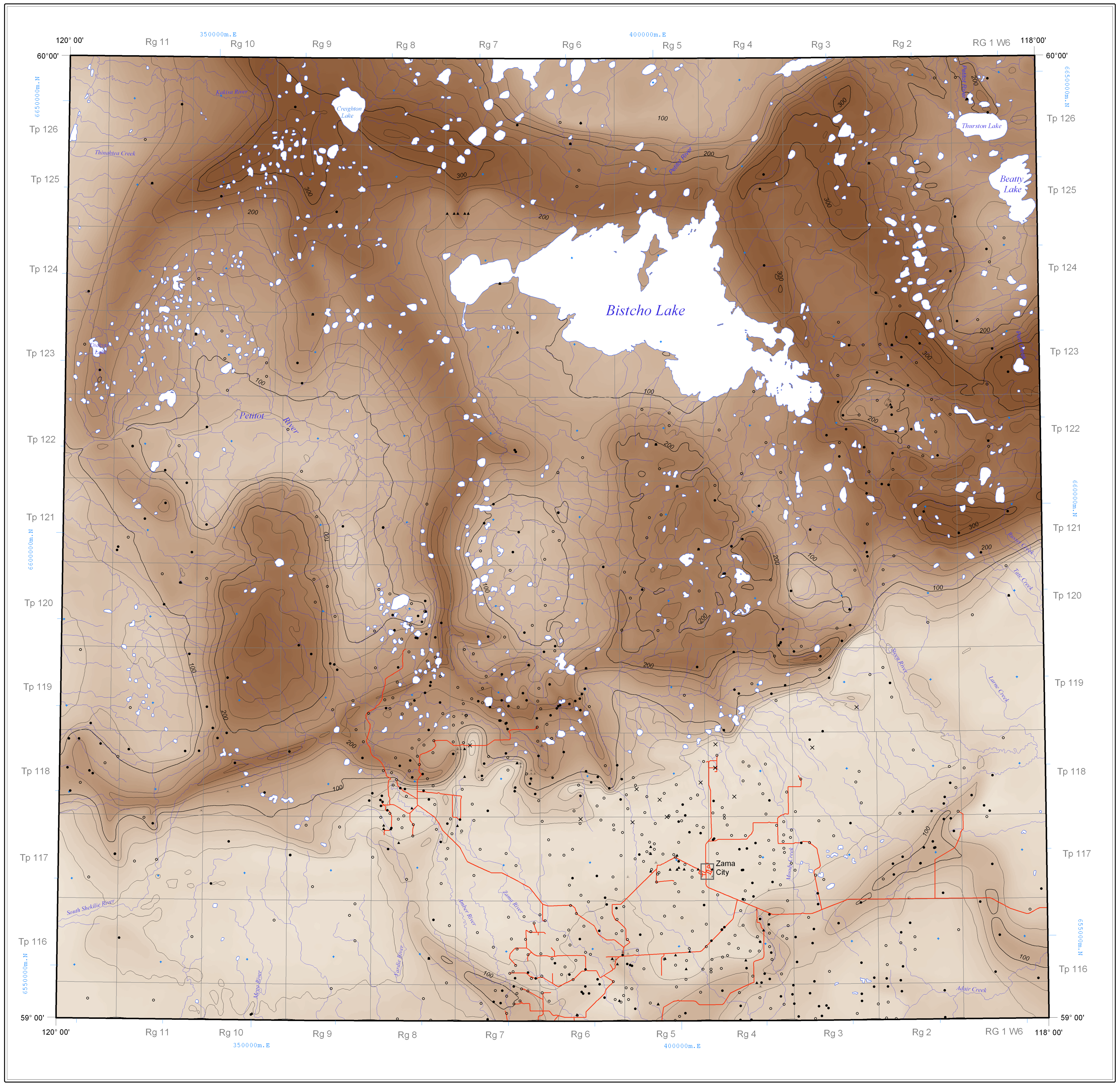
NTS 84M
DRIFT THICKNESS



Data

Petrophysical logs from oil and gas wells were the primary source of information used for constructing the bedrock topography. A suite of the common well logs (gamma, resistivity, spontaneous potential, density, neutron, sonic and caliper) were useful in making the pick for top of bedrock; however, the gamma and resistivity logs proved to be the most useful. The drift typically displays a lower gamma and a higher resistivity response than the subcropping bedrock, which is dominantly Cretaceous marine shale. Other sources of data were drill cuttings and water well lithologs. Surficial geology maps provided information on bedrock outcrops and till veneers over shallow bedrock (Kowalchuk et al., 2006; Paulen et al., 2006a and 2006b; Plouffe et al., 2006a; Smith et al., 2007). Data were used from 849 oil and gas wells, 132 water wells and 13 bedrock outcrop locations.

The well data are unevenly distributed throughout the map area, making the bedrock surface difficult to identify where data are sparse. In many of the wells where log traces are not available for the upper part of the hole, the depth of surface casing set in bedrock provides a limit on the maximum possible drift thickness. Conversely, shallow wells that did not intersect bedrock provide minimum drift thickness values. The bedrock topography contours were initially generated from well data of the bedrock surface picks using a computer-contouring program, followed by subsequent modifications to better reflect the geological model. The bedrock topography surface, in a digital grid format, was subtracted from a digital elevation model of the land surface. The resulting grid was then contoured to form an isopach map of the drift. Figure 1 illustrates a typical response on petrophysical logs of the drift and the top of bedrock pick at a depth of 338 metres from an oil and gas well located in Legal Subdivision 10, Section 22, Township 123, Range 2 west of the 6th Meridian (10-22-123-2W6).

Discussion

The physiographic regions of the Bistcho Lake map area are defined by Pettapiece (1986) and shown on the surface relief map in Figure 2. In the south, the Hay River Plain is part of the more extensive Fort Nelson Lowland. In the north and central areas, Bootis Hill, Elsa Hill, Cameron Hills and the Bistcho Plain are physiographic subdivisions of the entire Cameron Hills Uplands. The lowest elevation in the map area is found in the Hay River Plain, which is characterized by broad low-relief topography that gently rises in elevation from about 350 metres above sea level at the Hay River to 450 metres at the base of the Cameron Hills Uplands. Greater topographic relief is present within the Cameron Hills Uplands where elevations range from 450 metres to almost 800 metres in Bootis, Elsa and Cameron hills. The entire map area is blanketed by boreal forest and extensive bogs and fens. Surface drainage flows primarily in two directions from a divide along the south edge of the uplands. South of this divide, drainage flows toward the Hay River, whereas in most of the uplands flow is primarily westward into British Columbia through Bistcho Lake and the Petitot River. The bedrock is mantled by drift comprised of recent, glacial and preglacial unconsolidated sediments. The exceptions are a few bedrock outcrops located along the south flank of the uplands. Bootis, Elsa and Cameron hills generally reflect highs in the bedrock surface, but in places are underlain by thick drift. Earlier work by Borneuf and Pretula (1980) reported thick drift from isolated wells and Pawlowicz and Fenton (1995a and 1995b) compiled regional maps of bedrock topography and drift thickness for Alberta. Deeply buried valleys with thick drift were reported in the Zama Lake area to the south by Pawlowicz et al. (2005b, 2005c). Thick drift, in excess of 300 metres in places, was identified in several wells and is interpreted to be in-filling major paleovalleys in the Bistcho Lake map area (Figure 3; Pawlowicz et al., 2007). The geology of the bedrock underlying the drift consists of Cretaceous age Shaftesbury Formation and Loon River Formation (Fort St. John Group) marine shales (Green et al., 1970; Hamilton et al., 1999). The Base of Fish Scale bed (BFSC) was identified from well logs above 450 m in elevation in Bootis, Elsa and Cameron Hills and served as an important stratigraphic marker for determining the presence of bedrock at this approximate elevation. Bedrock outcrops and thin drift veneers were found along the south flank of the Cameron Hills Upland between 400 and 600 m in elevation during surficial mapping by Paulen et al. (2006a) and Smith et al. (2007). These outcrops are shown on the present map.

The drift thickness map shows the variability in thickness of unconsolidated sediment lying between the bedrock surface and the present-day land surface, and complements the Drift Thickness of Alberta map (Pawlowicz and Fenton, 1995b). The entire map area has the bedrock blanketed by drift, with the exception of a few outcrops and areas of thin till veneer (< 2 m) along the south flank of the uplands. The drift is also relatively thin (<25 metres) in the Hay River Plain adjacent to the uplands, where glacial erosion was more persistent than deposition. Much thicker drift is found in the buried valleys and beneath portions of the hills in the uplands. The bedrock topography map of the Bistcho Lake area shows the location of the major buried valleys (Figure 3; Pawlowicz et al., 2007). Thickest drift of 351 metres was recognized in a well in Township 123 and Range 1 in the Cameron Hills. Also, over 300 metres of drift was found in a number of wells along the Bistcho Paleovalley. The Shekilie Valley is another major paleovalley in the Cameron Hills Uplands filled by 200 to 300 metres of drift. The Amber, Moody and Adair valleys located in the south part of the map area contain less than 150 metes of drift. The present-day land surface, consisting primarily of extensive areas of broad low-relief topography, shows little evidence of these deep drift-filled valleys.

Composition and stratigraphy of the drift are not well known; however, information is available from oil and gas well drill cuttings, surficial geological studies (Fenton et al., 1994; Smith et al., 2005; Kowalchuk et al., 2006; Paulen et al., 2006a, 2006b; Plouffe et al., 2006a, 2006b; Smith et al., 2007) and holes drilled by the Alberta Geological Survey elsewhere in northern Alberta (Pawlowicz and Fenton, 1998). The drift appears to be composed dominantly of glacial sediments. Preglacial fluvial sediments may be present in the lower parts of some of the buried valleys, as is well documented in the Sand River area to the southeast (Andriashek and Fenton, 1989; Andriashek, 2003). In some places, a multi-layer sequence of till interbedded with glaciolacustrine and glaciofluvial sediments has been recognized. The deeply buried valleys may be expected to contain several glacial units as shown through detailed investigations elsewhere in north-central Alberta (Pawlowicz et al., 1998, 2001, 2005a; Fenton et al., 2005). Stratified sediments in drift overlying the buried valleys are potentially favourable locations for groundwater aquifers and shallow gas. Accumulations of shallow gas within drift, which are known to occur in the Zama Paleovalley to the south in Township 110, Range 3 west of the 6th Meridian (Pawlowicz et al., 2004; Alberta Energy and Utilities Board, 2006a) may also be present in the Bistcho map area. This may be due in part to adequate seals formed from thick clay-rich tills and glaciolacustrine sediments that trap any upward migrating gas. Artesian conditions encountered during drilling have been documented in the area (Alberta Energy and Utilities Board, 2006b; Alberta Environment, 2006) and are likely the result of over-pressured aquifers in buried valleys beneath confining clay-rich beds.

FEATURES LEGEND

Data sources

- Petroleum well, bedrock surface picked
- Petroleum well, bedrock surface above logged interval
- Petroleum well, bedrock surface below bottom of well
- Water well, bedrock surface picked
- Water well, bedrock surface above logged interval
- Water well, bedrock surface below bottom of well
- Bedrock outcrop
- Drift thickness surface to bedrock isopach contour interval 25 m

Drift Thickness

357 metres

0 metres

BASEMAP LEGEND

- Road - gravel
- Township/range - surveyed
- River
- Lake
- Town
- UTM, Zone 11 Grid 400000m.E

Figure 1. Log response of drift overlying shale. (oil and gas well 10-22-123-2W6)

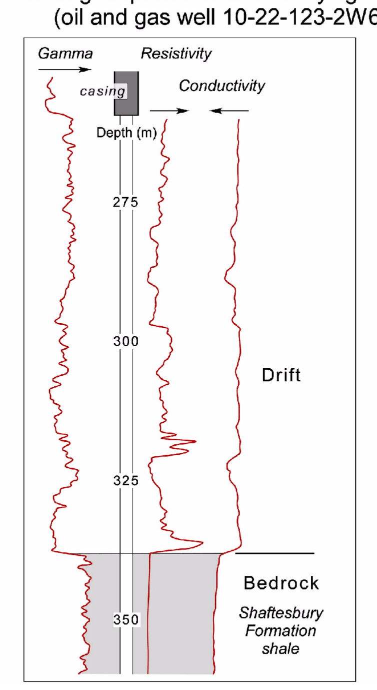


Figure 2. Present-day surface topography and physiography

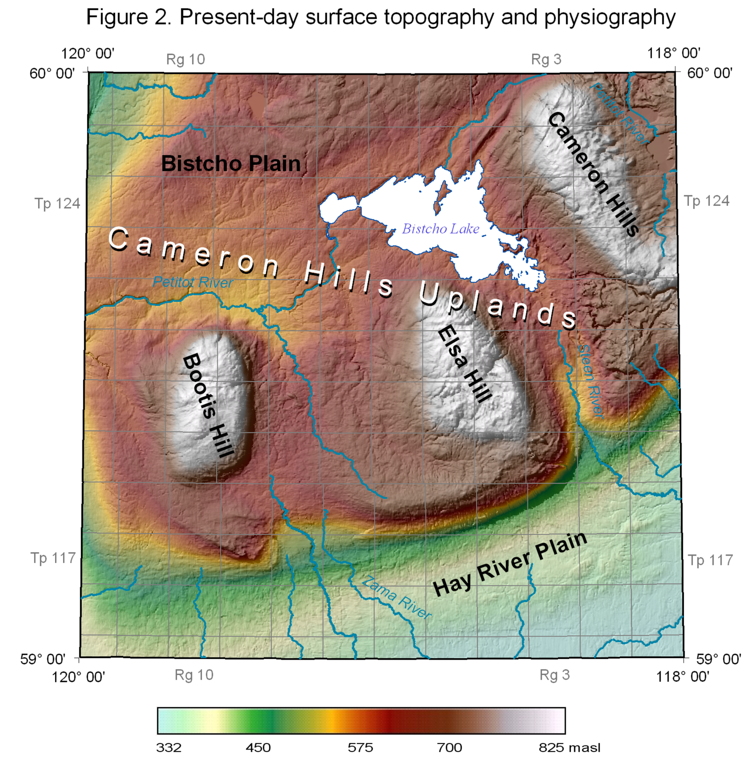
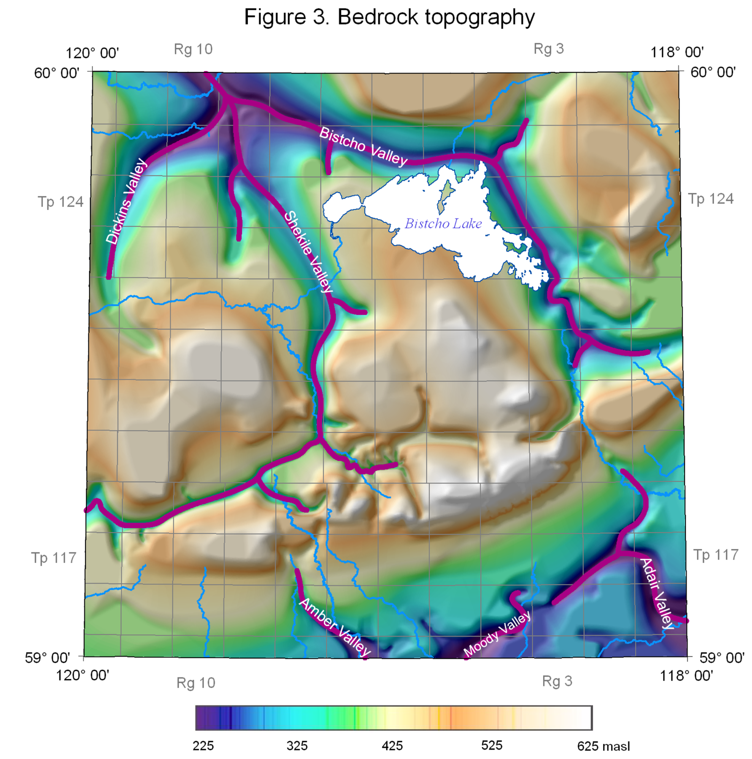


Figure 3. Bedrock topography



References

Alberta Energy and Utilities Board (2006a): Shiningbank Energy sweet gas well blowout brought under control; Alberta Energy and Utilities Board, EUB News Release 2006-02-28, 1 p.

Alberta Energy and Utilities Board (2006b): EUB Provincial surveillance and compliance summary 2005; Alberta Energy and Utilities Board, EUB ST99-2006, 92 p.

Alberta Environment (2006): Groundwater information system; Alberta Ministry of Environment, URL <http://www3.gov.ab.ca/env/water/groundwater/index.html> [December 2006].

Andriashek, L.D. (2003): Quaternary geological setting of the Athabasca oil sands (in situ) area, northeastern Alberta; Alberta Energy and Utilities Board, EUB/AGS Earth Sciences Report 2002-03, 286 p.

Andriashek, L.D. and Fenton, M.M. (1989): Quaternary stratigraphy and surficial geology of the Sand River area, 73L; Alberta Research Council, Alberta Geological Survey, Bulletin 57, 154 p.

Borneuf, D. and Pretula, B. (1980): Hydrogeology of the Zama – Bistcho Lakes area, Alberta; Alberta Research Council, Alberta Geological Survey, Earth Sciences Report 1980-03, 7 p.

Fenton, M.M., Schreiner, B.T., Nielsen, E. and Pawlowicz, J.G. (1994): Quaternary geology of the Western Plains; in Geological Atlas of the Western Canada Sedimentary Basin, G.D. Mossop and I. Shetson (comp.), Canadian Society of Petroleum Geologists and Alberta Research Council, Special Report 4, URL <http://www.ags.gov.ab.ca/publications/ATLAS_WWW/ATLAS.shtml>, [February 2007].

Fenton, M.M., Pawlowicz, J.G., Paulen, R.C. and Prior, G.J. (2005): Quaternary stratigraphy and till geochemistry of the southern Buffalo Head Hills: results of an auger coring program; Alberta Energy and Utilities Board, EUB/AGS Geo-Note 2005-10, 39 p.

Green, R., Mellon, G.B. and Carrigy, M.A. (1970): Bedrock geology of northern Alberta; Research Council of Alberta, Alberta Geological Survey, Map 24, scale 1:500 000.

Hamilton, W.H., Langenberg, W., Price, M.C. and Chao, D.K. (1999): Geological map of Alberta; Alberta Energy and Utilities Board, EUB/AGS Map 236, scale 1:1 000 000.

Kowalchuk, C., Ward, B.C., Paulen, R.C. and Plouffe, A. (2006): Surficial geology, Moody Creek (NTS 84M/02); Alberta Energy and Utilities Board, EUB/AGS Map 397, Geological Survey of Canada, Open File 5283, scale 1:50 000.

Paulen, R.C., Kowalchuck, C.J., Plouffe, A., Ward, B.C. and Smith, I.R. (2006a): Surficial geology of the Zama City Area (NTS 84M/SE); Alberta Energy and Utilities Board, EUB/AGS Map 361, Geological Survey of Canada, Open File 5184, scale 1:100 000.

Paulen, R.C., Plouffe, A. and Smith, I.R. (2006b): Surficial Geology of the Beatty Lake Area (NTS 84M/NE); Alberta Energy and Utilities Board, EUB/AGS Map 360, Geological Survey of Canada, Open File 5183, scale 1:100 000.

Pawlowicz, J.G. and Fenton M.M. (1995a): Bedrock topography of Alberta; Alberta Department of Energy, Alberta Geological Survey, Map 226, scale 1:2 000 000.

Pawlowicz, J.G. and Fenton M.M. (1995b): Drift thickness of Alberta; Alberta Department of Energy, Alberta Geological Survey, Map 227, scale 1:2 000 000.

Pawlowicz, J.G. and Fenton M.M. (1998): Reconnaissance till mineral and geochemical survey with emphasis on northern Alberta, project final report; Alberta Energy and Utilities Board, EUB/AGS Open File Report 1996-07, 102 p.

Pawlowicz, J.G., Fenton, M.M., Weiss, J.A. and Campbell, J.E. (2001): Pelican area Quaternary stratigraphy and geochemistry; in Alberta Geological Survey's Contribution for the Calgary Mining Forum, April 18-19, 2001, Alberta Energy and Utilities Board, EUB/AGS INF 123.

Pawlowicz, J.G., Hickin, A.S., Nicoll, T.J., Fenton, M.M., Paulen, R.C., Plouffe, A. and Smith, I.R. (2004): Shallow gas in drift: northwestern Alberta; Alberta Energy and Utilities Board, EUB/AGS INF 130, 1 p.

Pawlowicz, J.G., Fenton M.M. and Weiss, J.A. (2005a): Auger core lithologs, Sawn Lake area, southern Buffalo Head Hills, Alberta; Alberta Energy and Utilities Board, EUB/AGS Geo-Note 2005-07, 43 p.

Pawlowicz, J.G., Hickin A.S., Nicoll, T.J., Fenton, M.M., Paulen, R.C., Plouffe, A. and Smith, I.R. (2005b): Bedrock topography of the Zama Lake area, Alberta (NTS 84L); Alberta Energy and Utilities Board, EUB/AGS Map 328, scale 1:250 000.

Pawlowicz, J.G., Hickin, A.S., Nicoll, T.J., Fenton, M.M., Paulen, R.C., Plouffe, A. and Smith, I.R. (2005c): Drift thickness of the Zama Lake area, Alberta (NTS 84L); Alberta Energy and Utilities Board, EUB/AGS Map 329, scale 1:250 000.

Pawlowicz, J.G., Nicoll, T.J. and Sciarra, J.N. (2007): Bedrock topography of the Bistcho Lake area, Alberta (NTS 84M); Alberta Energy and Utilities Board, EUB/AGS Map 416, scale 1:250 000.

Pettapiece, W.W. (1986): Physiographic subdivisions of Alberta; Land Resource Research Centre, Research Branch, Agriculture Canada, physiographic map, scale 1:1 500 000.

Plouffe, A., Paulen, R.C. and Smith, I.R. (2006a): Surficial geology, Thinahtea Creek, Alberta (NTS 84 M/NW); Alberta Energy and Utilities Board, EUB/AGS Map 395, Geological Survey of Canada, Open File 5070, scale 1:100 000.

Plouffe, A., Paulen, R.C. and Smith, I.R. (2006b): Geochemistry and heavy mineral content of glacial sediments from northwest Alberta (NTS 84L, M): new opportunities for mineral exploration; Alberta Energy and Utilities Board, EUB/AGS Special Report 77, Geological Survey of Canada, Open File 5121, 29 p.

Smith, I.R., Paulen, R.C., Plouffe, A., Kowalchuk, C. and Peterson, R. (2005): Surficial mapping and aggregate resource assessment in northwest Alberta; in Summary of Activities 2005, British Columbia Ministry of Energy and Mines, p. 80-95.

Smith, I.R., Paulen, R.C. and Plouffe, A. (2007): Surficial geology, Mega River, Alberta (NTS84 M/SW); Geological Survey of Canada, Open File 5237, Alberta Energy and Utilities Board, EUB/AGS Map 396, scale 1:100 000.

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Recommended reference format:

Pawlowicz, J.G., Nicoll, T.J. and Sciarra, J.N. (2007): Drift thickness of Bistcho Lake area, Alberta (NTS 84M); Alberta Energy and Utilities Board, EUB/AGS Map 417, scale 1:250 000.

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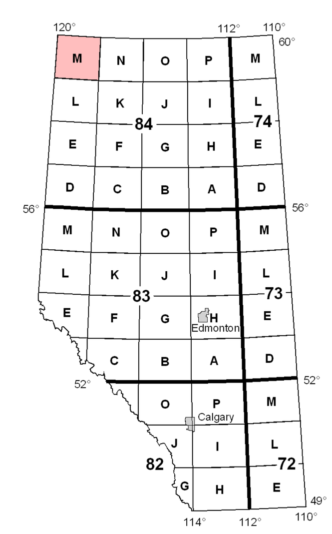
Map 417

Drift Thickness of Bistcho Lake Area, Alberta (NTS 84M)

Geology by: J.G. Pawlowicz, T.J. Nicoll and J.N. Sciarra



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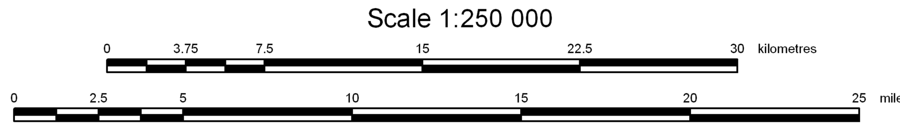

Projection: Universal Transverse Mercator, Zone 11
Datum: North American Datum, 1983

Shallow Gas & Diamond Opportunities in Northern Alberta and British Columbia 2003 - 2007

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey