
| 11 | AB/15-11-056-01W4/0 | AMOCO AB JOHN LAKE EX 15-11-56-1 | 1983 | 333 | 630 | Y | | Y | | | can't see calipers due to other curves on microfiche |
| 12 | 00/15-26-056-02W4/0 | TEXACO FROG LAKE 15-26-56-2 | 1983 | 390 | 603 | | | | | | |
| 13 | 00/13-35-056-02W4/0 | ESSO FROG LAKE 13-35-56-2 | 1984 | 400 | 621 | | | | | | |
| 14 | 00/14-06-057-01W4/0 | CNRL JOHN LAKE 14-6-57-1 | 1984 | 450 | 667 | Y | | Y | | | tadpoles, caliper but no azimuth |
| 15 | 00/14-18-057-01W4/0 | TEXACO FROG LAKE 14-18-57-1 | 1984 | 390 | 641 | | | | | | |
| 16 | 00/13-01-057-02W4/0 | TEXACO FROG LAKE 13-1-57-2 | 1984 | 420 | 640 | | | | | | |
| 17 | 00/15-12-057-02W4/0 | CNRL JOHN LAKE 15-12-57-2 | 1984 | 390 | 620 | | | | | | |
| 18 | 00/07-15-059-02W4/0 | CNRL CHANDLER 7-15-59-2 | 1989 | 470 | 589 | | | | | | |
| 19 | 00/07-16-059-02W4/0 | SUNCOR ET AL CHANDLER 7-16-59-2 | 1983 | 25 | 584 | | Y | | | | no breakout |
| 20 | 00/07-27-059-02W4/0 | TRANSWEST CHANDLER 7-27-59-2 | 1983 | 450 | 554 | | | | | | |
| 21 | 00/06-20-062-04W4/0 | GENESIS ET AL FTKENT 6-20-62-4 | 1985 | 275 | 525 | | | | | | |
| 22 | 00/11-24-062-04W4/0 | GENESIS ET AL FTKENT 11-24-62-4 | 1985 | 268 | 504 | | | | | | |
| 23 | 00/09-13-062-08W4/0 | AMOCO ET AL SUGDEN 9-13-62-8 | 1994 | 143 | 499 | | | | | | |
| 24 | 00/01-13-063-08W4/0 | CDNOXY ET AL SUGDEN 1-13-63-8 | 1985 | 251 | 500 | | | | | | |
| 25 | 00/11-14-063-08W4/0 | NUMAC 11A WOLF LAKE 11-14-63-8 | 1997 | 300 | 513 | | Y | | | | no breakout |
| 26 | 02/16-06-064-06W4/0 | MOBIL GARTH 16-6-64-6 | 1981 | 300 | 525 | Y | | Y | | | tadpoles, caliper no azimuth, Dresser Atlas log |
| 27 | 00/03-07-064-06W4/0 | MOBIL GARTH 3-7-64-6 | 1990 | 290 | 513 | Y | | Y | | | tadpoles, caliper no azimuth, Dresser Atlas log |

**Table D.3: Summary of breakout analysis data in the original study area for the Elk Point and Beaverhill Lake Groups**

| No. | UWI | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Dipmeter log recorded in microfiche obtained from AEUB | Dipmeter microfiche obtained from MJ | Missing data necessary for breakout analysis | Apparent breakout caused by pipe wear in deviated hole | Breakout present in Beaverhill Lake or Elk Point Groups | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | AA/14-20-064-06W4/0 | MOBIL GARTH OV 14-20-64-6 | 1980 | 335 | 547 | Y | | Y | | | can't see calipers due to other curves on microfiche |
| 29 | AA/02-21-064-06W4/0 | MOBIL GARTH EX 2-21-64-6 | 1983 | 315 | 504 | Y | | Y | | | tadpoles, caliper no azimuth, Dresser Atlas log |
| 30 | AA/03-27-064-06W4/0 | MOBIL GARTH EX 3-27-64-6 | 1982 | 300 | 521 | Y | | Y | | | tadpoles, caliper no azimuth, Dresser Atlas log |
| 31 | AA/09-27-064-06W4/0 | MOBIL GARTH EX 9-27-64-6 | 1981 | 300 | 530 | Y | | Y | | | tadpoles, caliper no azimuth, Dresser Atlas log |
| 32 | AA/09-28-064-06W4/0 | MOBIL GARTH OV 9-28-64-6 | 1980 | 160 | 520 | Y | | Y | | | can't see calipers due to other curves on microfiche |
| 33 | 00/16-01-064-07W4/0 | MOBIL SUGDEN 16-1-64-7 | 1980 | 280 | 519 | Y | | Y | | | can't see calipers due to other curves on microfiche |
| 34 | 02/07-13-065-04W4/0 | ESSO 83 B3-20 COLDLK 7-13-65-4 | 1984 | 20 | 195 | | | | | | |
| 35 | 00/06-27-065-05W4/0 | BP LEMING 6-27-65-5 | 1981 | 159 | 561 | | | | | | |
| 36 | 00/07-31-065-05W4/0 | BP LEMING 7-31-65-5 | 1981 | 153 | 551 | | | | | | |
| 37 | 00/11-01-065-06W4/0 | BP MARGUERITE LAKE 11-1-65-6 | 1981 | 150 | 550 | | | | | | |
| 38 | 00/07-08-065-06W4/0 | BP MARGUERITE LAKE 7-8-65-6 | 1981 | 154 | 561 | | | | | | |
| 39 | 11/12-08-066-05W4/0 | BP PCI 21 MARGLK 12-8-66-5 | 1981 | 150 | 528 | Y | | | | | no breakout |
| 40 | 14/12-08-066-05W4/0 | BP PCI 24 MARGLK 12-8-66-5 | 1981 | 155 | 526 | Y | | | | | no breakout (only 1 m Elk Point Group on log) |
| 41 | 17/12-08-066-05W4/0 | BP PCI 13-81 OB MARG LK 12-8-66-5 | 1981 | 156 | 522 | Y | | | | | no breakout |
| 42 | 00/06-13-066-06W4/0 | BP MARGUERITE 6-13-66-6 | 1981 | 157 | 519 | | | | | | |
| 43 | 00/12-30-069-07W4/0 | AEC FISHER 12-30-69-7 | 1988 | 436 | 534 | Y | | | | | no breakout over Beaverhill Lake Group |
| 44 | 00/08-20-070-03W4/0 | AEC FISHER 8-20-70-3 | 1997 | 124 | 531 | | Y | | | | no breakout |
| 45 | 03/05-14-070-04W4/0 | AEC 03 FISHER 5-14-70-4 | 1996 | 355 | 538 | | Y | | Y | | apparent breakout caused by well deviation |
| 46 | 05/05-14-070-04W4/0 | AEC 06 FISHER 5-14-70-4 | 1996 | 375 | 560 | | Y | | Y | | apparent breakout caused by well deviation |
| 47 | 00/11-14-070-04W4/0 | AECOG C11 FISHER 11-14-70-4 | 1998 | 124 | 514 | Y | | | | | no breakout |
| 48 | 00/12-14-070-04W4/0 | AEC 01 FISHER 12-14-70-4 | 1996 | 450 | 550 | Y | | Y | | | deviated, SHDT, Caliper 2-4 not presented on log |
| 49 | 00/07-15-070-04W4/0 | AECOG A7 FISHER 7-15-70-4 | 1998 | 380 | 507 | Y | | | | | no breakout, SHDT |
| 50 | 00/08-15-070-04W4/0 | AEC 02 FISHER 8-15-70-4 | 1996 | 390 | 540 | | Y | | | | no breakout, deviated well, digital dipmeter data available from the AEUB |
| 51 | 00/11-15-070-04W4/0 | AEC FISHER 11-15-70-4 | 1996 | 405 | 515 | | Y | | | | no breakout, some poor breakout in McMurray Fm |
| 52 | 00/13-15-070-04W4/0 | AEC 13A FISHER 13-15-70-4 | 1997 | 124 | 514 | Y | | | | | no breakout |
| 53 | 00/15-15-070-04W4/0 | AEC B15 FISHER 15-15-70-4 | 1997 | 359 | 504 | | Y | | | | no breakout |
| 54 | 00/09-16-070-04W4/0 | AEC A9 FISHER 9-16-70-4 | 1997 | 350 | 510 | Y | | | | | no breakout |

**Table D.3: Summary of breakout analysis data in the original study area for the Elk Point and Beaverhill Lake Groups**

| No. | UWI | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Dipmeter log recorded in microfiche obtained from AEUB | Dipmeter microfiche obtained from MJ | Missing data necessary for breakout analysis | Apparent breakout caused by pipe wear in deviated hole | Breakout present in Beaverhill Lake or Elk Point Groups | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 55 | 00/10-16-070-04W4/0 | AEC FISHER 10-16-70-4 | 1997 | 371 | 529 | | Y | | | | no breakout |
| 56 | 00/15-16-070-04W4/0 | AEC A15 FISHER 15-16-70-4 | 1997 | 114 | 518 | | Y | | | | no breakout |
| 57 | 00/16-16-070-04W4/0 | AEC B16 FISHER 16-16-70-4 | 1997 | 100 | 522 | Y | | | | | no breakout |
| 58 | 00/01-21-070-04W4/0 | AEC B1 FISH 1-21-70-4 | 1997 | 360 | 510 | | Y | | | | no breakout |
| 59 | 02/01-21-070-04W4/0 | AEC 1A FISHER 1-21-70-4 | 1997 | 400 | 511 | | Y | | | | no breakout |
| 60 | 03/01-21-070-04W4/0 | AEC C1 FISHER 1-21-70-4 | 1997 | 325 | 500 | | Y | | | | no breakout |
| **61** | **04/01-21-070-04W4/0** | **AEC D1 FISHER 1-21-70-4** | **1997** | **375** | **515** | | Y | | | Y | **breakout in Beaverhill Lake Group** |
| 62 | 00/02-21-070-04W4/0 | AEC C2 FISHER 2-21-70-4 | 1997 | 350 | 500 | | Y | | | | no breakout |
| **63** | **00/08-21-070-04W4/0** | **AEC A8 FISHER 8-21-70-4** | **1997** | **350** | **500** | | Y | | | Y | **breakout in Beaverhill Lake Group** |
| 64 | 00/10-21-070-04W4/0 | AEC A10 FISHER 10-21-70-4 | 1997 | 369 | 519 | Y | | | | | no breakout |
| 65 | 02/10-21-070-04W4/0 | AEC B10 FISHER 10-21-70-4 | 1997 | 350 | 515 | | Y | | | | no BO, some poor BO in McMurray FM |
| 66 | 02/15-21-070-04W4/0 | AEC 15B FISHER 15-21-70-4 | 1997 | 350 | 510 | | Y | | | | no breakout |
| 67 | 00/02-22-070-04W4/0 | AECOG D2 FISHER 2-22-70-4 | 1997 | 375 | 507 | Y | | | | | no breakout |
| **68** | **00/03-22-070-04W4/0** | **AEC B3 FISHER 3-22-70-4** | **1997** | **375** | **500** | | Y | | | Y | **breakout in Beaverhill Lake Group** |
| 69 | 00/04-22-070-04W4/0 | AEC 4C FISHER 4-22-70-4 | 1997 | 96 | 518 | | Y | | | | no breakout |
| 70 | 04/05-22-070-04W4/2 | AEC 104 FISHER 5-22-70-4 | 1996 | 450 | 525 | | | | | | |
| 71 | 05/05-22-070-04W4/0 | AECOG 105 FISHER 5-22-70-4 | 1997 | 390 | 530 | Y | | | | | no breakout, digital data available from the AEUB |
| 72 | 06/05-22-070-04W4/0 | AECOG A5 FISHER 5-22-70-4 | 1997 | 73 | 220 | Y | | | | | no breakout |
| 73 | 00/06-22-070-04W4/0 | AEC 6A FISHER 6-22-70-4 | 1997 | 110 | 515 | Y | | | | | no breakout |
| 74 | 00/07-22-070-04W4/0 | AECOG(E) A7 FISHER 7-22-70-4 | 2000 | 130 | 516 | | | | | | digital dipmeter data available from the EUB |
| 75 | 00/11-22-070-04W4/0 | AEC 11B FISHER 11-22-70-4 | 1997 | 350 | 514 | Y | | | | | no breakout |
| 76 | 04/11-22-070-04W4/0 | AECOG 2B11 FISHER 11-22-70-4 | 1997 | 70 | 513 | | Y | | | | no breakout |
| 77 | 00/12-22-070-04W4/0 | AEC FISHER 12-22-70-4 | 1996 | 400 | 515 | | Y | | | | no breakout |
| 78 | 03/12-22-070-04W4/0 | AEC 12C FISHER 12-22-70-4 | 1997 | 347 | 516 | | Y | | | | no breakout |
| 79 | 02/14-22-070-04W4/0 | AEC C14 FISHER 14-22-70-4 | 1997 | 340 | 502 | | Y | | | | no breakout |
| 80 | 00/03-23-070-04W4/0 | AECOG A3 FISHER 3-23-70-4 | 1998 | 123 | 513 | Y | | | | | no breakout |
| 81 | 00/14-28-070-04W4/0 | AECOG A14 FISHER 14-28-70-4 | 1998 | 125 | 513 | | Y | | | | no breakout |

## Table D.3: Summary of breakout analysis data in the original study area for the Elk Point and Beaverhill Lake Groups

| No. | UWI | Well Name | Year Logged | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Dipmeter log recorded in microfiche obtained from AEUB | Dipmeter microfiche obtained from MJ | Missing data necessary for breakout analysis | Apparent breakout caused by pipe wear in deviated hole | Breakout present in Beaverhill Lake or Elk Point Groups | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 82 | 00/07-32-070-04W4/0 | AEC FISHER 7-32-70-4 | 1996 | 375 | 525 | | | | | | |
| 83 | 00/06-33-070-04W4/0 | AEC FISHER 6-33-70-4 | 1997 | 400 | 500 | | Y | | | Y | breakout in Beaverhill Lake Group |
| 84 | 00/08-13-070-06W4/0 | AEC FISHER 8-13-70-6 | 1988 | 491 | 585 | Y | | | | | no breakout |
| 85 | 00/05-23-070-06W4/0 | AEC FISHER 5D-23-70-6 | 1987 | 275 | 544 | | | | | | |
| 86 | 00/10-34-072-06W4/0 | AMOCO AEC KIRBY 10-34-72-6 | 1980 | 160 | 588 | Y | | Y | | | no caliper orientation data indicated on log |
| 87 | 02/12-01-073-06W4/0 | AEC 07 KIRBY 12-1-73-6 | 1983 | 108 | 569 | Y | | | | | no dipmeter coverage in Beaverhill Lake Grp. |
| 88 | 00/07-03-073-06W4/0 | AMOCO AEC IPIATIK 7-3-73-6 | 1980 | 160 | 577 | Y | | | | Y | no breakout |
| 89 | 00/10-03-073-06W4/0 | AMOCO AEC IPIATIK KIRBY 10A-3-73-6 | 1984 | 160 | 579 | Y | | | | | no breakout |
| 90 | 00/06-05-073-06W4/0 | AMOCO AEC KIRBY 6-5-73-6 | 1990 | 100 | 572 | Y | | | | | no breakout |
| 91 | 00/11-09-073-06W4/0 | AMOC AEC IPIATIK 11-9-73-6 | 1995 | 160 | 534.9 | Y | | | | | no breakout |
| 92 | 00/10-11-073-06W4/0 | AEC AMOCO IPIATIK KIRBY 10-11-73-6 | 1984 | 160 | 605 | Y | | Y | | | caliper one not presented |
| 93 | 00/04-15-073-06W4/0 | AECOG ET AL KIRBY 4-15-73-6 | 1997 | 96 | 528.5 | Y | | | | | no breakout |
| 94 | 00/12-11-074-08W4/0 | ISH KIRBY 12-11-74-8 | 1997 | 440 | 530 | | | | | | |
| 95 | 00/12-14-074-08W4/0 | ISH KIRBY 12-14-74-8 | 2000 | 440 | 519.3 | | | | | | |
| 96 | 00/14-05-082-12W4/0 | TRANSWEST DIVIDE 14-5-82-12 | 1987 | 275 | 535 | Y | | Y | | | can't see calipers through other curves |
| 97 | 00/10-29-082-12W4/0 | HUSKY ET AL DIVIDE 10-29-82-12 | 1988 | 382 | 461 | Y | | | | | no breakout |
| 98 | 00/16-03-083-07W4/0 | GULF RESDELN 16-3-83-7 | 1981 | 175 | 505 | | | | | | |
| 99 | AA/11-15-083-07W4/0 | GULF RESDELN 11-15-83-7 | 1997 | 400 | 500 | Y | | Y | | | only one caliper curve shown (Dresser Atlas log) |

# APPENDIX E

## DATA ANALYSIS RESULTS FOR EXPANDED STUDY AREA

## Table E.1: Summary of vertical stresses for the Elk Point Group determined from bulk density data in the expanded area

| No. | Log Kelly Bushing | Ground Level | Well Name | UWI | Year Logged | Latitude (deg N) | Longitude (deg W) | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Prairie Evaporite Fm (m KB) | Elevation of Prairie Evaporite Fm (m) | Vertical Stress at Top of Prairie Evaporite Fm (MPa) | Normalized Vertical Stress Gradient at Top of Prairie Evaporite Fm (kPa/m) | Bulk Density Log Quality | % of Unknown Bulk Density Data above Prairie Evaporite Fm | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 647.4 | 642.8 | GULF SENEX 4-21-94-3 | 00/01-20-094-03W5/0 | 1996 | 57.164 | 114.432 | 30 | 1351 | 1105 | -458 | 24.4 | 22.1 | v.good | 2 | |
| 2 | 469.7 | 465.3 | NORCEN POR EDRA 1-29-101-24 | 00/01-29-101-24W4/0 | 1985 | 57.791 | 113.891 | 280 | 1070 | 682 | -212 | 16.1 | 23.7 | v.good | 40 | |
| 3 | 514.8 | 510.9 | ALSL BIRCH RIVER 2-10-102-23 | 00/02-10-102-23W4/0 | 1985 | 57.832 | 113.681 | 325 | 1075 | 669 | -154 | 15.7 | 23.4 | v.good | 48 | |
| 4 | 723.8 | 719.0 | GULF AEC SUFFIELD 3-32-15-5 | 00/03-32-015-05W4/0 | 1978 | 50.297 | 110.661 | 193 | 1717 | 1617 | -893 | 39.3 | 24.3 | poor | 12 | |
| 5 | 563.5 | 558.1 | GULF SENNEX 4-5-93-4 | 00/04-05-093-04W5/0 | 1987 | 57.035 | 114.612 | 801 | 1314 | 1080 | -517 | 24.1 | 22.3 | v.good | 74 | bulk density only recorded up to 801 m |
| 6 | 696.2 | 691.9 | PCP PROVOST 4-18-38-1 | 00/04-18-038-01W4/0 | 1994 | 52.262 | 110.142 | 201 | 1571 | 1314 | -617 | 30.3 | 23.1 | v.good | 15 | |
| 7 | 291.2 | 287.1 | MUTEX IOE EDRA 4-26-104-1 | 00/04-26-104-01W5/0 | 1969 | 58.052 | 114.054 | 130 | 857 | 496 | -204 | 12.0 | 24.3 | poor | 25 | bad hole wash out b/w 500-650 m KB |
| 8 | 676.7 | 672.1 | CLM ET AL BIRCH RIVER 4-29-98-21 | 00/04-29-098-21W4/0 | 1985 | 57.530 | 113.390 | 325 | 1190 | 792 | -115 | 18.1 | 22.9 | fair | 40 | FDC tool with some zones of hole enlargement present |
| 9 | 730.0 | 725.9 | CS ET AL AEC SUFFIELD 5-2-20-3 | 00/05-02-020-03W4/0 | 1978 | 50.664 | 110.326 | 470 | 2194 | 1635 | -905 | 39.6 | 24.2 | fair | 28 | |
| 10 | 793.1 | 788.5 | AECOG (E) CS ET AL SUFF 5-11-20-6 | 00/05-11-020-06W4/0 | 1978 | 50.679 | 110.737 | 229 | 2228 | 1695 | -902 | 41.1 | 24.3 | fair | 13 | |
| 11 | 809.0 | 805.7 | DOME HOME LIEGE 6-2-97-19 | 00/06-02-097-19W4/0 | 1986 | 57.385 | 112.977 | 236 | 1231 | 849 | -40 | 18.2 | 21.5 | poor | 27 | hole washed out |
| 12 | 860.8 | 856.7 | PENN WEST PROVOST 6-4-37-16 | 00/06-04-037-16W4/0 | 1989 | 52.147 | 112.231 | 356 | 2048 | 1965 | -1104 | 46.3 | 23.6 | fair | 18 | enlarged hole present leading to lower bulk densities |
| 13 | 666.2 | 661.7 | AECOG (E) CS ET AL SUFFIELD 6-25-19-4 | 00/06-25-019-04W4/0 | 1977 | 50.635 | 110.435 | 189 | 1351 | 1564 | -897 | 37.9 | 24.3 | good | 12 | |
| 14 | 749.2 | 744.6 | AEC GULF BERADI SUFFIELD 6-28-16-5 | 00/06-28-016-05W4/0 | 1978 | 50.374 | 110.635 | 189 | 1768 | 1653 | -903 | 40.3 | 24.4 | good | 11 | |
| 15 | 759.9 | 755.6 | AECOG (E) GULF SUFF 6-30-16-6 | 00/06-30-016-06W4/0 | 1977 | 50.374 | 110.820 | 190 | 1755 | 1654 | -894 | 39.7 | 24.0 | good | 11 | |
| 16 | 478.5 | 474.9 | PAN AM A-1 TELEGRAPH 6-30-86-13 | 00/06-30-086-13W4/0 | 1967 | 56.484 | 112.049 | 97 | 780 | 463 | 15 | 11.1 | 24.0 | fair | 20 | |
| 17 | 658.1 | 654.1 | CS ET AL AEC SUFFIELD 6-36-18-5 | 00/06-36-018-05W4/0 | 1978 | 50.562 | 110.566 | 362 | 1662 | 1560 | -902 | 37.0 | 23.7 | fair | 23 | |
| 18 | 661.1 | 656.8 | CS ET AL AEC SUFFIELD 7-11-19-5 | 00/07-11-019-05W4/0 | 1978 | 50.592 | 110.590 | 191 | 2131 | 1560 | -899 | 38.2 | 24.5 | fair | 12 | good quality older log |
| 19 | 666.8 | 662.6 | PACIFIC AMOCO EMPRESS 7-12-22-1 | 00/07-12-022-01W4/0 | 1974 | 50.852 | 110.011 | 210 | 1759 | 1558 | -891 | 37.3 | 23.9 | fair | 13 | |
| 20 | 698.5 | 693.7 | CS ET AL AEC SUFFIELD 7-18-19-3 | 00/07-18-019-03W4/0 | 1978 | 50.607 | 110.406 | 420 | 1737 | 1595 | -897 | 38.4 | 24.0 | fair | 26 | |
| 21 | 818.5 | 814.2 | BIG VALLEY RICH 7-25-34-21 | 00/07-25-034-21W4/0 | 1986 | 51.946 | 112.848 | 337 | 2279 | 2219 | -1401 | 52.5 | 23.7 | fair | 15 | zones of hole enlargement present |
| 22 | 730.0 | 726.3 | DENISON ET AL PRINCESS 7-26-21-11 | 00/07-26-021-11W4/0 | 1981 | 50.812 | 111.423 | 190 | 1899 | 1684 | -954 | 40.1 | 23.8 | fair | 11 | some minor washouts but generally good older log |
| 23 | 684.8 | 680.7 | SUNCOR BRUCE 8-2-46-14 | 00/08-02-046-14W4/0 | 1984 | 52.936 | 111.916 | 650 | 1663 | 1512 | -827 | 34.9 | 23.1 | fair | 43 | good quality older log |
| 24 | 740.4 | 736.1 | CS ET AL SUFFIELD 8-17-20-4 | 00/08-17-020-04W4/0 | 1978 | 50.694 | 110.514 | 456 | 2203 | 1640 | -899 | 38.8 | 23.6 | fair | 28 | good quality older log |
| 25 | 261.5 | 257.9 | IOD IOE CEGO BIRCH RIVER 8-17-105-1 | 00/08-17-105-01W5/0 | 1967 | 58.114 | 114.116 | 105 | 849 | 423 | -162 | 10.2 | 24.0 | fair | 24 | good quality older log |
| 26 | 754.7 | 750.7 | AECOG (E) SUFF 8-23-17-4 | 00/08-23-017-04W4/0 | 1985 | 50.448 | 110.440 | 202 | 1780 | 1663 | -908 | 40.5 | 24.4 | good | 12 | |
| 27 | 755.2 | 751.2 | CANSO ET AL AEC SUFFIELD 9-27-15-8 | 00/09-27-015-08W4/0 | 1980 | 50.291 | 111.017 | 191 | 1710 | 1649 | -894 | 39.9 | 24.2 | fair | 11 | |
| 28 | 609.9 | 605.9 | GPD NOEL ET AL SENEX 10-6-93-3 | 00/10-05-093-03W5/0 | 1968 | 57.043 | 114.437 | 487 | 1309 | 1060 | -450 | 24.6 | 23.2 | fair | 46 | good quality older log |
| 29 | 689.1 | 684.5 | SEA JOR EDRA 10-14-100-23 | 00/10-14-100-23W4/0 | 1985 | 57.680 | 113.655 | 320 | 1250 | 848 | -159 | 19.5 | 23.0 | v.good | 37 | |
| 30 | 516.9 | 513.6 | PAN AM D-1 CHIPEWYAN 10-16-91-18 | 00/10-16-091-18W4/0 | 1966 | 56.895 | 112.832 | 188 | 971 | 624 | -107 | 14.7 | 23.6 | fair | 30 | good quality older log |
| 31 | 766.3 | 762.3 | RENAISSANCE PROVOST 11-35-38-10 | 00/11-35-038-10W4/0 | 1992 | 52.311 | 111.327 | 750 | 2140 | 1570 | -804 | 36.3 | 23.1 | v.good | 48 | |
| 32 | 669.7 | 665.3 | EPIC BIRCH MTNS 12-4-99-21 | 00/12-04-099-21W4/0 | 1988 | 57.566 | 113.390 | 215 | 1180 | 772 | -102 | 17.6 | 22.8 | good | 27 | some minor washouts leading to lower bulk density |
| 33 | 850.6 | 845.9 | CDNRES ET AL OBERLIN 12-9-38-21 | 00/12-09-038-21W4/0 | 1984 | 52.254 | 112.955 | 390 | 2370 | 2234 | -1383 | 53.3 | 23.9 | fair | 17 | |
| 34 | 796.3 | 792.2 | MARK RED WILLOW 14-11-39-17 | 00/14-11-039-17W4/0 | 1987 | 52.346 | 112.345 | 364 | 2022 | 1920 | -1124 | 46.3 | 24.1 | v.good | 19 | |
| 35 | 854.2 | 850.0 | CHEVRON LINK 14-35-34-17 | 00/14-35-034-17W4/0 | 1989 | 51.967 | 112.308 | 364 | 2091 | 2022 | -1167 | 48.0 | 23.7 | good | 18 | minor zones of hole enlargement |
| 36 | 821.1 | 817.2 | HESS CDN-SUP NAMUR 15-19-96-18 | 00/15-19-096-18W4/0 | 1969 | 57.350 | 112.915 | 172 | 1222 | 857 | -35 | 19.5 | 22.8 | fair | 20 | good quality older log |
| 37 | 821.6 | 817.5 | VIRAGO ET AL RICH 15-30-34-20 | 00/15-30-034-24W4/0 | 1986 | 51.954 | 112.825 | 361 | 2393 | 2210 | -1388 | 54.0 | 24.5 | good | 16 | minor zones of hole enlargement |
| 38 | 749.2 | 745.2 | MUTEX IOE SEAFORTH 15-20-95-20 | 00/15-20-095-20W4/0 | 1969 | 57.261 | 113.209 | 212 | 1247 | 869 | -120 | 19.8 | 22.7 | fair | 24 | |
| 39 | 557.1 | 552.1 | ICOR ET AL HOOLE 16-1-80-24 | 00/16-01-080-24W4/0 | 1988 | 55.909 | 113.611 | 320 | 1485 | 1105 | -548 | 26.2 | 23.7 | v.good | 29 | |
| 40 | 830.2 | 824.5 | BEST PACIFIC SPIERS 16-16-34-15 | 00/16-16-034-15W4/0 | 1985 | 51.925 | 112.060 | 404 | 2442 | 1950 | -1120 | 44.9 | 23.0 | fair | 20 | zones of hole enlargement in first run |
| 41 | 691.3 | 687.9 | DOME ET AL EAST PANNY 16-35-95-2 | 00/16-35-095-02W5/0 | 1988 | 57.292 | 114.196 | 254 | 1399 | 1046 | -354 | 23.4 | 22.4 | good | 24 | minor zones of hole enlargement |
| 42 | 566.4 | 562.4 | UNOCAL WOODENHOUSE 6-3-87-22 | 00/06-03-087-22W4/0 | 1988 | 56.513 | 113.424 | 349 | 1240 | 919 | -353 | 20.7 | 22.6 | v.good | 38 | missing 240 m of data in middle of log interval |
| 43 | 746.6 | 740.8 | NORTHROCK MEDHAT 6-36-19-1 | 00/06-36-019-01W4/0 | 1980 | 50.650 | 110.020 | 188 | 2226 | 1662 | -915 | 39.2 | 23.6 | fair | 11 | |
| 44 | 748.9 | 744.9 | CS ET AL AEC SUFFIELD 8-22-19-5 | 00/08-22-019-05W4/0 | 1978 | 50.622 | 110.608 | 456 | 1760 | 1645 | -896 | 39.3 | 23.9 | fair | 27 | good quality older log |

## Table E.1: Summary of vertical stresses for the Elk Point Group determined from bulk density data in the expanded study area

| No. | Log Kelly Bushing | Ground Level | Well Name | UWI | Year Logged | Latitude (deg N) | Longitude (deg W) | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Prairie Evaporite Fm (m KB) | Elevation of Prairie Evaporite Fm (m) | Vertical Stress at Top of Prairie Evaporite Fm (MPa) | Normalized Vertical Stress Gradient at Top of Prairie Evaporite Fm (kPa/m) | Bulk Density Log Quality | % of Unknown Bulk Density Data above Prairie Evaporite Fm | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | 754.2 | 750.5 | AECOG (E) SUFF 10C-1-17-8 | 00/10-01-017-08W4/0 | 1985 | 50.407 | 110.975 | 200 | 1720 | 1657 | -902 | 40.0 | 24.2 | v.good | 12 | |
| 46 | 754.2 | 749.5 | DEVLAN MARTEN HILLS 10-4-75-3 | 00/10-04-075-03W5/0 | 1993 | 55.471 | 114.397 | 421 | 1852 | 1674 | -920 | 37.6 | 22.4 | v.good | 25 | missing data b/w 711 and 1643 m KB |
| 47 | 761.7 | 757.7 | GULF AEC FALCON SUFFIELD 11-5-15-6 | 00/11-05-015-06W4/0 | 1978 | 50.232 | 110.797 | 190 | 1750 | 1662 | -900 | 40.4 | 24.3 | v.good | 11 | difficult pick for Prairie Evaporite Fm |
| 48 | 789.3 | 785.1 | AECOG (E) SUFF 11C-14-18-8 | 00/11-14-018-08W4/0 | 1985 | 50.524 | 111.005 | 206 | 1745 | 1698 | -909 | 40.7 | 24.0 | v.good | 12 | |
| 49 | 797.8 | 793.9 | AECOG (GS) SUFF 11-18-18-8 | 00/11-18-018-08W4/0 | 1985 | 50.524 | 111.097 | 262 | 2242 | 1708 | -910 | 40.9 | 23.9 | v.good | 15 | |
| 50 | 718.6 | 714.0 | CANSO ET AL AEC SUFFIELD 12-7-15-7 | 00/12-07-015-07W4/0 | 1979 | 50.247 | 110.962 | 189 | 1677 | 1611 | -892 | 39.3 | 24.4 | fair | 11 | |
| 51 | 717.1 | 713.0 | GULF AEC HAWK SUFFIELD 12-12-15-7 | 00/12-12-015-07W4/0 | 1978 | 50.246 | 110.848 | 184 | 2154 | 1610 | -893 | 39.1 | 24.3 | fair | 11 | |
| 52 | 747.0 | 742.4 | AECOG (E) 12-21-15-8 | 00/12-21-015-08W4/0 | 1980 | 50.274 | 111.056 | 192 | 1688 | 1644 | -897 | 40.2 | 24.5 | fair | 11 | difficult pick for Prairie Evaporite Fm |
| 53 | 713.0 | 708.5 | CANSO ET AL AEC SUFFIELD 12-33-15-7 | 00/12-33-015-07W4/0 | 1980 | 50.305 | 110.917 | 189 | 1682 | 1607 | -894 | 38.8 | 24.2 | fair | 11 | |
| 54 | 708.1 | 704.1 | CS ET AL AEC SUFFIELD 14-32-19-4 | 00/14-32-019-04W4/0 | 1978 | 50.657 | 110.526 | 424 | 1731 | 1604 | -896 | 38.9 | 24.2 | fair | 26 | |
| 55 | 770.5 | 766.9 | PAN AM UNION A-1 YNGSTN 16-3-30-9 | 00/16-03-030-09W4/0 | 1967 | 51.546 | 111.178 | 747 | 1820 | 1667 | -897 | 38.8 | 23.3 | fair | 45 | |
| 56 | 852.9 | 849.3 | CANSO ET AL AEC SUFFIELD 12-33-15-7 | 00/12-33-015-07W4/0 | 1984 | 52.577 | 113.174 | 882 | 2289 | 2218 | -1365 | 52.4 | 23.6 | v.good | 40 | |
| 57 | 706.8 | 702.9 | AECOG (E) HAWK SUFF 6-26-15-7 | 02/06-26-015-07W4/0 | 1978 | 50.286 | 110.866 | 192 | 1676 | 1597 | -890 | 39.4 | 24.7 | v.good | 12 | |
| 58 | 791.4 | 788.4 | PCP HEATHDALE 10-16-27-8 | 00/10-16-027-08W4/0 | 1980 | 51.310 | 111.070 | 183 | 1699 | 1693 | -902 | 39.5 | 23.3 | fair | 11 | |
| 59 | 785.1 | 780.8 | AMOCO RICHDALE 3-4-31-12 | 00/03-04-031-12W4/0 | 1984 | 51.622 | 111.648 | 350 | 1877 | 1785 | -1000 | 43.3 | 24.2 | fair | 19 | very good quality older log |
| 60 | 852.5 | 848.4 | MOBIL CRAIGMYLE 9-18-32-17 | 00/09-18-032-17W4/0 | 1988 | 51.744 | 112.394 | 361 | 2155 | 2116 | -1264 | 50.6 | 23.9 | good | 17 | |
| 61 | 826.2 | 820.6 | STELLARTON SPIERS 11-15-34-15 | 00/11-15-034-15W4/0 | 1992 | 51.919 | 112.049 | 296 | 1975 | 1885 | -1059 | 45.8 | 24.3 | v.good | 15 | |
| 62 | 839.7 | 835.3 | CHEVRON ET AL HACKETT 1-7-36-18 | 00/01-07-036-18W4/0 | 1982 | 52.071 | 112.553 | 354 | 2121 | 2090 | -1250 | 50.2 | 24.0 | fair | 17 | no curve availabe < 2000 kg/m3 for digitizing, therefore calculations would be high |
| 63 | 728.3 | 723.8 | SCEPTRE ET AL STROME 8-23-43-16 | 00/08-23-043-16W4/0 | 1984 | 52.718 | 112.205 | 329 | 1810 | 1712 | -983 | 40.0 | 23.4 | fair | 19 | good quality older log |
| 64 | 706.8 | 702.2 | SUNCOR STROME 11-16-44-16 | 00/11-16-044-16W4/0 | 1983 | 52.795 | 112.269 | 321 | 1807 | 1695 | -988 | 39.5 | 23.3 | fair | 19 | breakout also analyzed for this well |
| 65 | 717.4 | 712.9 | SUNCOR HOLMBERG 4-1-45-16 | 00/04-01-045-16W4/0 | 1983 | 52.845 | 112.198 | 284 | 1682 | 1666 | -949 | 39.2 | 23.5 | fair | 17 | good quality older log |
| 66 | 698.4 | 693.8 | SUNCOR KILLAM NORTH 6-15-45-15 | 02/06-15-045-15W4/0 | 1983 | 52.877 | 112.097 | 252 | 1737 | 1599 | -901 | 37.9 | 23.7 | fair | 15 | very good quality older log |
| 67 | 707.8 | 703.3 | SUNCOR ET AL KILLAM 16-10-46-13 | 00/16-10-046-13W4/0 | 1984 | 52.956 | 111.795 | 275 | 1670 | 1444 | -736 | 33.4 | 23.2 | v.good | 19 | Schlumberger's LDT run |
| 68 | 632.0 | 626.4 | DOW 27 NACL FTSASK 9-3-55-22 | 00/09-03-055-22W4/0 | 1986 | 53.726 | 113.176 | 215 | 1910 | 1701 | -1069 | 40.0 | 23.5 | good | 12 | well deviated past the Prairie Evaporite Formation |
| 69 | 633.3 | 625.9 | NUL NGS FTSASK 7-34-55-21 | 00/07-34-055-21W4/0 | 1982 | 53.795 | 113.036 | 205 | 1875 | 1585 | -952 | 37.7 | 23.8 | fair | 12 | |
| 70 | 636.2 | 632.5 | PLPG FT SASK 16D-1-56-22 | 00/16-01-056-22W4/0 | 1975 | 53.817 | 113.125 | 198 | 1908 | 1617 | -980 | 37.7 | 23.3 | fair | 12 | |
| 71 | 647.5 | 642.9 | GULF ET AL THORHILD 16-22-59-22 | 00/16-22-059-22W4/0 | 1985 | 54.122 | 113.200 | 314 | 1844 | 1575 | -928 | 36.6 | 23.3 | v.good | 20 | |
| 72 | 651.1 | 647.1 | ANDERSON ET AL THORHILD 1-12-60-21 | 00/01-12-060-21W4/0 | 1980 | 54.167 | 113.002 | 186 | 1682 | 1474 | -823 | 34.7 | 23.6 | fair | 12 | good quality older log |
| 73 | 668.8 | 664.8 | AMOCO THORHILD 16-9-60-22 | 00/16-09-060-22W4/0 | 1984 | 54.178 | 113.229 | 322 | 1806 | 1584 | -915 | 37.3 | 23.6 | fair | 20 | good quality older log |
| 74 | 679.8 | 674.9 | CHEVRON ET AL LUCKY 15-8-61-18 | 00/15-08-061-18W4/0 | 1982 | 54.267 | 112.661 | 279 | 1358 | 1355 | -675 | 31.7 | 23.4 | fair | 20 | good quality older log |
| 75 | 554.0 | 549.0 | ICOR ET AL HOOLE 12-1-80-24 | 00/12-01-080-24W4/0 | 1987 | 55.906 | 113.629 | 302 | 1466 | 1117 | -563 | 26.3 | 23.5 | good | 27 | |
| 76 | 740.3 | 735.7 | PCP MEDICINE HAT 12-19-14-4 | 00/12-19-014-04W4/0 | 1988 | 50.188 | 110.549 | 455 | 2215 | 1640 | -900 | 38.9 | 23.7 | v.good | 27 | |
| 77 | 632.2 | 628.0 | AECOG (E) SUFF 7-22-17-5 | 00/07-22-017-05W4/0 | 1984 | 50.448 | 110.608 | 205 | 1640 | 1536 | -904 | 37.8 | 24.6 | fair | 13 | very good quality older log |
| 78 | 618.0 | 613.4 | SHELL FINA RUBEN 3-25-83-2 | 00/03-25-083-02W5/0 | 1979 | 56.220 | 114.175 | 15 | 1500 | 1261 | -643 | 30.1 | 23.8 | fair | 1 | good quality older log |
| 79 | 587.3 | 583.7 | GULF WABASCA 7-36-84-23 | 00/07-36-084-23W4/0 | 1975 | 56.325 | 113.489 | 183 | 1051 | 1001 | -414 | 23.0 | 23.0 | fair | 37 | missing data b/w 393 and 585 m KB |
| 80 | 669.3 | 665.4 | PAN AM A-1 JEAN LAKE 4-11-98-23 | 00/04-11-098-23W4/0 | 1966 | 57.484 | 113.631 | 188 | 1185 | 864 | -194 | 20.0 | 23.2 | fair | 21 | very good quality older log |
| 81 | 654.1 | 649.2 | CDN-SUP FRANCIS 7-22-74-22 | 00/07-22-074-22W4/0 | 1971 | 55.422 | 113.295 | 562 | 1682 | 1219 | -565 | 28.6 | 23.5 | fair | 46 | |
| 82 | 704.2 | 700.4 | CLM ET AL JEAN 8-16-98-22 | 00/08-16-098-22W4/0 | 1985 | 57.501 | 113.504 | 312 | 1225 | 855 | -150 | 19.5 | 22.8 | v.good | 36 | |
| 83 | 584.7 | 580.4 | CZAR ET AL LIEGE 7-13-92-24 | 00/07-13-092-24W4/0 | 1979 | 56.978 | 113.716 | 15 | 1185 | 885 | -300 | 20.2 | 22.8 | fair | 30 | missing data b/w 273 and 526 m KB |
| 84 | 530.9 | 523.9 | COLIN PANNY 1-31-95-4 | 00/01-31-095-04W4/0 | 1985 | 57.280 | 114.630 | 615 | 1209 | 975 | -444 | 21.5 | 22.1 | v.good | 62 | |
| 85 | 802.4 | 797.9 | HUSKY MEDICINE HAT 5-32-17-2 | 00/05-32-017-02W4/0 | 1988 | 50.475 | 110.251 | 339 | 1716 | 1711 | -909 | 40.1 | 23.4 | v.good | 20 | |
| 86 | 512.4 | 508.0 | GAO MINK 10-29-89-23 | 00/10-29-089-23W4/0 | 1983 | 56.751 | 113.628 | 189 | 1165 | 856 | -344 | 20.1 | 23.5 | fair | 22 | |
| 87 | 521.2 | 517.9 | PAN AM E-1 CHIPEWYAN 10-34-91-18 | 00/10-34-091-18W4/0 | 1967 | 56.939 | 112.805 | 190 | 920 | 604 | -83 | 14.1 | 23.4 | fair | 31 | very good quality older log |
| 88 | 763.7 | 759.7 | FCPI 12D PROVOST 12-21-35-6 | D0/12-21-035-06W4/0 | 1993 | 52.021 | 110.808 | 750 | 1662 | 1525 | -761 | 35.3 | 23.2 | v.good | 49 | |

## Table E.1: Summary of vertical stresses for the Elk Point Group determined from bulk density data in the expanded study area

| No. | Log Kelly Bushing | Ground Level | Well Name | UWI | Year Logged | Latitude (deg N) | Longitude (deg W) | Top Log Interval (m KB) | Bottom Log Interval (m KB) | Top Prairie Evaporite Fm (m KB) | Elevation of Prairie Evaporite Fm (m) | Vertical Stress at Top of Prairie Evaporite Fm (MPa) | Normalized Vertical Stress Gradient at Top of Prairie Evaporite Fm (kPa/m) | Bulk Density Log Quality | % of Unknown Bulk Density Data above Prairie Evaporite Fm | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 89 | 633.1 | 627.6 | DOW 103B FTSASK NACL 14-11-55-22 | 06/14-11-055-22W4/0 | 1988 | 53.742 | 113.166 | 18 | 1926 | 1657 | -1024 | 37.8 | 22.8 | v.good | 1 | bulk density of salt seems low at approx. 1500 kg/m3 |
| 90 | 701.7 | 698.1 | NCL PROVOST 8-14-40-3 | 00/08-14-040-03W4/0 | 1994 | 52.440 | 110.319 | 182 | 1503 | 1297 | -595 | 29.5 | 22.7 | v.good | 14 | |
| 91 | 692.8 | 688.8 | HUSKY D H BALDWINTON 7-1-44-24 | 01/07-01-044-24W3/0 | 1972 | 52.760 | 109.351 | 579 | 1858 | 1070 | -377 | 24.2 | 22.6 | fair | 54 | |
| 92 | 628.2 | 624.5 | HUSKY INC ET AL CABRI 7-16-24-27 | 01/07-16-024-27W3/0 | 1969 | 51.043 | 109.710 | 610 | 1611 | 1491 | -863 | 34.8 | 23.4 | fair | 41 | |
| 93 | 694.0 | 690.1 | TEXCAN ALSASK 10-1-28-29 | 01/10-01-028-29W3/0 | 1984 | 51.367 | 109.950 | 668 | 2158 | 1512 | -818 | 35.4 | 23.4 | fair | 44 | |
| 94 | 602.0 | 598.0 | HUSKY DH LOW LAKE 10-9-50-24 | 01/10-09-050-24W3/0 | 1971 | 53.301 | 109.452 | 426 | 1032 | 831 | -229 | 18.5 | 22.3 | fair | 51 | |
| 95 | 622.4 | 619.0 | ARCO BA POUNDMAKER 12-28-45-22 | 01/12-28-045-22W3/0 | 1967 | 52.909 | 109.145 | 145 | 1168 | 939 | -316 | 21.7 | 23.1 | fair | 15 | good quality older log |
| 96 | 741.0 | 737.3 | S P C HB LUSELAND 15-8-35-27 | 01/15-08-035-27W3/0 | 1976 | 51.996 | 109.821 | 140 | 1539 | 1414 | -673 | 33.1 | 23.4 | fair | 10 | |
| 97 | 718.0 | 712.3 | WASCANA SHOP CACTUS LK 15-34-34-27 | 01/15-34-034-27W3/0 | 1980 | 51.967 | 109.746 | 257 | 2095 | 1390 | -672 | 32.4 | 23.3 | fair | 18 | |
| 98 | 700.7 | 696.5 | SASKOIL SHOP LUSELAND 16-36-36-25W3 | 01/16-36-036-25W3/0 | 1980 | 52.142 | 109.434 | 190 | 2000 | 1292 | -591 | 30.0 | 23.2 | fair | 14 | good quality older log |
| 99 | 728.1 | 724.4 | WASCANA PLOVER LK SWD A1-5-35-26 | 11/01-05-035-26W3/0 | 1997 | 51.970 | 109.670 | 249 | 2121 | 1398 | -670 | 32.1 | 23.0 | v.good | 18 | |
| 100 | 723.5 | 719.4 | PENN WEST PLOVER LAKE SWD A6-15-35-27 | 11/06-15-035-27W3/0 | 1998 | 52.001 | 109.776 | 260 | 2105 | 1392 | -669 | 32.2 | 23.1 | v.good | 18 | |
| 101 | 742.2 | 737.3 | MURPHY CCTS LK N 7-30-36-28 | 21/07-30-036-28W3/0 | 1997 | 52.119 | 109.988 | 303 | 2130 | 1396 | -653 | 32.3 | 23.2 | v.good | 21 | |
| 102 | 646.3 | 641.8 | HUSKY LLOYD SCD B7-30-49-27 | 21/07-30-049-27W3/0 | 1998 | 53.254 | 109.939 | 213 | 954 | 949 | -302 | 21.0 | 22.1 | good | 22 | hole somewhat washed out - vertical stress will be low |
| 103 | 646.5 | 642.8 | HUSKY LLOYD SWD B12-30-49-27 | 21/12-30-049-27W3/0 | 1984 | 53.257 | 109.952 | 300 | 1735 | 952 | -306 | 21.9 | 23.0 | fair | 31 | good quality older log, near Husky's disposal area within the Prairie Evaporite Fm |
| 104 | 646.3 | 641.4 | HUSKY LLOYD SCD C7-30-49-27 | 31/07-30-049-27W3/0 | 1996 | 53.256 | 109.941 | 232 | 1075 | 950 | -304 | 20.8 | 21.9 | good | 24 | hole somewhat washed out - vertical stress will be low |
| 105 | 655.8 | 651.7 | GULF SHOP DRUID DD 1C16-10-34-22 | 31/16-10-034-22W3/0 | 1980 | 51.909 | 109.031 | 498 | 2034 | 1303 | -648 | 30.6 | 23.5 | fair | 38 | good quality older log |
| 106 | 638.5 | 633.5 | SIFTO CANADA UTILITY 3-9-40-22 | 41/03-09-040-22W3/0 | 1995 | 52.422 | 109.111 | 135 | 1249 | 1129 | -491 | 25.9 | 23.0 | good | 12 | |
| 107 | 692.6 | 687.6 | WASCANA LUSELAND SWD D3-18-36-25 | 41/03-18-036-25W3/0 | 1997 | 52.088 | 109.563 | 244 | 2047 | 1319 | -626 | 30.6 | 23.2 | v.good | 18 | |
| 108 | 662.3 | 656.3 | AMOCO KRRBRT 4 STORAGE DD 5-34-33-22 | 91/05-34-033-22W3/0 | 1996 | 51.870 | 109.050 | 158 | 1361 | 1359 | -697 | 31.4 | 23.1 | v.good | 11 | |
| 109 | 538.4 | 535.4 | BONAVISTA ET AL BEACON HILL 9-22-62-27 | 21/09-22-062-27W3/0 | 1987 | 54.377 | 109.958 | 103 | 742 | 715 | -177 | 15.8 | 22.2 | v.good | 14 | |
| 110 | 728.7 | 722.7 | WASCANA PLOVER LK SWD C16-5-35-26 | 31/16-05-035-26W3/0 | 1997 | 51.983 | 109.672 | 247 | 2114 | 1394 | -665 | 32.4 | 23.2 | v.good | 17 | |
| 111 | 734.9 | 730.4 | WASCANA PLOVER LK SWD D4-5-35-26 | 41/04-05-035-26W3/0 | 1997 | 51.972 | 109.689 | 247 | 2129 | 1405 | -670 | 32.6 | 23.2 | v.good | 17 | |
| 112 | 702.2 | 697.3 | MURPHY PLOVER LAKE 11-29-35-26 | 11/11-29-035-26W3/0 | 1997 | 52.035 | 109.683 | 301 | 2084 | 1355 | -653 | 31.4 | 23.2 | v.good | 22 | |

## Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups

**Definition of Column Headings:**

| | |
|---|---|
| Top: | top of interval (m log depth) |
| Bottom: | bottom of interval (m log depth) |
| Thickness: | thickness of interval (m) |
| P1AZ: | azimuth of C1 caliper with respect to magnetic north (degrees) |
| P1AZc: | azimuth of C1 caliper corrected to true north |
| Cmax Az wrt true North: | Breakout azimuth corrected to true north |
| C1: | C1-C3 caliper measurement (mm) |
| C2: | C2-C4 caliper measurement (mm) |
| % Enlarge | % difference between C1 and C2 readings |
| % Gauge | % difference between smaller caliper reading and hole gauge |
| Quality: | quality of breakout (see report for details) |
| Formation or Group: | formation or group identified in well ticket that breakout occurs within |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name **MURPHY ET AL GRAHAM 12-18-87-3**
UWI: 100/12-18-087-03W5/00
Borehole Diameter: 159 mm
Correction to True North: 23.27 degrees
Comments: Well drilled with NaCl Gel Chem mud but little breakout shown in well

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1152 | 1153 | 1 | 105 | 105 | 128 | 228.5 | 190.0 | 20.3% | 19.5% | good | BH LK Grp |
| 1153 | 1154 | 1 | 80 | 80 | 103 | 256.5 | 215.0 | 19.3% | 35.2% | good | BH LK Grp |
| 1478 | 1479 | 1 | 320 | 230 | 253 | 287.0 | 302.0 | 5.2% | 80.5% | poor | Prairie Evaporite Fm |
| 1493 | 1494 | 1 | 270 | 270 | 293 | 292.0 | 254.0 | 15.0% | 59.7% | good | Prairie Evaporite Fm |
| 1494 | 1495 | 1 | 270 | 270 | 293 | 298.5 | 267.0 | 11.8% | 67.9% | good | Prairie Evaporite Fm |
| 1495 | 1496 | 1 | 270 | 270 | 293 | 304.8 | 292.0 | 4.4% | 83.6% | good | Prairie Evaporite Fm |
| 1496 | 1497 | 1 | 270 | 270 | 293 | 311.0 | 292.0 | 6.5% | 83.6% | good | Prairie Evaporite Fm |
| 1497 | 1498 | 1 | 270 | 270 | 293 | 311.0 | 292.0 | 6.5% | 83.6% | good | Prairie Evaporite Fm |
| 1567 | 1568 | 1 | 305 | 305 | 328 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1568 | 1569 | 1 | 300 | 300 | 323 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1569 | 1570 | 1 | 300 | 300 | 323 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1570 | 1571 | 1 | 295 | 295 | 318 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1571 | 1572 | 1 | 295 | 295 | 318 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1572 | 1573 | 1 | 290 | 290 | 313 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1573 | 1574 | 1 | 290 | 290 | 313 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1574 | 1575 | 1 | 285 | 285 | 308 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1575 | 1576 | 1 | 280 | 280 | 303 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1576 | 1577 | 1 | 280 | 280 | 303 | 171.0 | 159.0 | 7.5% | 0.0% | good | Granite Wash Fm |
| 1577 | 1578 | 1 | 265 | 265 | 288 | 171.0 | 159.0 | 7.5% | 0.0% | good | Granite Wash Fm |
| 1578 | 1579 | 1 | 265 | 265 | 288 | 171.0 | 159.0 | 7.5% | 0.0% | good | Granite Wash Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name **COLIN ET AL KIDNEY 10-19-91-4**
UWI: 102/10-19-091-04W5/00
Borehole Diameter: 159 mm
Correction to True North: 0 (log corrected to true north)
Comments: Possibly other areas of breakout but caliper curves masked by pad resistivity traces in places
Comments: Well name on log header is DORSET ET AL KIDNEY 10-19-91-4

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1152 | 1153 | 1 | 290 | 290 | 290 | 225 | 220 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1153 | 1154 | 1 | 288 | 288 | 288 | 235 | 225 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1154 | 1155 | 1 | 286 | 286 | 286 | 250 | 230 | 8.70% | 44.65% | fair | Prairie Evaporite Fm |
| 1155 | 1156 | 1 | 284 | 284 | 284 | 240 | 225 | 6.67% | 41.51% | fair | Prairie Evaporite Fm |
| 1156 | 1157 | 1 | 282 | 282 | 282 | 230 | 220 | 4.55% | 38.36% | fair | Prairie Evaporite Fm |
| 1157 | 1158 | 1 | 280 | 280 | 280 | 225 | 200 | 12.50% | 25.79% | fair | Prairie Evaporite Fm |
| 1198 | 1199 | 1 | 195 | 105 | 105 | 175 | 180 | 2.86% | 10.06% | fair | Prairie Evaporite Fm |
| 1199 | 1200 | 1 | 195 | 105 | 105 | 175 | 185 | 5.71% | 10.06% | fair | Prairie Evaporite Fm |
| 1200 | 1201 | 1 | 195 | 105 | 105 | 175 | 195 | 11.43% | 10.06% | fair | Prairie Evaporite Fm |
| 1201 | 1202 | 1 | 195 | 105 | 105 | 180 | 195 | 8.33% | 13.21% | fair | Prairie Evaporite Fm |
| 1202 | 1203 | 1 | 195 | 105 | 105 | 185 | 200 | 8.11% | 16.35% | fair | Prairie Evaporite Fm |
| 1203 | 1204 | 1 | 200 | 110 | 110 | 190 | 200 | 5.26% | 19.50% | fair | Prairie Evaporite Fm |
| 1204 | 1205 | 1 | 200 | 110 | 110 | 185 | 200 | 8.11% | 16.35% | fair | Prairie Evaporite Fm |
| 1205 | 1206 | 1 | 200 | 110 | 110 | 175 | 195 | 11.43% | 10.06% | fair | Prairie Evaporite Fm |
| 1206 | 1207 | 1 | 200 | 110 | 110 | 175 | 195 | 11.43% | 10.06% | fair | Prairie Evaporite Fm |
| 1207 | 1208 | 1 | 200 | 110 | 110 | 180 | 195 | 8.33% | 13.21% | fair | Prairie Evaporite Fm |
| 1208 | 1209 | 1 | 200 | 110 | 110 | 175 | 195 | 11.43% | 10.06% | fair | Prairie Evaporite Fm |
| 1209 | 1210 | 1 | 205 | 115 | 115 | 180 | 195 | 8.33% | 13.21% | fair | Prairie Evaporite Fm |
| 1210 | 1211 | 1 | 205 | 115 | 115 | 180 | 195 | 8.33% | 13.21% | fair | Prairie Evaporite Fm |
| 1211 | 1212 | 1 | 210 | 120 | 120 | 175 | 190 | 8.57% | 10.06% | fair | Prairie Evaporite Fm |
| 1212 | 1213 | 1 | 210 | 120 | 120 | 175 | 190 | 8.57% | 10.06% | fair | Prairie Evaporite Fm |
| 1213 | 1214 | 1 | 210 | 120 | 120 | 180 | 190 | 5.56% | 13.21% | fair | Prairie Evaporite Fm |
| 1214 | 1215 | 1 | 210 | 120 | 120 | 180 | 190 | 5.56% | 13.21% | fair | Prairie Evaporite Fm |
| 1215 | 1216 | 1 | 210 | 120 | 120 | 165 | 180 | 9.09% | 3.77% | fair | Prairie Evaporite Fm |
| 1216 | 1217 | 1 | 210 | 120 | 120 | 160 | 175 | 9.38% | 0.63% | fair | Prairie Evaporite Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name **NCE ENER SENEX 14-9-92-4**
UWI: 100/14-09-092-04W5/0
Borehole Diameter: 200 mm
Correction to True North: 25.08 (corrected 18.2 deg E on log)
Comments: Oil-based mud used, hole near gauge and breakout difficult to identify

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1203 | 1204 | 1 | 200 | 110 | 135 | 200 | 205 | 2.50% | 25.79% | fair | Prairie Evaporite Fm |
| 1204 | 1205 | 1 | 195 | 105 | 130 | 200 | 205 | 2.50% | 25.79% | fair | Prairie Evaporite Fm |
| 1205 | 1206 | 1 | 190 | 100 | 125 | 200 | 210 | 5.00% | 25.79% | fair | Prairie Evaporite Fm |
| 1206 | 1207 | 1 | 190 | 100 | 125 | 200 | 205 | 2.50% | 25.79% | fair | Prairie Evaporite Fm |
| 1232 | 1233 | 1 | 355 | 265 | 290 | 200 | 210 | 5.00% | 25.79% | fair | Prairie Evaporite Fm |
| 1233 | 1234 | 1 | 355 | 265 | 290 | 200 | 210 | 5.00% | 25.79% | fair | Prairie Evaporite Fm |
| 1234 | 1235 | 1 | 345 | 255 | 280 | 200 | 210 | 5.00% | 25.79% | fair | Prairie Evaporite Fm |

Well Name **UNOCAL KIDNEY 10-32-90-4**
UWI: 00/10-32-090-04W5/0
Borehole Diameter: 158.9 mm
Correction to True North: 23.6
Comments: only one section of breakout at the top of the logged interval

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1138 | 1139 | 1 | 5 | 95 | 119 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1139 | 1140 | 1 | 10 | 100 | 124 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1140 | 1141 | 1 | 15 | 105 | 129 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1141 | 1142 | 1 | 20 | 110 | 134 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1142 | 1143 | 1 | 25 | 115 | 139 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1143 | 1144 | 1 | 30 | 120 | 144 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1144 | 1145 | 1 | 30 | 120 | 144 | 167 | 172 | 2.99% | 5.03% | fair | BH LK Grp |
| 1145 | 1146 | 1 | 30 | 120 | 144 | 165 | 170 | 3.03% | 3.77% | fair | Slave Point Fm |
| 1146 | 1147 | 1 | 30 | 120 | 144 | 159 | 164 | 3.14% | 0.00% | fair | Slave Point Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name **UNOCAL KIDNEY 9-5-91-4**
UWI: 00/09-05-091-04W5/0
Borehole Diameter: 158.9 mm Correction to True North: 23.5

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1016 | 1017 | 1 | 125 | 125 | 149 | 190 | 180 | 5.56% | 13.21% | poor | BH LK Grp |
| 1017 | 1018 | 1 | 125 | 125 | 149 | 200 | 180 | 11.11% | 13.21% | poor | BH LK Grp |
| 1018 | 1019 | 1 | 130 | 130 | 154 | 200 | 180 | 11.11% | 13.21% | poor | BH LK Grp |
| 1019 | 1020 | 1 | 130 | 130 | 154 | 200 | 180 | 11.11% | 13.21% | poor | BH LK Grp |
| 1020 | 1021 | 1 | 130 | 130 | 154 | 200 | 180 | 11.11% | 13.21% | poor | BH LK Grp |
| 1021 | 1022 | 1 | 125 | 125 | 149 | 200 | 180 | 11.11% | 13.21% | poor | BH LK Grp |
| 1022 | 1023 | 1 | 125 | 125 | 149 | 195 | 180 | 8.33% | 13.21% | poor | BH LK Grp |
| 1023 | 1024 | 1 | 120 | 120 | 144 | 190 | 180 | 5.56% | 13.21% | poor | BH LK Grp |
| 1024 | 1025 | 1 | 110 | 110 | 134 | 195 | 180 | 8.33% | 13.21% | poor | BH LK Grp |
| 1025 | 1026 | 1 | 105 | 105 | 129 | 200 | 185 | 8.11% | 16.35% | poor | BH LK Grp |
| 1026 | 1027 | 1 | 100 | 100 | 124 | 205 | 190 | 7.89% | 19.50% | poor | BH LK Grp |
| 1027 | 1028 | 1 | 95 | 95 | 119 | 205 | 185 | 10.81% | 16.35% | poor | BH LK Grp |
| 1028 | 1029 | 1 | 90 | 90 | 114 | 190 | 175 | 8.57% | 10.06% | poor | BH LK Grp |
| 1134 | 1135 | 1 | 260 | 260 | 284 | 175 | 162 | 8.02% | 1.89% | good | Watt Mountain Fm |
| 1135 | 1136 | 1 | 250 | 250 | 274 | 185 | 162 | 14.20% | 1.89% | good | Watt Mountain Fm |
| 1136 | 1137 | 1 | 230 | 230 | 254 | 190 | 162 | 17.28% | 1.89% | good | Watt Mountain Fm |
| 1137 | 1138 | 1 | 230 | 230 | 254 | 195 | 165 | 18.18% | 3.77% | good | Watt Mountain Fm |
| 1138 | 1139 | 1 | 230 | 230 | 254 | 190 | 165 | 15.15% | 3.77% | good | Watt Mountain Fm |
| 1139 | 1140 | 1 | 230 | 230 | 254 | 185 | 165 | 12.12% | 3.77% | good | Watt Mountain Fm |
| 1140 | 1141 | 1 | 230 | 230 | 254 | 180 | 162 | 11.11% | 1.89% | good | Prairie Evaporite Fm |
| 1264 | 1265 | 1 | 285 | 285 | 309 | 175 | 170 | 2.94% | 6.92% | fair | Prairie Evaporite Fm |
| 1265 | 1266 | 1 | 290 | 290 | 314 | 175 | 170 | 2.94% | 6.92% | fair | Prairie Evaporite Fm |
| 1288 | 1289 | 1 | 285 | 285 | 309 | 175 | 159 | 10.06% | 0.00% | fair | Prairie Evaporite Fm |
| 1289 | 1290 | 1 | 290 | 290 | 314 | 172 | 159 | 8.18% | 0.00% | fair | Prairie Evaporite Fm |
| 1290 | 1291 | 1 | 290 | 290 | 314 | 175 | 163 | 7.36% | 2.52% | fair | Prairie Evaporite Fm |
| 1291 | 1292 | 1 | 285 | 285 | 309 | 172 | 159 | 8.18% | 0.00% | fair | Prairie Evaporite Fm |
| 1292 | 1293 | 1 | 290 | 290 | 314 | 172 | 159 | 8.18% | 0.00% | fair | Prairie Evaporite Fm |
| 1293 | 1294 | 1 | 290 | 290 | 314 | 175 | 163 | 7.36% | 2.52% | fair | Prairie Evaporite Fm |
| 1294 | 1295 | 1 | 290 | 290 | 314 | 175 | 163 | 7.36% | 2.52% | fair | Prairie Evaporite Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name **MURPHY TROUT 9-3-89-3**
UWI: 00/09-03-089-03W5/0
Borehole Diameter: 200 mm
Correction to True North: 0 (log corrected 23 degrees to true north)
Comments: Breakout between 1403 and 1414 m KB seen in both the main and repeat passes

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1291 | 1292 | 1 | 100 | 100 | 100 | 250 | 225 | 11.11% | 41.51% | fair | Prairie Evaporite Fm |
| 1298 | 1299 | 1 | 105 | 105 | 105 | 265 | 250 | 6.00% | 57.23% | fair | Prairie Evaporite Fm |
| 1299 | 1300 | 1 | 100 | 100 | 100 | 270 | 250 | 8.00% | 57.23% | fair | Prairie Evaporite Fm |
| 1403 | 1404 | 1 | 205 | 115 | 115 | 200 | 205 | 2.50% | 25.79% | fair | Prairie Evaporite Fm |
| 1404 | 1405 | 1 | 205 | 115 | 115 | 210 | 225 | 7.14% | 32.08% | good | Prairie Evaporite Fm |
| 1405 | 1406 | 1 | 205 | 115 | 115 | 225 | 230 | 2.22% | 41.51% | good | Prairie Evaporite Fm |
| 1406 | 1407 | 1 | 215 | 125 | 125 | 220 | 235 | 6.82% | 38.36% | good | Prairie Evaporite Fm |
| 1407 | 1408 | 1 | 215 | 125 | 125 | 220 | 240 | 9.09% | 38.36% | good | Prairie Evaporite Fm |
| 1408 | 1409 | 1 | 210 | 120 | 120 | 220 | 240 | 9.09% | 38.36% | good | Prairie Evaporite Fm |
| 1409 | 1410 | 1 | 210 | 120 | 120 | 220 | 240 | 9.09% | 38.36% | good | Prairie Evaporite Fm |
| 1410 | 1411 | 1 | 205 | 115 | 115 | 220 | 235 | 6.82% | 38.36% | good | Prairie Evaporite Fm |
| 1411 | 1412 | 1 | 205 | 115 | 115 | 220 | 230 | 4.55% | 38.36% | good | Prairie Evaporite Fm |
| 1412 | 1413 | 1 | 200 | 110 | 110 | 210 | 220 | 4.76% | 32.08% | good | Prairie Evaporite Fm |
| 1413 | 1414 | 1 | 200 | 110 | 110 | 200 | 210 | 5.00% | 25.79% | good | Prairie Evaporite Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name **UNOCAL ET AL TROUT 8-10-89-3**
UWI: 00/08-10-089-03W5/0
Borehole Diameter: 159 mm
Correction to True North: 0 (log corrected 24 degrees to true north)
Comments: Breakout shows minor population between 1091 and 1100 m KB approx. 90 degrees from the major population

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1091 | 1092 | 1 | 210 | 210 | 210 | 170 | 165 | 3.03% | 3.77% | fair | BH LK Grp |
| 1092 | 1093 | 1 | 215 | 215 | 215 | 180 | 170 | 5.88% | 6.92% | fair | BH LK Grp |
| 1093 | 1094 | 1 | 215 | 215 | 215 | 200 | 180 | 11.11% | 13.21% | fair | BH LK Grp |
| 1094 | 1095 | 1 | 220 | 220 | 220 | 210 | 175 | 20.00% | 10.06% | fair | BH LK Grp |
| 1095 | 1096 | 1 | 230 | 230 | 230 | 210 | 175 | 20.00% | 10.06% | fair | BH LK Grp |
| 1096 | 1097 | 1 | 235 | 235 | 235 | 200 | 165 | 21.21% | 3.77% | fair | BH LK Grp |
| 1097 | 1098 | 1 | 240 | 240 | 240 | 190 | 165 | 15.15% | 3.77% | fair | BH LK Grp |
| 1098 | 1099 | 1 | 245 | 245 | 245 | 185 | 160 | 15.63% | 0.63% | fair | BH LK Grp |
| 1099 | 1100 | 1 | 250 | 250 | 250 | 170 | 160 | 6.25% | 0.63% | fair | BH LK Grp |
| 1107 | 1108 | 1 | 230 | 140 | 140 | 170 | 175 | 2.94% | 6.92% | poor | BH LK Grp |
| 1108 | 1109 | 1 | 225 | 135 | 135 | 170 | 185 | 8.82% | 6.92% | fair | BH LK Grp |
| 1109 | 1110 | 1 | 225 | 135 | 135 | 170 | 190 | 11.76% | 6.92% | fair | BH LK Grp |
| 1110 | 1111 | 1 | 220 | 130 | 130 | 170 | 205 | 20.59% | 6.92% | fair | BH LK Grp |
| 1111 | 1112 | 1 | 215 | 125 | 125 | 170 | 200 | 17.65% | 6.92% | fair | BH LK Grp |
| 1112 | 1113 | 1 | 215 | 125 | 125 | 170 | 195 | 14.71% | 6.92% | fair | BH LK Grp |
| 1113 | 1114 | 1 | 210 | 120 | 120 | 170 | 190 | 11.76% | 6.92% | fair | BH LK Grp |
| 1114 | 1115 | 1 | 205 | 115 | 115 | 165 | 185 | 12.12% | 3.77% | fair | BH LK Grp |
| 1326 | 1327 | 1 | 135 | 135 | 135 | 285 | 260 | 9.62% | 63.52% | good | Prairie Evaporite Fm |
| 1330 | 1331 | 1 | 130 | 130 | 130 | 290 | 265 | 9.43% | 66.67% | good | Prairie Evaporite Fm |
| 1331 | 1332 | 1 | 130 | 130 | 130 | 295 | 270 | 9.26% | 69.81% | good | Prairie Evaporite Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name **SUNCOR STROME 11-16-44-16**
UWI: 00/11-16-044-16W4/0
Borehole Diameter: 222 mm
Correction to True North: 20.1 degrees
Comments: Breakout shows minor population between 1710 and 1716 m KB approx. 90 degrees from the major population

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1470 | 1471 | 1 | 360 | 270 | 290 | 235 | 238 | 1.28% | 47.80% | poor | BH LK Grp |
| 1471 | 1472 | 1 | 360 | 270 | 290 | 235 | 240 | 2.13% | 47.80% | poor | BH LK Grp |
| 1472 | 1473 | 1 | 355 | 265 | 285 | 235 | 242 | 2.98% | 47.80% | poor | BH LK Grp |
| 1473 | 1474 | 1 | 355 | 265 | 285 | 235 | 245 | 4.26% | 47.80% | poor | BH LK Grp |
| 1474 | 1475 | 1 | 350 | 260 | 280 | 240 | 248 | 3.33% | 50.94% | poor | BH LK Grp |
| 1475 | 1476 | 1 | 350 | 260 | 280 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1476 | 1477 | 1 | 350 | 260 | 280 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1477 | 1478 | 1 | 350 | 260 | 280 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1478 | 1479 | 1 | 350 | 260 | 280 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1479 | 1480 | 1 | 350 | 260 | 280 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1480 | 1481 | 1 | 355 | 265 | 285 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1481 | 1482 | 1 | 355 | 265 | 285 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1482 | 1483 | 1 | 355 | 265 | 285 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1483 | 1484 | 1 | 355 | 265 | 285 | 235 | 250 | 6.38% | 47.80% | fair | BH LK Grp |
| 1484 | 1485 | 1 | 350 | 260 | 280 | 235 | 250 | 6.38% | 47.80% | fair | BH LK Grp |
| 1485 | 1486 | 1 | 350 | 260 | 280 | 235 | 250 | 6.38% | 47.80% | fair | BH LK Grp |
| 1486 | 1487 | 1 | 350 | 260 | 280 | 235 | 245 | 4.26% | 47.80% | fair | BH LK Grp |
| 1487 | 1488 | 1 | 350 | 260 | 280 | 235 | 245 | 4.26% | 47.80% | fair | BH LK Grp |
| 1488 | 1489 | 1 | 345 | 255 | 275 | 235 | 250 | 6.38% | 47.80% | fair | BH LK Grp |
| 1489 | 1490 | 1 | 345 | 255 | 275 | 235 | 250 | 6.38% | 47.80% | fair | BH LK Grp |
| 1490 | 1491 | 1 | 340 | 250 | 270 | 245 | 250 | 2.04% | 54.09% | poor | BH LK Grp |
| 1710 | 1711 | 1 | 280 | 190 | 210 | 260 | 265 | 1.92% | 63.52% | poor | Prairie Evaporite Fm |
| 1711 | 1712 | 1 | 280 | 190 | 210 | 260 | 275 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |
| 1712 | 1713 | 1 | 280 | 190 | 210 | 260 | 275 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |
| 1713 | 1714 | 1 | 280 | 190 | 210 | 260 | 275 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |
| 1714 | 1715 | 1 | 280 | 190 | 210 | 260 | 275 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |
| 1715 | 1716 | 1 | 280 | 190 | 210 | 260 | 275 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1731 | 1732 | 1 | 210 | 210 | 230 | 275 | 260 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |
| 1732 | 1733 | 1 | 215 | 215 | 235 | 265 | 255 | 3.92% | 60.38% | poor | Prairie Evaporite Fm |
| 1733 | 1734 | 1 | 215 | 215 | 235 | 265 | 255 | 3.92% | 60.38% | poor | Prairie Evaporite Fm |
| 1734 | 1735 | 1 | 215 | 215 | 235 | 275 | 265 | 3.77% | 66.67% | poor | Prairie Evaporite Fm |
| 1735 | 1736 | 1 | 210 | 210 | 230 | 275 | 265 | 3.77% | 66.67% | poor | Prairie Evaporite Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name **DORSET ET AL MARTENCK 11-12-80-5**
UWI: 00/11-12-080-05W5/0
Borehole Diameter: 209.55 mm (8.25")
Correction to True North: 20.3 degrees
Comments: Log recorded in feet

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1339 | 1340 | 1 | 80 | 80 | 100 | 350 | 340 | 2.94% | 113.84% | poor | BH LK Grp |
| 1340 | 1341 | 1 | 80 | 80 | 100 | 365 | 340 | 7.35% | 113.84% | poor | BH LK Grp |
| 1341 | 1342 | 1 | 80 | 80 | 100 | 370 | 355 | 4.23% | 123.27% | poor | BH LK Grp |
| 1342 | 1343 | 1 | 80 | 80 | 100 | 375 | 355 | 5.63% | 123.27% | poor | BH LK Grp |
| 1343 | 1344 | 1 | 80 | 80 | 100 | 365 | 355 | 2.82% | 123.27% | poor | BH LK Grp |
| 1344 | 1345 | 1 | 75 | 75 | 95 | 360 | 340 | 5.88% | 113.84% | poor | BH LK Grp |
| 1521 | 1522 | 1 | 5 | 95 | 115 | 270 | 330 | 22.22% | 69.81% | poor | Watt Mountain Fm |
| 1522 | 1523 | 1 | 5 | 95 | 115 | 270 | 405 | 50.00% | 69.81% | poor | Watt Mountain Fm |
| 1523 | 1524 | 1 | 10 | 100 | 120 | 330 | 410 | 24.24% | 107.55% | poor | Watt Mountain Fm |
| 1524 | 1525 | 1 | 10 | 100 | 120 | 270 | 370 | 37.04% | 69.81% | poor | Watt Mountain Fm |
| 1525 | 1526 | 1 | 10 | 100 | 120 | 270 | 350 | 29.63% | 69.81% | poor | Watt Mountain Fm |
| 1526 | 1527 | 1 | 5 | 95 | 115 | 270 | 300 | 11.11% | 69.81% | poor | Watt Mountain Fm |
| 1527 | 1528 | 1 | 5 | 95 | 115 | 270 | 370 | 37.04% | 69.81% | poor | Watt Mountain Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name **PCI LEIGE 11-8-95-22**
UWI: 00/11-08-095-22W4/0
Borehole Diameter: 222 mm
Correction to True North: 23.4 degrees
Comments: P1AZ was calculated from adding hole azimuth (AZIM) to the relative bearing (RB)

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 919 | 920 | 1 | 310 | 310 | 333 | 230 | 225 | 2.22% | 41.51% | fair | Waterways Fm |
| 920 | 921 | 1 | 310 | 310 | 333 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 921 | 922 | 1 | 310 | 310 | 333 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 922 | 923 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 923 | 924 | 1 | 300 | 300 | 323 | 240 | 230 | 4.35% | 44.65% | good | Waterways Fm |
| 924 | 925 | 1 | 300 | 300 | 323 | 240 | 230 | 4.35% | 44.65% | good | Waterways Fm |
| 925 | 926 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 926 | 927 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 927 | 928 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 928 | 929 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 929 | 930 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 930 | 931 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 931 | 932 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 932 | 933 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 933 | 934 | 1 | 305 | 305 | 328 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 934 | 935 | 1 | 305 | 305 | 328 | 250 | 225 | 11.11% | 41.51% | good | Waterways Fm |
| 935 | 936 | 1 | 310 | 310 | 333 | 250 | 225 | 11.11% | 41.51% | good | Waterways Fm |
| 936 | 937 | 1 | 310 | 310 | 333 | 250 | 230 | 8.70% | 44.65% | good | Waterways Fm |
| 937 | 938 | 1 | 310 | 310 | 333 | 250 | 230 | 8.70% | 44.65% | good | Waterways Fm |
| 938 | 939 | 1 | 300 | 300 | 323 | 250 | 230 | 8.70% | 44.65% | good | Waterways Fm |
| 939 | 940 | 1 | 300 | 300 | 323 | 245 | 235 | 4.26% | 47.80% | good | Waterways Fm |
| 940 | 941 | 1 | 300 | 300 | 323 | 230 | 225 | 2.22% | 41.51% | fair | Waterways Fm |
| 1041 | 1042 | 1 | 5 | 95 | 118 | 225 | 235 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1042 | 1043 | 1 | 5 | 95 | 118 | 225 | 235 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1043 | 1044 | 1 | 5 | 95 | 118 | 225 | 235 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1044 | 1045 | 1 | 0 | 90 | 113 | 260 | 270 | 3.85% | 63.52% | fair | Prairie Evaporite Fm |
| 1045 | 1046 | 1 | 350 | 260 | 283 | 260 | 270 | 3.85% | 63.52% | fair | Prairie Evaporite Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1046 | 1047 | 1 | 345 | 255 | 278 | 230 | 240 | 4.35% | 44.65% | fair | Prairie Evaporite Fm |
| 1047 | 1048 | 1 | 340 | 250 | 273 | 225 | 240 | 6.67% | 41.51% | fair | Prairie Evaporite Fm |
| 1048 | 1049 | 1 | 340 | 250 | 273 | 225 | 235 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1049 | 1050 | 1 | 340 | 250 | 273 | 225 | 235 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1248 | 1249 | 1 | 365 | 275 | 298 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1249 | 1250 | 1 | 365 | 275 | 298 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1250 | 1251 | 1 | 365 | 275 | 298 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1251 | 1252 | 1 | 360 | 270 | 293 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1255 | 1256 | 1 | 360 | 270 | 293 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1256 | 1257 | 1 | 355 | 265 | 288 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1257 | 1258 | 1 | 355 | 265 | 288 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1258 | 1259 | 1 | 355 | 265 | 288 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1259 | 1260 | 1 | 360 | 270 | 293 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |

Well Name **SCEPTRE MURPHY T'FLAGS A1-26-52-25**
UWI: 11/01-26-052-25W3/2
Borehole Diameter: 251 mm
Correction to True North: 0 (log corrected using magnetic declination of 21 degrees)
Comments: Breakout occurs at bottom of hole and, therefore, may be influenced by drilling effects. Breakout does occur in both the main and repeat pass.

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 578 | 579 | 1 | 335 | 335 | 335 | 270 | 265 | 1.89% | 66.67% | poor | Duperow Fm |
| 579 | 580 | 1 | 335 | 335 | 335 | 270 | 265 | 1.89% | 66.67% | poor | Duperow Fm |
| 580 | 581 | 1 | 335 | 335 | 335 | 270 | 265 | 1.89% | 66.67% | poor | Duperow Fm |
| 581 | 582 | 1 | 330 | 330 | 330 | 270 | 265 | 1.89% | 66.67% | poor | Duperow Fm |
| 582 | 583 | 1 | 325 | 325 | 325 | 270 | 265 | 1.89% | 66.67% | poor | Duperow Fm |

# Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups

**Definition of Column Headings:**

| | |
|---|---|
| Top: | top of interval (m log depth) |
| Bottom: | bottom of interval (m log depth) |
| Thickness: | thickness of interval (m) |
| P1AZ: | azimuth of C1 caliper with respect to magnetic north (degrees) |
| P1AZc: | azimuth of C1 caliper corrected to true north |
| Cmax Az wrt true North: | Breakout azimuth corrected to true north |
| C1: | C1-C3 caliper measurement (mm) |
| C2: | C2-C4 caliper measurement (mm) |
| % Enlarge | % difference between C1 and C2 readings |
| % Gauge | % difference between smaller caliper reading and hole gauge |
| Quality: | quality of breakout (see report for details) |
| Formation or Group: | formation or group identified in well ticket that breakout occurs within |

**SD of all corrected CMAX Az data from all wells: 53°**
**SD of Population 1 corrected CMAX Az data from all wells: 36°**
**SD of Population 2 corrected CMAX Az data from all wells: 35°**

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name: **MURPHY ET AL GRAHAM 12-18-87-3**
UWI: 100/12-18-087-03W5/00
Borehole Diameter: 159 mm
Correction to True North: 23.27 degrees
Comments: Well drilled with NaCl Gel Chem mud but little breakout shown in well

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1152 | 1153 | 1 | 105 | 105 | 128 | 228.5 | 190.0 | 20.3% | 19.5% | good | BH LK Grp |
| 1153 | 1154 | 1 | 80 | 80 | 103 | 256.5 | 215.0 | 19.3% | 35.2% | good | BH LK Grp |
| 1478 | 1479 | 1 | 320 | 230 | 253 | 287.0 | 302.0 | 5.2% | 80.5% | poor | Prairie Evaporite Fm |
| 1493 | 1494 | 1 | 270 | 270 | 293 | 292.0 | 254.0 | 15.0% | 59.7% | good | Prairie Evaporite Fm |
| 1494 | 1495 | 1 | 270 | 270 | 293 | 298.5 | 267.0 | 11.8% | 67.9% | good | Prairie Evaporite Fm |
| 1495 | 1496 | 1 | 270 | 270 | 293 | 304.8 | 292.0 | 4.4% | 83.6% | good | Prairie Evaporite Fm |
| 1496 | 1497 | 1 | 270 | 270 | 293 | 311.0 | 292.0 | 6.5% | 83.6% | good | Prairie Evaporite Fm |
| 1497 | 1498 | 1 | 270 | 270 | 293 | 311.0 | 292.0 | 6.5% | 83.6% | good | Prairie Evaporite Fm |
| 1567 | 1568 | 1 | 305 | 305 | 328 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1568 | 1569 | 1 | 300 | 300 | 323 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1569 | 1570 | 1 | 300 | 300 | 323 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1570 | 1571 | 1 | 295 | 295 | 318 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1571 | 1572 | 1 | 295 | 295 | 318 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1572 | 1573 | 1 | 290 | 290 | 313 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1573 | 1574 | 1 | 290 | 290 | 313 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1574 | 1575 | 1 | 285 | 285 | 308 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1575 | 1576 | 1 | 280 | 280 | 303 | 171.0 | 159.0 | 7.5% | 0.0% | good | Keg River Fm |
| 1576 | 1577 | 1 | 280 | 280 | 303 | 171.0 | 159.0 | 7.5% | 0.0% | good | Granite Wash Fm |
| 1577 | 1578 | 1 | 265 | 265 | 288 | 171.0 | 159.0 | 7.5% | 0.0% | good | Granite Wash Fm |
| 1578 | 1579 | 1 | 265 | 265 | 288 | 171.0 | 159.0 | 7.5% | 0.0% | good | Granite Wash Fm |

**SD of all corrected CMAX Az data: 34**
**SD of Population 1 corrected CMAX Az data: 27**
**SD of Population 2 corrected CMAX Az data: 0**

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name: **COLIN ET AL KIDNEY 10-19-91-4**
UWI: 102/10-19-091-04W5/00
Borehole Diameter: 159 mm
Correction to True North: 0 (log corrected to true north)
Comments: Possibly other areas of breakout but caliper curves masked by pad resistivity traces in places
Comments: Well name on log header is DORSET ET AL KIDNEY 10-19-91-4

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1152 | 1153 | 1 | 290 | 290 | 290 | 225 | 220 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1153 | 1154 | 1 | 288 | 288 | 288 | 235 | 225 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1154 | 1155 | 1 | 286 | 286 | 286 | 250 | 230 | 8.70% | 44.65% | fair | Prairie Evaporite Fm |
| 1155 | 1156 | 1 | 284 | 284 | 284 | 240 | 225 | 6.67% | 41.51% | fair | Prairie Evaporite Fm |
| 1156 | 1157 | 1 | 282 | 282 | 282 | 230 | 220 | 4.55% | 38.36% | fair | Prairie Evaporite Fm |
| 1157 | 1158 | 1 | 280 | 280 | 280 | 225 | 200 | 12.50% | 25.79% | fair | Prairie Evaporite Fm |
| 1198 | 1199 | 1 | 195 | 105 | 105 | 175 | 180 | 2.86% | 10.06% | fair | Prairie Evaporite Fm |
| 1199 | 1200 | 1 | 195 | 105 | 105 | 175 | 185 | 5.71% | 10.06% | fair | Prairie Evaporite Fm |
| 1200 | 1201 | 1 | 195 | 105 | 105 | 175 | 195 | 11.43% | 10.06% | fair | Prairie Evaporite Fm |
| 1201 | 1202 | 1 | 195 | 105 | 105 | 180 | 195 | 8.33% | 13.21% | fair | Prairie Evaporite Fm |
| 1202 | 1203 | 1 | 195 | 105 | 105 | 185 | 200 | 8.11% | 16.35% | fair | Prairie Evaporite Fm |
| 1203 | 1204 | 1 | 200 | 110 | 110 | 190 | 200 | 5.26% | 19.50% | fair | Prairie Evaporite Fm |
| 1204 | 1205 | 1 | 200 | 110 | 110 | 185 | 200 | 8.11% | 16.35% | fair | Prairie Evaporite Fm |
| 1205 | 1206 | 1 | 200 | 110 | 110 | 175 | 195 | 11.43% | 10.06% | fair | Prairie Evaporite Fm |
| 1206 | 1207 | 1 | 200 | 110 | 110 | 175 | 195 | 11.43% | 10.06% | fair | Prairie Evaporite Fm |
| 1207 | 1208 | 1 | 200 | 110 | 110 | 180 | 195 | 8.33% | 13.21% | fair | Prairie Evaporite Fm |
| 1208 | 1209 | 1 | 200 | 110 | 110 | 175 | 195 | 11.43% | 10.06% | fair | Prairie Evaporite Fm |
| 1209 | 1210 | 1 | 205 | 115 | 115 | 180 | 195 | 8.33% | 13.21% | fair | Prairie Evaporite Fm |
| 1210 | 1211 | 1 | 205 | 115 | 115 | 180 | 195 | 8.33% | 13.21% | fair | Prairie Evaporite Fm |
| 1211 | 1212 | 1 | 210 | 120 | 120 | 175 | 190 | 8.57% | 10.06% | fair | Prairie Evaporite Fm |
| 1212 | 1213 | 1 | 210 | 120 | 120 | 175 | 190 | 8.57% | 10.06% | fair | Prairie Evaporite Fm |
| 1213 | 1214 | 1 | 210 | 120 | 120 | 180 | 190 | 5.56% | 13.21% | fair | Prairie Evaporite Fm |
| 1214 | 1215 | 1 | 210 | 120 | 120 | 180 | 190 | 5.56% | 13.21% | fair | Prairie Evaporite Fm |
| 1215 | 1216 | 1 | 210 | 120 | 120 | 165 | 180 | 9.09% | 3.77% | fair | Prairie Evaporite Fm |
| 1216 | 1217 | 1 | 210 | 120 | 120 | 160 | 175 | 9.38% | 0.63% | fair | Prairie Evaporite Fm |

**SD of Population 1 corrected CMAX Az data: 13**

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

Well Name: **NCE ENER SENEX 14-9-92-4**
UWI: 100/14-09-092-04W5/0
Borehole Diameter: 200 mm
Correction to True North: 25.08 (corrected 18.2 deg E on log)
Comments: Oil-based mud used, hole near gauge and breakout difficult to identify

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1203 | 1204 | 1 | 200 | 110 | 135 | 200 | 205 | 2.50% | 25.79% | fair | Prairie Evaporite Fm |
| 1204 | 1205 | 1 | 195 | 105 | 130 | 200 | 205 | 2.50% | 25.79% | fair | Prairie Evaporite Fm |
| 1205 | 1206 | 1 | 190 | 100 | 125 | 200 | 210 | 5.00% | 25.79% | fair | Prairie Evaporite Fm |
| 1206 | 1207 | 1 | 190 | 100 | 125 | 200 | 205 | 2.50% | 25.79% | fair | Prairie Evaporite Fm |
| 1232 | 1233 | 1 | 355 | 265 | 290 | 200 | 210 | 5.00% | 25.79% | fair | Prairie Evaporite Fm |
| 1233 | 1234 | 1 | 355 | 265 | 290 | 200 | 210 | 5.00% | 25.79% | fair | Prairie Evaporite Fm |
| 1234 | 1235 | 1 | 345 | 255 | 280 | 200 | 210 | 5.00% | 25.79% | fair | Prairie Evaporite Fm |

**SD of Population 1 corrected CMAX Az data: 25**

Well Name: **UNOCAL KIDNEY 10-32-90-4**
UWI: 00/10-32-090-04W5/0
Borehole Diameter: 158.9 mm
Correction to True North: 23.6
Comments: only one section of breakout at the top of the logged interval

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1138 | 1139 | 1 | 5 | 95 | 119 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1139 | 1140 | 1 | 10 | 100 | 124 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1140 | 1141 | 1 | 15 | 105 | 129 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1141 | 1142 | 1 | 20 | 110 | 134 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1142 | 1143 | 1 | 25 | 115 | 139 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1143 | 1144 | 1 | 30 | 120 | 144 | 170 | 175 | 2.94% | 6.92% | fair | BH LK Grp |
| 1144 | 1145 | 1 | 30 | 120 | 144 | 167 | 172 | 2.99% | 5.03% | fair | BH LK Grp |
| 1145 | 1146 | 1 | 30 | 120 | 144 | 165 | 170 | 3.03% | 3.77% | fair | Slave Point Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1146 | 1147 | 1 | 30 | 120 | 144 | 159 | 164 | 3.14% | 0.00% | fair | Slave Point Fm |

**SD of Population 1 corrected CMAX Az data: 18**

Well Name: **UNOCAL KIDNEY 9-5-91-4**
UWI: 00/09-05-091-04W5/0
Borehole Diameter: 158.9 mm Correction to True North: 23.5

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1016 | 1017 | 1 | 125 | 125 | 149 | 190 | 180 | 5.56% | 13.21% | poor | BH LK Grp |
| 1017 | 1018 | 1 | 125 | 125 | 149 | 200 | 180 | 11.11% | 13.21% | poor | BH LK Grp |
| 1018 | 1019 | 1 | 130 | 130 | 154 | 200 | 180 | 11.11% | 13.21% | poor | BH LK Grp |
| 1019 | 1020 | 1 | 130 | 130 | 154 | 200 | 180 | 11.11% | 13.21% | poor | BH LK Grp |
| 1020 | 1021 | 1 | 130 | 130 | 154 | 200 | 180 | 11.11% | 13.21% | poor | BH LK Grp |
| 1021 | 1022 | 1 | 125 | 125 | 149 | 200 | 180 | 11.11% | 13.21% | poor | BH LK Grp |
| 1022 | 1023 | 1 | 125 | 125 | 149 | 195 | 180 | 8.33% | 13.21% | poor | BH LK Grp |
| 1023 | 1024 | 1 | 120 | 120 | 144 | 190 | 180 | 5.56% | 13.21% | poor | BH LK Grp |
| 1024 | 1025 | 1 | 110 | 110 | 134 | 195 | 180 | 8.33% | 13.21% | poor | BH LK Grp |
| 1025 | 1026 | 1 | 105 | 105 | 129 | 200 | 185 | 8.11% | 16.35% | poor | BH LK Grp |
| 1026 | 1027 | 1 | 100 | 100 | 124 | 205 | 190 | 7.89% | 19.50% | poor | BH LK Grp |
| 1027 | 1028 | 1 | 95 | 95 | 119 | 205 | 185 | 10.81% | 16.35% | poor | BH LK Grp |
| 1028 | 1029 | 1 | 90 | 90 | 114 | 190 | 175 | 8.57% | 10.06% | poor | BH LK Grp |
| 1134 | 1135 | 1 | 260 | 260 | 284 | 175 | 162 | 8.02% | 1.89% | good | Watt Mountain Fm |
| 1135 | 1136 | 1 | 250 | 250 | 274 | 185 | 162 | 14.20% | 1.89% | good | Watt Mountain Fm |
| 1136 | 1137 | 1 | 230 | 230 | 254 | 190 | 162 | 17.28% | 1.89% | good | Watt Mountain Fm |
| 1137 | 1138 | 1 | 230 | 230 | 254 | 195 | 165 | 18.18% | 3.77% | good | Watt Mountain Fm |
| 1138 | 1139 | 1 | 230 | 230 | 254 | 190 | 165 | 15.15% | 3.77% | good | Watt Mountain Fm |
| 1139 | 1140 | 1 | 230 | 230 | 254 | 185 | 165 | 12.12% | 3.77% | good | Watt Mountain Fm |
| 1140 | 1141 | 1 | 230 | 230 | 254 | 180 | 162 | 11.11% | 1.89% | good | Prairie Evaporite Fm |
| 1264 | 1265 | 1 | 285 | 285 | 309 | 175 | 170 | 2.94% | 6.92% | fair | Prairie Evaporite Fm |
| 1265 | 1266 | 1 | 290 | 290 | 314 | 175 | 170 | 2.94% | 6.92% | fair | Prairie Evaporite Fm |
| 1288 | 1289 | 1 | 285 | 285 | 309 | 175 | 159 | 10.06% | 0.00% | fair | Prairie Evaporite Fm |
| 1289 | 1290 | 1 | 290 | 290 | 314 | 172 | 159 | 8.18% | 0.00% | fair | Prairie Evaporite Fm |
| 1290 | 1291 | 1 | 290 | 290 | 314 | 175 | 163 | 7.36% | 2.52% | fair | Prairie Evaporite Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1291 | 1292 | 1 | 285 | 285 | 309 | 172 | 159 | 8.18% | 0.00% | fair | Prairie Evaporite Fm |
| 1292 | 1293 | 1 | 290 | 290 | 314 | 172 | 159 | 8.18% | 0.00% | fair | Prairie Evaporite Fm |
| 1293 | 1294 | 1 | 290 | 290 | 314 | 175 | 163 | 7.36% | 2.52% | fair | Prairie Evaporite Fm |
| 1294 | 1295 | 1 | 290 | 290 | 314 | 175 | 163 | 7.36% | 2.52% | fair | Prairie Evaporite Fm |

**SD of all corrected CMAX Az data: 53**
**SD of Population 1 corrected CMAX Az data: 30**
**SD of Population 2 corrected CMAX Az data: 0**

Well Name: **MURPHY TROUT 9-3-89-3**
UWI: 00/09-03-089-03W5/0
Borehole Diameter: 200 mm
Correction to True North: 0 (log corrected 23 degrees to true north)
Comments: Breakout between 1403 and 1414 m KB seen in both the main and repeat passes

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1291 | 1292 | 1 | 100 | 100 | 100 | 250 | 225 | 11.11% | 41.51% | fair | Prairie Evaporite Fm |
| 1298 | 1299 | 1 | 105 | 105 | 105 | 265 | 250 | 6.00% | 57.23% | fair | Prairie Evaporite Fm |
| 1299 | 1300 | 1 | 100 | 100 | 100 | 270 | 250 | 8.00% | 57.23% | fair | Prairie Evaporite Fm |
| 1403 | 1404 | 1 | 205 | 115 | 115 | 200 | 205 | 2.50% | 25.79% | fair | Prairie Evaporite Fm |
| 1404 | 1405 | 1 | 205 | 115 | 115 | 210 | 225 | 7.14% | 32.08% | good | Prairie Evaporite Fm |
| 1405 | 1406 | 1 | 205 | 115 | 115 | 225 | 230 | 2.22% | 41.51% | good | Prairie Evaporite Fm |
| 1406 | 1407 | 1 | 215 | 125 | 125 | 220 | 235 | 6.82% | 38.36% | good | Prairie Evaporite Fm |
| 1407 | 1408 | 1 | 215 | 125 | 125 | 220 | 240 | 9.09% | 38.36% | good | Prairie Evaporite Fm |
| 1408 | 1409 | 1 | 210 | 120 | 120 | 220 | 240 | 9.09% | 38.36% | good | Prairie Evaporite Fm |
| 1409 | 1410 | 1 | 210 | 120 | 120 | 220 | 240 | 9.09% | 38.36% | good | Prairie Evaporite Fm |
| 1410 | 1411 | 1 | 205 | 115 | 115 | 220 | 235 | 6.82% | 38.36% | good | Prairie Evaporite Fm |
| 1411 | 1412 | 1 | 205 | 115 | 115 | 220 | 230 | 4.55% | 38.36% | good | Prairie Evaporite Fm |
| 1412 | 1413 | 1 | 200 | 110 | 110 | 210 | 220 | 4.76% | 32.08% | good | Prairie Evaporite Fm |
| 1413 | 1414 | 1 | 200 | 110 | 110 | 200 | 210 | 5.00% | 25.79% | good | Prairie Evaporite Fm |

**SD of Population 1 corrected CMAX Az data: 15**

Well Name: **UNOCAL ET AL TROUT 8-10-89-3**
UWI: 00/08-10-089-03W5/0
Borehole Diameter: 159 mm

## Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups

Correction to True North: 0 (log corrected 24 degrees to true north)
Comments: Breakout shows minor population between 1091 and 1100 m KB approx. 90 degrees from the major population

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1091 | 1092 | 1 | 210 | 210 | 210 | 170 | 165 | 3.03% | 3.77% | fair | BH LK Grp |
| 1092 | 1093 | 1 | 215 | 215 | 215 | 180 | 170 | 5.88% | 6.92% | fair | BH LK Grp |
| 1093 | 1094 | 1 | 215 | 215 | 215 | 200 | 180 | 11.11% | 13.21% | fair | BH LK Grp |
| 1094 | 1095 | 1 | 220 | 220 | 220 | 210 | 175 | 20.00% | 10.06% | fair | BH LK Grp |
| 1095 | 1096 | 1 | 230 | 230 | 230 | 210 | 175 | 20.00% | 10.06% | fair | BH LK Grp |
| 1096 | 1097 | 1 | 235 | 235 | 235 | 200 | 165 | 21.21% | 3.77% | fair | BH LK Grp |
| 1097 | 1098 | 1 | 240 | 240 | 240 | 190 | 165 | 15.15% | 3.77% | fair | BH LK Grp |
| 1098 | 1099 | 1 | 245 | 245 | 245 | 185 | 160 | 15.63% | 0.63% | fair | BH LK Grp |
| 1099 | 1100 | 1 | 250 | 250 | 250 | 170 | 160 | 6.25% | 0.63% | fair | BH LK Grp |
| 1107 | 1108 | 1 | 230 | 140 | 140 | 170 | 175 | 2.94% | 6.92% | poor | BH LK Grp |
| 1108 | 1109 | 1 | 225 | 135 | 135 | 170 | 185 | 8.82% | 6.92% | fair | BH LK Grp |
| 1109 | 1110 | 1 | 225 | 135 | 135 | 170 | 190 | 11.76% | 6.92% | fair | BH LK Grp |
| 1110 | 1111 | 1 | 220 | 130 | 130 | 170 | 205 | 20.59% | 6.92% | fair | BH LK Grp |
| 1111 | 1112 | 1 | 215 | 125 | 125 | 170 | 200 | 17.65% | 6.92% | fair | BH LK Grp |
| 1112 | 1113 | 1 | 215 | 125 | 125 | 170 | 195 | 14.71% | 6.92% | fair | BH LK Grp |
| 1113 | 1114 | 1 | 210 | 120 | 120 | 170 | 190 | 11.76% | 6.92% | fair | BH LK Grp |
| 1114 | 1115 | 1 | 205 | 115 | 115 | 165 | 185 | 12.12% | 3.77% | fair | BH LK Grp |
| 1326 | 1327 | 1 | 135 | 135 | 135 | 285 | 260 | 9.62% | 63.52% | good | Prairie Evaporite Fm |
| 1330 | 1331 | 1 | 130 | 130 | 130 | 290 | 265 | 9.43% | 66.67% | good | Prairie Evaporite Fm |
| 1331 | 1332 | 1 | 130 | 130 | 130 | 295 | 270 | 9.26% | 69.81% | good | Prairie Evaporite Fm |

**SD of all corrected CMAX Az data: 102**
**SD of Population 1 corrected CMAX Az data: 14**
**SD of Population 2 corrected CMAX Az data: 28**

Well Name: **SUNCOR STROME 11-16-44-16**
UWI: 00/11-16-044-16W4/0
Borehole Diameter: 222 mm
Correction to True North: 20.1 degrees
Comments: Breakout shows minor population between 1710 and 1716 m KB approx. 90 degrees from the major population

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1470 | 1471 | 1 | 360 | 270 | 290 | 235 | 238 | 1.28% | 47.80% | poor | BH LK Grp |
| 1471 | 1472 | 1 | 360 | 270 | 290 | 235 | 240 | 2.13% | 47.80% | poor | BH LK Grp |
| 1472 | 1473 | 1 | 355 | 265 | 285 | 235 | 242 | 2.98% | 47.80% | poor | BH LK Grp |
| 1473 | 1474 | 1 | 355 | 265 | 285 | 235 | 245 | 4.26% | 47.80% | poor | BH LK Grp |
| 1474 | 1475 | 1 | 350 | 260 | 280 | 240 | 248 | 3.33% | 50.94% | poor | BH LK Grp |
| 1475 | 1476 | 1 | 350 | 260 | 280 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1476 | 1477 | 1 | 350 | 260 | 280 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1477 | 1478 | 1 | 350 | 260 | 280 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1478 | 1479 | 1 | 350 | 260 | 280 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1479 | 1480 | 1 | 350 | 260 | 280 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1480 | 1481 | 1 | 355 | 265 | 285 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1481 | 1482 | 1 | 355 | 265 | 285 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1482 | 1483 | 1 | 355 | 265 | 285 | 240 | 250 | 4.17% | 50.94% | fair | BH LK Grp |
| 1483 | 1484 | 1 | 355 | 265 | 285 | 235 | 250 | 6.38% | 47.80% | fair | BH LK Grp |
| 1484 | 1485 | 1 | 350 | 260 | 280 | 235 | 250 | 6.38% | 47.80% | fair | BH LK Grp |
| 1485 | 1486 | 1 | 350 | 260 | 280 | 235 | 250 | 6.38% | 47.80% | fair | BH LK Grp |
| 1486 | 1487 | 1 | 350 | 260 | 280 | 235 | 245 | 4.26% | 47.80% | fair | BH LK Grp |
| 1487 | 1488 | 1 | 350 | 260 | 280 | 235 | 245 | 4.26% | 47.80% | fair | BH LK Grp |
| 1488 | 1489 | 1 | 345 | 255 | 275 | 235 | 250 | 6.38% | 47.80% | fair | BH LK Grp |
| 1489 | 1490 | 1 | 345 | 255 | 275 | 235 | 250 | 6.38% | 47.80% | fair | BH LK Grp |
| 1490 | 1491 | 1 | 340 | 250 | 270 | 245 | 250 | 2.04% | 54.09% | poor | BH LK Grp |
| 1710 | 1711 | 1 | 280 | 190 | 210 | 260 | 265 | 1.92% | 63.52% | poor | Prairie Evaporite Fm |
| 1711 | 1712 | 1 | 280 | 190 | 210 | 260 | 275 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |
| 1712 | 1713 | 1 | 280 | 190 | 210 | 260 | 275 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |
| 1713 | 1714 | 1 | 280 | 190 | 210 | 260 | 275 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |
| 1714 | 1715 | 1 | 280 | 190 | 210 | 260 | 275 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |
| 1715 | 1716 | 1 | 280 | 190 | 210 | 260 | 275 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |
| 1731 | 1732 | 1 | 210 | 210 | 230 | 275 | 260 | 5.77% | 63.52% | fair | Prairie Evaporite Fm |
| 1732 | 1733 | 1 | 215 | 215 | 235 | 265 | 255 | 3.92% | 60.38% | poor | Prairie Evaporite Fm |
| 1733 | 1734 | 1 | 215 | 215 | 235 | 265 | 255 | 3.92% | 60.38% | poor | Prairie Evaporite Fm |
| 1734 | 1735 | 1 | 215 | 215 | 235 | 275 | 265 | 3.77% | 66.67% | poor | Prairie Evaporite Fm |
| 1735 | 1736 | 1 | 210 | 210 | 230 | 275 | 265 | 3.77% | 66.67% | poor | Prairie Evaporite Fm |

**SD of all corrected CMAX Az data:** **63**
**SD of Population 1 corrected CMAX Az data:** **9**

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

**SD of Population 2 corrected CMAX Az data:** 23

Well Name: **DORSET ET AL MARTENCK 11-12-80-5**
UWI: 00/11-12-080-05W5/0
Borehole Diameter: 209.55 mm (8.25")
Correction to True North: 20.3 degrees
Comments: Log recorded in feet

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1339 | 1340 | 1 | 80 | 80 | 100 | 350 | 340 | 2.94% | 113.84% | poor | BH LK Grp |
| 1340 | 1341 | 1 | 80 | 80 | 100 | 365 | 340 | 7.35% | 113.84% | poor | BH LK Grp |
| 1341 | 1342 | 1 | 80 | 80 | 100 | 370 | 355 | 4.23% | 123.27% | poor | BH LK Grp |
| 1342 | 1343 | 1 | 80 | 80 | 100 | 375 | 355 | 5.63% | 123.27% | poor | BH LK Grp |
| 1343 | 1344 | 1 | 80 | 80 | 100 | 365 | 355 | 2.82% | 123.27% | poor | BH LK Grp |
| 1344 | 1345 | 1 | 75 | 75 | 95 | 360 | 340 | 5.88% | 113.84% | poor | BH LK Grp |
| 1521 | 1522 | 1 | 5 | 95 | 115 | 270 | 330 | 22.22% | 69.81% | poor | Watt Mountain Fm |
| 1522 | 1523 | 1 | 5 | 95 | 115 | 270 | 405 | 50.00% | 69.81% | poor | Watt Mountain Fm |
| 1523 | 1524 | 1 | 10 | 100 | 120 | 330 | 410 | 24.24% | 107.55% | poor | Watt Mountain Fm |
| 1524 | 1525 | 1 | 10 | 100 | 120 | 270 | 370 | 37.04% | 69.81% | poor | Watt Mountain Fm |
| 1525 | 1526 | 1 | 10 | 100 | 120 | 270 | 350 | 29.63% | 69.81% | poor | Watt Mountain Fm |
| 1526 | 1527 | 1 | 5 | 95 | 115 | 270 | 300 | 11.11% | 69.81% | poor | Watt Mountain Fm |
| 1527 | 1528 | 1 | 5 | 95 | 115 | 270 | 370 | 37.04% | 69.81% | poor | Watt Mountain Fm |

**SD of Population 1 corrected CMAX Az data:** 19

Well Name: **PCI LEIGE 11-8-95-22**
UWI: 00/11-08-095-22W4/0
Borehole Diameter: 222 mm
Correction to True North: 23.4 degrees
Comments: P1AZ was calculated from adding hole azimuth (AZIM) to the relative bearing (RB)

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 919 | 920 | 1 | 310 | 310 | 333 | 230 | 225 | 2.22% | 41.51% | fair | Waterways Fm |
| 920 | 921 | 1 | 310 | 310 | 333 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 921 | 922 | 1 | 310 | 310 | 333 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 922 | 923 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 923 | 924 | 1 | 300 | 300 | 323 | 240 | 230 | 4.35% | 44.65% | good | Waterways Fm |
| 924 | 925 | 1 | 300 | 300 | 323 | 240 | 230 | 4.35% | 44.65% | good | Waterways Fm |
| 925 | 926 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 926 | 927 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 927 | 928 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 928 | 929 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 929 | 930 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 930 | 931 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 931 | 932 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 932 | 933 | 1 | 300 | 300 | 323 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 933 | 934 | 1 | 305 | 305 | 328 | 240 | 225 | 6.67% | 41.51% | good | Waterways Fm |
| 934 | 935 | 1 | 305 | 305 | 328 | 250 | 225 | 11.11% | 41.51% | good | Waterways Fm |
| 935 | 936 | 1 | 310 | 310 | 333 | 250 | 225 | 11.11% | 41.51% | good | Waterways Fm |
| 936 | 937 | 1 | 310 | 310 | 333 | 250 | 230 | 8.70% | 44.65% | good | Waterways Fm |
| 937 | 938 | 1 | 310 | 310 | 333 | 250 | 230 | 8.70% | 44.65% | good | Waterways Fm |
| 938 | 939 | 1 | 300 | 300 | 323 | 250 | 230 | 8.70% | 44.65% | good | Waterways Fm |
| 939 | 940 | 1 | 300 | 300 | 323 | 245 | 235 | 4.26% | 47.80% | good | Waterways Fm |
| 940 | 941 | 1 | 300 | 300 | 323 | 230 | 225 | 2.22% | 41.51% | fair | Waterways Fm |
| 1041 | 1042 | 1 | 5 | 95 | 118 | 225 | 235 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1042 | 1043 | 1 | 5 | 95 | 118 | 225 | 235 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1043 | 1044 | 1 | 5 | 95 | 118 | 225 | 235 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1044 | 1045 | 1 | 0 | 90 | 113 | 260 | 270 | 3.85% | 63.52% | fair | Prairie Evaporite Fm |
| 1045 | 1046 | 1 | 350 | 260 | 283 | 260 | 270 | 3.85% | 63.52% | fair | Prairie Evaporite Fm |
| 1046 | 1047 | 1 | 345 | 255 | 278 | 230 | 240 | 4.35% | 44.65% | fair | Prairie Evaporite Fm |
| 1047 | 1048 | 1 | 340 | 250 | 273 | 225 | 240 | 6.67% | 41.51% | fair | Prairie Evaporite Fm |
| 1048 | 1049 | 1 | 340 | 250 | 273 | 225 | 235 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1049 | 1050 | 1 | 340 | 250 | 273 | 225 | 235 | 4.44% | 41.51% | fair | Prairie Evaporite Fm |
| 1248 | 1249 | 1 | 365 | 275 | 298 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1249 | 1250 | 1 | 365 | 275 | 298 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1250 | 1251 | 1 | 365 | 275 | 298 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1251 | 1252 | 1 | 360 | 270 | 293 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1255 | 1256 | 1 | 360 | 270 | 293 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1256 | 1257 | 1 | 355 | 265 | 288 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |

**Table E.2: Detailed summary of breakout data in the Saskatchewan, Beaverhill Lake, and Elk Point Groups**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1257 | 1258 | 1 | 355 | 265 | 288 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1258 | 1259 | 1 | 355 | 265 | 288 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |
| 1259 | 1260 | 1 | 360 | 270 | 293 | 220 | 225 | 2.27% | 38.36% | fair | Prairie Evaporite Fm |

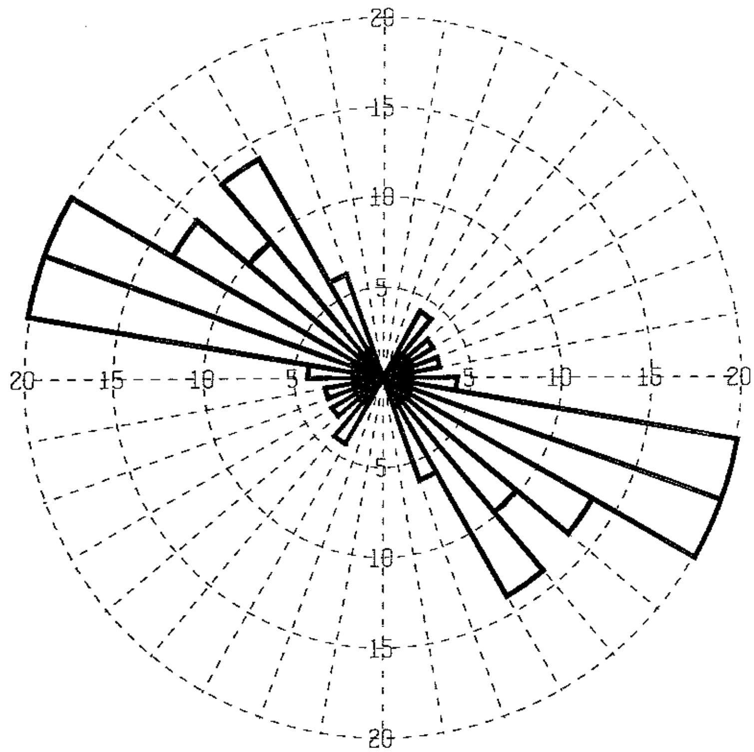
**SD of Population 1 corrected CMAX Az data: 40**

Well Name: **SCEPTRE MURPHY T'FLAGS A1-26-52-25**
UWI: 11/01-26-052-25W3/2
Borehole Diameter: 251 mm
Correction to True North: 0 (log corrected using magnetic declination of 21 degrees)
Comments: Breakout occurs at bottom of hole and, therefore, may be influenced by drilling effects. Breakout does occur in both the main and repeat pass.

| Top (m KB) | Bottom (m KB) | Thickness (m) | P1AZ (degrees) | CMAX Az (degrees) | CMAX Az wrt true N (degrees) | C1 (mm) | C2 (mm) | % Enlarge | % Gauge | Quality | Formation or Group |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 578 | 579 | 1 | 335 | 335 | 335 | 270 | 265 | 1.89% | 66.67% | poor | Duperow Fm |
| 579 | 580 | 1 | 335 | 335 | 335 | 270 | 265 | 1.89% | 66.67% | poor | Duperow Fm |
| 580 | 581 | 1 | 335 | 335 | 335 | 270 | 265 | 1.89% | 66.67% | poor | Duperow Fm |
| 581 | 582 | 1 | 330 | 330 | 330 | 270 | 265 | 1.89% | 66.67% | poor | Duperow Fm |
| 582 | 583 | 1 | 325 | 325 | 325 | 270 | 265 | 1.89% | 66.67% | poor | Duperow Fm |

**SD of Population 1 corrected CMAX Az data: 8**

**ALL WELLS IN ANALYZED IN THE EXPANDED AREA**

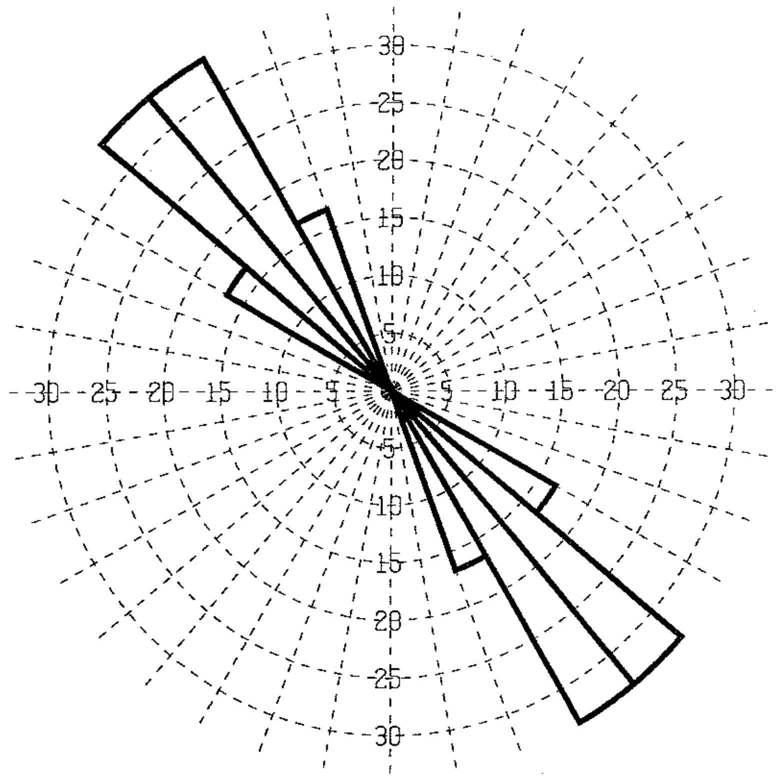



**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Activated
Minimum Azimuth ... 80 Degrees
Maximum Azimuth ... 180 Degrees
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 188
Maximum Percentage ... 22.9 Percent
Mean Percentage ...... 14.3 Percent
Standard Deviation ... 6.86 Percent
Vector Mean .......... 301.39 Degrees
Confidence Interval .. 5.09 Degrees
R-mag ................ 0.82

**Population 2**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Activated
Minimum Azimuth ... 0 Degrees
Maximum Azimuth ... 80 Degrees
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 26
Maximum Percentage ... 34.6 Percent
Mean Percentage ...... 20 Percent
Standard Deviation ... 12.67 Percent
Vector Mean .......... 51.03 Degrees
Confidence Interval .. 13.3 Degrees
R-mag ................ 0.83

**Figure E.2.1: Roseplot of borehole breakout data in the Beaverhill Lake Group and Elk Point Group for all wells analyzed in the expanded area. A small 5 m breakout zone from the Saskatchewan Group from Sceptre Murphy T'Flags A1-26-52-25W3 is also included in the data set.**

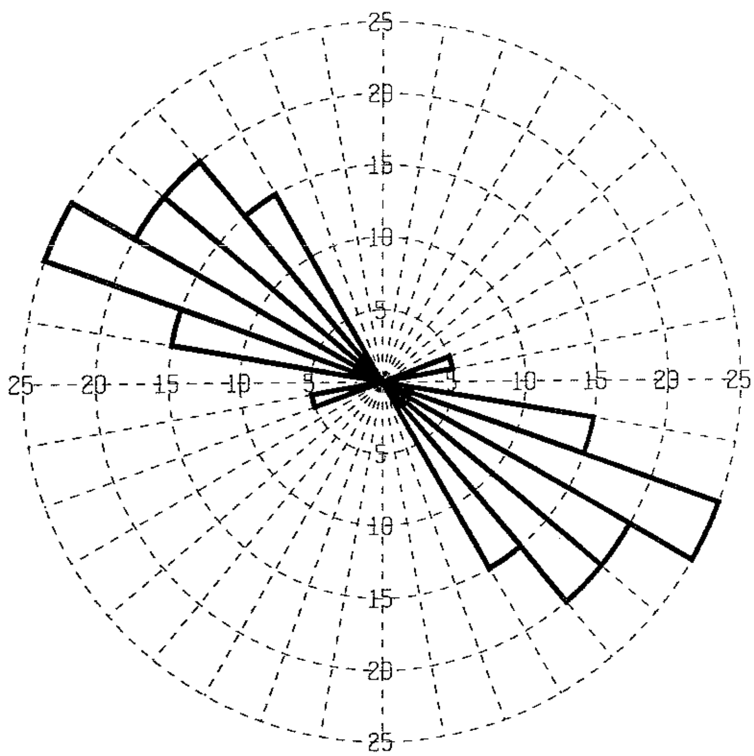
## ALL WELLS FROM ATLAS IN EXPANDED AREA




**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 6
Maximum Percentage ... 33.3 Percent
Mean Percentage ...... 25 Percent
Standard Deviation ... 8.91 Percent
Vector Mean .......... 319.09 Degrees
Confidence Interval .. 17.46 Degrees
R-mag ................ 0.93

**Figure E.2.2: Roseplot of borehole breakout data for all wells given in the Geolgical Atlas of the Western Canadian Sedimentary Basin (Bell et al., 1994) in the expanded area. Note that only average values for each of the 6 wells are presented and data are not presented on a per metre basis as in other roseplots. It should be also noted that the recorded breakout in these wells, although from Paleozoic-age rocks, are determined from above the Beaverhill Lake Group and Elk Point Group.**

## MURPHY ET AL GRAHAM 12-18-87-3W5

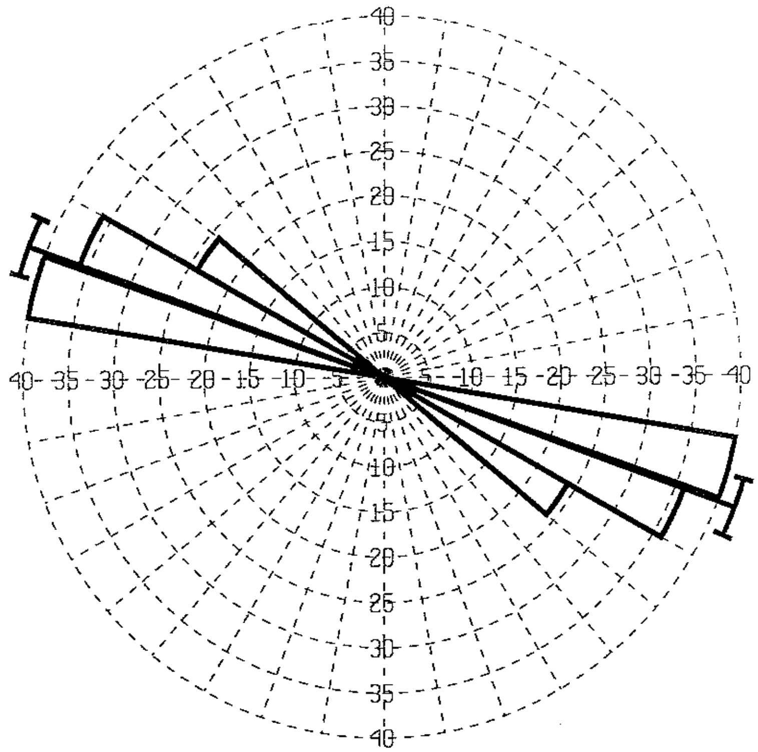



**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Activated
Minimum Azimuth ... 80 Degrees
Maximum Azimuth ... 180 Degrees
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 19
Maximum Percentage ... 26.3 Percent
Mean Percentage ...... 20 Percent
Standard Deviation ... 4.15 Percent
Vector Mean .......... 304.23 Degrees
Confidence Interval .. 12.37 Degrees
R-mag ................ 0.89

**Population 2**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Activated
Minimum Azimuth ... 0 Degrees
Maximum Azimuth ... 80 Degrees
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 1
Maximum Percentage ... 100 Percent
Mean Percentage ...... 100 Percent
Standard Deviation ... 0 Percent
Vector Mean .......... 73 Degrees
Confidence Interval .. 15.84 Degrees
R-mag ................ 1

**Figure E.2.3: Roseplot of borehole breakout data in the Beaverhill Lake Group and Elk Point Group for Murphy et al Graham 12-18-87-3W5.**

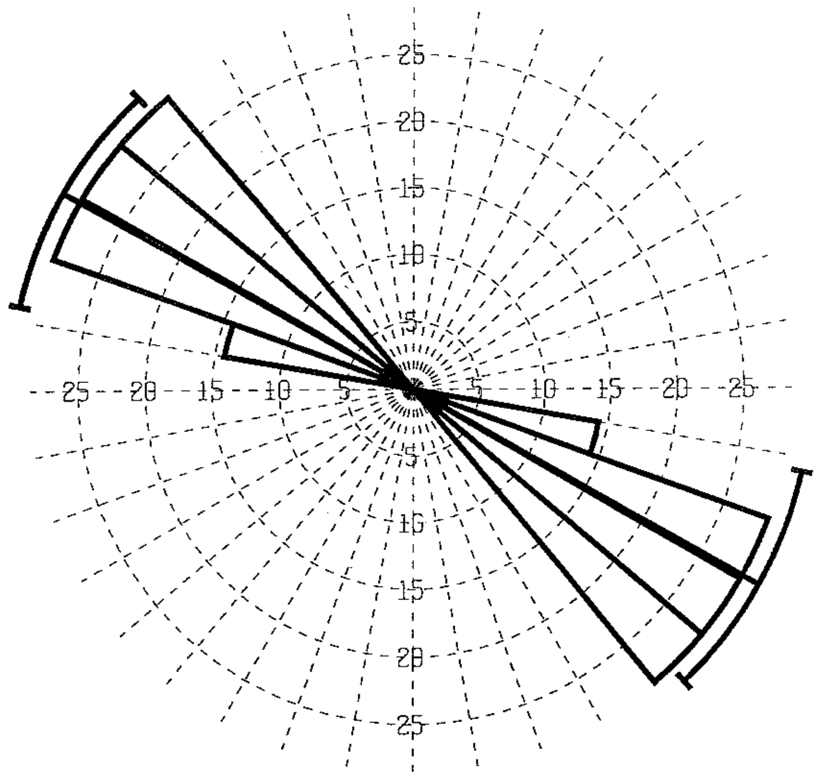
## COLIN ET AL KIDNEY 10-19-91-4W4




**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 25
Maximum Percentage ... 40 Percent
Mean Percentage ...... 33.3 Percent
Standard Deviation ... 7.45 Percent
Vector Mean .......... 290.58 Degrees
Confidence Interval .. 4.52 Degrees
R-mag ................ 0.98.

**Figure E.2.4: Roseplot of borehole breakout data in the Elk Point Group for COLIN ET AL KIDNEY 10-19-91-4W4.**

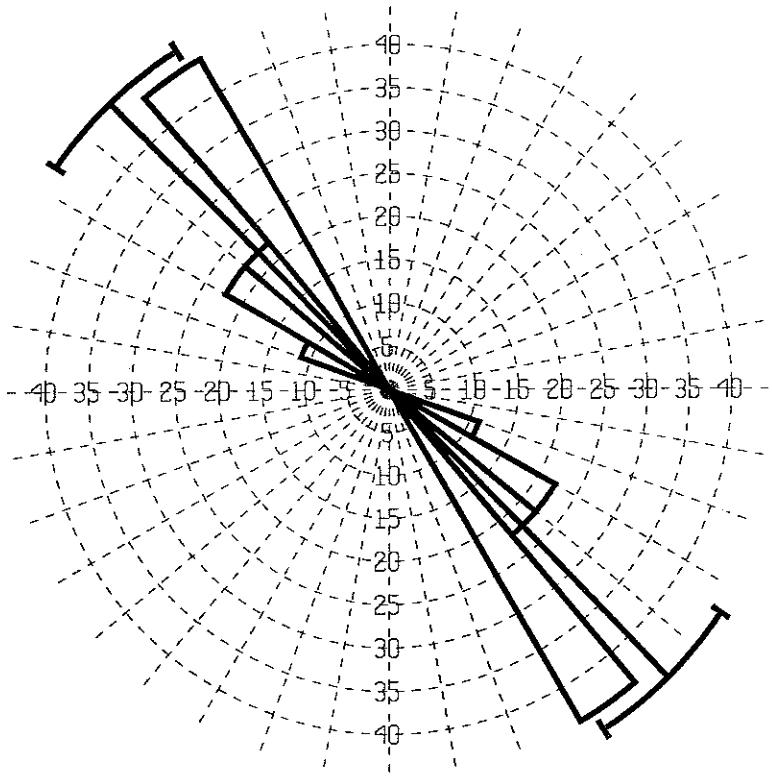
## NCE ENER SENEX 14-9-92-4W5




**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 7
Maximum Percentage ... 28.6 Percent
Mean Percentage ...... 25 Percent
Standard Deviation ... 6.61 Percent
Vector Mean .......... 299.39 Degrees
Confidence Interval .. 17.33 Degrees
R-mag ................ 0.92

**Figure E.2.5: Roseplot of borehole breakout data in the Elk Point Group for NCE ENER SENEX 14-9-92-4W5.**

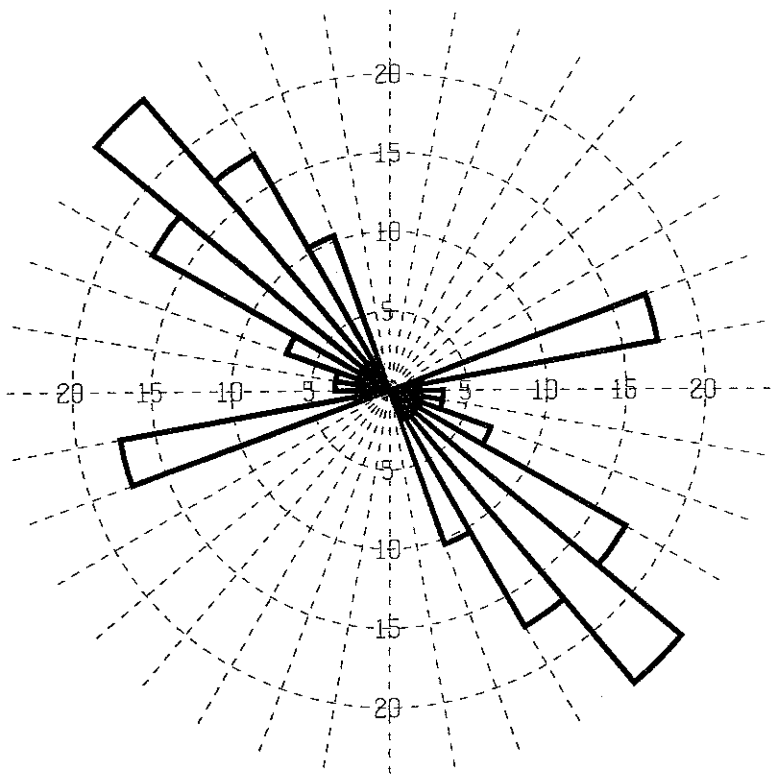
## UNOCAL KIDNEY 10-32-90-4W5




**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 9
Maximum Percentage ... 44.4 Percent
Mean Percentage ...... 25 Percent
Standard Deviation ... 12.94 Percent
Vector Mean .......... 315.76 Degrees
Confidence Interval .. 11.98 Degrees
R-mag ................ 0.95.

**Figure E.2.6: Roseplot of borehole breakout data in the Beaverhill Lake Group for UNOCAL KIDNEY 10-32-90-4W5.**

## UNOCAL KIDNEY 9-5-91-4W5

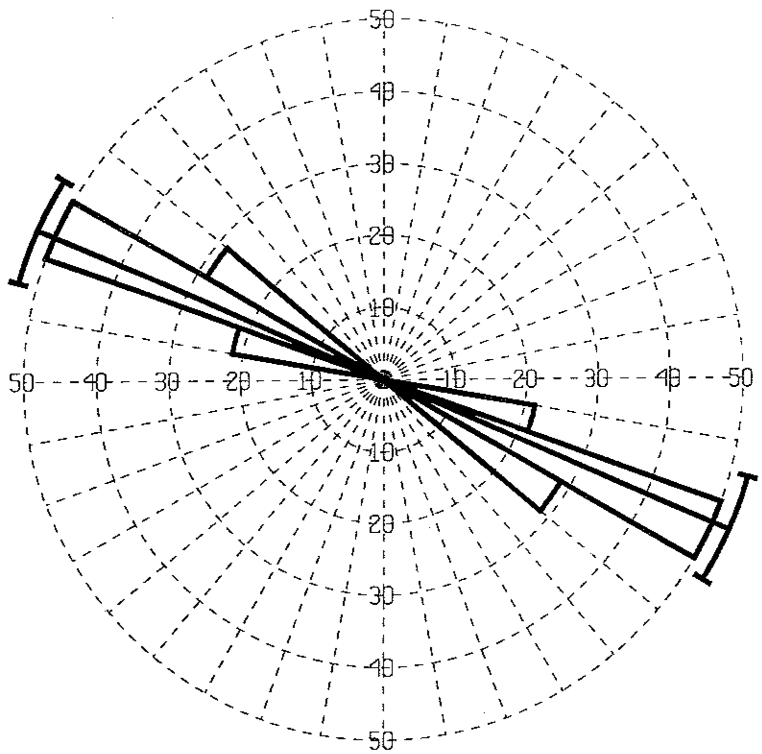



**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Activated
Minimum Azimuth ... 80 Degrees
Maximum Azimuth ... 180 Degrees
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 24
Maximum Percentage ... 29.2 Percent
Mean Percentage ...... 14.3 Percent
Standard Deviation ... 9.2 Percent
Vector Mean .......... 314.33 Degrees
Confidence Interval .. 12.02 Degrees
R-mag ................ 0.87

**Population 2**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Activated
Minimum Azimuth ... 0 Degrees
Maximum Azimuth ... 80 Degrees
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 5
Maximum Percentage ... 100 Percent
Mean Percentage ...... 100 Percent
Standard Deviation ... 0 Percent
Vector Mean .......... 74 Degrees
Confidence Interval .. 7.09 Degrees
R-mag ................ 1

**Figure E.2.7: Roseplot of borehole breakout data in the Beaverhill Lake Group and Elk Point Group for UNOCAL KIDNEY 9-5-91-4W5.**

## MURPHY TROUT 9-3-89-3W5

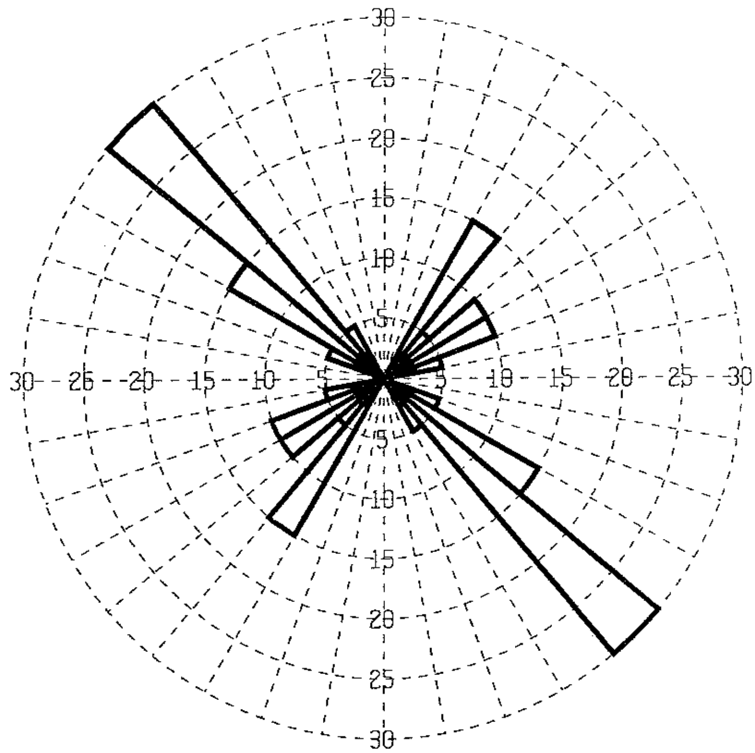



**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 14
Maximum Percentage ... 50 Percent
Mean Percentage ...... 33.3 Percent
Standard Deviation ... 13.3 Percent
Vector Mean .......... 293.6 Degrees
Confidence Interval .. 8.55 Degrees
R-mag ................ 0.96.

**Figure E.2.8: Roseplot of borehole breakout data in the Elk Point Group for MURPHY TROUT 9-3-89-3W5.**

ADVANCED GEOTECHNOLOGY

**UNOCAL ET AL TROUT 8-10-89-3W5**

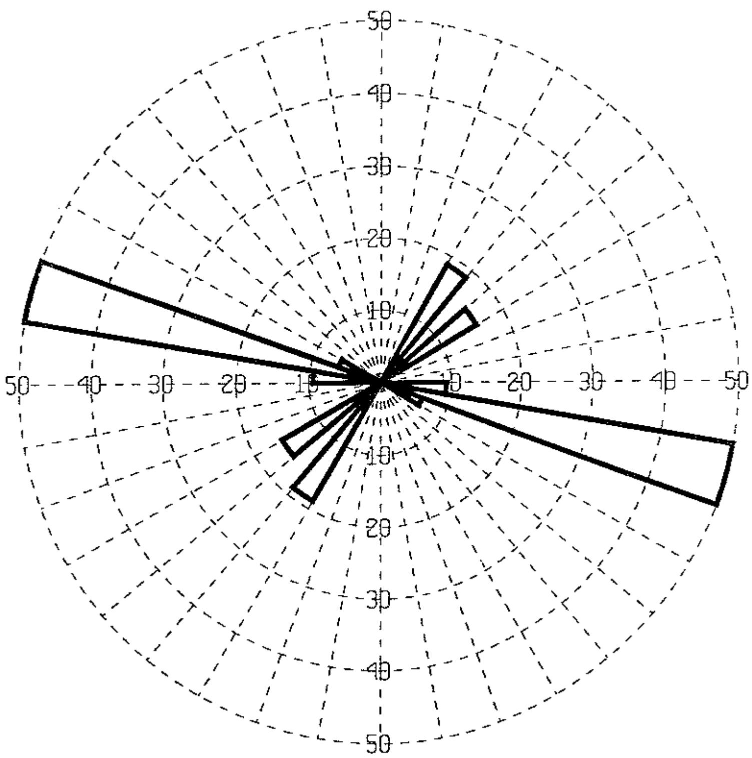



**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Activated
Minimum Azimuth ... 80 Degrees
Maximum Azimuth ... 180 Degrees
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 11
Maximum Percentage ... 54.5 Percent
Mean Percentage ...... 25 Percent
Standard Deviation ... 19.89 Percent
Vector Mean .......... 309.12 Degrees
Confidence Interval .. 8.36 Degrees
R-mag ................ 0.97

**Population 2**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Activated
Minimum Azimuth ... 0 Degrees
Maximum Azimuth ... 80 Degrees
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 9
Maximum Percentage ... 33.3 Percent
Mean Percentage ...... 20 Percent
Standard Deviation ... 8.76 Percent
Vector Mean .......... 48.83 Degrees
Confidence Interval .. 18.01 Degrees
R-mag ................ 0.89

**Figure E.2.9: Roseplot of borehole breakout data in the Beaverhill Lake Group and Elk Point Group for UNOCAL ET AL TROUT 8-10-89-3W5.**

## SUNCOR STROME 11-16-44-16W4




**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Activated
Minimum Azimuth ... 80 Degrees
Maximum Azimuth ... 180 Degrees
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 21
Maximum Percentage ... 76.2 Percent
Mean Percentage ...... 33.3 Percent
Standard Deviation ... 33.27 Percent
Vector Mean .......... 281.43 Degrees
Confidence Interval .. 3.48 Degrees
R-mag ................ 0.99

**Population 2**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ........... Activated
Minimum Azimuth ... 0 Degrees
Maximum Azimuth ... 80 Degrees
Data Type ........... Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 11
Maximum Percentage ... 54.5 Percent
Mean Percentage ...... 50 Percent
Standard Deviation ... 5.25 Percent
Vector Mean .......... 40.37 Degrees
Confidence Interval .. 13.81 Degrees
R-mag ................ 0.92

**Figure E.2.10: Roseplot of borehole breakout data in the Beaverhill Lake Group and Elk Point Group for SUNCOR STROME 11-16-44-16W4.**

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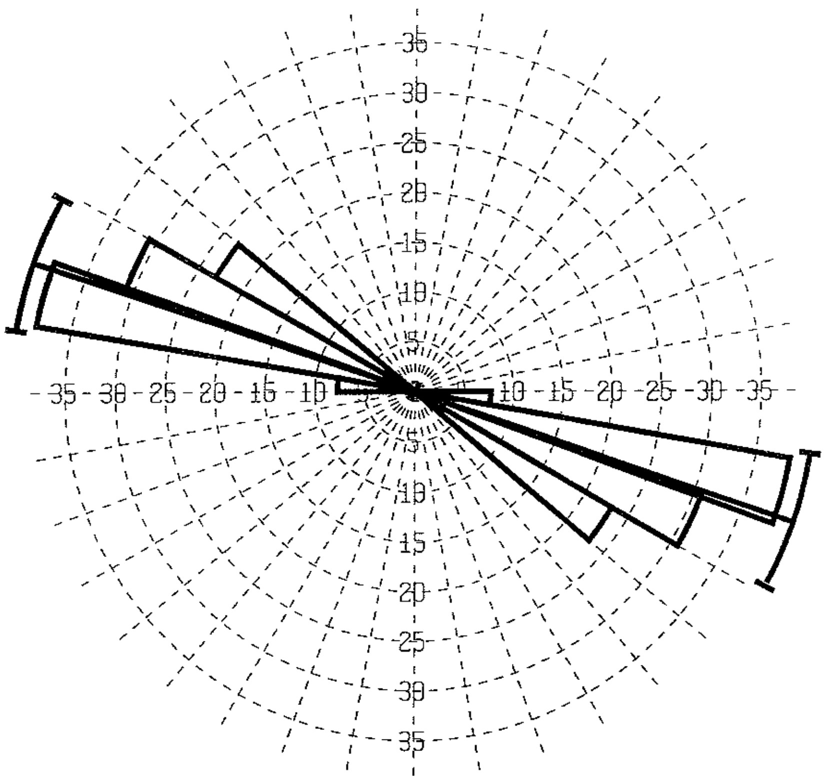
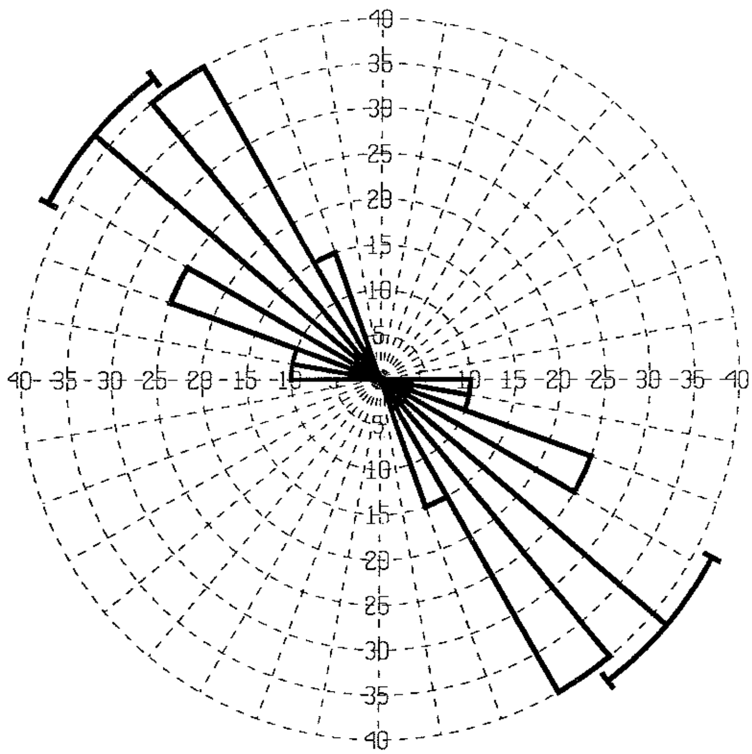
**DORSET ET AL MARTENCK 11-12-80-5W5**




**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 13
Maximum Percentage ... 38.5 Percent
Mean Percentage ...... 25 Percent
Standard Deviation ... 12.16 Percent
Vector Mean .......... 288.86 Degrees
Confidence Interval .. 9.98 Degrees
R-mag ................ 0.95

**Figure E.2.11: Roseplot of borehole breakout data in the Beaverhill Lake Group and Elk Point Group for DORSET ET AL MARTENCK 11-12-80-5W5.**

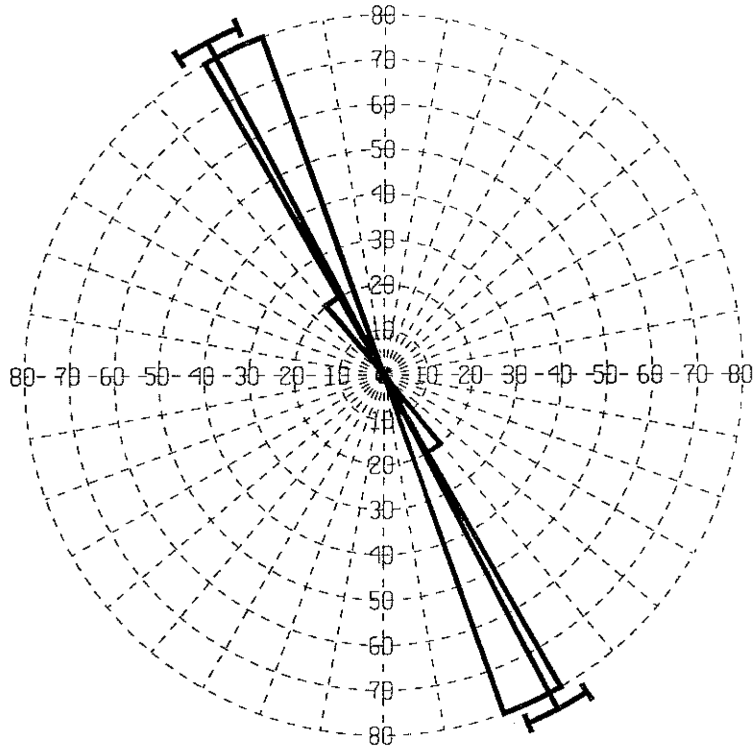
**PCI LEIGE 11-8-95-22W4**



**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 40
Maximum Percentage ... 40 Percent
Mean Percentage ...... 20 Percent
Standard Deviation ... 12.02 Percent
Vector Mean .......... 310.25 Degrees
Confidence Interval .. 12.36 Degrees
R-mag ................ 0.78

**Figure E.2.12: Roseplot of borehole breakout data in the Beaverhill Lake Group and Elk Point Group for PCI LEIGE 11-8-95-22W4.**

## SCEPTRE MURPHY T'FLAGS A1-26-52-25W3




**Population 1**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Deactivated
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 5
Maximum Percentage ... 80 Percent
Mean Percentage ...... 50 Percent
Standard Deviation ... 34.64 Percent
Vector Mean .......... 332.01 Degrees
Confidence Interval .. 5.03 Degrees
R-mag ................ 0.99

**Figure E.2.13: Roseplot of borehole breakout data in the Saskatchewan Group (Duperow Formation) for SCEPTRE MURPHY T'FLAGS A1-26-52-25W3.**

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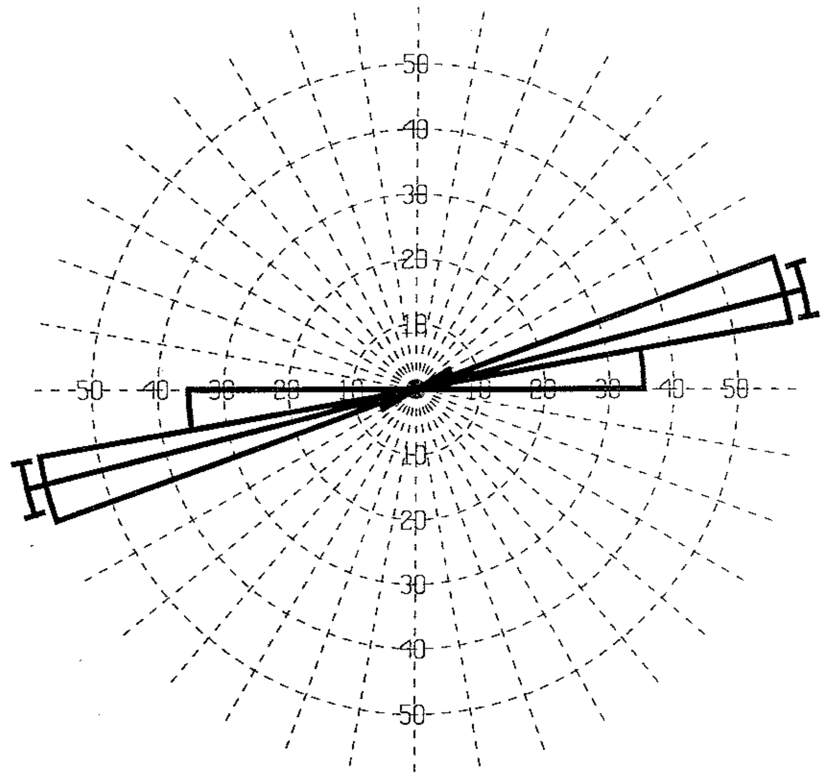
## VOYAGER ET AL BRUCE 6-14-48-14W4




**Population 1**
No breakouts observed.

**Population 2**
Calculation Method ... Frequency
Class Interval ....... 10 Degrees
Filtering ............ Activated
Minimum Azimuth ... 0 Degrees
Maximum Azimuth ... 80 Degrees
Data Type ............ Bidirectional
Rotation Amount ...... 0 Degrees
Population ........... 17
Maximum Percentage ... 58.8 Percent
Mean Percentage ...... 33.3 Percent
Standard Deviation ... 23.72 Percent
Vector Mean .......... 75.78 Degrees
Confidence Interval .. 3.87 Degrees
R-mag ................ 0.99

**Figure E.2.14: Roseplot of borehole breakout data in the Elk Point Group for VOYAGER ET AL BRUCE 6-14-48-14W4. The breakout for this well has been re-classified as population 2 from the original work.**

ADVANCED GEOTECHNOLOGY

**APPENDIX F**

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