Welcome to the Alberta Geological Survey's contributions for the

10th Annual

# Calgary Mining Forum:

## New Resources for the New Economy

Alberta Geological Survey

# Minerals Section

# Open House

**April 18-19, 2001**

EUB
Alberta Energy and Utilities Board

AGS
Alberta Geological Survey

**Once again the Calgary Mineral Exploration Group Society is pleased to present the annual Calgary Mining Forum, which this year includes the Alberta Geological Survey's Minerals Section Open House. The Calgary Mining Forum is Alberta's venue for bringing together people involved in mineral exploration in Alberta, Canada, and throughout the World. During the two days there will be talks, posters, and trade show exhibits from industry, government, and academia.**


## ACKNOWLEDGEMENTS

## THE CALGARY MEG IS PLEASED TO THANK THE FOLLOWING SPONSORS AND SUPPORTERS:

### SPONSORS

**Alberta Chamber of Resources**
**Alberta Geological Survey, Energy and Utilities Board**
**Alberta Ministry of Energy**
**EuroZinc Mining Corporation**
**Jacques Whitford Environment Limited**
**McLeod & Company**
**Paul A. Hawkins & Associates Ltd.**
**Print Three**
**Yorkton Securities**

### SUPPORTERS

**Alex Knox Consulting**
**Associated Mining Consultants Ltd.**
**Daniel A. Beauchamp Consulting**
**Don Sawyer**
**Felix Geophysical Services Inc.**
**Leeward Capital Corp.**
**Platino Resources Inc.**
**Ted Glenn Consulting**
**Tim Sandberg Consulting**

# ORGANIZING COMMITTEE

| | |
|---|---|
| **Co-Chair** | **Reg Olson, *Alberta Geological Survey***<br>**Ph. (780) 427-1741 Fax (780) 422-1459**<br>**reg.olson@gov.ab.ca** |
| **Co-Chair** | **Paul Hawkins, *Paul A. Hawkins & Associates Ltd.***<br>**Ph. (403) 242-7745 Fax (403) 246-1992**<br>**Phawkins1@compuserve.com** |
| **Trade Show** | **Matt Kennedy, *Jacques Whitford Environment Ltd.***<br>**Ph. (403) 781-4133 Fax (403) 263-7116**<br>**mkennedy@jacqueswhitford.com** |
| **Trade Show** | **Rob Natyshen, *Alberta Geological Survey***<br>**Ph (780) 466-1779 Fax (780) 422-1459**<br>**rob.natyshen@gov.ab.ca** |
| **Speakers** | **Jim Davis, *Leeward Capital Corp.***<br>**Ph. (403) 265-2777 Fax (403) 265-6410**<br>**jimd@taiga-ltd.com** |
| **Speakers** | **Michael Marchand, *Platino Resources Inc.***<br>**Ph. (403) 282-5105 Fax (403) 282-5105**<br>**marchndm@telusplanet.net** |
| **Posters** | **Jill Weiss, *Alberta Geological Survey***<br>**Ph. (780) 427-2948**<br>**jill.weiss@gov.ab.ca** |
| **Registration** | **Ted Glenn, *Consultant***<br>**Ph. (403) 288-6649**<br>**wglenn@telusplanet.net** |
| **Registration** | **Brent Felix, *Felix Geophysical Services Inc.***<br>**Ph (403) 251-5051 Fax (403) 251-5051**<br>**info@felixgeophysical.com** |
| **Volume of Abstracts/ Webmaster** | **Tim Sandberg, *Consultant***<br>**Ph. (403) 249-7611 Fax (403) 217-1604**<br>**tsandberg@home.com** |

# MEG EXECUTIVE

# BOARD OF DIRECTORS 2000 -2001


**Calgary MEG Society**
**P.O. Box 1027, Station M**
**Calgary, Alberta T2P 2K4**
**www.meg.calgary.ab.ca**


| | |
|---|---|
| **President** | **Alex Knox**<br>**(403) 283-7597**<br>**a.w.knox@cadvision.com** |
| **Vice President** | **Brent Felix**<br>**(403) 251-5051**<br>**info@felixgeophysical.com** |
| **Past President** | **Jim Cassie**<br>**Ph. (403) 250-5185 fax (403) 250-3445**<br>**jcassie@cadvision.com** |
| **Secretary** | **Henry Lyatsky**<br>**(403) 282-5873**<br>**lyatskyh@cadvision.com** |
| **Treasurer** | **Dan Beauchamp**<br>**(403) 259-6734**<br>**beauchda@cadvision.com** |
| **Membership Director** | **Mark Bowman**<br>**(403) 264-9496**<br>**bowmanm@calgary.amcl.ca** |
| **Program Director** | **Jim Decker**<br>**Ph. (403) 237-8100 Fax (403) 262-3452**<br>**jhdecker@msn.com** |
| **Forum Co-Chair** | **Reg Olson**<br>**(780) 427-1741**<br>**reg.olson@gov.ab.ca** |
| **Forum Co-Chair/**<br>**Liaison Officer** | **Paul Hawkins**<br>**(403) 242-7745**<br>**phawkins1@compuserve.com** |

# TALKS

# POSTERS

# Mineral Exploration Group

# VOLUME OF ABSTRACTS

# APRIL 18 and 19, 2001

**Talks**

# Table of Contents

# Alberta Kimberlite Update: Present and Future AGS Studies

D. Roy Eccles, Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
roy.eccles@gov.ab.ca

Ultramafic diatremes have been discovered in three separate areas of northern Alberta:

- In 1990, the Mountain Lake Diatreme, which is located northeast of Grande Prairie, was discovered by Monopros Limited
- In 1997, Ashton Mining of Canada Inc., in a joint partner venture with Alberta Energy Company and Pure Gold Resources Ltd., discovered kimberlites on the southeast flank of the Buffalo Head Hills. To date, Ashton has discovered 35 kimberlitic pipes.
- In 1998, Kennecott Canada Exploration Inc., in conjunction with Montello Resources Ltd., discovered seven kimberlites in the Birch Mountains area.

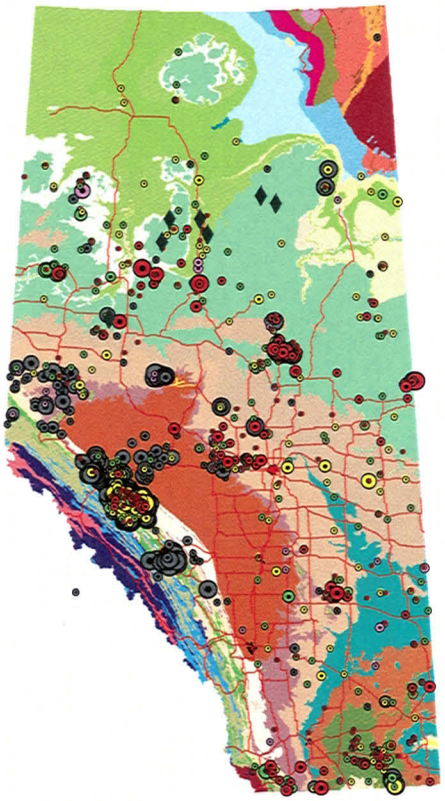
Companies in all three diatreme areas, as well as other areas of Alberta, are active and have results that continue to forward the Alberta diamond play. For example, Ashton reported that kimberlite K252 contained 66.2 carats per hundred tonnes (cpht) from a 1.28 tonne mini-bulk sample and plan on bulk sampling the kimberlite in 2001. In addition, Ashton confirmed the presence of large stones (e.g., K252 contained 0.85 carats that were greater than 0.8 mm). In December 2000, New Blue Ribbon Resources Ltd. reported a new kimberlite discovery in the Birch Mountains, which brings the total number of diatremes in the Birch Mountains area to eight.

One goal of Alberta Geological Survey (AGS) Mineral Section is to provide kimberlite-related information for the benefit of industry, government and the public. Specifically, 1.) document up-to-date, high-quality, unbiased mineral information for Alberta's geological information base; and 2.) disseminate the necessary kimberlite information requested by junior and senior mining companies interested in exploring Alberta.

This presentation will highlight selected examples of the AGS's present (soon to be released) and future kimberlite-related projects. Reports that are either near publication, or will be published in conjunction with the 2001 MEG Forum, include:

1. A structural-emplacement model for kimberlitic diatremes in northern Alberta (AGS Earth Science Report 2000-01). The model has been constructed from new interpretations of data compiled for the Precambrian basement and Phanerozoic sedimentary rocks in the Peerless Lake area. Emplacement of the Buffalo Head Hills kimberlites is consistent with worldwide examples in which kimberlite diatremes are associated with Phanerozoic grabens that result from the frequent transcurrent and/or extensional reactivation of a deep-seated mobile zone.
2. A regional geochemical sampling program for diamond potential was completed in the Peerless Lake map area, north-central Alberta (AGS Earth Science Report 2000-08). The area encompasses the Buffalo Head Hills kimberlites and is intended to provide reconnaissance-scale information from an area with known diamondiferous kimberlites.
3. An updated diamond-indicator mineral summary map will soon be available on-line, allowing industry to download geochemical data from 10 000+ indicator grains throughout Alberta. The probe data will include information from both government and publicly available industry surveys.

## Alberta Kimberlite Update



**Pyrope Garnet (>15.5% MgO)**

- 1 grain
- 2 to 5
- 6 to 9
- 10 to 405

**Eclogitic Garnet (<23% FeO, >5 wt% MgO)**

- 1 grain
- 2 to 5
- 6 to 9
- 10 to 405

**Chrome Diopside (>0.5% $Cr_2O_3$, <5% FeO)**

- 1 grain
- 2 to 5
- 6 to 9
- 10 to 18

**Picroilmenite (>8% MgO)**

- 1 grain
- 2 to 5
- 6 to 9
- 10 to 16

**Chromite (>20% $Cr_2O_3$, >5% MgO)**

- 1 grain
- 2 to 5
- 6 to 9
- 10 to 94

Future AGS activities include the sampling of Alberta diatreme rocks from the Mountain Lake, Buffalo Head Hills and Birch Mountains areas to report on their physical (e.g., textural classification), and geochemical (e.g., major and trace element) characteristics. The physical and geochemical characteristics will be compared between diatreme fields in Alberta and with data from occurrences of kimberlite worldwide. These objectives will be accomplished in logical 'groupings' to facilitate interpretations and ensure quick, periodic release of data.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Structural Interpretation of Radarsat and Landsat7 TM Images for Kimberlite Exploration in the Buffalo Head Hills Area, North-central Alberta

F. Paganelli (speaker)[1], E. C. Grunsky[2] and J. P. Richards[1]

1. Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB, Canada T6G 2E3, flora.paganelli@ualberta.ca
2. Alberta Geological Survey, Alberta Energy and Utilities Board, eric.grunsky@gov.ab.ca

The objective of this study is to develop a methodology in the use of RADARSAT Principal Component Analysis and integrated Landsat7 TM images that will provide a useful tool for kimberlite exploration in northern central Alberta.

The analysis of four RADARSAT Principal Components extracted from the RADARSAT Standard Mode S1/S7 scenes acquired both in ascending and descending mode and their combination in color composite imagery provided sufficient detail to outline the major lineaments characterizing the meso- and mega-scale structures of the Buffalo Head Hills. This method minimizes data redundancy inherent in the RADARSAT scenes, while emphasizing the unique information in each scene related to topography, structural patterns, drainage, and vegetation canopy variations.

The NNE-trending faults bounding the eastern edge of the Buffalo Head Hills along the Loon River Graben were clearly delineated, as well as a conjugate set of NW- and NE-trending fault systems forming block fault structures within the Buffalo Head Hills, and at its eastern boundary. ENE-trending lineaments have been outlined, which offset all the previous structures and therefore appear to be the latest tectonic event. These features are consistent with the tectonic evolution of the Buffalo Head Hills as part of the cratonic platform within the Western Canadian Sedimentary Basin (WCSB), influenced by uplift and extensional events associated with formation of the Peace River Arch, and the down-warp phase imposed by the Laramide Orogeny.

The integration of Landsat7 TM and RADARSAT PC imagery not only highlights structural features, but the thermal band also clearly outlines the location of known kimberlite occurrences in the SE corner of the Buffalo Head Hills, at the intersection of NNE- and ENE-trending lineaments. Similar untested features were recognized in other parts of the district, and these will be further investigated using integrated aeromagnetic data followed by field studies.

This methodology, using multi-beam RADARSAT imagery integrated with Landsat7 TM multi-spectral imagery, has proved to be a valuable tool for structural mapping and recognition of kimberlite intrusions in the study area, and suggests that it could be usefully applied to exploration in other areas of northern Alberta.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# A Comprehensive Conceptual Model for the Pine Point Pb-Zn Ore District, NWT

J. J. Adams, K. Muehlenbachs, B. J. Rostron, and C. A. Mendoza
Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB
jennifer.adams@gov.ab.ca

A variety of conceptual models have been proposed to explain MVT mineralization at Pine Point, NWT due to contradictory age dates, undefined metal sources, irreconcilable ? 34S values and many potential flow systems. Definition of a comprehensive metallogenic model for Pine Point will facilitate future MVT exploration strategies including studies conducted at the margins of the Alberta basin.

This study shows that stable isotopic and fluid inclusion analyses of hydrothermal carbonate gangue minerals associated with Pine Point ore constrain the age of mineralization, regional flow paths and evolution of parent fluids, metals, and S. Saddle dolomites, deposited by ore-forming fluids, record gradual enrichment of ? D values from -111 to -53‰ VSMOW along the Presqu'ile barrier. ? 18O values of saddle dolomites record a gradual depletion in parent fluid composition along the barrier, however at Pine Point, the parent fluids became 2.5‰ SMOW more enriched in 18O. Similarly, salinities of fluid inclusion waters increase 10 to 15 eqv. wt% NaCl just west of Pine Point. The dramatic shift in isotopic composition and salinity delineates a mixing zone around Pine Point. This is supported by ? D values of Pine Point saddle dolomite inclusion waters (-88 to -110‰) that are 30‰ more depleted than the nearest samples along the barrier.

The depleted ? D values suggest that Cretaceous meteoric waters (-160 to -170 ‰) mixed with Devonian brines (approx. -50‰) during a topography-driven flow system associated with the Laramide Orogeny. Stable isotopic signatures of saddle dolomites also document mixing of two distinct fluids at Pine Point: a highly saline, 18O-enriched, D-depleted fluid and a moderately saline, 18O-depleted, D-enriched fluid. Non-equilibrium ore textures suggest that metals and sulphur were transported separately to the ore district. Metal-bearing veins in Precambrian basement and lithogeochemical analyses of basement rocks underlying Pine Point indicate that metals were sourced from the basement. This finding is supported by the similarity of solute chemistry of fluid inclusions at Pine Point and basement fluids. Excess S in fluid inclusions and evidence for transport of dissolved H2S out of the deep basin indicate that reduced S may have moved along the barrier to Pine Point. Stable isotopic compositions and solute chemistry of barrier and Pine Point fluid inclusions point to mixing at Pine Point of highly saline, metal-bearing fluids from the basement, and H2S-bearing barrier fluids from downdip sour gas fields.

World-wide formation dates of Pb-Zn ore districts are coincident with orogenic activity adjacent to their parent sedimentary basins. This correlation is thought to reflect the development of regional topography-driven flow systems in response to tectonic uplift along the orogenic belt. The Pine Point system also demonstrates that orogenic activity initiates thermochemical sulphate reduction at maximum burial conditions prior to uplift. Concomitantly, the transition from compressional to extensional stress regimes during uplift may have reactivated basement faults in the Pine Point area, allowing for basement fluids to move into the ore district.

# A Review of the Potential for Selected Sedimentary-Hosted Mineralization in Northern Alberta

R. J. Rice, Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
randy.rice@gov.ab.ca

The sedimentary-hosted mineral potential of northern Alberta (north of the Peace River Arch) has not received sufficient acknowledgement. The Minerals Section, Alberta Geological Survey has embarked on a re-evaluation of that potential with the objective of vectoring mineral exploration toward regions of greatest prospectivity.

**MVT Pb-Zn** potential is being addressed through a regional integrated structural, stratigraphic and fluid flow investigation utilizing both petroleum and mineral industry core and geophysical data. In the NW along the Great Slave Lake Shear Zone (GSLSZ) anomalous Zn values, to 5.1% Zn/11 m, have been recorded from M. Devonian Keg River dolostone at 1,300 m. Such depths are non-economic, however 30 km to the northeast top Devonian (Winterburn) is weakly anomalous (40 ppm Pb & Zn/3 m) at only 80 m. Regardless of depth, all showings need evaluation to establish controls on known occurrences for extension to regions of shallower carbonate stratigraphy. In the NE, Paleozoic carbonates south of Wood Buffalo Park are shallower and outcrop (Devonian Waterways Fm.) along the Clearwater River east and north of Fort McMurray. Aeromagnetic data over this region suggests the presence of basement structures and minor occurrences of both Pb and Cu mineralization are known.

The potential for several types of stratiform Pb-Zn mineralization also exists beneath the northern plains. **Sandstone-hosted Pb-Zn** mineralization has been reported from a near basal L. Devonian clean quartz sandstone, up to 30 m thick, above and on the flanks of the Tathlina Uplift in NW Alberta. In the NE, near Fort McMurray, heavy oil impregnated Cretaceous Mannville Grp. clastics overlying a Devonian carbonate-evaporate sequence on weathered basement have been the subject of past and recent polymetallic investigations. The potential for **shale-hosted, Sedex-type Zn** mineralization exists in shale-bentonite sequences of the M. Cretaceous basal Fort St. John Grp. in the Steen River area where values to 820 ppm Zn/3 m have been reported at 60-90 m. The U. Devonian - L. Mississippian basal Exshaw Fm. shale-bentonite sequence has similar potential with values of 125-400 ppm Zn/6m reported from wells covering the central and southern plains. It is not inconceivable that the Exshaw Fm. under the northern plains might be equally anomalous and contain regions of much higher grade where intersected by significant structures such as GSLSZ.

Globally, **shale-hosted Ni-Zn** deposits are currently a minor resource with deposits known from China and the Yukon, Canada. The potential significance to local economies remains however. Several black shale units associated with carbonate sequences occur in the subsurface of northern Alberta. The basal Exshaw Fm. is not only anomalous in Zn but also in Ni with 75-150 ppm/6 m reported. In NW Alberta this formation is shallower and part of a regional transition from carbonates to basinal shales which constitutes an important element of the shale Ni-Zn deposit model. The potential for this mineralization is enhanced in regions over, or near, the GSLSZ and Steen River Structure. Other black shale units in NW Alberta, such as the basal Jurassic Nordegg – black shale transition in the Fernie Grp., for which no/little trace element data is currently known might also be considered candidates for this style of mineralization.

## Sedimentary-Hosted Mineralization

NW Alberta may also have potential for **sediment-hosted Cu** mineralization. Although no supporting geochemical data are known to currently exist, the M. Devonian carbonate succession of this region overlies weathered basement and is known to contain hematitic red bed and evaporite sequences. In the region of significant structural elements such as the Tathlina Uplift, Steen River Structure and the GSLSZ the possibility of Kipushi-type Cu mineralization should be considered.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Surficial Geology and Till Geochemistry of the Pelican Area (NTS 83P): A Preliminary Report

J. E. Campbell, M. M. Fenton, J. G. Pawlowicz, J. A. Weiss and M. Price,
Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
janet.campbell@gov.ab.ca

April 2000 marked the start of a new multiyear program initiative by the Minerals Section of the Alberta Geological Survey focusing on the surficial geological mapping and Quaternary stratigraphy of northern Alberta. At present, approximately 70% of northern Alberta remains unmapped with respect to the surficial geology, and very little is known about the glacial history in this portion of the province. The main objective of this program is to provide basic Quaternary geological information essential to mineral exploration, energy development, and resource management in northern Alberta.

This years' work focused on the Pelican area (NTS 84P). The project consists of several components: mapping of the surficial sediments, collection of till samples for geochemical and diamond indicator analyses, stratigraphic testhole drilling, and compilation of drift thickness and bedrock surface topography data.

This presentation will focus on the preliminary results of the surficial geological mapping and till geochemical sampling components from this past summer's investigations.

Some of the highlights are:

- Surficial geology in the Pelican area is different from other areas we have mapped in northern Alberta: i.e. glaciofluvial and/or glaciolacustrine cover is much more extensive.
- Multiple till deposits were encountered in exposures and in stratigraphic testholes.
- There is regional variation in till composition reflecting variations in provenance.
- Significant areas of glacio-tectonic deposits such as thrust ridges containing deformed bedrock, and glacial excavated depressions with associated hummocky deposits (hill-hole pairs) have been identified.
- Glacial tills which are rich enough in bitumen to give off a distinctive odor were discovered in new surface excavations and test holes in both the Pelican and Peerless study areas.
- Multiple ice flow directions have been documented.
- Evidence of local late stage ice re-advance has been documented in several localities.
- Confirmation that there is an extensive cover of quartzite-rich gravel over the Pelican Mountains (Tertiary?).
- Discovery of glacially crushed preglacial gravel in the Avenir pit southeast of Wandering River .
- Discovery that the Wapiti Formation extends further southeastward from the Pelican Mountains than had previously been known.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Pelican Area (NTS 83P) Bedrock Topography, Drift Thickness and Stratigraphy

J. G. Pawlowicz, L. D. Andriashek, M. M. Fenton and J. E. Campbell,
Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
john.pawlowicz@gov.ab.ca

Bedrock topographic and drift thickness maps provide valuable information on such aspects as: depth to bedrock and morphology of the bedrock surface, thickness and nature of the drift cover which may affect geophysical surveys, location of buried aquifers and that are sources of groundwater, and drill casing depths. Stratigraphic information of the glacial sediments in conjunction with surficial geological mapping is needed to understand the glacial history of the region. For this study was collected from six auger core holes and seven rotary core holes drilled during 1999 and 2000. The majority of data however, used for making the bedrock surface picks come from preexisting groundwater and energy drill hole data. The output of this investigation is the release of 1:250,000 scale maps of the bedrock topography and drift thickness.

The Pelican map sheet is located in north-central Alberta between 55° and 56°N and 112° and 114°W. The main physiographic features are the east-west trending Pelican Mountains and May Hill highland. To the northwest in the Wabasca area the land surface drops away to a broad lowland. The present day Athabasca River cuts a deep incision along a north-south line and in the southwest corner of the map sheet. Calling Lake, which is the largest lake in the area is located south of the Pelican Mountains and interestingly, as reported by industry, contains an anomalously high number of diamond indicator minerals.

The region is underlain by bedrock of Cretaceous age. Preglacial gravel, likely of Tertiary age cap the highest portions of the Pelican Mountains. Glacial sediments mask the entire map sheet with drift thickness ranging from a few metres on the highlands to over 200m in the buried channels. Buried channels form the most dramatic aspect of the bedrock topography and two major channels have been recognized. The Wiau channel located north of May Hill is >200 metres deep and trends towards Wabasca in the northwest. Another major channel extends from Wandering River towards the northwest where it intersects the Wiau channel west of the Athabasca River. These channels are characterized by deeply buried preglacial and glaciofluvial sediments overlain by lacustrine sediments and till. Core data has revealed a paleo-weathered surface in the till, which provides strong evidence of a nonglacial interval separating two glacial advances. Stratigraphic correlations in the drift are being made using geochemical and geophysical log data. Early indications are that concentrations of some elements correspond to geophysical log signatures in the till.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Mineral Aggregate in Alberta: Past and Future

W. A. D. Edwards and E. K. Kimball*
Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
dixon.edwards@gov.ab.ca or errin.kimball@gov.ab.ca

The Alberta aggregates industry employs 10,000 people, has total annual revenues of ~$500 million and produces aggregate from 5962 sand and gravel pits with a total surface disturbance of ~260 sq. km. Gravel operators report that resources are being rapidly depleted and the quality is in decline. A study completed last year indicates that Calgary reserves will be substantially depleted in 25 years. Deposits are unevenly distributed so those haul distances of >55 km occurs for 25% of Alberta's existing road system. Walls, in his address to the Alberta Chamber of Resources (Feb. 2001), said that sand and gravel deposits should be identified in province wide planning, making it possible: to identify the existence of resources in areas where alternate zoning has been requested; provide authorities with information to honor comprehensive plans; and ensure permitting of reserves.

The Alberta Geological Survey (AGS) mapped 18% of Alberta, at a map scale of 1:50 000, between 1976 and 1983 and another 35% of the province, at a scale of 1:250 000, between 1984 and 1990. AGS information has been effective for planning and management of aggregate resources, especially in regions before they become densely populated. The remaining 47% of Alberta without public mapping of sand and gravel is in northern or rural Alberta. Large reserves in northern Alberta must be identified: to maintain resource roads, for development of the public road infrastructure, and to preserve deposits during land use planning. AGS plans to complete mapping of the province by 2011.

The budget for this mapping is much less than earlier mapping budgets, and the results will be reconnaissance information. Detailed resource information is much more credible than reconnaissance information, but land use planning proceeds with or without aggregate resources information. It is extremely important to get any scale of information into the process as early as possible.

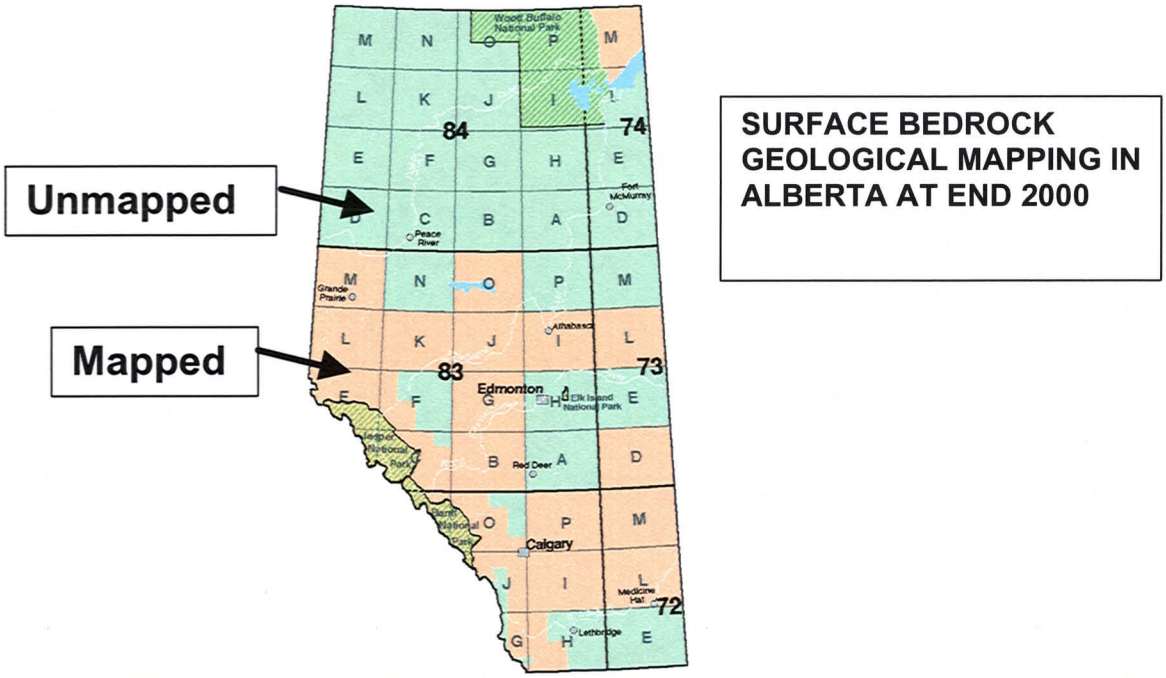
Mapping of sand and gravel resources is not enough. The predicted shortfall of sand and gravel sources for aggregate makes it essential to identify bedrock aggregate sources (crushed stone). Walls (2001) suggested that crushed stone from large deposits adjacent to the eastern slopes would likely be railed into the large urban markets within 25 years. Eastern slopes mapping is especially urgent, as industrial development in this area is already restricted and information must be available for any new or revised planning initiatives.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Alberta Geological Survey Minerals Section Program, A Reflection on Results from FY 2000-2001 and Looking Forward to the Future

R. A. Olson (AGS Minerals Section Leader),
Alberta Geological Survey, Alberta Energy and Utilities Board, 4th Floor, Twin Atria Building,
4999-98 Avenue, Edmonton, Alberta, T6B 2X3
reg.olson@gov.ab.ca

In 1998-1999, an internal document entitled "*Alberta's Mineral Strategy – A Strategic Framework*" which was prepared by the Alberta Department of Energy, concluded that 95% of Alberta's near-surface geological, geochemical and geophysical maps are "*inadequate to support mineral exploration*". An example of this is shown in the following figure, which shows that less than 50% of Alberta currently has surface bedrock geological mapping at 1:250,000 scale or larger.




As a result, the government of Alberta's Throne Speech for 1999/2000 committed the province to "*improve geological information on minerals*" in Alberta. In late 1999 a survey of industry and other industry stakeholders that was conducted on behalf of the AGS by Dr. R. Macqueen concluded that industry needs re: (a) regional mapping at 1:250,000 scale or larger is first priority, (b) selected thematic studies of particular locales or mineral deposit types was second priority, and (c) detailed geoscience mapping in highly selected locales was third priority. The Alberta Geological Survey (AGS) reported much or all of the above last year at MEG Forum 2000.

## Alberta Geological Survey Minerals Section Program

In response to this need from industry, the government of Alberta, through the Energy and Utilities Board, has increased funding to the Minerals Section of the Alberta Geological Survey. As a result, during the past FY 2000-2001 the AGS has supplemented their previously existing minerals staff (comprising 4 senior scientists, and 6 technologists and support staff), with 9 newly hired staff (a Section Leader experienced in mineral deposits geology, 5 other experienced senior geoscientists, 2 experienced GIS and database staff, and 1 technologist).

During the past FY the AGS conducted: (a) Quaternary geological mapping at 1:250,000 to 1:100,000 scale and surficial drilling in the Calling Lake map area (NTS 83P); (b) orientation geochemical surveys over kimberlitic diatremes at the Mountain Lake (NTS 83N), Buffalo Head Hills (NTS 84B) and Birch Mountains (NTS 84A, H) map areas; (c) bulk lithogeochemical and petrographic studies of the kimberlitic diatremes at the Mountain Lake and Buffalo Head Hills areas; (d) a compilation of faults and possible fault-related lineaments into a queriable GIS database along the axis of the Peace River Arch in northwest to north-central Alberta; (e) a compilation of lineaments and structural elements in the Buffalo Head Hills map area identified from Radarsat imagery and from lightning strike data; (f) a compilation of over 15,000 diamond indicator mineral results, and a 'guide' to the interpretation of these data, from government and publicly available industry sampling in Alberta; (g) a study of drill core on file at the AGS from the Steen River Structure in northwestern Alberta (NTS 84N) and the Alberta portion of the Athabasca Basin in northeastern Alberta (NTS 74E, L); and (h) selected other thematic studies. The thematic studies include: (i) a "Geophysical Catalogue" of the publicly available airborne and ground geophysical surveys (excluding seismic) in Alberta; (j) a compilation of prior assessment work and samples from the northern Birch Mountain area; and (k) an assembly of references pertinent to diamond exploration, kimberlite and ultramafic diatreme emplacement and related topics for Alberta, plus a number of other thematic studies. Several of the more detailed thematic studies that the AGS completed during the past FY were delivered by or in collaboration with external consultants with expertise pertinent to the Alberta situation.

For next year, planned work by the AGS will continue many of the initiatives started this past FY. However, geological and geochemical mapping, and selected thematic studies of locates or deposit types of interest to industry, will continue to be the AGS's primary focus. A longer term plan for minerals-related mapping and other geoscience work and applied research by the AGS, in cooperation and collaboration where feasible with our federal counterparts in the Geological Survey of Canada, is under active development by AGS management and senior geoscientific staff. This '10 year plan' will be reported on to the MEG and other interested stakeholders later in FY 2001-2002. However, rest assured the long-term minerals program will include a plan to change all or most of the unmapped portion of Alberta in the above figure, to "mapped"!

EUB
Alberta Energy and Utilities Board

AGS
Alberta Geological Survey

# Industrial Mineral Status and Perspective

W. A. D. Edwards* and E. K. Kimball
Alberta Geological Survey, Alberta Energy and Utilities Board, 4th Floor, Twin Atria Building,
4999-98 Avenue, Edmonton, Alberta, T6B 2X3
dixon.edwards@gov.ab.ca or errin.kimball@gov.ab.ca

Alberta industrial mineral production was $643 million in 1999 and accounts for 9% of the national total. Sand and gravel, limestone (cement and lime), and sulphur (gas and oil sands by-product) have the largest production with a combined value of ~$575 million. Other significant production includes peat, quartz (silica), salt, shale (structural clay products), building stone and ammolite. In 1999 and 2000 industrial mineral assessment (exploration) reports were filed for diamond (38), limestone (2), heavy minerals associated with diamond (2), shale/riprap, bentonite associated with diamond, silica sand, and alumina associated with oil sands. The value of these reports was $33.4 million for diamond exploration and ~$800,000 for the other industrial minerals.

**Sand and gravel and Limestone**

High energy costs are the most significant factor for the cement and lime industry. The Graymont, Inland, and Lafarge operations have converted or are converting from gas to coal. Sand and gravel remains the primary source of mineral aggregate. The Alberta Geological Survey has sand and gravel information for 53% of Alberta and plans to map the remaining unmapped portion of the province over the next ten years.

**Building stone and Mineral Aggregate**

Rock from the Lafarge, Graymont, and Thunderstone quarries in the Bow Valley Corridor that is unsuitable for the primary line of production (cement, lime, building stone, respectively) is now being used for landscape rock and other aggregate uses. The ready market for surplus rock is an indicator that the aggregate industry in the Calgary region is evolving. Supplies of sand and gravel are rapidly depleting and a switch to crushed stone aggregate will probably occur over the next 25 years.

**Diamonds**

Forty-four kimberlites have now been discovered in Alberta and exploration is continuing in the Buffalo Head Hills and Birch Mountains regions. Overall 50% of the Buffalo Head Hills kimberlites have proven to be diamondiferous versus a worldwide average of only ~ 10%. Potential for an economic kimberlite being found and developed in Alberta is high. Even if some kimberlites are deemed uneconomic for gemstone their identification may prove valuable for the industrial minerals industry: associated minerals, such as garnet, have industrial application; kimberlite rock itself may have aggregate potential; and thick, laterally restricted ash beds may have bentonite potential. The anticipated ease and low environmental impact of mining near-surface, highland kimberlites and their setting in an otherwise soft sedimentary sequence makes kimberlites an attractive exploration target for more than their diamond content.

# Use of Palm IIIs to Collect Quaternary Field Data

M. M Fenton*, E. J. Waters*, J. A. Weiss, J. G. Pawlowicz, J. E. Campbell,
Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
joan.waters@gov.ab.ca; mark.fenton@gov.ab.ca

A major effort of the Quaternary group at the Alberta Geological Survey (AGS) is the continued development of digital systems for field sampling and mapping, to be in keeping with Survey plans to move toward a digital database approach to storing, analyzing and distributing geologic information.

This group is utilizing advances in data management and communications technology, including the internet, to make our geological information more readily and rapidly available. One problem has always been to quickly and efficiently transform data, collected during the Quaternary mapping into digital form. Over the past three years trials have been run using various other devices, including the Newton (with Field Worker software) and the Zarus. The primary problem was the inability to get a cheap, compact and easily programmable and customizable tool into the hands of the field geologist. This presentation will outline our use of the Palm to collect field data and quickly move it into an easily distributable medium. A related Poster Session provides additional information and a demonstration.

The mapping team successfully used Palm IIIxe hand held computers to collect most of its field data during the 2000 field season. Software available from Pendragon Software Corp. was used to deploy data collection forms to the handhelds. Reasons for selecting the Palm/Pendragon Forms system include obsolescence of existing tools, low cost of the Palms and a high degree of ease and flexibility in designing and using the new system. Each evening the day's data were transferred to an Access database and relevant files updated in ArcView.

Users were trained to operate the Palm system in the field in about a day, and had relatively few difficulties learning the tool. Scheduling time for the programmer to participate in the first few days of fieldwork proved of great benefit, both for hands-on training "under field conditions" for the geologists and in refining the various data input forms to make them more efficient and easier to use. Immediate benefits of the Palm include; time (overtime) saved during evening data transfer, up-to-date field maps each morning, and having the digital field notes, sample site maps and database available when we returned to the office. AGS plans to continue developing its digital systems for field sampling and mapping, including expansion of the types of data collected with the Palm.

EUB
Alberta Energy and Utilities Board

AGS
Alberta Geological Survey

# A Preliminary Compendium of Drill Core on File at the Alberta Geological Survey, and a Bibliography of Pertinent References, for that Portion of the Athabasca Basin in Alberta

B. Kupsch and R. A. Olson
Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3

During fiscal year 2000-2001 the Alberta Geological Survey (AGS), as part of their contribution to the joint government–industry Extech IV–Athabasca Uranium Multidisciplinary Study, completed Earth Sciences Report 2000-18. This report is a compendium of data from drill holes that occur within or proximal to the portion of the Athabasca Basin within northeastern Alberta, and includes a bibliography of assessment reports and other publications that pertain to the region.

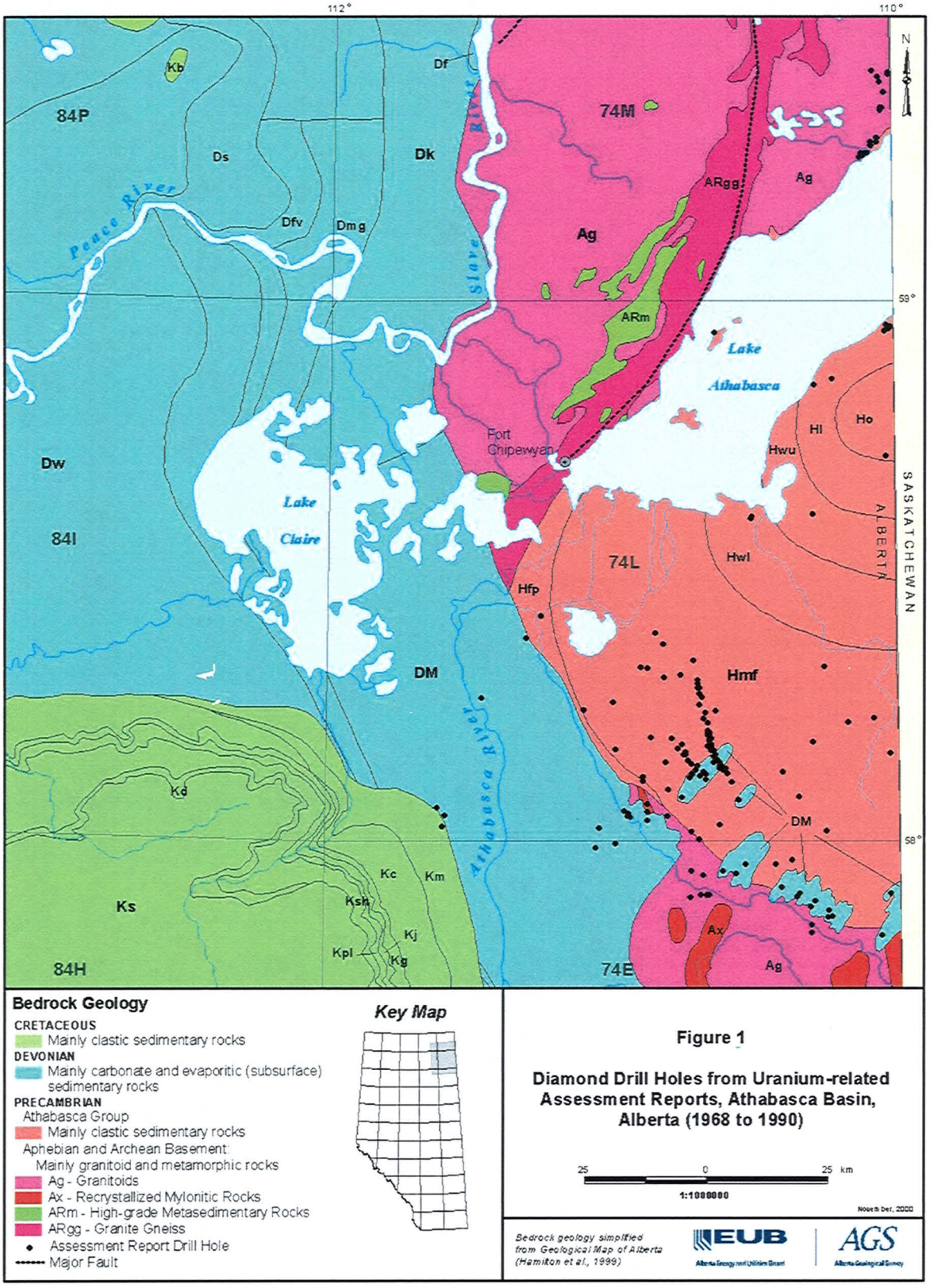
There are a total of 164 publicly available assessment reports that document exploration within or proximal to the Athabasca Basin in Alberta. These assessment reports and the drill core logs currently on file at the AGS indicate at least 393 holes have been drilled to test for uranium within and proximal to the Athabasca Basin in Alberta. However, there are only 358 drill core logs currently on file at the AGS for these holes; the reason for and the location of the missing 35 logs are unknown. For the 358 holes for which there are drill logs, selected data and information about each hole have been captured in digital format in two Microsoft Excel® spreadsheets; in future these data will be transferred into an Access® or Oracle® database.

In total, there is core in storage at the AGS's Mineral Core Research Facility in Edmonton from 180 of the 393 holes drilled within and proximal to the Athabasca Basin in Alberta (Figure 1). However, the AGS currently has on file only 176 drill core logs; the reason for and the location of the 4 missing core logs are uncertain. The core in storage at the MCRF from the Athabasca Basin region has a combined total length of slightly more than 27,000 m, and can be subdivided into: (a) 1,751.7 m of Devonian core in 60 holes, (b) 17,677.0 m of Athabasca Group core in 147 holes, and (c) 7,644.8 m of Precambrian basement core in 157 holes.

The core from the Athabasca Basin region that now is on file at the MCRF is an important resource for ongoing research into the geology of this economically prospective region (for uranium, and possibly selected other metals and commodities). Re-logging of the Alberta core on file at the MCRF could provide important insights into: (a) regional variations in the Precambrian basement, (b) the variation in lithostratigraphic units, sequence stratigraphy, alteration, and other studies of the Athabasca Group, (c) the potential for the unconformably overlying Devonian strata to contain mineral resources, and (d) depth to bedrock and bedrock topography, which would be important to future exploration in this prospective region of northeastern Alberta.

A detailed and comprehensive study of Athabasca Group core on file at the AGS was started during early 2001, and includes work by: (a) Dr. Paul Ramaekers under contract to the AGS, and (b) a B.Sc. thesis to

be completed in April, 2001 by Ms. B. Kupsch. Both will continue their studies during FY 2001-2002. This work will include a comprehensive report to be issued by Dr. Ramaekers on revisions to the stratigraphy and sedimentary characteristics of the Athabasca Group within Alberta, and a proposed M.Sc. thesis by Ms. Kupsch of core from the uraniferous Maybelle River area that will be completed during mid 2003.


112°
110°
N
59°
58°
84P
Kb
Df
Ds
Dk
Dfv
Dmg
Peace River
Slave River
74M
ARgg
Ag
Ag
ARm
Lake
Athabasca
Fort
Chipewyan
Hl
Ho
Hwu
Dw
Lake
Claire
84I
74L
Hwl
Hfp
SASKATCHEWAN
ALBERTA
DM
Hmf
Athabasca River
Kd
DM
Kc
Km
Ks
Ksh
Kj
Kpl
Kg
Ax
84H
74E
Ag
Bedrock Geology
CRETACEOUS
Mainly clastic sedimentary rocks
DEVONIAN
Mainly carbonate and evaporitic (subsurface) sedimentary rocks
PRECAMBRIAN
Athabasca Group
Mainly clastic sedimentary rocks
Aphebian and Archean Basement
Mainly granitoid and metamorphic rocks
Ag - Granitoids
Ax - Recrystallized Mylonitic Rocks
ARm - High-grade Metasedimentary Rocks
ARgg - Granite Gneiss
Assessment Report Drill Hole
Major Fault
Key Map
Figure 1
Diamond Drill Holes from Uranium-related Assessment Reports, Athabasca Basin, Alberta (1968 to 1990)
25 0 25 km
1:1000000
November, 2000
Bedrock geology simplified from Geological Map of Alberta (Hamilton et al., 1999)
EUB
AGS

# Geochemical Exploration for Kimberlites in Northern Alberta

D. Seneshen (speaker)[1], E. Grunsky[1], A. Rencz[2], G. Hall[2], and C. Dunn3

The 2000 FY geochemical exploration program focused on defining surface geochemical techniques capable of detecting both exposed and buried kimberlite pipes in northern Alberta. The main objective of the program was to identify sample media and analytical techniques that could be used to explore for diamonds and other commodities both on the regional and detailed scales. The long-term goal of the project is to produce a geochemical map of the northern Alberta over the next 10 years.

A total of 806 samples were collected during detailed orientation surveys at (1) Mountain Lake (1 pipe), (2) Buffalo Head Hills (3 pipes), and (3) Birch Mountains (1 pipe). Samples collected over the pipes included aspen bark (n=23), willow twigs (n=23), spruce needles (n=102), A-horizon soil (n=212), B-horizon soil (n=202), C-horizon till (n=196), peat (n=24), and sub-peat sediments (n=24). The sample spacing varied from 25 to 50-m over the pipes and from 50 to 100-m in background areas. The pH of bog water was measured at 50-m intervals near TQ155 in the Buffalo Head Hills. The A-horizon and vegetation samples were processed at the Geological Survey of Canada (GSC) and sent to Acme Laboratories for multi-element analysis (Group 1F, 4A, and 4B), LOI, pH, and conductivity. Peat, sub-peat sediments, B-horizon soil, and C-horizon till were processed at the Alberta Geological Survey (AGS) Laboratory and sent to Acme for Group 1F analysis, pH, and conductivity. Splits of the same B- and C-horizon samples were submitted to Activation Laboratories for Enhanced Enzyme Leach analysis.

A treetop orientation survey was conducted in the Buffalo Head Hills area to test for anomalies over kimberlite pipes using a lower sample density. A total of 205 spruce-top samples were collected at a density of 1 per 4 km2 for 500 km2 over a two-day period. At each site, a GPS coordinate is recorded and the samples are placed in pre-labeled cloth bags. Samples are collected at a rate of 1 every 2 minutes at this sample density, and the cost of such a survey works out to approximately $25/km2. The rationale behind collecting spruce-top samples is that spruce will preferentially concentrate kimberlite indicator elements (e.g. P, Ni, Nb, Au, Rb) in the crowns of the tree.

The encouraging results of the 2000 FY geochemical program are summarized as follows:

1. Magnetic and gravity anomalies could be followed up with high density sampling (1 per 0.01 km2) of spruce-top twigs, ground-level spruce needles, A- and B-horizon soils, or C-horizon till over prospective targets. Spruce-top twigs should be ashed and submitted for Group 1F analysis. Important pathfinder elements for the detection of kimberlite pipes are Au, P, Ni, Nb, and Rb. Spruce needles should be ashed and submitted for Group 1F analysis. Pathfinders that could be spatially correlated with kimberlite pipes are P, Ni, Nb, K, Rb, La, Mn, Fe, and Al. Soils and till should be disaggregated using a mortar and pestle, sieved to -63 μm, and submitted for Group 1F analysis. Important pathfinders in soils and till are Ni, Cr, Nb, Ti, Th, Al, Sc, and REE.
2. Peat-bog sampling is a viable method for the detection of buried kimberlites. Sub-peat sediments should be sieved to +63-250 μm, and submitted for Enhanced Enzyme Leach analysis. Important pathfinders to kimberlites are Ni, La, Th, Al, and Eu. Sieved peat samples (-63 μm) should be

1 Alberta Geological Survey, Alberta Energy and Utilities Board, 4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3 dave.seneshen@gov.ab.ca

2 Geological Survey of Canada (Ottawa, Ontario)

3 Consulting Geochemist (Sidney, British Columbia)

submitted for Group 1F analysis. Significant pathfinders in peat include Ni, Nb, Zr, Y, Ce, and Eu. There may also be H+ anomalies in bog water near buried pipes.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Mineral Exploration Group

# VOLUME OF ABSTRACTS

# APRIL 18 and 19, 2001

**Poster Session**

# Table of Contents

# Peerless Lake Area (NTS 84B) Update on Diamond Indicator Minerals and Geochemistry

M. M. Fenton and J. G. Pawlowicz
Alberta Geological Survey, Alberta Energy and Utilities Board, 4th Floor, Twin Atria Building,
4999-98 Avenue, Edmonton, Alberta, T6B 2X3
mark.fenton@gov.ab.ca or john.pawlowicz@gov.ab.ca

The Peerless Lake map sheet is located in north central Alberta between 56° and 57°N, and 114° and 116°W. The area has three main geomorphic features: the Buffalo Head Hills to the west and the Peerless Lake highland to the east separated by the north-south trending Loon River lowland. The area is overlain with a cover of glacial drift that may be over 200 metres thick and masks much of the bedrock topography. The bedrock consists of Upper Cretaceous aged marine sandstone and shale that is poorly exposed. A small occurrence of preglacial gravel was identified on top of the Buffalo Head Hills.

This poster presents the results of additional diamond indicator mineral and geochemical data obtained from till samples. These data will be part of the final data release this spring of the Quaternary sampling and mapping project for the Peerless Lake map sheet. Indicator minerals were collected from 60 samples, three of which were glaciofluvial sand and the remaining 57 till. Samples consisted of approximately 25 kg of sediment which were processed at the Saskatchewan Research Council laboratory for heavy mineral concentrates and picked for diamond indicator grains. A total of 127 grains were picked and sent to University of Saskatchewan for microprobe analysis. Probe results showed that most of these have chemistries indicative of kimberlite source.

Samples with anomalous number of indicator grains appear to be located in two regions. Firstly, to the northwest in the Buffalo Head Hills a till sample returned 18 kimberlite indicators, which is consistent with the kimberlites discovered in this area by Ashton Mining of Canada. The other area showing higher than average number of grains with good kimberlite chemistries is in the extreme south portion of the map sheet near the Utikima River. Here, two till samples each yielded 6 or more indicators of chrome diopside, G9 chrome pyrope garnet, picroilmenite and olivine. But the most striking anomaly was from nearby sample NAT98-264 of glaciofluvial sand that yielded 47 G9 chrome pyrope garnets, 1 G1 titanium pyrope garnet, 1 G10 low calcium pyrope garnet and 5 olivines. The significance of this number of indicators from a single sample may be compared to an earlier sample collected by Alberta Geological Survey staff in 1995 in the Buffalo Head Hills which produced over 150 pyrope garnets. As it turned out, this site was situated within 500 metres of a kimberlite that was later discovered by Ashton. This many kimberlite indicators gives a strong suggestion of a nearby source.

The area north of Peerless Lake shows a number of the till samples containing one or two indicators in close proximity. This area is now known to have at least 3 kimberlites that were recently discovered by Ashton, which however are buried by more than 100 metres of drift.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Peerless Lake Area (NTS 84B) Bedrock Topography and Drift Thickness

M. M. Fenton and J. G. Pawlowicz
Alberta Geological Survey, Alberta Energy and Utilities Board, 4th Floor, Twin Atria Building,
4999-98 Avenue, Edmonton, Alberta, T6B 2X3
mark.fenton@gov.ab.ca or john.pawlowicz@gov.ab.ca

The Peerless Lake map sheet is located in north-central Alberta between 56° and 57°N, and 114° and 116°W. The area has three main geomorphic features: the Buffalo Head Hills to the west and the Peerless Lake highland to the east separated by the north-south trending Loon River lowland. The entire area is overlain with a cover of glacial drift that masks much of the bedrock topography. The underlying bedrock consists of Upper Cretaceous aged marine sandstone and shale that is poorly exposed. A small occurrence of preglacial gravel was recognized on top of the Buffalo Head Hills.

The bedrock topography and drift thickness have been derived from a synthesis of data collected from energy exploration holes, groundwater test holes, kimberlite exploration holes and from a few Alberta Geological Survey auger core holes drilled in 1997 and 1998 during this investigation. Data were used from about 400 drillholes. The output of this investigation is the release of 1:250,000 scale maps of the bedrock topography and drift thickness.

The present day surface topography represents a subdued aspect of the underlying bedrock topography. Areas of thick glacial sediments are masking older drainage systems. Two major buried channels have been recognized. A north-south trending channel through the Loon River Lowland has drift thickness of over 200 metres in places. This channel orientation may be influenced by a structural weakness in the bedrock identified by Eccles and others in their kimberlite studies of the region. Another major buried channel trends from the Wabasca region in the southeast towards Lubicon Lake in the west. This channel also reaches a depth of over 200 metres and appears to be the western extension of the Wiau channel, that continues eastward into Saskatchewan and contains the largest known drift aquifer in Alberta.

Drift thickness is generally much thinner on the Buffalo Head Hills and in a few of the kimberlite locations in the hills, bedrock is exposed at surface. The Peerless Lake Highland shows a more extensive cover of thicker drift however, in places >100 metres. The hilly upland area in the southwest portion of the map sheet along Tp 82 contains moderately thick drift of generally <100 metres.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Surficial Geology and Till Geochemistry of the Pelican Area (NTS 83P): A Preliminary Report

J. E. Campbell, M. M. Fenton, J. G. Pawlowicz, J. A. Weiss and M. Price,
Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
janet.campbell@gov.ab.ca

April 2000 marked the start of a new multiyear program initiative by the Minerals Section of the Alberta Geological Survey focusing on the surficial geological mapping and Quaternary stratigraphy of northern Alberta. At present, approximately 70% of northern Alberta remains unmapped with respect to the surficial geology, and very little is known about the glacial. The main objective of this program is to provide basic Quaternary geological information essential to mineral exploration, energy development, and resource management in northern Alberta.

This year's work focused on the Pelican area (NTS 84P). The project consists of several components: mapping of the surficial sediments, collecting of till samples for geochemical and diamond indicator analyses, stratigraphic testhole drilling, and compilation of drift thickness and bedrock surface topography data.

This presentation will focus on the preliminary results of the surficial geological mapping and till geochemical sampling components of the project resulting from this summer's investigations.

Some of the highlights are:

- Surficial geology in the Pelican area is different from other areas we have mapped in northern Alberta: i.e. glaciofluvial and/or glaciolacustrine cover is much more extensive.
- Multiple till deposits were encountered in exposures and in stratigraphic testholes.
- There is regional variation in till composition reflecting variations in provenance.
- Significant areas of glacio-tectonic deposits such as thrust ridges containing deformed bedrock, and glacial excavated depressions with associated hummocky deposits (hill-hole pairs) have been identified.
- Glacial tills which are rich enough in bitumen to give off a distinctive odor were discovered in new surface excavations and test holes in both the Pelican and Peerless study areas.
- Multiple ice flow directions have been documented.
- Evidence of local late stage ice re-advance has been documented in several localities.
- Confirmation that there is an extensive cover of quartzite-rich gravel over the Pelican Mountains (Tertiary?).
- Discovery of glacially crushed preglacial gravel in the Avenir pit southeast of Wandering River .
- Discovery that the Wapiti Formation extends further southeastward from the Pelican Mountains than had previously been known.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Pelican Area (NTS 83P) Bedrock Topography, Drift Thickness and Stratigraphy

J. G. Pawlowicz, L. D. Andriashek, M. M. Fenton and J. E. Campbell,
Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
john.pawlowicz@gov.ab.ca

Bedrock topographic and drift thickness maps provide valuable information on such aspects as: depth to bedrock and morphology of the bedrock surface, thickness and nature of the drift cover which may affect geophysical surveys, location of buried aquifers and that are sources of groundwater, and drill casing depths. Stratigraphic information of the glacial sediments in conjunction with surficial geological mapping is needed to understand the glacial history of the region. For this study was collected from six auger core holes and seven rotary core holes drilled during 1999 and 2000. The majority of data however, used for making the bedrock surface picks come from preexisting groundwater and energy drill hole data. The output of this investigation is the release of 1:250,000 scale maps of the bedrock topography and drift thickness.

The Pelican map sheet is located in north-central Alberta between 55° and 56°N and 112° and 114°W. The main physiographic features are the east-west trending Pelican Mountains and May Hill highland. To the northwest in the Wabasca area the land surface drops away to a broad lowland. The present day Athabasca River cuts a deep incision along a north-south line and in the southwest corner of the map sheet. Calling Lake, which is the largest lake in the area is located south of the Pelican Mountains and interestingly, as reported by industry, contains an anomalously high number of diamond indicator minerals.

The region is underlain by bedrock of Cretaceous age. Preglacial gravel, likely of Tertiary age cap the highest portions of the Pelican Mountains. Glacial sediments mask the entire map sheet with drift thickness ranging from a few metres on the highlands to over 200m in the buried channels. Buried channels form the most dramatic aspect of the bedrock topography and two major channels have been recognized. The Wiau channel located north of May Hill is >200 metres deep and trends towards Wabasca in the northwest. Another major channel extends from Wandering River towards the northwest where it intersects the Wiau channel west of the Athabasca River. These channels are characterized by deeply buried preglacial and glaciofluvial sediments overlain by lacustrine sediments and till. Core data has revealed a paleo-weathered surface in the till, which provides strong evidence of a nonglacial interval separating two glacial advances. Stratigraphic correlations in the drift are being made using geochemical and geophysical log data. Early indications are that concentrations of some elements correspond to geophysical log signatures in the till.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Pelican Area (NTS 83P) Quaternary Stratigraphy and Geochemistry

J. G. Pawlowicz, M. M. Fenton and J. E. Campbell,
Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
john.pawlowicz@gov.ab.ca

This poster compliments the others focusing on the Pelican map area. The area is covered by drift ranging in thickness from a few meters to >200m (see accompanying poster of drift thickness and bedrock topography). Data on the stratigraphy comes from six auger cores holes and seven rotary core holes drilled during 1999 and 2000 together with preexisting logs from groundwater and energy drill holes. The longest records were from holes drilled in the deep preglacial channels.

During the drilling the core was logged, photographed and placed in core boxes. Each of the rotary holes was geophysically logged immediately after drilling. Subsequent laboratory analyses of core samples focused primarily on the till, although a few were run on bedrock and lacustrine samples. The samples collected were lightly crushed and sieved to recover the <0.063 mm fraction. This fine matrix fraction was sent to an external lab for geochemical analysis which consisted of total digestion then analysis by NAA and ICP-AES followed by ICP-MS. These procedures analyzed for Au, Ag, Al, As, Ba, Be, Bi, Br, Ca , Cd, Ce, Co, Cr, Cs, Cu, Eu, Fe, Ga , Ge , Hf, Hg, In, Ir, K, La, Li, Lu, Mg , Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Sb, Sc, Se, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti , Tl, U, V , W, Zn and Zr.

The coring recovered a variety of sediment types and added substantially to our understanding of the geology of the region. The discovery of a buried weathering surface in two of the coreholes proves that the continental glaciers advanced over the region at least twice with an extensive nonglacial interval between the two ice advances. Core recovered from a rotary hole near Sandy Lake, in the northwest part of the area, revealed a thick sequence of lacustrine clay and silt (55 m) underlying till. This reveals the presence of a substantial glacial lake, perhaps ponded against the Pelican Mountains? The subsurface data also proves that Wiau buried channel (>140m deep) extends northwest from Athabasca River into the Wabasca region thus greatly extending distribution of the largest aquifer in Alberta. This aquifer already furnishes water for energy development in the Winifred region to the east. Over two metres of coal were intersected in an auger corehole drilled in the southwest portion of the area east of Hondo. We are presently uncertain if this coal is in place or perhaps transported to that site by glacial tectonism.

At the time this abstract was prepared the geochemical data had just been received form the lab. A preliminary glance shows that the geochemistry of the till units varies with depth. Some elements vary relatively more than others. These may be useful in defining till units that can be correlated through the area.

EUB
Alberta Energy and Utilities Board

AGS
Alberta Geological Survey

# Pelican Area (NTS 83P): Application of Digital and GIS Technologies to Quaternary Geological Mapping

J.A. Weiss, E.J. Waters, M.C. Price, J.G. Pawlowicz, and J.E. Campbell, M.M. Fenton
Alberta Geological Survey, Alberta Energy and Utilities Board, 4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
jill.weiss@gov.ab.ca, joan.waters@gov.ab.ca

The Alberta Geological Survey has implemented a new digital mapping strategy in order to meet its objectives to complete the Quaternary mapping of the northern half of the province over the next decade. Modern mapping technologies and their associated tools will enable geologists to prepare integrated digital products including maps, reports and databases. At the same time, these new tools facilitate AGS's long-term goal to produce a comprehensive data store that can be leveraged both by other AGS scientific teams and the public.

This past summer, the Quaternary team initiated the new methods while mapping the Quaternary geology and stratigraphy of the Pelican map area (NTS 83P). As the digital environment is logistically more complicated than paper based methods, preparation for data capture begins well before geologists enter the field. Steps to develop the preliminary Pelican digital map include: 1) transfer of air photo interpretation of the surficial geology onto transparent basemaps (i.e. basemaps plotted on film); 2) scanning of air photo interpretation markups into image format (.TIF); 3) georeferencing and digitizing of the scanned images in "heads-up" mode using ArcInfo software. Three types of features are digitized into ArcInfo coverage format from the air photo interpretation: polygons of the Quaternary lithologic unit boundaries; lines representing such geographic features as eskers and drumlins; and point features such as dunes and kettles. Each feature is also tagged with attribute information. Satellite imagery and provincial base map data coupled with the digital air photo interpretation provides a comprehensive base map to "ground truth" in the field.

Armed with GPS, digital cameras, Palm IIIxe hand-held computers, and laptops geologists enter the field. Site information is collected using the GPS units and Palm IIIxe. Spatial data from the GPS, site and sample descriptive information from the Palm and digital photos are uploaded to the MSAccess database each evening, in a format ready to display and query in ArcView. These point data, together with drilling information, are used to incorporate field observations into the digitized air photo interpretation to produce the final map. In future, the digitized air photo interpretation will be used with ArcView in the field so that changes resulting from field checking can be made on the spot. In the fall, geologists return to the office with products that extract more easily into publishable formats:drilling lithologs and database, surficial site database, and ArcView coverages. After verification, final cartographic maps are prepared using ArcView and MCAD Contour.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Update on Alberta Mineral Assessment Reporting and Core at the AGS

T. Berezniuk and R. W. Natyshen, Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
tim.berezniuk@gov.ab.ca or rob.natyshen@gov.ab.ca

In 2000 twenty-six assessment reports were filed on 1300 permits and covered an area of 10,707,204 hectares. The combined value of the reports was $16,605,536. The reported exploration in 2000 focused on: diamonds 9,727,765 ha and $9,218,838; gold and precious metals 828,632 ha and $7,295,209; limestone 8592 ha and $46,560; bentonite 142,215 ha and $44,929. Assessment reports become public one year after filing. Some of the most recent reports to become public will be on hand at the poster display and also a list of reports produced since 1986 will be available. Assessment reports can be viewed at the Alberta Geological Survey (AGS) Library. Copies of the reports may be purchased at AGS Information Sales[1].

One condition of the Metallic and Industrial Minerals Regulations is the submission of core drilled during exploration. Core is selected in consultation with the AGS and sent by the company to the AGS Mineral Core Research Facility (MCRF) in Edmonton. The MCRF contains ~45,000 meters of mineral core for use by industry or the scientific community. In 2000 one hundred and thirty four holes were drilled totaling 8,397 metres of which 6,188 metres of core were submitted to the MCRF. Core can be viewed and sampled at the MCRF one year after the assessment work for the drilling is filed. A current list of core submissions will be available at the poster session and some core, including kimberlites, will be displayed.

[1]Alberta Geological Survey (Library; Information Sales), Phone: (780) 422-3767; Fax: (780) 422-1918, Internet: http//www.ags.gov.ab.ca

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Digital Compilation of Structural Elements in Northern Alberta - A New Tool for Mineral Exploration.

Pana, D., Waters, E. J., Grobe, M.,
Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
dinu.pana@gov.ab.ca

Exploration for a wide range of mineral deposits is critically dependent on knowledge of the location and age of fractures, which may have acted as pathways and traps for mineralizing fluids and favoured kimberlite emplacement. As a first step to aid government and industry in their efforts to better target possible occurrences of non-energy minerals in the province, a regional compilation of the known and interpreted subsurface and surface structural features in the Peace River Arch region in northwestern Alberta was recently initiated.

The east-northeast trending subsurface geological structure, traditionally called the Peace River Arch (PRA), dominates the Phanerozoic geological evolution of northwestern Alberta.

The present digital compilation of structural features in the Peace River Arch area is an innovative approach in both handling and delivering geological information. The literature search resulted in a list of references that consists of approximately 300 titles of articles and abstracts, and includes 19 Ph.D., M.Sc. and B.Sc. theses. Lineaments from various literature sources (digital and non-digital) were compiled digitally into ArcView® layers (i.e., shapefiles), individually tagged and linked to a Microsoft Access® database. The database includes attribute information for each line feature, such as reference, author's criteria for inferring a fault's existence, formation(s) affected, fault type, orientation of fault plane, and AGS comments. The shapefiles containing the compiled and inferred faults/lineaments and their attributes are distributed on a CD-ROM with the free ArcExplorer® software. In addition, the CD-ROM includes a comprehensive reference list arranged in chronological order from 1958 to 2000.

The digital format provides a flexible structure capable of incorporating additional information and allows various options for data selection based on such query criteria as location, timing, orientation and authorship. The product is envisioned as an open, flexible structure allowing for continuous updates and refinements. Time constraints required careful selection and prioritization of sources to be converted to GIS format. Consequently, the user should be aware that other structures have been described in the geological literature but have not yet been included in the database. At this stage the digital compilation includes a total of 518 faults captured from published isopach and structural maps for various stratigraphic intervals in the subsurface of northern Alberta. As well, it includes a total of 294 lineaments derived from facies and/or thickness changes that are depicted on maps in the Geological Atlas of the Western Canada Sedimentary Basin (Mossop and Shetsen, 1994), areas tentatively interpreted by the authors to be structurally controlled, and a large number of lineaments derived from satellite images.

Users should keep in mind that faults, while represented as lines on a map, are frequently more zonal in nature. A fault plotted on a map as a line may in fact be a shear zone and/or fault zone on the order of several kilometres wide. The lineaments captured in this compilation are positioned with an accuracy of about the same order of magnitude as that of the original source materials. An example of appropriate use of the Peace River Arch compilation data might be that, where a fault or an intersection of faults can be inferred to have economic potential, this should be regarded as a zone of interest for further more focused investigation, not as an immediate drilling target.

**Digital Compilation of Structural Elements in Northern Alberta**

In order to facilitate understanding of the geological significance of the compiled structural features an accompanying digital report (PDF document on CD-ROM) provides an overview of the Late Proterozoic to Recent tectonostratigraphic evolution of northern Alberta. Aspects that may be relevant for both energy and non-energy minerals are addressed, with particular emphasis on exploration for sediment-hosted mineral deposits within each tectonostratigraphic phase.

This work may inspire further comprehensive multidisciplinary studies of relationships between tectonics and mineral occurrences. The rewards can be expected to be more than just academic, because energy and non-energy minerals are still waiting to be discovered and produced in Alberta.

EUB
Alberta Energy and Utilities Board

AGS
Alberta Geological Survey

# Geochemical Exploration for Kimberlites in Northern Alberta

D. Seneshen (speaker)[1], E. Grunsky[1], A. Rencz[2], G. Hall[2], and C. Dunn[3]

1. Alberta Geological Survey, Alberta Energy and Utilities Board, 4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3 dave.seneshen@gov.ab.ca
2. Geological Survey of Canada (Ottawa, Ontario)
3. Consulting Geochemist (Sidney, British Columbia)

The 2000 FY geochemical exploration program focused on defining surface geochemical techniques capable of detecting both exposed and buried kimberlite pipes in northern Alberta. The main objective of the program was to identify sample media and analytical techniques that could be used to explore for diamonds and other commodities both on the regional and detailed scales. The long-term goal of the project is to produce a geochemical map of the northern Alberta over the next 10 years.

A total of 806 samples were collected during detailed orientation surveys at (1) Mountain Lake (1 pipe), (2) Buffalo Head Hills (3 pipes), and (3) Birch Mountains (1 pipe). Samples collected over the pipes included aspen bark (n=23), willow twigs (n=23), spruce needles (n=102), A-horizon soil (n=212), B-horizon soil (n=202), C-horizon till (n=196), peat (n=24), and sub-peat sediments (n=24). The sample spacing varied from 25 to 50-m over the pipes and from 50 to 100-m in background areas. The pH of bog water was measured at 50-m intervals near TQ155 in the Buffalo Head Hills. The A-horizon and vegetation samples were processed at the Geological Survey of Canada (GSC) and sent to Acme Laboratories for multi-element analysis (Group 1F, 4A, and 4B), LOI, pH, and conductivity. Peat, sub-peat sediments, B-horizon soil, and C-horizon till were processed at the Alberta Geological Survey (AGS) Laboratory and sent to Acme for Group 1F analysis, pH, and conductivity. Splits of the same B- and C-horizon samples were submitted to Activation Laboratories for Enhanced Enzyme Leach analysis.

A treetop orientation survey was conducted in the Buffalo Head Hills area to test for anomalies over kimberlite pipes using a lower sample density. A total of 205 spruce-top samples were collected at a density of 1 per 4 $km^2$ for 500 $km^2$ over a two-day period. At each site, a GPS coordinate is recorded and the samples are placed in pre-labeled cloth bags. Samples are collected at a rate of 1 every 2 minutes at this sample density, and the cost of such a survey works out to approximately \$25/$km^2$. The rationale behind collecting spruce-top samples is that spruce will preferentially concentrate kimberlite indicator elements (e.g. P, Ni, Nb, Au, Rb) in the crowns of the tree.

The encouraging results of the 2000 FY geochemical program are summarized as follows:

1. Magnetic and gravity anomalies could be followed up with high density sampling (1 per 0.01 $km^2$) of spruce-top twigs, ground-level spruce needles, A- and B-horizon soils, or C-horizon till over prospective targets. Spruce-top twigs should be ashed and submitted for Group 1F analysis. Important pathfinder elements for the detection of kimberlite pipes are Au, P, Ni, Nb, and Rb. Spruce needles should be ashed and submitted for Group 1F analysis. Pathfinders that could be spatially correlated with kimberlite pipes are P, Ni, Nb, K, Rb, La, Mn, Fe, and Al. Soils and till should be disaggregated using a mortar and pestle, sieved to -63 μm, and submitted for Group 1F analysis. Important pathfinders in soils and till are Ni, Cr, Nb, Ti, Th, Al, Sc, and REE.

2. Peat-bog sampling is a viable method for the detection of buried kimberlites. Sub-peat sediments should be sieved to +63-250 μm, and submitted for Enhanced Enzyme Leach analysis. Important pathfinders to kimberlites are Ni, La, Th, Al, and Eu. Sieved peat samples (-63 μm) should be submitted for Group 1F analysis. Significant pathfinders in peat include Ni, Nb, Zr, Y, Ce, and Eu. There may also be H+ anomalies in bog water near buried pipes.

# Steen River meteorite impact structure: A prospective target for Hydrocarbons, And possibly Metallic Minerals or Diamondiferous Kimberlites

B. Molak* (AGS), R.A. Olson (AGS) and S. Balzer (Caithness Consultants)
c/o Alberta Geological Survey, 4th Floor, Twin Atria Building,
4999-98th Avenue, Edmonton, Alberta, T6B 2X3
boris.molak@gov.ab.ca, reg.olson@gov.ab.ca, s.balzer@home.com

The Steen River Structure (SRS) has been the focus of several research studies and exploration programs since its discovery in the 1960's. Situated in northwest Alberta, the SRS lies about 115 km north of High Level along the western border of NTS map sheet 84N (Figure 1). Lacking a surface expression, the SRS is buried by over 200 m of Cretaceous to Recent sedimentary units, but is reasonably well defined by its aeromagnetic signature (Figure 2).

The origin of the SRS has been somewhat equivocal. In general, the similarity of its structural geometry, stratigraphy and breccia unit to other known meteorite impact features has supported an extraterrestrial (astrobleme) origin. However, some prior workers based on geophysical surveys and intrusive magmatic-appearing core from drilling programs, have suggested the possibility the structure is in whole or in part a volcanic cryptoexplosion feature.

In early 2000, New Claymore Resources Ltd. drilled 3 diamond core holes (STOO1 to STOO3; Figure 2) at the SRS to test 3 discrete aeromagnetic anomalies that were considered possibly related to kimberlitic or ultramafic diatreme emplacement. The stratigraphy in each hole comprises: overburden (ranging from 9.1 m to 18.3 m in depth), Cretaceous strata (ranging from 224.0 m to 275.6 m in thickness), and a nonconformably underlying heterolithic, medium- to greenish 'ultramafic appearing' breccia that continues to end-of-hole (~252.1 m to 389.2 m) in each of the 3 holes, except ST003 in which the breccia ends about 362.7 and from their to EOH at 377.4 m the underlying lithology is Precambrian granitoid and gneiss. Many shock-metamorphic features exist, including: cataclastized rocks and mineral grains, planar deformation lamellae, diaplectic glass, kink bands in biotite and ubiquitous vitrification.

Results from the AGS study confirm that the SRS breccia is primarily of meteorite impact origin (Figure 3). Although portions of the core visually resembles a kimberlitic ultramafic intrusive rock, the detailed mineralogy, petrography and chemical composition show that it clearly is not, but instead it is predominantly a meteorite impact breccia, or suevite. The suevite breccia in places comprises a magmatic melt phase, but this magmatic appearing lithology is a result of impact shock and heat, and not deep-seated intrusive magmatic activity. The result of this research is soon to be published as AGS Earth Science Report 2001-04.

The SRS is well known to be an attractive target for hydrocarbon exploration, and exploitable hydrocarbon resources have been found in several places. However, the economic potential of the SRS to host or have spatially associated metallic mineral deposits or diamondiferous kimberlites remains enigmatic and uncertain.


**Figure 1: Location, Steen River Structure (SRS)**

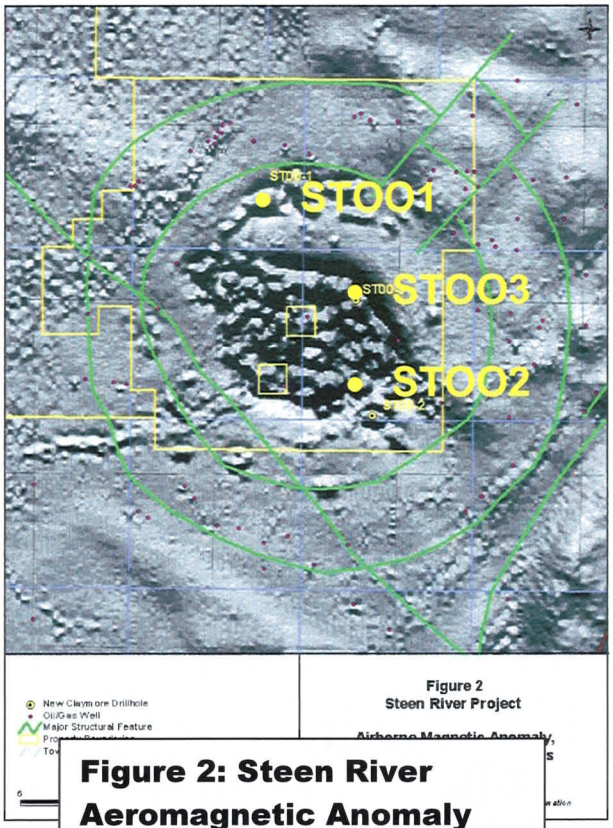



**Figure 2: Steen River Aeromagnetic Anomaly**

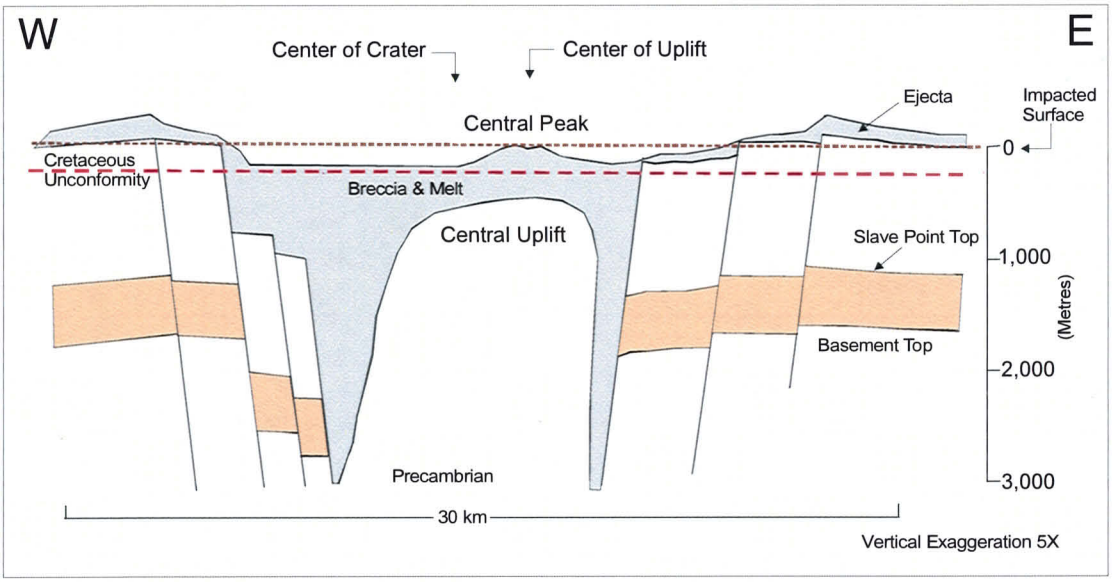



**Figure 3: Schematic Cross-Section through the Steen River Structure (after Hildebrand, 2000)**

# A Comprehensive Conceptual Model for the Pine Point Pb-Zn Ore District, NWT

J. J. Adams, K. Muehlenbachs, B. J. Rostron, and C. A. Mendoza
Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB
Jennifer.adams@gov.ab.ca

A variety of conceptual models have been proposed to explain MVT mineralization at Pine Point, NWT due to contradictory age dates, undefined metal sources, irreconcilable $\delta^{34}S$ values and many potential flow systems. Definition of a comprehensive metallogenic model for Pine Point will facilitate future MVT exploration strategies including studies conducted at the margins of the Alberta basin.

This study shows that stable isotopic and fluid inclusion analyses of hydrothermal carbonate gangue minerals associated with Pine Point ore constrain the age of mineralization, regional flow paths and evolution of parent fluids, metals, and S. Saddle dolomites, deposited by ore-forming fluids, record gradual enrichment of δD values from -111 to -53‰ VSMOW along the Presqu'ile barrier. $\delta^{18}O$ values of saddle dolomites record a gradual depletion in parent fluid composition along the barrier, however at Pine Point, the parent fluids became 2.5‰ SMOW more enriched in $^{18}O$. Similarly, salinities of fluid inclusion waters increase 10 to 15 eqv. wt% NaCl just west of Pine Point. The dramatic shift in isotopic composition and salinity delineates a mixing zone around Pine Point. This is supported by δD values of Pine Point saddle dolomite inclusion waters (-88 to -110‰) that are 30‰ more depleted than the nearest samples along the barrier.

The depleted δD values suggest that Cretaceous meteoric waters (-160 to -170 ‰) mixed with Devonian brines (approx. -50‰) during a topography-driven flow system associated with the Laramide Orogeny. Stable isotopic signatures of saddle dolomites also document mixing of two distinct fluids at Pine Point: a highly saline, $^{18}O$-enriched, D-depleted fluid and a moderately saline, $^{18}O$-depleted, D-enriched fluid. Non-equilibrium ore textures suggest that metals and sulphur were transported separately to the ore district. Metal-bearing veins in Precambrian basement and lithogeochemical analyses of basement rocks underlying Pine Point indicate that metals were sourced from the basement. This finding is supported by the similarity of solute chemistry of fluid inclusions at Pine Point and basement fluids. Excess S in fluid inclusions and evidence for transport of dissolved $H_2S$ out of the deep basin indicate that reduced S may have moved along the barrier to Pine Point. Stable isotopic compositions and solute chemistry of barrier and Pine Point fluid inclusions point to mixing at Pine Point of highly saline, metal-bearing fluids from the basement, and $H_2S$-bearing barrier fluids from downdip sour gas fields.

World-wide formation dates of Pb-Zn ore districts are coincident with orogenic activity adjacent to their parent sedimentary basins. This correlation is thought to reflect the development of regional topography-driven flow systems in response to tectonic uplift along the orogenic belt. The Pine Point system also demonstrates that orogenic activity initiates thermochemical sulphate reduction at maximum burial conditions prior to uplift. Concomitantly, the transition from compressional to extensional stress regimes during uplift may have reactivated basement faults in the Pine Point area, allowing for basement fluids to move into the ore district.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Petrography of the Mountain Lake Pipe, Grande Prairie, Alberta, Canada

Andrzej (Andrew) Skupinski[1] and C. Willem Langenberg[2]

1. Tatra Mineralogical Ltd., 228 Ranchlands Court NW, Calgary, Alberta T3G 1N9 tatramin @cadvision.com
2. Alberta Geological Survey, Alberta Energy and Utilities Board willem.langenburg@gov.ab.ca

Twelve samples rich in altered juvenile olivine from the Mountain Lake Pipe (holes ML95-1 and ML95-3) were studied for texture and mineralogy. Contrary to an earlier interpretation that Mountain Lake Pipe rocks are entirely extrusive crater-facies products, all of the samples studied show olivine pellets and evidence of pelletal nucleation, both of which are characteristic of diatreme-facies kimberlite. Rocks of the Mountain Lake Pipe show a mixed origin and have been tentatively classified as hybrid alkaline ultramafic rocks, with some petrological affinities to alnoitic magmas. Despite the occurrence of such diamond indicator minerals as garnet (G5, G9, G11), chrome diopside, chromite and picro-ilmenite, which indicate contribution of a kimberlitic component, the economic potential of the rocks as a diamond source is estimated as low.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Structural Emplacement Model for Kimberlitic Diatremes in Northern Alberta

D. Roy Eccles, Eric C. Grunsky, Matthias Grobe and Jill Weiss
Alberta Geological Survey, Alberta Energy and Utilities Board, 4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
roy.eccles@gov.ab.ca

A study to evaluate structural controls on the Buffalo Head Hills kimberlites in the Peerless Lake area of north-central Alberta was initiated because of the recognition of a set of north-trending lineaments that appear to be spatially correlated with the orientation of the Loon River lowlands, irregularities in the Phanerozoic sedimentary cover, and the emplacement of several kimberlitic diatremes. The combination of aeromagnetic and Radarsat imagery, draped on a digital-elevation model, clearly depicts the relationship between kimberlite intrusions and the intersection of north- and northeast-trending fault sets observed at surface.

A structural-emplacement model constructed for the Buffalo Head Hills kimberlites is consistent with worldwide examples in which kimberlite diatremes are associated with Phanerozoic grabens that result from the frequent transcurrent and/or extensional reactivation of a deep-seated mobile zone.

The Precambrian basement in the Peerless Lake area has been greatly modified by a long tectonic history. The contact between the Buffalo Head and Utikuma subdomains of the Buffalo Head Terrane is inferred to represent a deep-seated crustal feature (mobile zone) due to the presence of

- a differentiated horst-and-graben block structure indicative of crustal uplift;
- sharply defined, north-trending lineaments of deformed Precambrian surface and pronounced elongated, linear aeromagnetic signatures that suggest dominant structural controls;
- localized geothermal patterns and retrograde metamorphism;
- a distinct north-trending gravity low that may be associated with deep-seated topographic displacement and/or granite plutonism; and
- low ? 18O values, similar to those reported from the Kimiwan Anomaly, which are believed to be indicative of extensional tectonism.

A basement to surface cross section (approximately 1600 m), orientated west to east in the study area, shows that the Phanerozoic strata in the Peerless Lake area have been affected by structural events throughout its depositional history. The locations of three north-trending, steeply dipping, normal faults were identified. The faults appear to propagate through the entire Phanerozoic and possibly provided important pathways for the emplacement of kimberlitic diatremes. Extensional reactivation events likely occurred during the Paleoproterozoic, Middle to Late Devonian, and Late Cretaceous. During deposition of Middle to Late Devonian Woodbend and Winterburn sedimentary rocks, the faults defined the boundaries of a graben structure that coincides with the boundaries of the Loon River lowlands and has been informally named the Loon River graben. The main border fault, located on the western edge of the Loon River graben, correlates with the north-trending parallel fault sets that exist at surface.

The authors speculate that the regional distribution of the known Buffalo Head Hills kimberlites is controlled by the extension of deep, north-trending basement fault zones at the regional scale. It is further

speculated that northeast-trending faults have significant impact on the location and shape of specific kimberlite bodies. To date, advanced bulk-sample testing of selected kimberlites for diamonds has occurred mainly on the western edge of the graben. This work may support the conclusion, drawn from other studies, that the most significant diamond concentrations occur on the main border fault or western shoulder of the graben.

This study shows that surficial lineaments in Cretaceous strata can direct exploration companies to tectonic zones in the Phanerozoic and basement, and therefore to potential conduits for kimberlites and metalliferous hydrothermal systems. Furthermore, the structural features at the exposed surface of the Phanerozoic stratigraphic sequence reflect a complex tectonic history that extends as far back as the early Proterozoic.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# Mineral Aggregate Information: Plans and Digital Products

W.A.D. Edwards, M.C. Price, E.J. Waters, T. Berezniuk, D.K. Choa
Alberta Geological Survey, Alberta Energy and Utilities Board, 4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3

Sand and gravel is the primary source in Alberta for mineral aggregate. Aggregate is essential in developing the transportation infrastructure in the province, particularly in northern Alberta, and supporting other industrial growth such as energy, forestry and mining. Understanding the availability and longevity of gravel and sand supplies is critical, particularly as mining of aggregated is a major surface disturbance incompatible with other important land uses. The Alberta Geological Survey (AGS) is a key supplier of information to government for land and resource management.

The AGS mapped 18% of Alberta, at a map scale of 1:50 000, between 1976 and 1983 and mapped another 35% of the province, at a scale of 1:250 000, between 184 and 1990. The information generated from this mapping is published in 143 maps and 17 reports (~4500 deposits). Recent stakeholder feedback indicates a continuing need for this aggregate information (1500 publications purchased last 5 years) and a desire by most clients for digital data.

The AGS is planning to create a digital database of deposit locations and estimates of material type from this existing information. The digital data will be distributed on CD-ROM where it can be viewed using Environmental Systems Research Institute's ArcExplorepÒ, a free geographic data viewer. Digitizing has started and a prototype, containing data from six 1:250 000 map areas, will be demonstrated at the Calgary Mining Forum. The CD will be inexpensive and provide the private sector and government with a comprehensive, integrated digital source of sand and gravel information for management, planning and exploration. The completed CD, with full coverage of existing data, should be on sale by March 2003.

Our second long-term goal is to map the outstanding, unmapped portion of the province over the next 10 years. All information gained through this new mapping will be added to the CD and a revised version distributed annually.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey

# The Use of Multibeam Radarsat for Mapping Geologic Structures and Surface Morphology

E. C. Grunsky, Alberta Geological Survey, Alberta Energy and Utilities Board,
4th Floor, Twin Atria Building, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3
eric.grunsky@gov.ab.ca

The geology of the northern part of Alberta is largely unmapped. As part of a mapping strategy, the Alberta Geological Survey (AGS) acquired multibeam Radarsat 1 satellite imagery for extracting features associated with geologic structure and surficial processes.

During the period September to November 1999, a total of 280 scenes of Radarsat1 Standard Beam modes S1 and S7 were captured for both ascending and descending passes. Autumn was chosen in order to minimize the effect of vegetation and to maximize microwave reflectance from the ground surface.

Standard Beam Mode 1 (S1) is useful for interpreting areas of low or gently rolling relief. Standard Beam Mode 7 (S7) is commonly used for interpretation in areas of high relief. By combining these two beam modes in both ascending and descending directions, a range of features can be described by contrasts between the responses of the two beam modes.

A process of orthorectification followed by the application of a Gaussian smoothing filter and principal components analysis on four images (S1 ascending/descending, S7 ascending/descending) reveals distinctive features, which assist in the discrimination of surface topography, geologic structure, drainage patterns and surface moisture content.

The Winnefred Lake area in northeastern Alberta is underlain by the Western Canada Sedimentary Basin (WCSB); a thick sequence of Phanerozoic carbonate and clastic sequences which is overlain by a glacial till of varying thickness. The region is host to major oil and gas deposits. Processing the multi-beam Radarsat 1 images of the Winnefred Lake area show features associated with glaciation and geologic structure related to tectonic processes and possible qualitative measures of variation in the water saturation of the ground surface.

EUB Alberta Energy and Utilities Board | AGS Alberta Geological Survey