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PAPER 83-8

CURRENT ACTIVITIES FORUM 1983
PROGRAM WITH ABSTRACTS

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1983

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PROGRAM/*PROGRAMME*

Wednesday, 19 January, 1983/*Mercredi, 19 janvier, 1983*

8:45-8:50	R.A. Price Director General/*Directeur général*	Opening remarks/*Allocution d'ouverture.*
8:50-9:00	J.G. Fyles Chief Geologist/*Géologue en chef*	Outline of GSC Program/*Esquisse du Programme de la C.G.C.*
9:00-9:25	M.J. Keen	Practical problems and issues and the earth sciences offshore.
9:25-9:50	H. Gabrielse	Major transcurrent displacements along and west of the northern Rocky Mountain Trench, British Columbia.
9:50-10:15	B.S. Norford	The ISPG program in northern and western Canada.
10:15-10:35	**Coffee Break/*Pause-café***	
10:35-11:00	T. Frisch	Granulite facies metamorphism and anatexis in southeastern Ellesmere Island.
11:00-11:25	T.R. Iannelli	Continental to marine transitions in the Late Proterozoic Borden Rift Basin, northwestern Baffin Island.
11:25-11:50	P.H. Thompson, J.B. Henderson	Polymetamorphism in the Healey Lake map area - implications for the Thelon Tectonic Zone.
11:50-12:15	J.A. Percival, K.D. Card, A.K. Goodacre	Geology and gravity signature of Kapuskasing Uplift, a window through the Abitibi-Michipicoten greenstone belt.
12:15-13:45	**Lunch/*Lunch***	
13:45-14:10	J.M. Franklin, L. Anglin	Gold deposits in Superior and Churchill provinces: assessment of structural versus syngenetic controls.
14:10-14:35	J.M. Duke	The Finnish Chromite Province: some observations and implications for chromite exploration in Canada.
14:35-15:00	F.P. Agterberg, F.M. Gradstein	System of interactive computer programs for quantitative stratigraphic correlation.
15:00-15:25	J.R. Belanger, G.F. Bonham-Carter, A.N. Rencz	Extracting geological information from remote sensing imagery
15:30-17:00		Poster sessions/*Séances-posters*
	Dinner/*Dîner*	
20:00-22:00		Informal get-together in exhibit area; cash bar/*Soirée à l'endroit où sont exposés les posters (service d'un bar)*

Poster sessions/*Séances-posters* (10:00-17:00; 20:00-22:00)

Thursday, 20 January, 1983/*Jeudi, 20 janvier, 1983*

9:00-9:25	P.J. Hood, J. Irvine, J. Hansen	The application of the aeromagnetic gradiometer survey technique to gold exploration in the Val d'Or mining camp, Quebec.
9:25-9:50	D.J. Teskey, S.D. Dods, P.J. Hood	Enhancement techniques for use with the new 1:1 000 000 magnetic anomaly maps.
9:50-10:15	W.D. Goodfellow	Regional geochemistry of the Nahanni map area: interpretation of results and implications for exploration.
10:15-10:40	E.M. Cameron	The sulphur cycle in early Precambrian oceans
	Coffee Break/*Pause-café*	
11:00-11:25	A.S. Dyke, L.A. Dredge J.-S. Vincent	Configuration and dynamics of Laurentide Ice Sheet during the Late Wisconsinan maximum.
11:25-11:50	R.L. Grasty, J.M. Carson, B.W. Charbonneau, P.B. Holman	Natural radiation exposure in Canada
11:50-12:15	J.S. Scott	Geological research for the Canadian Nuclear Fuel Waste Program

Poster Sessions/*Séances-posters* (10:00-15:00)

POSTER SESSIONS/*SÉANCES-POSTERS*

19-20 January, 1983/*19 et 20 janvier, 1983*

Atlantic Geoscience Centre/
Centre géoscientifique de l'Atlantique

M.J. Keen
AGC in deep water

Cordilleran Geology Division/
Division de la géologie de la Cordillère

H. Gabrielse
Cordilleran Geology Division highlights of the 1982 program and forecast for 1983.

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

B.S. Norford
The ISPG program in northern and western Canada.

Central Laboratories and Technical Services/
Laboratoires centraux et services techniques

D.A. Walker
Applications of scanning electron microscopy in the geosciences.

Economic Geology Division/
Division de la géologie économique

H.E. Dunsmore
Simulation of evaporitic processes relating to formation of mineral deposits.

O.R. Eckstrand
Sulphur isotope data for selected nickel deposits of the Labrador Trough and the Thompson Belt.

G.A. Gross, C.R. McLeod
Mineral resources on the seafloor.

J.W. Lydon
Comparisons of the Millenbach and Mathiatis (Cyprus) alteration pipes.

Precambrian Geology Division/
Division de la géologie du Précambrien

P.F. Hoffman
Geological compilation (1:250 000 scale) of Athapuscow Aulacogen, East Arm of Great Slave Lake, District of Mackenzie.

P.F. Hoffman, M.R. St-Onge
Geological compilation (1:250 000 scale) of the north half of Wopmay Orogen, District of Mackenzie.

R. Tirrul
Minimum supracrustal shortening estimate, northern Asiak Fold-Thrust Belt, Wopman Orogen, District of Mackenzie.

M.R. St-Onge
Geology, Redrock Lake and eastern Calder River map area, District of Mackenzie: the central Wopmay Orogen (early Proterozoic), Bear Province, and the western Archean Slave Province.

J.G. Patterson, J.A. Fraser, T. Frisch, A.N. LeCheminant, M. Schau, S. Tella
Geological compilation at 1:1000 000 of the District of Keewatin north of 64°

K.E. Eade, W.D. McRitchie, R. MacDonald
Geology of the southwestern Churchill Province (1:100 000 scale)

A. Davidson, N.G. Culshaw
Crustal structure in the Grenville Province of Ontario.

I.F. Ermanovics
Tectonics of southern Nain Province, Labrador.

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

Recent instrumentation developments in Resource Geophysics and Geochemistry Division

S.B. Ballantyne, D.J. Ellwood
A tin-tungsten geochemical case history: Surprise Lake Batholith, British Columbia

Recent magnetic anomaly and gradiometer maps by Regional Geophysics Subdivision

CIDA/GSC
Airborne radiometric/magnetic survey, Rwanda

K.L. Ford, J.M. Carson
Detailed radioelement distribution patterns, central and eastern Meguma terrane, Nova Scotia

Y.T. Maurice, B.W. Charbonneau
Recognition of uranium concentration processes using airborne radiometric measurements

Current seismic reflection surveys in Resource Geophysics Subdivision

V.R. Slaney, J. Simard
Application of satellite imagery

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

S.A. Edlund
Vegetation zonation in the Arctic.

S.H. Richard
Ottawa valley Quaternary geology.

A.S. Dyke, L.A. Dredge, W.W. Shilts
Mineral tracing in till.

V.K. Prest
Wisconsinan Glacier Complex.

T.W. Anderson, C.F.M. Lewis
The Mid-Holocene Nipissing Flood into Lake Ontario.

P.A. Egginton
Drainage problems in biogeochemical prospecting

I.M. Kettles
Geochemistry of glacial drift, Frontenac Axis

W.W. Shilts, L.E. Farrell
Applications of sonar profiling of lakes to geological and environmental problems.

J.B. Percival, T.J. Katsube
Observation of microcavities that affect radionuclide migration through crystalline rocks.

Geological Information Division/
Division de l'information géologique

D. Reade
GEOSCAN

J. Wilks
Computer-based information services;

Publications

Co-operative Mineral Agreements/
Ententes Conjointes Sur L'Exploration Minerale

W.P. Binney
The MacLean Extension orebody, Buchans, Newfoundland

J.R. Henderson
Analysis of structure and stratigraphy as factors controlling gold mineralization in Nova Scotia

PRACTICAL PROBLEMS AND ISSUES AND THE EARTH SCIENCES OFFSHORE*

M.J. Keen[1]

Abstract

A listing of practical problems and issues of great national interest in which the earth sciences play a part includes: hydrocarbon developments (Venture, Hibernia, Beaufort Sea..); electrical power generation (Fundy tidal power, Labrador-Newfoundland transmission...); environmental concerns (waste disposal at sea, oil spills...); maritime boundary disputes (Georges Bank, west coast, Beaufort Sea, Ste. Pierre and Miquelon...); Law of the Sea (definition of the Juridical Shelf edge, north-south dialogue...); seafloor mineral deposits and Canadian industry (black smokers...); technology development; and so on.

These problems and issues demand good science and technology of great variety which often costs a lot. A listing of the topics which need attention in the light of the issues and problems includes: ice scour; sediment transport; slope stability; resource assessment; geological and geophysical mapping in all water depths; mapping technology, including sampling and surveying in all water depths; and so on.

These problems are scientifically and technologically very challenging.

[1] Atlantic Geoscience Centre, Dartmouth

MAJOR TRANSCURRENT DISPLACEMENTS ALONG THE NORTHERN ROCKY MOUNTAIN TRENCH AND RELATED LINEAMENTS IN NORTH-CENTRAL BRITISH COLUMBIA

H. Gabrielse[1]

Abstract

Palinspastic restoration of depositional basins and other tectonic elements in the Cordillera is complicated by the widespread emplacement of easterly transported oceanic and arc terranes during the mid-Mesozoic and the slicing by later Mesozoic and early Cenozoic dextral transcurrent faults. The northern Rocky Mountain Trench and a number of other prominent lineaments east of the eastern margin of the Intermontane Belt, are the loci of transcurrent faults with cumulative displacement of more than 1000 km. The faults and related structures are part of a regional strain system expressed in large scale dextral transcurrent faults and possibly related folds and thurst faults affecting the region between the northern Rocky Mountain Trench and the continental margin. Temporally and perhaps dynamically related to a phase of transcurrent faulting was the uplift of two metamorphic core complexes associated with plutonism, volcanism and lamprophyre dyke emplacement.

[1] Cordilleran Geology Division, Vancouver

THE ISPG PROGRAM IN NORTHERN AND WESTERN CANADA

B.S. Norford[1]

Abstract

The Institute of Sedimentary and Petroleum Geology is the division responsible for studies of the geology and resource potential of the sedimentary basins of western and northern Canada, excepting the Pacific region. The vast area extends from the Precambrian Shield west into the Rocky Mountains and their northward continuations and from the conterminous United States north to the Beaufort Sea and the Arctic Islands. In addition, ISPG has national responsibilities in oil, gas and coal assessment and resource prediction.

Mapping, structural, stratigraphic and biostratigraphic studies and geophysical interpretations of the rocks forming the basins provide three and four dimensional reconstructions of the individual sedimentary basins. Sedimentological and paleoecological studies allow interpretations of depositional environments. Geochemical, paleontological and coal petrological studies provide data on the temperature histories of the basins and on the thermal maturities of the rocks and of the contained hydrocarbon, coal, metal and other mineral resources.

The geology and distribution of oil, gas and coal resources are appraised at regular intervals and the potentials assessed for future discoveries and commercial development. Research is conducted into petroleum generation, movement and reservoir accumulation and also into the methodologies of resource evaluation for both coal and petroleum. The latter currently are focussed on geomathematical predictions of sizes of undiscovered pools.

[1] Institute of Sedimentary and Petroleum Geology, Calgary

* Titles are given in language in which the presentation was made.

GRANULITE FACIES METAMORPHISM AND ANATEXIS IN SOUTHEASTERN ELLESMERE ISLAND

Thomas Frisch[1]

Abstract

Recent reconnaissance mapping has delineated the Precambrian Shield (northernmost Churchill Structural Province) of southeastern Ellesmere Island as a major granulite facies terrane of probable late Archean age. Supracrustal rocks abound and include migmatitic garnet-cordierite-sillimanite-biotite gneiss, diopside-forsterite-wollastonite marble, sillimanite quartzite, two-pyroxene amphibolite and orthopyroxene-bearing gneiss. Other orthopyroxene-bearing quartzofeldspathic gneisses are probably deformed intrusive rocks, which are also represented by massive to crudely gneissic, orthopyroxene-bearing granite and tonalite. The orthopyroxene-bearing rocks carry primary biotite invariably and primary hornblende commonly. Among various intrusive granitic rocks is peraluminous granite with garnet, cordierite and/or sillimanite and locally rich in aluminous metasedimentary inclusions. This granite, which commonly forms stock-sized bodies, is thought to have been generated by anatexis of aluminous metasediments under granulite facies conditions. The granulite facies metamorphism is provisionally envisaged to have taken place at moderate to low pressure and high temperature.

[1] Precambrian Geology Division

CONTINENTAL TO MARINE TRANSITIONS IN THE LATE PROTEROZOIC BORDEN RIFT BASIN, NORTHWESTERN BAFFIN ISLAND

Thomas R. Iannelli[1]

Abstract

The facies equivalent Arctic Bay and Fabricius Fiord formations were deposited early in the history of the Borden Rift Basin and contain sedimentation patterns consistent with an origin in a structurally controlled trough. Strata of these formations total more than 600 m in thickness and comprise a roughly contemporaneous assemblage of marginal, transitional, and basinal lithofacies that constitute a conformable transgressive sequence upon which is superimposed fault influenced progradational terrigenous clastic complexes.

Marginal lithofacies consist of fault margin fringing arkosic sandstones and conglomerates, calcareous sandstones, sandy and stromatolitic carbonates and subordinate siltstones and shales arranged in fining-, coarsening-, and shallowing-upward cycles which accumulated in proximal braidplain, alluvial fan, delta fan, and tidal to beach environments. Basinwards of these sediments a transitional sequence of mixed calcareous and noncalcareous quartzarenites, siltstones and shales and sandy to stromatolitic carbonates, grouped into coarsening- and shallowing-upward cycles, were deposited in supratidal to shallow subtidal environments along the platform margins of the trough. In the slope to basin and axial portions of the trough a basinal assemblage dominated by black shales and with subordinate argillaceous sandstones and carbonates accumulated in largely shallow to deep subtidal environments. The latter facies association, interpreted in terms of a structurally controlled subtidal shale basin model, is a suitable target for future base metal exploration. This work should concentrate on methods of delineating fault controlled second and third order troughs and slope to basin transition zones.

[1] Department of Geology, The University of Western Ontario, London, Ontario. N6A 5B7

POLYMETAMORPHISM IN THE HEALEY LAKE MAP AREA – IMPLICATIONS FOR THE THELON TECTONIC ZONE

Peter H. Thompson[1] and John B. Henderson[1]

Abstract

In the northwestern Precambrian Shield a tectonic zone with distinctive but varied geological, geophysical, and topographic characteristics can be traced 850 km northward from the Alberta border across the MacDonald and Bathurst faults to the Arctic coast. Between these faults the zone runs approximately parallel to and 20-50 km east of the Thelon Front, the boundary defined by G.M. Wright as the western limit of "Hudsonian" orogenesis, and the border between the Slave and Churchill structural provinces. North to the Bathurst Fault, the zone and that part of the Front defined by C.H. Stockwell appear to maintain this spacing except in the central part where the two converge and coincide for about 50 km. Recent mapping in the Healey Lake area, north of MacDonald Fault, revealed that the most prominent changes in metamorphic grade and structural

style are Archean rather than Proterozoic, and that they do not coincide with the Thelon Front (as originally defined) or with superimposed Proterozoic isograds and structures. In this area, the preferred location for the structural province boundary is the western edge of a straight zone of mylonitized rocks (up to 10 km wide) that is part of the 850 km long tectonic zone.

Late Archean metamorphism produced an eastward prograding, low pressure sequence of mineral assemblages (chlorite-biotite, cordierite-andalusite, sillimanite-migmatite) that, within the migmatite zone, grades abruptly into high pressure kyanite-garnet (sillimanite) migmatites. To the southeast, mylonitized orthopyroxene-plagioclase granulites are also thought to be products of this event. The Archean structural fabric that strikes north to north-northeast and dips eastward developed, at least in part, while the high grade rocks were partially molten. The Archean metamorphic sequence was later overlain by sufficient crustal material that medium pressure, greenschist to amphibolite facies assemblages (chlorite-muscovite, staurolite-chlorite, staurolite-kyanite-biotite) were variably overprinted on both low and high pressure Archean pelitic schist and migmatite. In the granulites, garnet and hornblende rims developed at orthopyroxene-plagioclase contacts. The only marker separating these events is an as yet undated swarm of basic dykes. The relatively narrow range of P-T conditions indicated by the younger mineral assemblages and the continuity of rock units indicate the Healey Lake area is entirely within the footwall of a major thrust that was emplaced from the east from beyond the area mapped. The location and westward direction of post-dyke thrusting was probably influenced to a large extent by the Archean structures.

The tectonic history of the boundary zone as seen in the area between the MacDonald and Bathurst faults may not be typical of the zone as a whole. The fact that the distinctive gravity and magnetic signatures that are prominent in this segment are to a large extent absent from the segments to the north and south suggest a somewhat different story is to be expected.

[1] Precambrian Geology Division

GEOLOGY AND GRAVITY SIGNATURE OF KAPUSKASING UPLIFT, A WINDOW THROUGH THE ABITIBI-MICHIPICOTEN GREENSTONE BELT

J.A. Percival[1], K.D. Card[1], and A.K. Goodacre[2]

Abstract

Between the Abitibi (2725-2702 Ma) and Michipicoten (2749-2696 Ma) metavolcanic-metasedimentary belts of the Superior Province is an Archean gneissic terrane where metamorphic grade reaches the granulite facies in the Kapuskasing structural zone. From west to east (Wawa to Foleyet, Ontario), several lithotectonic domains are identified: 1) the Michipicoten belt of low metamorphic grade (P_F2.5 kb); 2) a domal gneiss terrane in the amphibolite facies, intrusive into domain 1; and 3) the Kapuskasing structural zone comprising high grade supracrustal and plutonic gneiss with Archean metamorphic pressure >6.3 kb. Separating the Kapuskasing zone from low grade metavolcanic rocks and plutons of the Abitibi belt to the east is a major fault zone expressed in outcrop as cataclastic veins and seams and in the gravity profile as the trough of a paired high (west)/low (east) anomaly. A good correlation is obtained between the observed anomaly and that calculated by assuming a ~30° westerly dip for the fault zone. The Wawa-Foleyet transect thus appears to represent a continuous oblique section through some 20 km of Archean crust that owes its westward tilt to a southeast-verging thrust. The age of major uplift is not known, although geochronological evidence suggests activity at ~2600, ~1720 and ~1100 Ma.

Reconstruction of the section defines three megalayers with undulating boundaries in the upper and middle crust. From top to bottom these include: 1) from 0 to ~5 km, a metavolcanic-metasedimentary succession; 2) from ~5 to ~15 km, tabular batholiths of gneissic and xenolithic tonalite-granodiorite; and 3) from ~15 to >25 km, a high grade heterogeneous lithological assemblage consisting in part of rocks older than megalayer 1.

[1] Precambrian Geology Division
[2] Earth Physics Branch

GOLD DEPOSITS IN SUPERIOR AND CHURCHILL PROVINCES; ASSESSMENT OF STRUCTURAL VERSUS SYNGENETIC CONTROLS

J.M. Franklin[1] and L. Anglin[1]

Abstract

Mapping and geochemical studies at Geraldton, Ontario and Snow Lake, Manitoba, plus brief examination of approximately 15 gold mines in Superior Province, reveal the dominance of structural control on both the mega- and local-scales. Many deposits occur in linear zones, typically hundreds of kilometres in length, that are characterized by the juxtaposition of volcanic and sedimentary successions. These contacts are intensely deformed long-lived faults that typically began as growth faults, with concomitant fault-scarp conglomerate; later, many became transcurrent faults, along which sedimentary and volcanic successions became interleaved. Gold occurs in structurally controlled veins (axial planar, fold-nose dilations, brittle fracture or ladder-type), as disseminations in shear zones, in altered, sheared or fractured intrusions, and in replacement sulphide zones in iron formations. Alteration includes almost ubiquitous carbonatization, and in amphibolite terranes, retrograde silicate assemblages. Some areas are typified by alkali depletion, others by addition. Shearing is accompanied by the formation of sericite and destruction of feldspar. Lead isotope data indicate that some of the gold may have formed syngenetically, but most was deposited 50 to 200 Ma after the enclosing rocks. The amount of gold required for most major deposits or districts generally precludes a local, stratigraphically controlled source.

[1] Economic Geology Division

THE FINISH CHROMITE PROVINCE: SOME OBSERVATIONS AND IMPLICATIONS FOR CHROMITE EXPLORATION IN CANADA

J.M. Duke[1]

Abstract

A number of 2.45 Ga mafic-ultramafic layered intrusions occur at the unconformable contact between Archean basement gneisses and overlying Proterozoic Karelian schists in northern Finland. Stratiform chromite deposits occur in four of these bodies: Kemi, Penikat, Tornio and Koitelainen. Only the Kemi deposit is currently being mined and it ranks as the world's third largest productive chromite deposit with reserves of 50×10^6 t averaging 26% Cr_2O_3. The Kemi intrusion is a steeply dipping, sill-like body at least 15 km long, up to 2 km wide, and comprises a lower ultramafic zone and an upper mafic zone. A conformable chromitite layer occurs in the lower part of the ultramafic zone and has peridotite in both the footwall and hanging wall. The chromitite is only a few centimetres to a few metres thick over much of the intrusion, however, over a 4.5 km strike length in the widest part of the intrusion there are several successive swellings where the layer attains thicknesses of 30 to 90 m. It is these swellings that constitute the orebodies and eight have been identified. It seems likely that this remarkable thickening of the chromitite is a primary magmatic feature and understanding its origin would have important implications for exploration. The Koitelainen intrusion is a gently dipping sheet-like body up to 2.3 km thick which outcrops over a crudely circular 400 km^2 area. Chomitite layers have been discovered recently at two distinct levels in the intrusion. The Lower Chromitite occurs in pyroxenitic rocks in the uppermost part of the ultramafic zone. The Upper Chromitite occurs at least 1500 m higher in the cumulate sequence within anorthositic rocks in the upper zone of the intrusion. It has postulated in the past that this upper chromitite was derived by salic contamination of the magma due to melting of roof rocks.

[1] Economic Geology Division

SYSTEM OF INTERACTIVE COMPUTER PROGRAMS FOR QUANTITATIVE STRATIGRAPHIC CORRELATION

F.P. Agterberg[1] and F.M. Gradstein[2]

Abstract

A new system of interactive computer programs expands the use of the RASC (Ranking and Scaling) (bio)stratigraphy of exploratory wells or sections. The objective of this system is to achieve quantitative stratigraphic correlation and to aid in tracing the depositional history of sedimentary basins.

Existing computer algorithms are used (1) to rank fossil events in wells or outcrop sections to arrive at the average sequence in time, (2) to scale the average sequence along a relative time scale, (3) to test the stratigraphic-normality of the individual (well) sequences, and (4) to allow participation of rare index fossil events or of a marker horizon occurrence in the scaled sequence. The RASC

computer program also prints the fossil name dictionary and a regional occurrence table of the events. For use of the new system information on lithology and actual depth of samples along the wells will have to become part of the input for the RASC computer program. Special attention should be paid to the problem of relating observed stratigraphic events and their average positions along the RASC distance scale to the numerical time scale in order to arrive at the best possible biochronology.

By means of this interactive system, it should not only be possible to perform quantitative stratigraphic correlation and geohistory analysis but also to evaluate the propagation of errors due to uncertainties in the original data and the assumptions made.

[1] Economic Geology Division
[2] Atlantic Geoscience Centre, Dartmouth

EXTRACTING GEOLOGICAL INFORMATION FROM REMOTE SENSING IMAGERY

J.R. Bélanger[1], G.F. Bonham-Carter[2], and A.N. Rencz[3]

Abstract

The analysis of remote sensing imagery can be based on qualitative and quantitative approaches or a combination of both. In the quantitative analysis, the spectral signatures must be recorded in a digital format to permit the processing of the information by mathematical algorithms; the qualitative approach, on the other hand, relies on analog techniques for recording and reproducing the spectral signatures. Since each approach possesses advantages and drawbacks, it is important to combine both the digital processing of the original information and the analog reproduction of the imagery.

The proposed approach uses the digitally recorded Landsat MSS data to enhance mathematically the texture and the structure of the image but reproduces the imagery in an analog format comparable to colour air photography, to permit interpretation by geologists familiar with airphotos.

The ability of multispectral Landsat data to discriminate between rock types in the area covered by NTS 55 M and 65 P is examined, as an example of mathematical treatment. Bedrock units comprising Archean and Aphebian metasediments and igneous rocks separated by a major unconformity from Dubawnt (Helikian) clastic sediments and volcanics, were digitized with a pixel size of 500 m. Bedrock exposure is less than 5%, water cover about 25%. A Landsat image (39-15) taken on July 29, 1973 was resampled into pixels orientated parallel to a UTM coordinate system, then filtered and regridded using a median filter to give 500 m pixels. Ratios of Landsat bands, and textural parameters derived from the 8 x 8 neighborhood surrounding each pixel, were determined. Several multivariate statistical experiments were used to discriminate between rock types. The results were interpreted with reference to variations in lithologic composition and resulting geomorphologic expression.

[1] Terrain Sciences Division
[2] Economic Geology Division
[3] Canada Centre for Remote Sensing

THE APPLICATION OF THE AEROMAGNETIC GRADIOMETER SURVEY TECHNIQUE TO GOLD EXPLORATION IN THE VAL D'OR MINING CAMP, QUEBEC

Peter J. Hood[1], John Irvine[2], and Jens Hansen[3]

Abstract

Increasing interest is being shown by the mineral exploration industry in the aeromagnetic gradiometer survey technique mainly because of its value in unravelling areas of complex geology. One of the most interesting applications to date has been in delineating the drift-covered geological formations and structural features of the Val d'Or area of Quebec, an area famous for its gold mines. In 1980 a combined aeromagnetic/VLF EM gradiometer survey of the Val d'Or sheet (NTS 32 C/4) was flown at a height of 150 m by the GSC and the results were published in January 1982 as 4 coloured maps using the Applicon plotter, namely total field, vertical gradient, VLF total field and quadrature. The main magnetic anomalies delineated by the earlier 1948 total field survey flown with an 800 m flight line spacing correspond well with those of the 1980 survey, but most of the fine detail is missing. The resolution of the vertical gradient data is much superior to that of the total field and many of the intrusive plugs with which gold is associated e.g., East Sullivan, Lamaque, Sigma, Siscoe and Sullivan can be readily identified. The Bourlamaque and associated acid intrusives are mapped with an accuracy that can only be achieved by more expensive ground geophysics and drilling. The important Cadillac Break and subsidiary faulting is delineated over its known length both on the aeromagnetic and on the VLF EM maps.

[1] Resource Geophysics and Geochemistry Division
[2] Kenting Earth Sciences Ltd.
[3] Consultant, Ottawa

ENHANCEMENT TECHNIQUES FOR USE WITH THE NEW 1:1 000 000 MAGNETIC ANOMALY MAPS

D.J. Teskey[1], S.D. Dods[1], and P.J. Hood[1]

Abstract

One of the advantages of the digital compilation of magnetic anomaly maps is that data enhancement techniques to bring out features not readily visible on the original coloured or contoured maps can be employed. The most interesting application to this point has been the 'Simulated Low Sun Angle' or 'Shaded Relief' technique. In this technique an arbitrary vertical scale is assigned to the measured field; the normal to each magnetic relief pixel and the angle between the normal and the supposed sun direction is calculated. A colour is then assigned on the Applicon plotter so that the apparent brightness is proportional to the cosine of this angle. The technique is usually run at two orthogonal sun declinations for each map to bring out most of the detail. The technique appears to be particularly effective in the delineation of diabase dykes such as the Mackenzie dyke swarm, the margins at the Athabasca and Thelon plates and geological boundaries such as that between the Wollaston and Rottenstone domains in Northern Saskatchewan. Other useful techniques are derivatives of various orders which an often be used to delineate contacts and offsets more clearly than the original total field.

[1] Resource Geophysics and Geochemistry Division

REGIONAL GEOCHEMISTRY OF THE NAHANNI MAP AREA: INTERPRETATION OF RESULTS AND IMPLICATIONS FOR EXPLORATION

Wayne D. Goodfellow[1]

Abstract

During the summer of 1981, a helicopter-supported surficial regional geochemical survey was carried out of the Nahanni map area (NTS 105 I) as part of the Nahanni Integrated Multidisciplinary Pilot Project (NIMPP). The objectives of this survey were two-fold: (1) to better understand the processes affecting the availability, transportation and fixation of ore-forming elements in the secondary environment and (2) to assess the mineral potential of this highly prospective area. In terms of process studies, this regional stream sediment and water survey was unique in that the information necessary for the proper interpretation of the geochemistry was already available from detailed studies of bedrock and surficial geology, ore deposit mineralogy and geochemistry and local high density and spring geochemistry carried out previously as part of NIMPP.

The regional stream sediment and water geochemistry was effective in outlining known W and base metal deposits as well as a number of new areas for exploration. With regard to W mineralization, the interpretation of the surficial geochemistry is relatively simple in areas not strongly influenced by glacial processes given a knowledge of the physical mechanisms by which grains of the major W minerals scheelite and wolframite are dispersed. The nature of processes controlling the disperson of Zn and Pb from base metal deposits, on the other hand, is more complex and requires a greater understanding of solution chemistry. Streams and springs draining the XY and Anniv Zn-Pb deposits for example, are buffered at alkaline pH by the dissociation constants for H_2CO_3 and HCO_3 dissolved from calcareous sediments which host these deposits. Under alkaline conditions, the hydromorphic transport of Pb is suppressed since galena is only sparingly souble whereas Zn forms stable carbonate complexes. Any Pb that is solubilized by local acid conditions generated during oxidation of pyrite is rapidly precipitated as a carbonate or sulphate; some of the Zn is likewise fixed as carbonate and silicate as shown by a thick blanket of "zinc-crete" formed above exposed portions of the XY deposit. It follows, therefore, that in alkaline ground and stream water, the dispersion of lead is limited to physical processes which are only operative in areas of high relief where the mineralization is exposed to erosion by stream action, and the galena grains are carried in suspension downstream. This is the case at the XY deposit where Zn and Pb are dispersed as clastic particles and the Zn anomalies are reinforced by hydromorphically transported Zn. In more recessive terrains or in areas where the mineralization is not exposed in streams, Pb is found to be low both in the stream sediment and water but because of its hydromorphic mobility, Zn is enriched in both. the dispersion patterns observed in the vicinity of the Anniv deposit, which lies in an area of low relief, are of this character. Considering these dispersion mechanisms for Zn and Pb, the low response for Pb associated with a major belt of high Zn contents oriented parallel and west of the XY-Anniv Zn-Pb should not be used to downgrade its potential for stratabound Zn-Pb deposits. Furthermore, other areas of high Zn having similar physical and chemical characteristics likewise deserve further attention. This conclusion is supported by the enrichment in this belt of elements which have been shown to be concentrated in chemo-stratigraphic units which host the Anniv and XY Zn-Pb deposits.

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THE SULPHUR CYCLE IN EARLY PRECAMBRIAN OCEANS

Eion M. Cameron[1]

Abstract

Sulphate is a major constituent of modern oceans, but is unlikely to have been present in the earliest, reduced ocean waters. Its appearance in major quantity during the early Precambrian was an event of some significance:

1. Approximately 10 times more oxygen is stored in sulphate than is present in the atmosphere. An oceanic sulphate reservoir was an essential precondition for the development of an oxygenated atmosphere.
2. Sulphate-reducing bacteria were a major step in the evolution of life.
3. The sulphide of many ore deposits is believed to have been derived from the inorganic or biogenic reduction of sulphate.

Reduction of sulphate to sulphide causes an enrichment of ^{32}S (relative to ^{34}S) in the sulphide. This enrichment is generally greater for biogenic reduction than for high temperature, inorganic reduction. With the development of permanent oceanic sulphate reservoir and the evolution of sulphate-reducing bacteria isotopic partitioning was established in the exogene cycle with ^{32}S enriched in sulphide and ^{34}S in sulphate.

Early Precambrian sediments have been examined for evidence indicating when isotopic partitioning commenced. This is believed to have taken place during the early Proterozic at ~2.35 Ga. This coincides with other features that indicate a decline in submarine heat flow at this time. It is suggested that the oxidation of the atmosphere and oceans may have been the result of a reduction in the rate of exchange of reduced mantle material with the ocean, consequent on a secular decline in heat flow.

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CONFIGURATION AND DYNAMICS OF THE LAURENTIDE ICE SHEET DURING THE LATE WISCONSIN MAXIMUM

Arthur S. Dyke[1], Lynda A. Dredge[1], and Jean-Serge Vincent[1]

Abstract

Early in this century Tyrrell considered the Laurentide Ice Sheet to have three major domes centred in Keewatin, Labrador, and Patricia. In 1943 Flint argued that these centres were of only local and temporary importance and favoured a single-domed ice sheet. Despite the lack of supporting geological evidence, and despite the proposition of a Foxe Dome in the interim, the single-dome concept was not seriously challenged until the late 1970s and, in fact, is still strenuously supported. This paper extends and modifies recent conclusions that the Laurentide Ice Sheet and more than one dome at the Late Wisconsin maximum. We propose a model incorporating five domes (M'Clintock, Foxe, Labrador, Hudson, and(?) Caribou) based on the position of ice divides, ice flow patterns, drift composition, late-glacial features, postglacial isostatic recovery and free-air gravity anomalies. Our Labrador and Hudson domes closely correspond to Tyrrell's Labradorean and Patrician ice sheets; our Caribou and M'Clintock domes together with the Franklin Ice Complex over the Queen Elizabeth Islands north of the Laurentide Ice Sheet, correspond to Tyrrell's original Keewatin Ice Sheet. The style of glaciation of the Foxe Basin region was not known to Tyrrell, but our reconstruction of the Foxe Dome is in close agreement with the original proposal of Ives and Andrews in 1943. Like Tyrrell, our reconstruction is based on field evidence obtained through extensive mapping; the single dome model continues to be unsupported by geological data.

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NATURAL RADIATION EXPOSURE IN CANADA

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Abstract

Published airborne gamma ray survey data from 33 areas of Canada were used to compile information on the average ground level exposure from natural radiation. The exposures at ground level were calculated from the surface concentrations of potassium, uranium and thorium and were confirmed over a calibration strip by measurements with an ionization chamber.

The highest levels of radioactivity were found in northern Canada and were generally related to granitic rocks. These radiation levels, however, reflect to some extent the lack of vegetation and high percentage of rock outcrop. The lowest areas of radioactivity were associated with the Athabasca sandstone.

Outdoor exposure rates from potassium, uranium and thoirium for the 33 areas had an average of 4.4 μR/h, of which 48 per cent originated from potassium, 43 per cent from the thorium series and 9 per cent from the uranium series. When the effects of forests and seasonal variations of soil moisture and snow cover are considered, the population weighted average outdoor exposure rate from potassium, uranium and thorium was found to be 3.1 μR/h. This is considerably less than the world average of 5.2 μR/h estimated by the United Nations Scientific Committee on the Effects of Atomic Radiation in 1977 (UNSCLEAR).

In computing an average annual radiation dose to the Canadian population, the effect of building material was considered together with additional components of natural radiation from cosmic rays, atmospheric radon and the internal radioactivity of the body. This resulted in an annual dose equivalent of approximately 63 millirems, which is somewhat lower than the world average of 78 millirems estimated by UNSCLEAR.

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GEOLOGICAL RESEARCH FOR CANADIAN NUCLEAR FUEL WASTE MANAGEMENT PROGRAM

J.S. Scott[1]

Abstract

Since 1973 the Geological Survey of Canada, in concert with Earth Physics Branch and CANMET, has co-operated with Atomic Energy of Canada Limited (AECL) in the development and conduct of a multidisciplinary program of geoscience research for disposal of nuclear fuel waste. The present geoscience program conducted by the Geological Survey, other branches of EMR, Environment Canada, Ontario Hydro, contractors from universities and industry is supported primarily by AECL and forms a significant component of the Canadian Nuclear Fuel Waste Management Program for which AECL has primary responsibility.

Research is focussed upon evaluation of the concept of disposal in an engineered repository within stable igneous intrusive rocks of the Canadian Shield. Research areas located at Chalk River, East Bull Lake and Atikokan, Ontario and near Pinawa, Manitoba provide the basis for field and laboratory scale studies. Studies at research areas are complemented by general field studies pertaining to regional stresses, seismicity and glaciation. Limited work is begin done on sedimentary rocks and subseabed disposal concepts.

Identification and evaluation of potential pathways for radionuclide migration, the development of methodologies for subsurface investigations and the development of a capability for prediction of repository performance over long periods of time ("reverse Huttonianism") are primary program objectives.

Preliminary analysis and synthesis of field and laboratory data from research areas has shown that: major fracture sets can be correlated at various scales of mapping, the relative probability of fracture occurrence in the subsurface can be predicted, the relative geological ages of fractures can be determined from fracture fillings and the fracture characteristics of a specific intrusive rock mass is related to its tectonic history.

Evaluation of the suitability of a rock mass for nuclear fuel waste disposal purposes can only be determined by a systems variability analysis of the rock mass and engineered components of the multiple barrier system.

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