GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA

PAPER 84-8

CURRENT ACTIVITIES FORUM 1984 PROGRAM WITH ABSTRACTS

Canada

1984

PAPER 84-8

CURRENT ACTIVITIES FORUM 1984
PROGRAM WITH ABSTRACTS

1984

Available in Canada through

authorized bookstore agents
and other bookstores

or by mail from

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

and from

Geological Survey of Canada
601 Booth Street
Ottawa, Canada K1A 0E8

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

Cat. No. M44-84/8 Canada: $4.00
ISBN 0-660-52518-6 Other countries: $4.80

Price subject to change without notice

CURRENT ACTIVITIES FORUM

17–19 January, 1984

1984 Forum Chairman
J.S. Scott, Director, Terrain Sciences Division

Place:	**Congress Centre**, Colonel By Drive, Ottawa, Ontario.
Non-Technical Event:	An informal evening get-together with cash bar on 18 January, 1984.
Program:	About 36 poster sessions and 17 formal presentations. The list of poster sessions will be printed in our December Circular.
Survey Visit:	On Thursday afternoon, 19 January, 1984, the Survey will hold displays and/or demonstrations for visitors at 601 Booth Street of the following facilities: Library, Analytical Chemistry Lab, Mineralogy Labs, Quaternary Paleoecology Lab, Geochronology Lab, Paleomagnetic Lab, Geochemistry Labs, Radiocarbon dating Lab, Sedimentology Lab, Geomathematical Lab, the research collection of Canadian ore and host rocks, and Mineral Resource Information Services (CANMINDEX).
Popular Lecture:	Tuesday evening, 2000 h, 17 January, 1984. R.L. Grasty will present "Natural Background Radiation in Canada" to the general public. The poster sessions will be open from 1930 h to 2130 h.

PROGRAM/PROGRAMME

Wednesday, 18 January, 1984/Mercredi, le 18 janvier 1984

0845-0900	R.A. Price J.G. Fyles	Welcome/Accueil. Opening remarks/Allocution d'ouverture.
0900-0925	J.A. Kerswill, C.D. Anglin	Some thoughts on gold deposits hosted by iron formation with particular reference to the Lupin mine, Contwoyto Lake area, NWT and to gold mineralization in the Geraldton camp, Ontario.
0925-0950	T.I. Urbancic, C.J. Mwenifumbo	Multiparameter logging techniques applied to gold exploration.
0950-1015	Y.T. Maurice	Gold, tin, uranium and other elements in the Nonacho sediments and adjacent basement rocks near MacInnis Lake, District of Mackenzie, NWT.
1015-1020		**Official Opening of Poster Session/ Ouverture officielle des scéances consacrées aux expositions visuelles**
1020-1045		**Coffee Break/Pause-café**
1045-1110	G.L. Williams	Maturation studies and hydrocarbon occurrences, offshore Eastern Canada.
1110-1135	M.P. Cecile, M.A. Shakur, H.R. Krouse	The isotopic composition of western Canadian barites and the possible derivation of oceanic sulphate w34S and w18O age curves.
1135-1200	C.J. Yorath, R.G. Currie, E.E. Davis, R.P. Riddihough	Exploring the Juan de Fuca Ridge System.
1200-1330		**Lunch/Déjeuner**
1330-1355	D.A. St-Onge	A preliminary evaluation of transport distance in an esker.
1355-1420	W.W. Shilts	Some applications of sonar surveys of small lakes.
1420-1445	S.E. Pullan, J.A.M. Hunter, R.A. Burns, R.M. Gagne, R.L. Good, H.A. MacAuley	Field experience with shallow seismic reflection techniques.
1445-1510	P.J. Hood, M.E. Bower, C.D. Hardwick, D.J. Teskey	Aeromagnetic reconnaissance of Nares Strait, NWT.
1510-1535	G.A. Gross	The metallogenic significance of metalliferous sediments, Precambrian to Recent.

Poster sessions/Expositions visuelles (1015-1700; 2000-2200)

Thursday, 19 January, 1984/Jeudi, le 19 janvier 1984

0900-0925	B.F. Bonham-Carter, W.D. Goodfellow	Geochemical anomaly maps using drainage basin data: a mathematical method applied to Pb-Zn in the Selwyn Basin, Yukon.
0925-0950	R.V. Kirkham	Molybdenum tectonics.
0950-1015	M.B. Lambert	Evolution of the Cameron and Beaulieu River volcanic belts, Slave Province, NWT.
1015-1045		**Coffee Break/Pause-café**
1045-1110	P.F. Hoffman, R. Tirrul, J.P. Grotzinger	Subsidence and deformation histories of the east half of the continental margin prism in Wopmay Orogen, NWT.
1110-1135	M.R. St-Onge, J.E. King, A.E. Lalonde	Deformation, metamorphism and generation of anatectic granites in the west half of the continental margin prism in Wopmay Orogen, NWT.
1135-1200	K.D. Card, V.K. Gupta, P.H. McGrath, F.S. Grant	Geological and geophysical characteristics of the Sudbury region, Ontario.
1200-1330		**Lunch/Déjeuner**
1300		**Poster sessions close/Fermeture des expositions visuelles**
1330-1630		Visits to Geological Survey of Canada laboratories at 601 Booth. Visites aux laboratoires de la Commission géologique du Canada au 601, rue Booth.

Poster sessions/Expositions visuelles (0900-1300)

CURRENT ACTIVITIES FORUM/*FORUM DES TRAVAUX EN COURS*

18-19 January, 1984/*18 et 19 janvier 1984*

Congress Hall Level Modules E-G.

Poster Sessions/*Séances consacrées aux expositions visuelles*

Precambrian Geology Division
Division de la géologie du Précambrien

P.F. Hoffman, M.R. St-Onge, R. Tirrul, J.E. King
Stratigraphy, structure and metamorphism of the Calderian wedge, a deformed 1.9 Ga continental margin prism in Wopman Orogen, NWT.

M. St-Onge, J.E. King, A.E. Lalonde
Deformation, metamorphism and generation of anatectic granites in the west half of the continental margin prism in Wopmay Orogen, NWT.

M.B. Lambert
Cameron and Beaulieu River volcanic belts, NWT.

J. Percival, P.H. McGrath
Subsurface geometry of the Kapuskasing Uplift based on geology, geobarometry, gravity, and aeromagnetic interpretation.

M. Schau, W.W. Heywood
Geological compilation (1:500 000 scale) of Melville Peninsula, north of 68°N.

P.H. McGrath, J.B. Henderson, F.M. Lindia
Interpretation of a gravity profile over an Archean greenstone belt using an interactive computer program.

S. Hanmer
A structural reconnaissance of the Central Metasedimentary Belt, Grenville Province.

P.H. Thompson, J.B. Henderson
The Thelon Tectonic Zone – first impressions.

R.S. Hildebrand, S.A. Bowring
Geology and U-Pb geochronology, Leith Peninsula map area, District of Mackenzie.

M.J. Jackson
Shallow to deep water carbonate facies, Cowles Lake Formation, eastern Wopman Orogen.

Terrain Sciences Division
Division de la science des terrains

P.H. Wyatt
Acid neutralizing capacity of glacial drift from Frontenac Arch.

R.N.W. Dilabio
Till geochemistry in the Lynn Lake area, Manitoba.

R.N.W. Dilabio
Glacial dispersal of Nb, Zn, Y, Be in Lac Brisson area, Quebec and Labrador.

D.R. Sharpe
Landform investigations on Wollaston Peninsula, Victoria Island.

M.F. Nixon
An approach to till sampling, western Victoria Island.

S.G. Evans, J.J. Clague
Big Slide, British Columbia: a multiple retrogressive flow slide in Pleistocene lacustrine sediments.

L.E. Jackson, Jr.
Geotechnical and geochemical considerations in open pit coal mine recalamation, Rocky Mountains and Foothills,

Central Laboratories and Technical Services
Laboratoires centraux et services techniques

R.K Herd
Rock, Mineral, and Meteorite Collections: Access, Research and Growth.

Co-operative Mineral Agreement
Entente coopérative relative aux questions minérals

T.E. Lane
Carbonate breccias, Newfoundland Zinc Mines, Newfoundland

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

I.R. Jonasson, W.D. Goodfellow
Sedimentary and Diagenetic Textures and Deformation Structures Within the Sulphide Zone of the Howard's Pass (XY) Zn-Pb Deposit, Yukon and Northwest Territories.

W.D. Goodfellow, I.R. Jonasson
Environment of Formation of the Howard's Pass (XY), Zn-Pb Deposit, Selwyn Basin, Yukon and Northwest Territories.

V.R. Slaney
Recent developments in remote sensing.

B.W. Charbonneau
Interpretation at 1:1 000 000 scale of radiometric, gravity, and aeromagnetic data and geology along the Athabasca Axis.

P.G. Killeen, C.J. Mwenifumbo, A.V. Dyck, Q. Bristow, G.R. Bernius
Developments in borehole geophysics.

Staff, Regional Geophysics subdivision
Aeromagnetic colour interval and shaded relief maps of Canada.

E.M. Cameron, K. Hattori, R.W. Sullivan
Strontium and sulphur isotopic geochemistry of the Hemlo deposit and other sulphate occurrences in Superior Province.

W.D. Goodfellow, D.J. Ellwood, C.F. Bonham-Carter, D.F. Garson.
New drainage geochemical anomaly maps: interpretation of digitized bedrock and surficial geology, geochemistry, topography and mineral occurrences, with implications for exploration in the Yukon.

P.J. Friske
Surficial geochemistry of the Hemlo area (preliminary results).

G.E.M. Hall
Assessment of analytical methods to determine gold.

Economic Geology Division
Division de la géologie économique

J.M. Duke, O.R. Eckstrand, B. Williamson
Mineralogy and geochemistry of komatiites of the Malartic Group, northwestern Quebec.

Joint Canada-U.S. Project Group
The search for seafloor mineral deposits.

R.T. Bell
Aspects of uranium metallogeny in the Canadian Cordillera.

J.W. Lydon, H. Jamieson
Effects of heterogenetic ground water circulation on the volcanogenic sulphide deposits of Cyprus.

W.D. Sinclair
Tin and tungsten deposits in southeast China.

Atlantic Geoscience Centre
Centre géoscientifique de l'Atlantique

J. Syvitski
Mass movement and sediment gravity flow deposits in marine sediments.

Institute of Sedimentary and Petroleum Geology
Institut de géologie sédimentaire et pétrolière

M.P. Cecile
The Lower Paleozoic Misty Creek Embayment, Selwyn Basin, Yukon and Northwest Territories.

Geological Information Division
Division de l'information géologique

D. Reade, A. Kopf-Johnson
GEOSCAN

J. Wilks
Computer-based information services;

Publications

THE SURVEY VISIT
GSC Current Activities Forum 1984

You are invited to visit the laboratories and the library at Survey Headquarters, 601 Booth Street, during the afternoon of Thursday January 19, after the technical and poster sessions have closed.

The demonstrations and displays will afford visitors an opportunity to view the range of equipment and services available in various divisions of the Geological Survey.

GEOLOGICAL INFORMATION DIVISION

Library

The GSC library is pleased to have this opportunity to welcome visitors who may not be aware of the size and scope of the collections and the facilities and services available to the geoscience community.

PRECAMBRIAN GEOLOGY DIVISION

Geochronology Laboratory

The steps involved in the process of zircon U-Pb age determinations, from initial rock sample through mineral concentrate, magnetic selection, surface abrasion of crystals, hand picking, chemical dissolution, lead purification, to mass spectrometric isotopic analysis and computation will be demonstrated. The equipment includes a state-of-the-art Finnigan MAT-261 solid source mass spectrometer, and argon extraction apparatus and modified AEI MS-10 argon mass spectrometer for K-Ar age determination.

Paleomagnetic Laboratory

The facilities of the paleomagnetic laboratory are used to investigate the history of the earth's magnetic field as recorded by the remnant magnetization of rocks. Equipment includes spinner magnetometers for measuring direction and intensity of remnant magnetization, alternating field and thermal demagnetizers to progressively eliminate the least stable magnetic components and a susceptibility bridge for measuring magnetic susceptibility anisotropy.

RESOURCE GEOPHYSICS AND GEOCHEMISTRY DIVISION

Geochemistry Laboratories

Analytical instrumentation and computerized data acquisition and management will be displayed and explained. Two Perkin-Elmer 500 Atomic Absorption spectrophotometers, one set up for flame-AA and the other for graphite furnace-AA are used to analyze leaches and waters for a variety of elements. A Dionex Model 12 fully automated ion chromatograph is used to determine F, Cl, Br, NO_2, NO_3, PO_4 and SO_4 in waters and F, Cl, and S in solid samples after decomposition by pyrohydrolysis. A Scintrex AAZ-2 'portable' atomic absorption spectrophotometer with an Apple II computer is used for the analysis of waters for base metals, Mn, and Fe. The Scintrex UA-3 Uranium Analyser is a portable instrument used for the determination of U in waters, down to 0.5 ppb.

CENTRAL LABORATORIES AND TECHNICAL SERVICES DIVISION

Mineralogy Laboratories

Mineralogy will display X-ray powder camera, X-ray diffraction, electron microprobe and scanning electron microscopy techniques used for the identification and characterization of minerals and mineral assemblages. Two MAC microprobes, an ETEC AUTOSCAN S.E.M. and a Cambridge S-180 S.E.M. will demonstrate energy-dispersive analysis. Mineral separation laboratories will demonstrate the Wilfley table used to prepare zircon concentrates for age dating.

Analytical Chemistry

An automated atomic absorption spectrometer programmed to generate coefficients from a set of standards is used to determine concentration data on unknowns. Specimens are dilute acid solutions from acid or fusion treatment of rock samples. An automated wavelength dispersive X-ray fluorescence spectrometer measures line and background intensities for 18 elements. Samples are fused borate glass disks submitted to approximately 20 minutes of X-radiations. An automated energy dispersive X-ray fluorescence spectrometer can be programmed to generate X-ray spectra when a powdered specimen is irradiated from any one of seven secondary target materials.

TERRAIN SCIENCES DIVISION

Quaternary Paleoecology Laboratory

In this laboratory, pollen and wood are identified. A microscope will be set up to observe typical specimens.

Radiocarbon Dating Laboratory

There will be a tour of the laboratory, lasting 30 to 60 minutes. The group will be limited to 6 to 8 people (two separate tours may be scheduled depending on interest).

Sedimentology Laboratory

There will be a demonstration of a centrifuge separation of clay-sized fraction from till (for geochemical analysis).

ECONOMIC GEOLOGY DIVISION

Computing Laboratory

Mathematical applications in geology; a demonstration of two interactive computer programs: RASC, Ranking and Scaling of stratigraphic events; and CASC. Correlation and subsidence curves.

Research Collection

A display of Canadian ores and host rocks.

Mineral Resource Information Services.

The unit will display some of the methods supporting research in the Division. The prime role is building and maintaining mineral deposit-related files, notably the core file CANMINDEX. Plots, and if possible, live retrievals will be on hand.

SOME THOUGHTS ON GOLD DEPOSITS HOSTED BY IRON FORMATION WITH PARTICULAR REFERENCE TO THE LUPIN MINE, CONTWOYTO LAKE AREA, NWT AND TO GOLD MINERALIZATION IN THE GERALDTON CAMP, ONTARIO.*

J.A. Kerswill[1] and C.D. Anglin[2]

In some gold deposits in iron formation, notably the Lupin Mine, much of the mineralization is stratiform. Such gold is relatively uniformly distributed in thin but laterally extensive beds of cherty sulphide-rich iron formation, consistent with syngenetic conentration of gold from hydrothermal fluid during deposition or early diagenesis of the chemical sediments.

In other deposits, for example portions of the Hard Rock and MacLeod-Cockshutt Mines in the Geraldton area, gold is restricted to veins and/or sulphide-rich areas immediately adjacent to veins. These gold ores are structurally-controlled and evidence to date indicates an entirely epigenetic origin.

A number of deposits in iron formation possess both styles of mineralization suggesting a more complex genesis. At the Lupin Mine, significant gold occurs in arsenic-rich ore adjacent to gold-bearing quartz veins.

Similarities and differences in other features may be genetically significant. In both areas iron formation occurs as thin beds within thick sequences of turbidites in an Archean greenstone belt. Iron formation at Lupin is typically sulphide- or silicate-rich. Much of the iron formation at Geraldton is oxide-rich although there are local carbonate- and sulphide-rich zones. Sulphide-rich iron formation at Lupin may be a primary chemical sediment, but the carbonate- and sulphide-rich zones at Geralton are epigenetic replacements of oxide facies. At Lupin gold is apparently restricted to iron formation, but at the Hard Rock and MacLeod-Cockshutt mines gold also occurs in shear zones in greywacke and albite porphyry. Arsenopyrite, associated with pyrite, is ubiquitous in gold ore in iron formation at Geraldton. At Lupin there is an intimate association between gold and arsenic in ore adjacent to quartz veins but much of the well-bedded pyrrhotite-rich stratiform ore is arsenic-poor.

The above evidence suggests that gold deposits in iron formation can be formed with or without syngenetic concentration of gold during chemical sedimentation. The presence of sulphides may be the most critical exploration guide for both types. Complex structures related to regional shear zones are favourable for the Geraldton type. Syngenetic pyrrhotite-rich iron formation may be the most critical indicator for Lupin type, and significant oxide facies may be a negative characteristic. Arsenides, although they seem to be directly linked to epigenetic gold concentration processes, are a positive feature for both types.

[1] Economic Geology Division
[2] Memorial University

MULTIPARAMETER LOGGING TECHNIQUES APPLIED TO GOLD EXPLORATION

T.I. Urbancic[1] and C.J. Mwenifumbo[2]

Gold is usually found in such small quantities that direct detection with geophysical techniques has not been possible. Instead such techniques have been used to delineate lithological units favourable for gold mineralization. Multiparameter techniques might be used to further subdivide these units into zones with the maximum likelihood for high gold content.

Most gold deposits are associated with mass rock alteration zones (adularization, sericitization, pyritization and silicification). These zones are often characterized by enrichment in potassium, and in sulphides. Theoretically it should be possible to use gamma ray spectrometry to outline areas enriched in potassium (as well as the radioactive elements U and Th); to use IP/resistivity methods to detect the presence of sulphides, and temperature gradient measurements to locate structural features such as faults and lithological boundaries.

Several boreholes intersecting gold mineralization in the Larder Lake area of Ontario were logged with gamma ray spectral, IP/resistivity and temperature methods. Two types of ore bodies are found in this area: carbonate ore bodies consisting of irregular lenses of quartz stockworks lying within highly altered and brecciated carbonatized ultramafic rocks, and flow type ore bodies, consisting of pyritized and silicified zones lying within altered volcanic tuffs and flows. This study was conducted in the flow type ore bodies, where the gold is associated with pyrite mineralization.

Preliminary logging data indicate that, in the Larder Lake area, zones with low resistivity values, high potassium content and an increased IP effect are associated with increased pyrite content (greater than 5%) and gold mineralization. If there is a corresponding increase in uranium and thorium content, the lithological unit lacks any substantial amount of auriferous mineralization. In general there is a negative correlation between the temperature gradient and resistivity except in the volcanic units with brown carbonate alteration which show a positive correlation of low resistivity to low temperature gradient. In most of the boreholes examined, the gold mineralization occurs within these pyritized brown carbonate alteration zones.

[1] University of Toronto, Toronto, Ontario
[2] Resource Geophysics and Geochemistry Division

* Titles appear in the language in which the presentation was given.

GOLD, TIN, URANIUM AND OTHER ELEMENTS IN THE NONACHO SEDIMENTS AND ADJACENT BASEMENT ROCKS NEAR MACINNIS LAKE, DISTRICT OF MACKENZIE, NORTHWEST TERRITORIES

Y.T. Maurice[1]

Heavy mineral layers in a pink arkose-quartz-rich conglomerate unit of the Nonacho Group contain notable amounts of U, Th, Sn, Nb, Ta and Au. Enrichment in Th, Sn, Nb, Ta and to a lesser extent in U is related to the detrital dispersal and accumulation of thorite-uranothorite, cassiterite and a suspected but undetected Nb-Ta mineral. These minerals probably originated from sources to the west of the Nonacho basin, in the Fort Smith belt. The clastic minerals are quite consistently enriched in the heavy mineral layers throughout the arkose-conglomerate unit although Sn appears to be more concentrated towards the base of the sedimentary pile. A decline in the concentrations of the various clastic minerals from south to north is also apparent and reflects increasing distance from source.

Hydrothermal enrichment in U and Au is superimposed upon the detrital pattern in the arkose-conglomerate unit. This activity appears to have been confined to the area adjacent to the southeastern shore of MacInnis Lake and is probably related to hydrothermal activity that led to the formation of nearby U-Cu-Au-Ag veins in basement rocks as well as in Nonacho Group sediments. Uranium is believed to have precipitated in the intergranular spaces of heavy mineral layers in the arkose-conglomerate unit as a result of interaction with Ti compounds and/or in response to reducing conditions associated with the presence of magnetite. Gold is more erratically distributed and is not confined to the heavy mineral layers.

[1] Resource Geophysics and Geochemistry Division

HYDROCARBON OCCURRENCES AND MATURATION STUDIES, OFFSHORE EASTERN CANADA

The staff of the Eastern Petroleum Geology Subdivision[1]

The eastern Canadian continental margin consists of a series of basement highs and platforms which separate areas of greater subsidence, the Mesozoic-Cenozoic sedimentary basins. These basins, containing up to 12 km of sediments, have been actively explored for hydrocarbons for more than two decades. The Scotian Shelf appears to be gas prone with the probability of commercial production from the Venture and adjacent fields. Much of the Grand Banks has been disappointing, the major success being east of the Avalon Uplift in the East Newfoundland Basin where the Hibernia oil field is located. This basin is oil prone. The other area of success, the Labrador Shelf, is also a gas prone province with several significant discoveries. The remoteness and harsh environment, however, may delay development.

Maturation studies at the Atlantic Geoscience Centre (AGC) and the Institute of Sedimentary and Petroleum Geology (ISPG) most recently have been directed towards the development of predictive hydrocarbon generation models which would highlight areas with potential as well as explain past successes and failures. At AGC there are three approaches to the analytical studies: visual kerogen analyses; vitrinite reflectance; and fluorescence. The ISPG studies in organic geochemistry have included light gas analysis (C_1-C_4), the gasoline range, and C_{15+} extract data. Recent studies, based on subsidence rates and geothermal history, have allowed us to calibrate the Time Temperature Index (TTI) with the analytical studies, so that we can use calculated as well as observed values for vitrinite reflectance and visual kerogen in the different sedimentary basins. The results have led to development of an improved hydrocarbon generation model for the Scotian Shelf, particularly as it applies to the terrestrially derived organic material. They also enable us to identify areas with full maturity and the length of time a stratigraphic unit has been exposed to conditions of maturity. Work is now in progress to develop similar type models for the Labrador Shelf and East Newfoundland Basin and to relate these to paleogeography.

[1] Atlantic Geoscience Centre,
Bedford Institute of Oceanography,
Box 1006, Dartmouth, N.S.
B2Y 4A2

THE ISOTOPIC COMPOSITION OF WESTERN CANADIAN BARITES AND THE POSSIBLE DERIVATION OF OCEANIC SULPHATE $\delta^{34}S$ AND $\delta^{18}O$ AGE CURVES

M.P. Cecile[1], M.A. Shakur[2], and H.R. Krouse[2]

Seventeen samples of stratiform barite hosted in Middle Cambrian to Middle Mississippian marine sedimentary rocks of the western Canadian Cordillera were analyzed to determine their $\delta^{34}S$ and $\delta^{18}O$ values. Whereas some samples had isotopic values close to those for time equivalent evaporites, others were clearly more enriched in the heavy oxygen and sulphur isotopes. Samples with isotopic values close to the evaporite curve were from very thick stratiform barites hosted in organic-rich shales, and from thin and nodular beds hosted in organic-free sedimentary strata. All samples enriched in heavy isotopes were collected from thin or nodular deposits hosted in organic-rich sedimentary strata. Enrichment of barite in heavy isotopes can be achieved by a barite precipitation-dissolution process that cycles barium between oxygenated and reduced zones in either redox stratified wet sediment, or sea water. This cycle requires either barite to settle from oxygenated sea water into more reducing water, or to precipitate within or settle into wet sediment where Eh values are decreasing in situ during sediment buildup. Because all anomalously isotopically heavy barites are hosted in organic-rich strata, barite dissolution during this cycle likely occurs through the bacterial metabolism of organic matter and sulphate, during which sulphate with ^{16}O and ^{32}S is preferentially broken down. The main products of this bacterial activity are CO_2 and H_2S which can react to form carbonates or pyrite, or escape from the system, resulting in a depletion of light isotopes from the remaining aqueous sulphate. Because thick deposits of barite hosted in organic-rich shale, unlike smaller deposits hosted in the same strata, do not show heavy isotopic enrichment, the main factor controlling isotope fractionation is likely the rate of barite precipitation relative to barite dissolution and reduction. $\delta^{34}S$ versus $\delta^{18}O$ values for six samples of Late Devonian plot fall on a line with a slope of 2. The data and observations presented here and in published reports indicate that alteration of the isotopic composition of stratiform barite strongly favours enrichment in heavy isotopes with respect to coeval sea water sulphate. It should be possible then, to construct a barite sulphate isotopic composition age curves by averaging the lower $\delta^{18}O$ and $\delta^{34}S$ values for samples of the same age.

[1] Geological Survey of Canada
3303 - 33rd Street N.W.
Calgary, Alberta
T2L 2A7

[2] Department of Physics
University of Calgary
Calgary, Alberta
T2N 1N4

EXPLORING THE JUAN DE FUCA RIDGE SYSTEM

C.J. Yorath[1], R.G. Currie[1], E.E. Davis[2] and R.P. Riddihough[2]

For the past two years the Juan de Fuca Ridge system has once again been the focus of intense scientific interest. Hydrothermal sulphide generating complexes, complete with exotic chemosynthetic organisms, have been identified in a number of localities on the southern portion of the Juan de Fuca Ridge proper. Important to the successful scientific study and exploration of these phenomena is detailed survey information including swath echo sounding and acoustic imagery. During the summer of 1983, in co-operation with the United States National Oceanic and Atmospheric Administration (NOAA) and the University of Hawaii, scientists of the Geological Survey of Canada and Earth Physics Branch at the Pacific Geoscience Centre conducted detailed bathymetric and side-scan surveys of the ridge system utilizing SEABEAM and SEAMARC II methods. The results show complex volcanic edifices including cones, shield volcanoes and pillow hills. Fissure eruptions and massive flows up to 100 km^2 were observed. Youthful, small scale normal faults facing the rift axes are ubiquitous. Important new information on major faults may result in modifications of our understanding of the geometry and evolution of the ridge system.

[1] Cordilleran Geology Division,
Pacific Geoscience Centre,
Box 6000, Sidney, B.C.
V8L 4B2

[2] Earth Physics Branch,
Pacific Geoscience Centre,
Box 6000, Sidney, B.C.
V8L 4B2

A PRELIMINARY EVALUATION OF TRANSPORT DISTANCE IN AN ESKER

D.A. St-Onge[1]

In the Redrock Lake region (85 G) in the Northwest Territories, meltwater flow from the last ice sheet was concentrated along well defined corridors. These "glaciofluvial corridors", which are spaced every 10 to 12 km, contain esker ridges, washed till and minor ridges of ice contact diamicton or poorly sorted bouldery gravel. Esker materials range from corase sands to boulders 60-80 cm in diameter. Boulders are not distributed randomly within the esker sediments but frequently form the principal component of short esker segments averaging 10-30 m in length. These segments of estremely coarse open work material often recur ever 1.5-2 km along some eskers. Meltwater and its sediment load were carried down to the glacier base along tunnels in the ice mass. Boulders carried by this fast moving water did not travel far along the esker tunnel but were deposited as soon as the gradient flattened i.e. when the water reached the main tunnel at the base of the ice. The finer gravel and coarse sand fractions were then carried and deposited farther downstream. This interpretation of the grain size distribution implies that, although esker ridges may be continuous for several tens of kilometres, they may be deposited as successive, comparatively small segments. This model has obvious implication for mineral exploration based on glaciofluvial sediments.

[1] Terrain Sciences Division

SOME APPLICATIONS OF SONAR SURVEYS OF SMALL LAKES

W.W. Shilts[1]

More than 50 small to medium sized Canadian lakes have been surveyed using portable SONAR equipment mounted on small inflatable boats. This equipment produces high resolution seismic reflection profiles using a low-frequency (3.5-7.0 kHz) accoustical pulse as an energy source. Under ideal conditions we have been able to penetrate as much as 70 m of solt, fine grained postglacial and proglacial lacustrine sediment. Sonar profiles have a wide range of practical applications, some of which are listed below. Sonar surveys can:

1. be used to compare among lakes, sediment facies and volumes relative to bedrock basin size, properties of value in estimating effects of acid rain;
2. delineate sites of groundwater inflow and of disruption of sediment by groundwater processes;
3. clarify the seismic or neotectonic history of a lake by mapping sediment disruptions;
4. help in interpretation and correction of geophysical surveys of lake basins by outlining the shapes and dimensions of sediment bodies. This is particularly important for surveys depending on sediment conductivity;
5. be used to map sediment facies and to evaluate offshore effects of natural and man-made changes to the shoreline.
6. be critical in establishing the late-glacial history of a lake basin which may, in turn, provide important clues to the deglaciation history of the region around the lake;
7. be used to guide palynological and other limnological sampling, particularly when used in conjunction with divers; and
8. outline methane and nitrogen gas pockets that are common in postglacial gyttja.

There are probably many other applications of the SONAR technique, particularly in evaluating dynamic changes to lake bottoms, such as subaqueous landslides, changes in sedimentation rates, and changes in location and sizes of gas pockets which may have an influence on chemistry of the postglacial organic sediments.

[1] Terrain Sciences Division

FIELD EXPERIENCE WITH THE SHALLOW SEISMIC REFLECTION TECHNIQUE

S.E. Pullan[1], J.A.M. Hunter[1], R.A. Burns[1],
R.M. Gagne[1], R.L. Good[1] and H.A. MacAulay[1]

Mapping of the overburden thickness for engineering purposes has traditionally been accomplished by seismic refraction methods. However, the recent development of digital, enhancement, multi-channel engineering seismographs, and the availability of micro-computers for data handling and processing, have made shallow seismic reflection techniques a viable alternative. Over the last few years the Terrain Geophysics Section of the Geological Survey of Canada has been involved in the development and testing of shallow reflection methods. We have shown that, where unconsolidated overburden exceeds 20 m in thickness, the reflection method can be the most efficient means of mapping the topography of the overburden-bedrock interface as well as possible structure within the overburden. Using a 7 kg sledge hammer as an energy source, we have obtained reflections from bedrock as deep as 200m below surface, and as shallow as 15 m. Recent experiments with other non-explosive sources have shown that these limits may well be extended in both directions by more powerful and higher frequency sources.

Field experience and some examples of shallow seismic reflection profiles will be discussed.

[1] Resource Geophysics and Geochemistry Division

AEROMAGNETIC RECONNAISSANCE OF NARES STRAIT, NWT

Peter Hood[1], Margaret Bower[1], C.D. Hardwick[2],
and D.J. Teskey[1]

An aeromagnetic reconnaissance of the Nares Strait between Greenland and Ellesmere Island has been carried out as part of the co-operative project between the Geological Survey of Canada and the National Aeronautical Establishment. In the Kane Basin, the resultant stacked profiles clearly show an abrupt termination of a band of 500 gamma amplitude anomalies (indicative of transcurrent faulting) which extends from the Bache Peninsula on Ellesmere Island towards the southern end of Humbolt Glacier on Greenland. At the northern end of Kane Basin the aeromagnetic profiles abruptly flatten out indicating that there is a sediment-filled faulted basin at the entrance to Kennedy Channel. At the northern end of the Nares Strait a line of isolated anomalies some 200 gammas or so in amplitude extends from Judge Daly Promontory along Robeson Channel to the Arctic Ocean for a distance of 100 km. The elongated anomaly appears to be due to an axial dyke.

Thus collectively the aeromagnetic evidence indicates that lateral strike-slip displacement has occurred along the Nares Strait.

[1] Resource Geophysics and Geochemistry Division

[2] National Aeronautical Establishment, Ottawa.

THE METALLOGENIC SIGNIFICANCE OF METALLIFEROUS SEDIMENTS, PRECAMBRIAN TO RECENT

Gordon A. Gross[1]

Modern chemically precipitated metalliferous sediments are directly comparable in composition and depositional environment to many of the older metal-rich sediments in the geological record. Four genetic categories of iron-rich metalliferous sediments are common; those derived by effusive hydrothermal processes, iron formations; by mixed clastic and chemical deposition, ironstones; by accretion forming nodules and crusts; and stratiform deposits derived from laterite and residual gossan materials, including bog-iron.

Sediments of effusive hydrothermal origin are common in the geological record and are referred to here as the "stratafer" group, recognizing their bedded and stratiform nature and the predominance of iron-rich minerals. The stratafer group includes all types of banded cherty iron formation and genetically related manganese and polymetallic sulphide facies as well as oxide, carbonate, silicate, and sulphide facies of metal-rich chemical-biogenic sediments analogous to the iron formations and derived by similar processes.

Selected examples of ancient and recent sediments of the stratafer group are compared to demonstrate that differences in lithology and composition reflect different tectonic and sedimentation conditions in their depositional environment and in the hydrothermal effusive systems that provided the metal constituents and silica.

[1] Economic Geology Division

GEOCHEMICAL ANOMALY MAPS USING DRAINAGE BASIN DATA: A MATHEMATICAL METHOD APPLIED TO Pb-Zn IN THE SELWYN BASIN, YUKON

G.F. Bonham-Carter[1] and W.D. Goodfellow[2]

A quantitative method for producing anomaly maps from surficial geochemical surveys has been developed and tested using Pb-Zn data from the Nahanni area.

The quantity of an element in a stream sample is reduced to a background (predicted from local geology) plus a residual component. Large positive residuals may reflect mineralization in the catchment basin, but must first be corrected for dilution.

Steps in this method applied to the Nahanni map sheet are:

1. Digitization of drainage catchment boundaries located from the topographical map.
2. Digitization of 1:125 000 bedrock and surficial geology.
3. Calculation of areal proportions of bedrock units, and/or surficial geology units, present in each catchment basin.
4. Prediction of local background due to areal proportions of mapped units in each catchment basin, using a mathematical model.
5. Correction of residuals for dilution using catchment basin area and local background, to give a mineralization rating value.
6. Plotting of Applicon colour maps at 1:250 000 or 1:125 000 to show catchment basins coloured according to (a) original data, (b) residuals, and (c) ratings.

In the Nahanni map area, bedrock geology explains at least half the total variation for zinc, and at least one fifth for lead. We show that prediction of known Pb-Zn deposits is improved by making corrections for local background and dilution, and propose several new catchment areas worthy of follow-up. The method shows promise particularly for areas of high relief where watershed boundaries can be readily determined.

[1] Economic Geology Division

[2] Resource Geophysics and Geochemistry Division

MOLYBDENUM TECTONICS

R.V. Kirkham[1]

Most molybdenum resources are contained in porphyry (stockwork) deposits, which are closely related to felsic to intermediate subvolcanic intrusions. Magnetic anomaly data available for many ocean basins permit reasonably rigourous tectonic reconstructions for the sites of emplacement of Cenozoic subvolcanic intrusions and their associated porphyry deposits. Tectonic syntheses of older terranes, however, are far more speculative and the deposits themselves are useful guides to the tectonic setting.

Metal contents of porphyry deposits are probably largely a function of magma composition which is controlled by tectonic setting and P-T-X conditions at the site of magma generation and not by the upper crustal environment of magma emplacement and ore formation. This view is supported by examples such as the Battle Mountain district in Nevada, where porphyry Cu and Mo deposits occur together but are related to distinct intrusions emplaced at different times under separate tectonic regimes.

Porphyry Cu deposits with variable amounts of Mo characteristically form in calc-alkaline magmatic arcs developed above subduction zones. Those formed in continental arcs generally have higher Mo and lower Au contents than similar deposits formed in island arcs. However, the important Au- and Mo-rich deposit at Bingham, Utah and the Mo-bearing Sipalay deposit in the Philippines are notable exceptions to this pattern. Mo, Mo-W and some Cu-Mo deposits have formed in magmatic belts developed mainly as a result of the collision of crustal blocks, but perhaps also related to subduction processes in some areas. Many porphyry Mo deposits, including the important Climax and Henderson deposits in Colorado and Quartz Hill deposit in Alaska, are related to felsic intrusions emplaced in rift or extension environments created by the migration of triple junctions during the transition from subduction to transform plate boundaries.

[1] Economic Geology Division

EVOLUTION OF THE CAMERON AND BEAULIEU RIVER VOLCANIC BELTS, SLAVE PROVINCE, NWT

M.B. Lambert[1]

Regional extension in a 3 billion year old sialic crust produced grabens and horsts in the southern part of the present Slave Province and thus established fault-bound basins for subsequent accumulation of volcanic and sedimentary supracrustal successions. The Cameron and Beaulieu River volcanic belts encompass a large horst and at the present level of erosion make steep contact against the basement rather than above it.

During the Archean penecontemporaneous volcanism from fissures at margins of fault blocks began with voluminous subaqueous effusions of mafic lava and ended with eruptions of felsic lavas, domes and pyroclastics. Magma compositions changed from tholeiitic to calc-alkaline with time.

The present belts are highly deformed successions of onlapping volcanics that accumulated along margins of grabens. They have been compressed against and moulded around basement blocks and plutons which acted as buttresses during deformation. The present width of these belts may be as much a reflection of their original width as of their thickness.

[1] Precambrian Geology Division

SUBSIDENCE AND DEFORMATION HISTORIES OF THE EAST HALF OF THE CONTINENTAL MARGIN PRISM IN WOPMAY OROGEN, NORTHWEST TERRITORIES

Paul F. Hoffman[1], **Rein Tirrul**[1], **and John P. Grotzinger**[1]

A 1.9 Ga continental margin prism (Coronation Supergroup) was deposited across the west margin of the pre-2.5 Ga Slave Craton in three stages: 1. rifting of the craton leading to continental breakup -- Akaitcho Group immature submarine clastics and bimodal volcanics; 2. passive-margin subsidence -- Epworth Group storm-dominated clastic and dolomite shelf built on unrifted crust, and contiguous starved deepwater slope and rise clastics draped over Akaitcho rift basins; and 3. abortive westward subduction of the margin -- Recluse Group flysch, molasse and gabbro sills deposited in a foredeep that migrated eastward in front of the tectonically prograding foreland thrust-fold belt. The thrust-fold belt forms the front of a deformational wedge, caught between obliquely converging plates, in which the continental margin prism was tectonically thickened and translated eastward above a basal décollement located a few hundred metres above the crystalline basement. In the east half of the deformational wedge, where metamorphic grade is greenschist to anchizonal, there is an upper structural level of upright chevron folds of foredeep flysch and a lower level of relatively closely-spaced and steeply-ramping imbricates of Epworth shelf strata. Subsurface structure is well constrained by downplunge projections from oblique sections exposed by younger cross-folding. The estimated east-west shortening of the prism is 40-45% averaged across the belt, implying that the shelf edge has moved no less than 45 km toward the craton. Additional shortening accompanied late low-amplitude folding involving the basement. All the above structures were affected to varying degree by two younger shortening events which caused, in succession, irregular northeast trending basement folds and associated cover folds and cleavages, spatially associated with mysterious deep-seated thermal anomalies, and a throughgoing system of conjugate brittle transcurrent faults accommodating an estimated 15% east-west shortening and equal north-south extension. The younger events are ascribed to collisions remote from the Coronation Supergroup. Extraction of new ideas and information from Wopmay Orogen continues at a rate that is still accelerating despite almost 20 years of investigation.

[1] Precambrian Geology Division

DEFORMATION, METAMORPHISM AND GENERATION OF ANATECTIC GRANITES IN THE WEST HALF OF THE CONTINENTAL MARGIN PRISM OF WOPMAY OROGEN, NORTHWEST TERRITORIES

Marc R. St-Onge[1], Janet E. King[1] and André E. Lalonde[1]

In the early Proterozoic Wopmay Orogen, the west half of the deformed and easterly transported Coronation continental margin prism is characterized by a set of high-T, low-P metamorphic culminations associated with crust and mantle derived magmas. Pre-1.9 Ga initial rifting established the Coronation Margin and led to the development of an east-tapering marginal prism with the rift zone, the craton-derived slope and rise facies and the foredeep units preserved in the west half of the prism. Collision with a terrane to the west during the Calderian Orogeny resulted in thickening and easterly translation of the marginal prism with respect to the underlying Archean basement. Late northeast-southwest cross folds provide oblique sections of both the deformed Coronation prism and the underlying granitic basement. In the west part of the prism, basement gneisses are overlain by 300 to 600 m of autochthonous early Proterozoic sediments and volcanics, which show relatively low strains and contain the stratigraphic transition from rift zone to passive margin units. Structurally overlying the autochthonous low strain domain is a high strain domain characterized by several sets of east-verging recumbent folds and interpreted to be the ductile equivalent of the basal décollement in the foreland thrust-fold belt to the east. The profile of the thermal culmination associated with the Calderian Orogeny is that of an east-verging thermal lobe rooted west of a series of basement massifs. The underside of the thermal culmination is outlined by inverted mineral isograds (staurolite; andalusite; sillimanite; sillimanite + K feldspar) with the main part of the exposed basement remaining relatively cold. Synkinematic growth of sillimanite and downward relaxation of the inverted isograds across the high strain-low strain transition indicates that the units above the base of the ductile décollement were transported while hot. Crust and mantle derived magmas, emplaced into the upper structural levels of the allochthonous and deforming marginal prism within the Calderian thermal culmination, form a plutonic suite which is compositionally varied from gabbro to granite but which is dominated by peraluminous biotite granites. Aluminous xenocrysts and stable oxygen isotope data suggest a large component of sediment melting and assimilation in the generation of the granites. The absence of Calderian plutons in the basement units and the relative "cold nature" of the basement during the Calderian metamorphic event indicate that the plutonic suite was generated in, and/or transported with, the deformed marginal prism. Basement involvement in the Calderian deformation is manifested by regional upright to east-verging basement-cored folds associated with retrograde biotite-chlorite-muscovite growth. West of the basement-cored folds, relict kyanite-K feldspar assemblages in a stack of thrust nappes indicate a phase of high P-T metamorphism predating the low-P Calderian metamorphic overprint. The west side of the exposed Coronation prism is truncated by the north-south Wopmay Fault Zone in which the geometry of micro- and mesoscopic structures in sheared units documents a history of predominantly dextral simple shear with a large component of resolved pure shear, an indication of the obliquity of the Calderian collision event.

[1] Precambrian Geology Division

GEOLOGICAL AND GEOPHYSICAL CHARACTERISTICS OF THE SUDBURY REGION, ONTARIO

K.D. Card[1], V.K. Gupta[2], P.H. McGrath[3], F.S. Grant[4]

The southern part of the Canadian Shield in the Sudbury region is geologically diverse, including Archean and Proterozoic rocks of the Superior, Southern, and Grenville structural provinces, and a unique mafic-felsic intrusion of Middle Proterozoic age, the Sudbury Intrusive Complex. Each of these geological elements has distinctive geophysical characteristics which reflect their lithologic makeup and tectonic history. The Superior Province in the north comprises late Archean metavolcanic, metasedimentary, plutonic, and genissic units, including granulites. Gravity and magnetic models indicate that the greenstone belts and granite plutons generally extend to depths of less than 6 km, whereas the granulite gneiss terranes probably represent upthrust exposures of middle or lower crust. The Southern Province, consisting of Early Proterozoic sediments, volcanics and mafic and felsic intrusions, does not hav a well-defined geophysical expression, but rather has a number of individual gravity and magnetic anomalies. An intense magnetic low over the axis of the Huronian basin cannot be accounted for by any reasonable thickness of sediments, but is probably due to basement shearing and alteration along a major structural zone, the Great Lakes Tectonic Zone. An intense magnetic anomaly near Lake Temagami is attributable to a magnetite-rich mafic-ultramafic(?) body at a depth of 3 km. The Temagami anomaly, along with the Sudbury gravity-magnetic anomaly, occurs along a linear anomalous zone that extends some 350 km from Elliot Lake to Englehart. The Sudbury anomaly cannot be accounted for by the Sudbury Intrusive Complex but must be mainly due to a large, dense magnetic body at depth, possibly a hidden mafic-ultramafic complex genetically related to the Sudbury Intrusive Complex.

[1] Precambrian Geology Division
[2] Ontario Geological Survey, Toronto
[3] Resource Geophysics and Geochemistry Division
[4] Paterson, Grant and Watson, Toronto