Geological Survey of Canada
Commission géologique du Canada

PAPER 86-8

# CURRENT ACTIVITIES FORUM 1986 PROGRAM WITH ABSTRACTS

1986

Canada

GEOLOGICAL SURVEY OF CANADA
PAPER 86-8

# CURRENT ACTIVITIES FORUM 1986
# PROGRAM WITH ABSTRACTS

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

1986

Available in Canada through

authorized bookstore agents and other bookstores

or by mail from

Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Canada K1A 0S9

and from

Geological Survey of Canada offices:

601 Booth Street
Ottawa, Canada K1A 0E8

3303-33rd Street N.W.,
Calgary, Alberta T2L 2A7

100 West Pender Street
Vancouver, British Columbia V6B 1R8
(mainly B.C. and Yukon)

A deposit copy of this publication is also available
for reference in public libraries across Canada

Cat. No. M44-86/8 Canada: $4.00
ISBN 0-660-53137-2 Other countries: $4.80

Price subject to change without notice

# CURRENT ACTIVITIES FORUM

# 21-23 JANUARY, 1986

**1986 Forum Chairman**

**J.C. McGlynn, Director, Precambrian Geology Division**

**Place:** Halls A and E, Ottawa Congress Centre, 55 Colonel By Drive, Ottawa.

**Non-Technical Event:** An informal get-together with cash bar on Wednesday afternoon (22 January) from 1600h to 1900h.

**Popular Lecture:** At 1930h on the evening of Tuesday, 21 January. D.J. McLaren will present a talk entitled "Meteorites, Comets, and Dinosaurs". The poster sessions will be open from 1930h to 2100h.

**Program:** About 50 poster sessions and 18 formal presentations.

# PROGRAM / PROGRAMME

**Wednesday, 22 January 1986 / *Mercredi, le 22 janvier 1986***

| | | |
|---|---|---|
| 0900 – 0915 | R.A. Price, J.G. Fyles | Welcome and opening remarks / *Accueil et allocution d'ouverture* |
| 0915 – 0940 | J.P. Grotzinger | Evidence for Early Proterozoic foredeep subsidence and sedimentation: a new interpretation of the Kilohigok basin, Northwest Territories |
| 0940 – 1005 | S. Hanmer | The Great Slave Lake Shear Zone, NWT; southeast boundary of the Slave Craton |
| 1005 – 1010 | | **Official Opening of Poster Sessions / *Ouverture officielle de la salle des exposants-chercheurs*** |
| 1010 – 1035 | | **Coffee break / *Pause-café*** |
| 1035 – 1100 | R. Stephenson | The Peace River Arch project |
| 1100 – 1125 | G. Stockmal | Regional tectonic implications of the Lithoprobe East marine deep seismic reflection line across the northern Canadian Appalachians |
| 1125 – 1150 | G.M. Yeo, Gao Ruixing | Late Carboniferous dextral movement on the Cobequid-Hollow fault system, Nova Scotia: evidence and implications for the Pictou Coalfield |
| 1150 – 1330 | | **Lunch / *Déjeuner*** |
| 1330 – 1355 | W.D. Goodfellow, E.E. Davis, B.D. Bornhold, J.D. Adshead, B. Blaise, G.M. Le Cheminant | Massive sulphides discovered in a sedimented rift valley, northern Juan de Fuca Ridge: geological setting, mineralogy and geochemistry |
| 1355 – 1420 | J.D. Adshead, B.D. Bornhold, E.E. Davis | Geochemistry of deposits from mound and collapse structures near Juan de Fuca Ridge |
| 1420 – 1445 | C.R. van Staal | Preliminary results of structural investigations in the Bathurst mining camp of northern New Brunswick |
| 1445 – 1515 | | **Coffee break / *Pause-café*** |
| 1515 – 1540 | R.F.J. Scoates, J.M. Duke, O.R. Eckstrand, B. Williamson | Layer disruption, PGE mineralization, and the role of supercooling in the crystallization of the Bird River Sill, Manitoba |
| 1540 – 1605 | C.A. Kaszycki, R.N.W. DiLabio | Sedimentology and geochemistry of surficial materials within Lake Agassiz Basin, Lynn Lake-Leaf Rapids area, Manitoba |

**Poster sessions / *Salle des exposants-chercheurs (1000 – 1900)***
**Informal get-together; cash bar / *Réunion-détente; bar payant (1600-1900)***

**Thursday, 23 January 1986 / *Jeudi, le 23 janvier 1986***

| | | |
|---|---|---|
| 0900 – 0925 | R.J. Mott | The Sangamon Interglaciation in Atlantic Canada: the past as a key to the future |
| 0925 – 0950 | R.A. Klassen | Glacial history and drift composition in Labrador |
| 0950 – 1015 | S.G. Evans, J.J. Clague | The engineering geomorphology of Big Slide, British Columbia |
| 1015 – 1040 | R.I. Thompson | Repeated extension on the proto-Pacific margin, west-central Yukon |
| 1040 – 1110 | | **Coffee break / *Pause-café*** |
| 1110 – 1135 | R.T. Bell | Wernecke megabreccias: geological and metallogenic aspects and significance |
| 1135 – 1200 | H.P. Trettin, R. Parrish | Pearya: a fragment of the Caledonides in northern Ellesmere Island |
| 1200 – 1225 | A.N. Rencz, G.F. Bonham-Carter | Remote and ground based detection of a carbonatite biogeochemical anomaly in southeastern Ontario |
| 1225 – 1250 | P. Hood, D.J. Teskey | Helicopter-borne aeromagnetic gradiometer surveys: a progress report |
| 1250 | | **End of sessions / *Fin des présentations*** |

**Poster sessions / *Salle des exposants-chercheurs (0900–1300)***

# POSTER SESSIONS / TRAVAUX PRÉSENTÉS PAR LES EXPOSANTS-CHERCHEURS

## Resource Geophysics and Geochemistry Division
## *Division de la géophysique et de la géochimie appliquées*

**C.J. Mwenifumbo, P.G. Killeen**
Borehole geophysics applications
**L.E. Stephens, G.R. Bernius**
Rock properties lab: magnetic susceptibility studies
**A.K. Sinha, D.C. Gresham, L.E. Stephens**
Application of deep EM techniques in mineral exploration and geological mapping
**A.G. Darnley, K.A. Richardson, R.L. Grasty, J.M. Carson, P.B. Holman, B.W. Charbonneau**
Radioactivity map of Canada - 1:5 000 000
**J. Broome**
Microcomputer demonstration of shaded relief map technique of aeromagnetic data
**D.J. Teskey, S.D. Dods**
Coloured magnetic anomaly map of Canada—1:1 million
**Y.T. Maurice, M. Mercier**
The distribution and geochemical dispersal mechanisms of gold in southwestern Quebec

## Terrain Sciences Division
## *Division de la science des terrains*

**P.P. David, P. Bedard, L. Chauvin, P. LaSalle**
The McGerrigle Mountain granite trains of Gaspésie, Quebec
*Les trainées de granite des monts McGerrigle de la Gaspésie, Québec*
**W.W. Shilts, S.L. Smith**
Stratigraphy of placer gold deposits; overburden drilling in Chaudière Valley, Quebec
**D.R. Sharpe**
Glacial landforms of south Victoria Island, Northwest Territories
**D.G. Harry**
Norman Wells pipeline, terrain research and monitoring
**C.A. Kaszycki, R.N.W. DiLabio**
Till geochemistry - Granville Lake-Brochet area, Manitoba
**P. Henderson**
Dispersal patterns of certain heavy mineral species and granule compositions in the bottom sediments of Hudson Bay
**D.R. Grant**
Extent and elevation of three separate glaciations, western Newfoundland
**R.J. Fulton**
Surficial materials of the Canadian Cordillera
**F.M. Nixon, D.R. Sharpe**
Variation of sediment characteristics with depth of sampling in a periglacial environment
**O.L. Hughes, C. Tarnocai**
Paleosols of the Little Bear River site, District of Mackenzie

## Economic Geology and Mineralogy Division
## *Division de la géologie économique et de la minéralogie*

**D.C. Harris**
Mineralogy of Hemlo gold deposit
**D.A. Walker**
Geological applications of image and particle analysis
**A.R. Miller, R.S. Needham, P.G. Stuart-Smith, J.R. Chiarenzelli**
Middle Proterozoic saprolitic weathering, Pine Creek Geosyncline, Northern Australia and Churchill Structural Province, Canada
**R. Mason, V. Bulman, L. Evans**
Surface geology at McIntyre-Hollinger Mines, Timmins, Ontario
**J.W. Lydon, A.G. Galley**
Metasomatic zonation of Mathiati alteration pipe, Cyprus
**N. Melnik, R. Mason**
Hydrothermal alteration associated with the copper orebodies at the McIntyre Mine, Timmins

**V. Ruzicka, G.M. LeCheminant**
Uranium and uranium - polymetallic deposits associated with unconformities
**S. Swinden**
Metallogeny of the southern part of the Roberts Arm Belt, Newfoundland
**T.C. Birkett**
The Fleming chert-breccia, Labrador Trough
**G.P. Watson**
The Mount Costigan breccia pipe, New Brunswick
**A.L. Sangster**
Willemite-native silver mineralization, Kirkmont, Nova Scotia
**H.E. Dunsmore**
Unconventional resources within residual evaporitic brines, Western Canada Basin
**K. Stevens, E. Procyshyn**
Fluid inclusion and mineral zoning studies in the Candego mine area, Gaspé, Québec

## Atlantic Geoscience Centre
## *Centre géoscientifique de l'Atlantique*

**H. Josenhans, C. Schafer**
Manned submersible observations from the Labrador Shelf and Baffin fiords
**S. Srivastava**
Results of ODP Leg 105 Baffin Bay and Labrador Sea
**P. Mudie, R. Jackson**
Canadian Ice Island - geological and geophysical results
**R. Macnab, J. Woodside**
Gravity and magnetic mapping off Canada's east coast
**Technology transfer — Huntec**
SEAMOR — a new deep water seabed mapping system
**C.E. Keen, W. Kay**
Lithoprobe East - profiles and interpretation

## Precambrian Geology Division
## *Division de la géologie du Précambrien*

**P.F. Hoffman**
Geological map (1:1 million) of the Precambrian Canadian Shield, districts of Mackenzie and Keewatin
**O. van Breemen, R.R. Parrish**
Current research in U-Pb zircon geochronology
**R.R. Parrish, S. Carr**
Crustal scale extensional tectonics of the southern Omineca belt, British Columbia: new data and new interpretations
**M.R. St-Onge, S.B. Lucas, D.J. Scott, N.J. Bégin**
Eastern Cape Smith Belt: an Early Proterozoic thrust-fold belt and basal shear zone exposed in oblique section, Wakeham Bay and Cratère du Nouveau Québec map areas, northern Quebec
**J.A. Percival, K.D. Card**
Metamorphism and plutonism of the Quetico Belt, Ontario
**J.E. King**
Structural studies in the Northwestern Metamorphic-Internal Zone of Wopmay Orogen, NWT
**S. Hanmer**
The Great Slave Lake Shear Zone, NWT; southeast boundary of the Slave Craton
**G.M. Yeo, Gao Ruixing**
Late Carboniferous tectonics and sedimentation in Stellarton Gap, Nova Scotia

## Other divisions
## *Autres divisions*

**A. Kopf-Johnson, J. Wilks**
GEOSCAN - a national geoscience database
**R.I. Thompson**
Repeated extension on the proto-Pacific margin, west-central Yukon
**R. Stephenson**
The Peace River Arch project
**A.V. Okulitch, H.P. Trettin**
Bedrock geology (1:2 million) of the Arctic Islands and adjoining mainland
**Geological Survey of Canada**
Studies of the Juan de Fuca Ridge
**Publications**

## EVIDENCE FOR EARLY PROTEROZOIC FOREDEEP SUBSIDENCE AND SEDIMENTATION: A NEW INTERPRETATION OF THE KILOHIGOK BASIN, NORTHWEST TERRITORIES

John P. Grotzinger[1]

Field work completed during the summer of 1985 has revealed new information that strongly supports a foredeep model for the origin of the Kilohigok Basin. Previous interpretations consider this basin to be an aulocogen, or a rift-bounded splay off an aulocogen. In contrast to previous models, the foredeep model more accurately explains stratigraphic relations within the basin, places constraints on the origin of the Thelon Tectonic Zone, and provides a more comprehensive understanding of the tectonic evolution of the Western Slave Province and its relation to Wopmay Orogen.

Within the foredeep model, the Goulburn Group of Kilohigok Basin has five succesively overlying tectono-stratigraphic sedimentary units of regional extent: basal shallow-water siliciclastic/carbonate platform, overlain by deep-water flysch, overlain by shallow-marine and fluvial molasse, in turn overlain by shallow-water shelf carbonates, followed by another sequence of shallow-marine and fluvial molasse. This stratigraphy represents an initial stable shelf (passive margin?) that was tectonically drowned by rapid subsidence of the outer shelf, associated with arching and subaerial exposure of the inner shelf. Shelf drowning represents the onset of foredeep subsidence subparallel to the current trend of the Thelon Tectonic Zone. Arching and subsidence were co-parallel, and exactly perpendicular to the tectonic transport direction of intrabasinal nappes, believed to be a higher structural level of the Thelon Tectonic Zone. This relationship indicates that convergence and uplift along the Thelon Tectonic Zone was probably responsible for foredeep subsidence within the Kilohigok Basin. With progressive convergence and uplift, the basin became filled and entered the molasse phase of sedimentation. Eventually convergence and/or uplift decreased, reducing sediment influx and allowing a regionally continuous carbonate platform to develop. This marks the end of a first cycle of foredeep sedimentation. A second cycle of foredeep development is indicated by a final phase of molasse sedimentation that overlies the carbonate platform. However, unlike the earlier molasse, the final molasse contains a dominant population of felsic volcanic and hypabyssal plutonic clasts. This suggests that the final molasse was related to unroofing of an arc complex, which has subsequently been entirely eroded. This arc complex may have been a high-level equivalent of plutonic rocks within the Thelon Tectonic Zone.

[1] Lamont-Doherty Geological Observatory, Palisades, New York, 10964

## THE GREAT SLAVE LAKE SHEAR ZONE, NWT: SOUTHEAST BOUNDARY OF THE SLAVE CRATON

Simon Hanmer*

The Great Slave Lake shear zone is NE-SW dextral transcurrent mylonite zone up to 25 km wide, extending from the Slave Delta for at least several hundred kilometres along the southeast side of Great Slave Lake. It coincides very closely in time and space with the emplacement of a composite biotite ± hornblende megacrystic granite batholith emplaced into actively forming migmatites northwest of Thubin Lakes. Preliminary U/Pb dating (S. Bowring, Washington University) indicates that the shear zone was active around 1.9 Ga. The shear zone is a tight sheaf of discrete shear belts whose maximum preserved metamorphic grade passes from granulite to lower greenschist facies with decreasing age of maximum deformation. The width of the active shear zone also decreased as progressively larger volumes were abandoned by the deformation in three stages. This means that the locus of active shearing moved laterally within the shear zone and the volume abandoned at each stage constitutes a shear belt on the present-day map. Spatial variation in the ratio of megacrystic granite to metasediment screens, reflecting variable packing of the gregarious plutons in the batholith, influenced the distribution of strain rate within the shear zone e.g. sillimanite grade mylonites are preserved in the northwest part of the shear zone where metasediment screens are abundant while younger biotite – muscovite – garnet mylonites occur in the southeast where such screens are rare. An extensive and comprehensive assemblage of mechanically independent kinematic indicators demonstrates a consistently dextral displacement history. The finite extension lineation is subhorizontal except for a narrow corridor located at the internal rheological boundary between closely and loosely packed megacrystic granite plutons where deformation (flow) is heterogeneous. Such heterogeneous flow is present at both high and low metamorphic grades and indicates that the rheological boundary is a fundamental feature of the batholith whose general structure was already determined during the early high grade shearing. The final batholithic components within and muscovite leucogranite along the northwest side and outside of the Great Slave Lake Shear Zone were emplaced syntectonically with respect to late chlorite grade shearing. The muscovite granite forms a major part of the basement to the Great Slave Supergroup in the East Arm of Great Slave Lake.

*Precambrian Geology Division

## THE PEACE RIVER ARCH PROJECT

Randell Stephenson [1]

The Peace River Arch is a regional geological structure within the Western Canadian Sedimentary Basin in north-central western Alberta and northeastern British Columbia. In contrast with adjacent parts of the basin, which were experiencing significant subsidence at the time, the Peace River Arch was an anomalously positive tectonic element during all or part of the Early Paleozoic Era. Later in the Paleozoic, in association with the development of economically and tectonically significant basement and intrabasinal fault systems, the Peace River Arch inverted and became a site of relatively excess subsidence and sediment accumulation.

ISPG's multidisciplinary Peace River Arch Project, a comprehensive study and appraisal of the geology, geochemistry, and geophysics of the Peace River Arch by government and university scientists in co-operation with the oil and gas industry, is aimed at discovering the fundamental processes leading to the formation generally of intrabasinal arches and troughs – which, despite their obvious economic importance, arc as yet inadequately understood.

The presentation includes descriptions of some of the various components of the project established so far as well as some of those planned, and will emphasize the interdependence of the results of each. In particular, preliminary results of a major crustal seismic refraction program, undertaken in June 1985 with the co-operation of a number of Canadian universities, exploration companies, and EMR's Earth Physics Branch, and how these results help to constrain ideas on the origin and tectonic evolution of intrabasinal arches, will be presented.

[1] Institute of Sedimentary and Petroleum Geology, Calgary

## REGIONAL TECTONIC IMPLICATIONS OF THE LITHOPROBE EAST MARINE DEEP SEISMIC REFLECTION LINE ACROSS THE NORTHERN CANADIAN APPALACHIANS

G. Stockmal

Approximately 2600 km of 30-fold marine deep seismic reflection data, recorded to 15-20 seconds 2-way travel time (approx. 50-60 km depth), have been gathered north of Newfoundland and across the adjacent continental shelves and basins since the fall of 1984. These data, which provide the critical third dimension needed for interpreting deep crustal tectonics, have profoundly influenced our interpretations of surface and near-surface geology. In particular, lines 84-1 and 84-2, which cross all of the major geological terranes defined in Newfoundland, were positioned with the aim of relating deep crustal structure to surface geology.

A preliminary interpretation tentatively established the underthrust eastern limit of the stretched Grenville continental craton, the allochthonous nature of at least the western portion of the Dunnage zone, a tectonically disrupted Moho, and the vertical nature of the Dover Fault which separates the Gander and Avalon zones. The Baie Verte Lineament (boundary between the miogeocline and Dunnage zones) and the Gander River Ultramafic Belt (boundary between Dunnage and Gander zones) have no deep crustal expression, suggesting that they are allochthonous features.

The salient seismic features, the arcuate shape of the Anticosti foreland basin, and the major regional change in structural geometry and sense of vergence between Newfoundland and the Gaspé Peninsula to the south, can be explained by a plate tectonic model that involves lithospheric delamination and tectonic wedging beneath western Newfoundland.

## LATE CARBONIFEROUS DEXTRAL MOVEMENT ON THE COBEQUID-HOLLOW FAULT SYSTEM, NOVA SCOTIA: EVIDENCE AND IMPLICATIONS FOR THE PICTOU COALFIELD

Gary Yeo* and Gao Ruixing**

Stellarton Gap is a broad, northeast-trending trough, underlain by Carboniferous strata, between the Cobequid and Antigonish Highlands of northern Nova Scotia. The pre-Carboniferous highland areas are bounded to the south and northwest respectively by the Cobequid and Hollow faults. These faults subtend one another to form the Stelleraton Graben, in which the productive seams of the Pictou Coalfield lie. Rapid facies changes and coarsening of clastics towards these faults, and localization of thick conglomerates adjacent to them indicate that they were a major control on sedimentation. Comprehension of this structural control is central to the effective analysis of this Carboniferous basin.

Field observations of meso-scale structures and structural analysis of fracture patterns along the eastern Cobequid and Hollow faults reveal that late Carboniferous movement on both faults was dextral. The offset of Devonian volcanics along the Cobequid Fault and Silurian strata along the Hollow Fault indicates displacement of 20 to 35 km. Deformation and orientation of secondary faults and folds within Stellarton Graben are indicative of a large-scale, dextral, Riedel shear pattern. These findings are consistent with evidence from the western Cobequid Fault. They confirm speculation by many workers that dextral movement took place on the Hollow Fault as well. In response to this, the Stellarton Graben developed as a synsedimentary rhomb graben in late Westphalian B-C time. In consequence, it is unlikely that the coal seams known within the graben ever extended outside it (with the possible exception of the Thorburn coals). Juxtaposition of unlike facies belonging to the partly time-correlative "Merigomish" and Stellarton formations is also explained by dextral faulting. Stellarton Graben could not have been an obstacle to derivation of the New Glasgow Conglomerate from a southern source area since it was probably not in existence in early Westphalian B time.

Contribution to Canada-Nova Scotia Mineral Development Agreement 1984-89.

*Geological Survey of Canada, 601 Booth Street, Ottawa, K1A 0E8
**Geology Department, University of New Brunswick, P.O. Box 4400, Fredericton, New Brunswick, E2B 5A3

# MASSIVE SULPHIDES DISCOVERED IN A SEDIMENTED RIFT VALLEY, NORTHERN JUAN DE FUCA RIDGE: GEOLOGICAL SETTING, MINERALOGY AND GEOCHEMISTRY

W.D. Goodfellow [1], E. Davis [2], B.D. Bornhold [3], J.D. Adshead [4]
B. Blaise [3], and G.M. Le Cheminant [5]

Massive sulphides were cored from one of a chain of mound-like structures occurring in a sedimented rift-valley (Middle Valley) during a PARIZEAU cruise to the Northern Juan de Fuca Ridge. The mound hosting sulphides ranges up to 60 m high by 400 m across, displays a high heat flow and diffuse seismic profile, and appears to have formed on top of the sedimentary sequence.

The sulphides are at least 2.25 m thick (core ended in sulphides) and are overlain by 21 cm of rusty brown hydrothermal sediment. Texturally, the sulphides appear bedded and range in grain size from black sulphidic muds to coarse grained sulphides. Clasts (?) of indurated sulphides which occur throughout give the sulphides a fragmental appearance. This texture can also be seen on a microscopic scale where talc-cemented sulphidic fragments are overgrown by pyrrhotite and re-cemented by talc.

The sulphides comprise granular aggregates of pyrite and pyrrhotite with variable amounts of sphalerite, chalcopyrite, isocubanite, marcasite and galena. Barite, amorphous silica and talc form the matrix. The sulphides occur as a coarsely crystalline network of hexagonal pyrrhotite blades commonly rimmed by pyrite and infilled with sphalerite. Botryoidal marcasite after phyrrotite was observed in some samples. Chalcopyrite and isocubanite overgrow sphalerite and pyrrhotite. Barite forms euhedral clusters or rosettes of rhombic and hexagonal crystals often interpenetrated with sulphides. The sulphide textures are clearly replacement in origin and the product of interaction between early formed sulphides and hydrothermal fluids at vent sites.

Preliminary bulk analyses show that the sulphides contain 2.7 to 4.6% Zn, 0.23 to 0.41% Cu, 1.1 to 7.5 ppm Ag, 43 to 165 ppm Mo, 119 to 158 ppb Au, 0.13 to 3.10% Ba, 2.2 to 7.10% MgO, 134 to 248 ppm As, 20 to 46 ppm Sb, and 81 to 136 ppm Se.

The geological setting of sulphides in Middle Valley may have influenced the duration and locus of hydrothermal activity. Because of the insulating effect of a thick relatively impermeable sediment cover, heat loss from the underlying oceanic crust took place by prolonged discharge from long-lived vents. The focussing of ore-forming fluids is conducive to the formation of large sulphide deposits, either in mounds or in the underlying hydrothermally altered fluid discharge conduit.

[1] Resource Geophysics and Geochemistry Division
[2] Earth Physics Branch, Pacific Geoscience Centre
[3] Cordilleran Geology Division, Pacific Geoscience Centre
[4] Terrain Sciences Division
[5] Economic Geology and Mineralogy Division

## GEOCHEMISTRY OF DEPOSITS FROM MOUND AND COLLAPSE STRUCTURES NEAR JUAN DE FUCA RIDGE

J.D. Adshead[1], B.D. Bornhold[2], and E.E. Davis[2]

A hydrothermal mound about 400 m in diameter (heat flow anomaly 3W $m^{-1}$; gradient 3°C $m^{-1}$) rises 60 m above flat-lying sediments filling the axial valley of the northern Juan de Fuca Ridge. Mound sediments comprise dark brown plume deposits which occur as clusters of several discrete bands in core intervals of 2-3 cm interbedded with fine grained olive grey sediments in which indurated layers up to 8 cm in thickness are present.

Brown bands have high Ba (2000 ppm; barite particles < 2 µm are common), Mn, and organic carbon contents relative to olive grey sediments, and are composed mainly of silicates <20 µm. These bands lack carbonate (foraminifera), reflecting relatively rapid sedimentation, and contain concentrations of sponge spicules and scattered sand-size, Fe-rich grains. Plume bands have an Fe content and texture similar to associated olive grey sediments.

Indurated layers are noncalcareous and have higher Si and Mg and lower Ca contents than associated lutites. Locally derived clasts of indurated sediment were periodically deposited on the mound surface. Influxes of silica, clasts, and Ba-enriched plumes composed largely of resuspended silicate sediments are suggestive of late stage hydrothermal activity.

A collapse structure with no heat flow anomaly (15-20 m surface depression; 1.5-2 km diameter) is located about 10 km from the mound. Striking examples of diagenetic pyrite cementation and grain replacement are evident in core sediments. The average composition of detrital feldspars in pyrite-cemented sediment is 0.65 Ab, indicating that silicate detritus is derived mainly from the continent 200 km to the east rather than from ridge sources (0.5-0.3 Ab) several kilometres distant.

[1] Terrain Sciences Division
[2] Pacific Geoscience Centre, Sidney, British Columbia

## PRELIMINARY RESULTS OF STRUCTURAL INVESTIGATIONS IN THE BATHURST MINING CAMP OF NORTHERN NEW BRUNSWICK

C.R. van Staal[1]

The structure of the Cambro-Ordovician Tetagouche Group in the northern part of the Bathurst camp is described. At least five generations of folds are present. The earliest four generations of folds have an important influence on the large scale structure of the investigated area. There is, however, considerable overlap in style between the different generations of folds which combined with the lack of continuous outcrop makes structural analysis problematic.

The $F_1$ deformation is responsible for transposition of bedding particularly in layering parallel movement and high strain zones. The $F_1$ deformation, however, is markedly heterogeneous with the result that primary structures are well preserved locally, thereby giving the impression that the overall structure and stratigraphy are simple.

Deformation changes the appearance and nature of rocks making correlation of rock units, even within small areas, difficult. The only two potential structural markers are the banded iron formation and the red, hematitic and manganiferous phyllites but their use in structure analysis is hindered by poor exposure and their discontinuous nature. Both iron-rich horizons are associated with massive sulphides but are not the lateral equivalents of one single horizon repeated by folding, low angle faulting or both as suggested previously.

Contribution to Canada-New Brunswick Mineral Development Agreement 1984-89.

[1] Precambrian Geology Division

## LAYER DISRUPTION, PGE MINERALIZATION AND THE ROLE OF SUPERCOOLING IN THE CRYSTALLIZATION OF THE BIRD RIVER SILL, MANITOBA

R.F.J. Scoates*, J.M. Duke*, O.R. Eckstrand* and B. Williamson*

The Ultramafic Series of the Bird River Sill is a layered sequence of peridotites, dunites and chromitites. The peridotites and dunites, which are now pervasively altered to serpentine, chlorite, amphibole and carbonate, were olivine-chromite cumulates with variable amounts of intercumulus pyroxene. Megadendritic and harrisitic textures, characterized respectively by skeletal crystals of pyroxene and olivine, occur in some peridotites and indicate crystallization from supercooled melts. The chromitites are chromite or chromite-olivine orthocumulates: adcumulate textures are not observed in the chromitites. There are virtually no features indicative of magmatic current activity. Chromitite layers are disrupted in a manner analogous to soft sediment deformation in sedimentary rocks. The style of disruption indicates that the chromitites were not only denser than the peridotite layers but also more viscous and behaved in a more competent manner. A sulphide-bearing peridotite layer characterized by moderate enrichment in platinum group elements (up to 1800 ppb Pd, 480 ppb Pt), very high Se/S ratios (10x chondrite) and the local development of harrisitic texture occurs at the base of the chromitite-bearing interval. A genetic model is proposed for the Ultramafic Series which involves the relatively rapid accumulation of a crystal mush by crystallization at or near the floor of the magma chamber. Intercumulus liquid migrated upward and collected under certain relatively impermeable chromitite layers. This led to the local fluidization of the cumulus mush and also played a role in the concentration of PGE.

Contribution to Canada-Manitoba Mineral Development Agreement 1984-89.

*Economic Geology and Mineralogy Division

## SEDIMENTOLOGY AND GEOCHEMISTRY OF SURFICIAL MATERIALS WITHIN THE LAKE AGASSIZ BASIN, LYNN LAKE - LEAF RAPIDS AREA, MANITOBA

C.A. Kaszycki* and R.N.W. DiLabio*

The geochemistry of surficial sediments within this region is complicated by the presence of multiple tills of dramatically different provenance, as well as by a mantle of glaciolacustrine clay. Ice flow within the Lynn Lake – Leaf Rapids area was from both Keewatin and Labrador ice centres during the Wisconsinan. Inundation by glacial Lake Agassiz during deglaciation caused deposition of calcareous laminated silt and clay in the southeastern part of the region.

The influence of the allochthonous clays on the geochemistry of the surficial sediments is a concern for geochemical exploration, particularly their effect on the geochemistry of modern lake sediments. Reconnaissance geochemical sampling has been conducted on till, modern lake sediments, and glaciolacustrine clay. Variations in the geochemical signature of these sediment types will be compared to bedrock geology and evaluated in terms of their sensitivity to lithologic variation. Selected lake basins were studied in detail to evaluate the influence of the types of surficial sediment on the modern lake sediments. Preliminary results and interpretations will be given.

Contribution to Canada-Manitoba Mineral Development Agreement 1984-89.

*Terrain Sciences Division

## THE SANGAMON INTERGLACIATION IN ATLANTIC CANADA: THE PAST AS A KEY TO THE FUTURE

R.J. Mott[1]

Stratigraphy and paleoecology studies of buried organic deposits in Atlantic Canada document vegetation and climate for the last interglacial stage (ca. 125-75 ka). Following retreat of Illinoian glaciers, vegetation responded rapidly to the warming climate. Tundra and boreal forests were quickly replaced by forests dominated by thermophilous hardwoods and white pine throughout the Maritime Provinces. Mixed coniferous forests dominated Newfoundland. Boreal forests of spruce and fir and forest tundra soon returned as climate deteriorated. Mixed forests of temperate hardwoods and conifers recurred with a second warming cycle. Boreal forests and forest tundra followed once again as climate cooled. A third warming trend culminated in widespread spruce and pine forests. Succeeding cycles, each one cooler than the former presaged advancing Wisconsinan glaciation. Tentative correlations with deep-sea isotope and continental pollen records can be seen. The vegetation and derived climatic sequence seems similar to the present interglacial which is probably still in its early stages. This broadly parallel evolution lends support to postglacial atmospheric models developed from pollen sequences, and thus enhances their predictive capability.

[1] Terrain Sciences Division

## GLACIAL HISTORY AND DRIFT COMPOSITION IN LABRADOR

R.A. Klassen[1]

Quaternary geological studies in Labrador funded by the Canada-Newfoundland Mineral Development Agreement are designed to outline the history of ice flow in the region and to establish drift composition and its relation to bedrock sources. The studies provide a framework within which dispersal trains at regional (hundreds of kilometres), local (tens of kilometres) and detailed (hundreds of metres) scales can be identified and they form a basis for developing techniques of drift prospecting. Patterns of dispersal are based on geochemical analysis of till and on the distribution of indicator erratics, which are erratics having distinctive lithologic characteristics and well-defined bedrock sources.

Striae and glacially streamlined landforms record a complex history of ice flow in Labrador and indicate an earlier northeast-trending regional phase and a later eastward to southeastward trending phase. Flow directions recorded on the Glacial Map of Canada principally show the later trends. Regional glacial dispersal patterns, defined by iron formation of Labrador Trough, volcanic rock of Seal Lake Group, and green gneiss of Red Wine Alkaline Complex, among others, reflect transport directions associated with both phases of flow and demonstrate transport distances of several hundred kilometres. The proportions of debris transported during the different phases may vary between the coast and the interior of Labrador. On a local scale, glacial flow has produced broad, eastward-opening dispersal trains as a result of variation in ice flow directions.

Contribution to Canda-Newfoundland Mineral Development Agreement 1984-89.

[1]Terrain Sciences Division

## THE ENGINEERING GEOMORPHOLOGY OF BIG SLIDE, BRITISH COLUMBIA

S.G. Evans* and J.J. Clague*

Big Slide is an extensive landslide complex located on the east side of Fraser River, 12 km north of Quesnel, British Columbia. Successive flights of aerial photographs from 1931 and detailed field observations since 1983 show rapid and large scale landscape change due to retrogressive landslides and associated mudflow activity over a vertical distance of approximately 230 m. The materials involved in the movements are upper sections of Pleistocene lacustrine statified sands and silts which were deformed and sheared by the overriding of ice during the lastt glaciation. At the head of the complex retrogressive slump movements are taking place within the glacially disturbed zone. The rate of headscarp retreat between 1953 and 1981 varied between 6 and 12 m/a. Downslope transport of the slump blocks results in their disaggregation and the formation of mudflows which extend down to the Fraser River over a vertical distance of about 155 m. Movements measured on these mudflows between 1983 and 1985 have yielded extraordinary rates of up to 271 m/a. Both rates of headscarp retrogression and mudflow movement are the highest recorded in the literature for this type of slope movement. Volume calculations made from 1:5000 scale maps show that within the landslide complex, between 1973 and 1982, 5.6 x $10^6$ $m^3$ of material were moved, 1.9 x $10^6$ $m^3$ were deposited, resulting in a net yield into the Fraser River of 3.7 x $10^6$ $m^3$. This yield represents a significant point source of sediment in the Fraser watershed.

*Terrain Sciences Division

## REPEATED EXTENSION ON THE PROTO-PACIFIC MARGIN, WEST-CENTRAL YUKON

R.I. Thompson[1]

In west central Yukon (Ogilvie Mountains), the proto-Pacific continental margin was extended at least twice in the Proterozoic and probably a third time in the early Paleozoic.

Pebbly mudstone, shale, and stromatolitic reefs and reef margin facies fill half-grabens formed after (1200 Ma) deposition of the Wernecke Supergroup. Faults dip steeply northward, are syndepositional and extensional. They may be an expression of the Racklan "orogeny" described from the Mackenzie Mountains. Shelf stabiltiy retured with deposition of a thick shallow-water dolomite (Pinguicula?).

The second extensional event occurred at 777 Ma. North dipping extension faults formed half-grabens that were filled by coastal fan complexes, volcanics, shale and carbonate – a depositional pattern seen in the Gulf of Aqaba today. This event affected the Mackenzie Mountains (Coates Lake Group; Hayhook Orogeny) and probably southern British Columbia (Toby conglomerate, Irene volcanics; Goat River orogeny), northern Washington and Idaho (Shed Roof conglomerate), and southern Nevada (Kingston Peak Formation).

Cambrian and Early Ordovician extension is a possibility. A belt of shales and volcanics separates shelf carbonate on the north from shale, sandstone and gritty sandstone on the south. The sandstone is southerly derived; presence of feldspar in the coarser grained facies suggests a southern landmass containing granitoid rocks as a source.

Discrete faults created during rifting influenced the development of the fold and thrust pattern within the Ogilvie Mountains: an abrupt northward swing in fold and fault trend coincides with a northward swing in old extension-related faults.

[1] Cordilleran Geology Division

## WERNECKE MEGABRECCIAS: GEOLOGICAL AND METALLOGENIC ASPECTS AND SIGNIFICANCE

R.T. Bell[1]

Breccias are significant and extensive units in the Precambrian of the Wernecke and Ogilivie Mountains. In northeastern Wernecke Mountains megabreccia complexes provide a laterally extensive arcuate zone at least 90 km long and 8 to 16 km wide coalescing with the Richardson Fault Array. The breccia bodies contain clasts that are both exotic and indigenous to the Wernecke Supergroup into which they intrude.

Breccia intrusion commenced during deposition of the Wernecke Supergroup. In the Wernecke Mountains most breccias do not intrude beyond the base of the uppermost group. The breccias have acted as conducts for mineralizing fluids. Various mineralogical combinations of Fe, Cu, U, Co, Ba, Ag, Au and REE occur in and marginal to the breccias.

The breccias, associated stratigraphy and metallogenic features of the late Precambrian of the Werneckes compare very favourably with those of South Australia which include the world class Roxby Downs (Olympic Dam) deposit. Stratigraphic similarities proposed by Jefferson and metallogenic similarities proposed by Bell support an Australian-Canadian connection. The breccias are the effects of slow but persistent extension of the region resulting in final supercontinental breakup in the early Cambrian.

[1] Economic Geology and Mineralogy Division

## PEARYA: A FRAGMENT OF THE CALEDONIDES IN NORTHERN ELLESMERE ISLAND

H.P. Trettin[1] and R. Parrish[2]

Pearya, introduced by Schuchert in 1923 as a Precambrian borderland, is related to the Caledonian-Appalachian mobile belt by the Grenville-age of its crystalline basement and the presence of a Middle Ordovician collisional orogen that includes Lower Ordovician ultramafic-mafic complexes as well as Middle Ordovician "granites" of different kinds. By contrast, the crystalline basement of the Franklinian mobile belt is Aphebian-Archean in age and no deformations occurred in the Ordovician. Transported by sinistral strike slip, it was amalgamated with the Franklinian mobile belt under intense deformation, probably in the Late Silurian. "Granite" of crustal origin was intruded near the Middle-Late Devonian boundary.

[1] Institute of sedimentary and Petroleum Geology, Calgary
[2] Precambrian Geology Division

## REMOTE AND GROUND BASED DETECTION OF A CARBONATITE BIOGEOCHEMICAL ANOMALY IN SOUTHEASTERN ONTARIO

A.N. Rencz* and G.F. Bonham-Carter*

An analysis of airborne data using the multi-detector electro-optical imaging scanner (MEIS) was conducted to establish the relationship between spectral features of vegetation and a carbonatite showing in Algonquin Park, Ontario. Initially airborne radiometric studies detected the anomaly. Subsequent ground surveys established the area as a carbonatite rich in rare earth elements and phosphorus. Results of till sampling illustrate a southeast dispersal of carbonatitic debris related to the last glaciation.

Samples of leaf tissue from sugar maple (*Acer saccharum*) were collected on a grid to include sampling over the known anomaly (high), samples in the zone 'upglacier' of the deposit (background) and samples in the zone of dispersal. Tissues were analyzed for content of rare earth elements and phosphorus.

Airborne flights were flown parallel and perpendicular to the direction of ice flow. Eight narrow band filters centred over the 'red edge' were used 445, 550, 682, 703, 713, 753, 782, and 798 nm. Spatial resolution was 0.85 m.

Reflectance values in the anomalous regions were identified and statistically compared to background regions. Reflectance values were also related to tissue levels of trace elements and to content of elements in till.

Image data were analyzed by two methods to determine if the imagery could detect changes in vegetation due to the carbonatite. First, the reflectance values and ratios of values were analyzed to determine if background results differed from anomalous regions. Additionally the results at 8 wavelengths were modelled to determine if characteristics of a function defining the reflectance curve differed between anomalous and background areas. In each analysis only data from the centres of trees were analyzed. These data were formed using a top-hat transformation.

Two other Canadian companies completed the development of helicopter-borne gradiometer systems in 1985, these and the earlier systems will be reviewed in the paper.

Helicopter-borne aeromagnetic gradiometer contracts have now been awarded for surveys in three eastern provinces, namely Nova Scotia, New Brunswick and Quebec. It is clear that the helicopter-borne aeromagnetic gradiometer technique combined with VLF EM is an excellent geophysical tool to assist geological mapping programs in areas of rugged terrain.

*Economic Geology and Mineralogy Division

## HELICOPTER-BORNE AEROMEGNETIC GRADIOMETER SURVEYS: A PROGRESS REPORT

Peter Hood[1] and D.J. Teskey[1]

It is now clear that national aeromagnetic surveys should be carried out in two phases in order to provide adequate coverage for multi-purpose usage. In the first phase, a regional aeromagnetic survey should be carried out at a sufficient height to permit a reasonably wide line spacing so that costs are not excessive. In Canada, the Phase I survey has been carried out for about 65% of the country at an elevation of 300 m and a flight line separation of 800 m. In the second phase, the areas of complex geology and/or interesting mineral possibilities are reflown at a lower elevation and a closer line spacing. It is also clear that aeromagnetic gradiometer surveys should be carried out in the second phase because vertical gradient data have a number of distinct advantages over total field i.e. single sensor data, including superior resolution and direct mapping of vertical contacts.

After the pioneer work at the Geological Survey of Canada to demonstrate the effectiveness of aeromagnetic gradiometer survey in geological mapping, a technoloty transfer process was effected during the period 1982-84 to permit fixed-wing gradiometer surveys to be offered by Canadian airborne geophysical survey contractors.

There is however a problem in carrying out Phase II aeromagnetic gradiometer surveys in areas of mountainous terrain such as the Gaspé Peninsula of Quebec because gradiometer surveys must always be drape flown. Accordingly for the past three years the GSC has been fostering the development of helicopter-borne aeromagnetic gradiometer survey through R and D contracts to the Canadian airborne geophysical survey industry and two systems were built.

In 1984 a tender for helicopter-borne vertical gradiometer work was issued for an area in the Gaspé Peninsula of southeastern Quebec. This first helicopter-borne gradiometer survey produced very encouraging results demonstrating that this somewhat expensive technique can provide detailed aeromagnetic coverage of rugged terrain. The area was previously drape flown using fixed-wing aircraft and there is a significant improvement in resolution in the 1984 survey results.

[1] Resource Geophysics and Geochemistry Division