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ABSTRACTS OF PUBLICATIONS IN SCIENTIFIC JOURNALS BY OFFICERS OF THE GEOLOGICAL SURVEY OF CANADA, APRIL 1979 TO DECEMBER 1979

RÉSUMÉS DE PUBLICATIONS PAR LES CHERCHEURS DE LA COMMISSION GÉOLOGIQUE DU CANADA PARUES DANS DES REVUES SCIENTIFIQUES AVRIL 1979 - DÉCEMBRE 1979

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RÉSUMÉS DE PUBLICATIONS PAR LES CHERCHEURS DE LA COMMISSION GÉOLOGIQUE DU CANADA PARUES DANS DES REVUES SCIENTIFIQUES AVRIL 1979 – MARS 1980

Abbey, Sydney

"ROCK ANALYSIS" METHODS AT THE GEOLOGICAL SURVEY OF CANADA; Geostandards Newsletter, v. 3, p. 97-101, 1979.

Methods in use are divided in three categories: (a) Everyday methods for usual and trace constituents of rocks, based on automatic titrations, x-ray fluorescence and direct reading optical emission spectroscopy; (b) Alternative Methods, based on atomic absorption, non-dispersive infrared, photographic optical emission and various conventional chemical techniques; (c) Special Methods, for constituents determined only on special request, and based on ion-selective electrode measurements, atomic absorption, flame emission photometry, visible spectrophotometry and optical emission. Mention is also made of modifications of existing methods and development of additional ones for handling unusual compositions, as well as work on reference materials.

Abbey, Sydney, Meeds, R.A., and **Belanger, P.G.**

REFERENCE SAMPLES OF ROCKS – THE SEARCH FOR "BEST VALUES"; Geostandards Newsletter, v. 3, no. 2, p. 121-133, 1979.

Because of the disparate data reported in collaborative analyses of reference samples of rocks, various methods have been proposed for deriving "best values". This work compares those methods and several additional ones. Included are two simplified estimates of "mode" which yield values close to those of the Dominant Cluster and Gamma Transformation methods. An example is also cited of the hazards that may result from too superficial reading of raw data.

Agterberg, F.P.

STATISTICS APPLIED TO FACTS AND CONCEPTS IN GEOSCIENCE; Geologie en Mijnbouw, v. 58, no. 2, p. 201-208, 1979.

This is a brief review of alternative methods of problem-solving in geoscience. Special attention is given to applications of the theory of probability, mathematical statistics, computers and artificial intelligence. It is desirable to maintain a clear-cut distinction between reliable facts which can be stored in data banks and concepts which should be incorporated in the specifications of statistical models designed for specific purposes. Two illustrative examples deal with the probability of occurrence of mineral deposits. This probability is conditional upon the occurrences of geological features systematically quantified and processed for large regions.

Agterberg, F.P.

ALGORITHM TO ESTIMATE THE FREQUENCY VALUES OF ROSE DIAGRAMS FOR BOUNDARIES OF MAP FEATURES; Computers and Geosciences, v. 5, p. 215-230, 1979.

The FORTRAN IV program RODIA described in this paper serves to compute the frequency values of a rose diagram from the binary image of a map pattern. The two-dimensional autocovariance function of the binary image is converted into a table of intercept values by using a linear or an exponential model. The frequency values of the rose diagram are computed from these intercept values. RODIA can be used to determine the preferred orientations of contacts between rock units and sets of contours on a map.

Aitken, J.D.

REVISED MODELS FOR DEPOSITIONAL GRAND CYCLES, CAMBRIAN OF THE SOUTHERN ROCKY MOUNTAINS, CANADA; Bulletin of Canadian Petroleum Geology, v. 26, no. 4, p. 515-542, 1978.

Re-examination of depositional Grand Cycles in the Cambrian of western Canada leads to a major revision in interpretation of the two cycles chosen as "types". The Stephen-type and Sullivan-type cycles are products of similar paleogeographies: each represents an increment to a stable-shelf, low-latitude depositional platform that was bounded outboard by a carbonate-shoal complex and inboard by the cratonal shoreline. Water depth in the almost normally marine inshore basin so confined was in general below prevailing wave base. In the Stephen-type cycle, the platform-edge complex of peritidal carbonates was narrow (rarely more than 20 km wide) and discontinuous, and "high-energy" events in the inshore basin were infrequent. In the Sullivan-type cycle, the peritidal carbonate complex expanded to as much as 400 km, and the fill of the inshore basin records many "high-energy" events. These differences are attributed to differences in tidal range. The broad carbonate-shoal complex of the Sullivan-type cycle prevented tidal exchange except through one or more large tidal passes postulated to exist south of the study-area, and tidal resonance is postulated to have led to a large tidal range. In the Stephen-type cycle, many small passes through the narrow shoal complex facilitated tidal exchange and prevented resonance from developing.

Comparison of other Cambrian Grand Cycles with the two "types" reveal that, although elements of the two "type" cycles recur throughout the succession, facilitating interpretation and synthesis, no Grand Cycle is identical to either of the "types" nor to any other Grand Cycle.

Hofmann, H.J. and **Aitken, J.D.**

PRECAMBRIAN BIOTA FROM THE LITTLE DAL GROUP, MACKENZIE MOUNTAINS, NORTHWESTERN CANADA; Canadian Journal of Earth Sciences, v. 16, p. 150-166, 1979.

Well preserved Precambrian algal microfossils and megafossils have been recovered in the northern Mackenzie Mountains from several levels and localities in a basinal, limestone-dominated rhythmite formation of the Little Dal Group. The microbiota includes the filaments **Archaeotrichion, Taeniatum,** and **Siphonophycus,** and the sphaeromorph acritarchs **Kildinella, Trachysphaeridium, Nucellosphaeridium,** and **Chuaria circularis.** The megafossils, all of probable algal affinities, comprise large carbonaceous ribbons assigned to the new vendotaenid species **Tawuia dalensis** n.g. n. sp., and the irregular compressions **Moriana**? **antiqua** and **Beltina danai.** The same formation has also yielded a dubiofossil probably representing traces on bedding planes made by small cylindrical, discoid, or spheroidal organisms, questionably referred to **Bergaueria.** The biota suggests a late Helikian to early Hadrynian age (1.1-0.8 Ga) for the Little Dal Group, and adds to the growing body of evidence for the existence of eucaryotic organisms at that time.

On décrit des mégafossiles et microfossiles algaires d'âge précambrien provenant de plusieurs niveaux et localités d'une formation à rythmites calcareuses du Groupe de Little Dal dans les monts Mackenzie. La microflore comprend les filaments **Archaeotrichion, Taeniatum** et **Siphonophycus,** les Acritarches sphéromorphes **Kildinella, Trachysphaeridium, Nucellosphaeridium** et **Chuaria circularis.** Les mégafossiles, tous probablement d'affinités algaires, comprennent de grands rubans carbonés de **Tawuia dalensis** n.g. n. sp., appartenant aux Vendotaenidés, et les compressions irrégulières de **Morania**? **antiqua** et **Beltina danai.** La même formation a livré un dubiofossile qui est rapporté avec doute à **Bergaueria** et qui représente probablement des traces laissées par de petits organismes cylindriques, discoïdes ou sphéroïdes sur des plans de stratification. Le biota suggère un âge néohélikien à paléohadrynien (1.1-0.8 Ga) pour le Groupe de Little Dal, et apporte des évidences supplémentaires sur l'existence des eucaryotes à ce moment là.

Baragar, W.R.A., Plant, A.G., Pringle, G.J., and **Schau, Mikkel**

DIAGENETIC AND POSTDIAGENETIC CHANGES IN THE COMPOSITION OF AN ARCHEAN PILLOW; Canadian Journal of Earth Sciences, v. 16, no. 11, p. 2102-2121, 1979.

An Archean basaltic pillow of greenschist metamorphic facies and a modern sea-floor pillow with minor diagenetic alteration are comparably zoned from rim to core as follows: a 'glassy' rim, a zone of incipient crystallization, and a crystalline interior, but the petrography of each is appropriate to its metamorphic stage. The Archean pillow varies markedly in composition inward, with the major changes taking place at the rim and at the margin of the crystalline interior; the centre is a broad zone of fairly uniform composition. Relative to the centre zone, alkalis and silica are greatly depleted and iron, lime, and magnesia greatly enriched at the rim, whereas the proportions are approximately reversed at the margin of the crystalline interior. The abundance and, in part, composition of metamorphic minerals reflect the same zoning: chlorite and epidote predominate at the rim, and feldspars concentrate at the margin of the crystalline interior. The bulk of the crystalline interior is a uniform intergrowth of actinolite-epidote-chlorite-albite-sphene-quartz-calcite. Epidote is iron-enriched and iron-depleted at the rim and the margin of the crystalline interior respectively. These variations can be attributed to a pre-existing diagenetic alteration analogous to that recognized in the modern pillow where palagonitization of the glassy rim is attended by oxidation of iron and a concentration of certain elements, notably alkalis, at the pillow margins. With metamorphism, epidote develops at the pillow rims because of oxidation induced by palagonitization and the residual glass is replaced by chlorite. Elements incompatible with these minerals migrate to the margin of the crystalline interior where they can be accommodated in the developing metamorphic assemblage. Little net change in the composition of the pillow is evident.

En comparant la zonation de la surface jusqu'au centre d'un coussin basaltique du faciès métamorphique des schistes verts datant de l'Archéen et d'un coussin moderne provenant des fonds marins avec une altération diagénétique mineure, on observe les zones suivantes: une bordure "vitreuse", une zone où la cristallisation s'amorce et un intérieur cristallin; toutefois, la pétrographie de chaque coussin est compatible avec son degré de métamorphisme. La composition du coussin de l'Archéen varie de façon marquée vers l'intérieur et des changements majeurs se produisent près de la surface et aux bordures de l'intérieur cristallin alors que le centre est une vaste zone de composition relativement uniforme. Par rapport à la zone centrale, il y a appauvrissement en alcalis et en silice alors qu'il y a enrichissement marqué en fer, en chaux et en magnésie vers la surface; les proportions sont approximativement renversées à la bordure de l'intérieur cristallin. L'abondance et, en partie, la composition des minéraux métamorphiques reflètent la même zonation: la chlorite et l'épidote dominent près de la surface et les feldspaths se concentrent à la limite de l'intérieur cristallin. Globalement, l'intérieur cristallin est formé par une intercroissance uniforme d'actinote-épidote-chlorite-albite-sphène-quartz-calcite. L'épidote est plus riche en fer et plus pauvre en fer respectivement à partir de la surface jusqu'à l'intérieur cristallin. On peut attribuer ces variations à une altération diagénétique antérieure, analogue à celle qu'on observe dans le coussin moderne où la palagonitisation de la surface vitreuse s'accompagne de l'oxydation du fer et de la concentration de certains éléments, surtout les alcalis, aux bordures du coussin. En subissant le métamorphisme, l'épidote se développe aux bordures du coussin à cause de l'oxydation induite par la palagonitisation et le verre résiduel est remplacé par de la chlorite. Les éléments incompatibles avec ces minéraux migrent jusqu'à la bordure de l'intérieur cristallin où ils peuvent être accomodés dans le développement de l'assemblage métamorphique. Il y a peu d'évidence d'un changement net dans la composition du coussin.

Bonardi, Maurizio

COMPOSITION OF TYPE DACHIARDITE FROM ELBA: A RE-EXAMINATION; Mineralogical Magazine, v. 43, p. 548-549, 1979.

The Elba dachiardite is unique in that it is Cs-bearing and its Ca content is the highest reported so far for the mineral. In the aforementioned comparative study of dachiardite from other localities, none was found to contain Cs.

Summerhayes, C.P., **Bornhold, B.D.,** and Embley, R.W.

SURFICIAL SLIDES AND SLUMPS ON THE CONTINENTAL SLOPE AND RISE OF SOUTH WEST AFRICA: A RECONNAISSANCE STUDY; Marine Geology, v. 31, p. 265-277, 1979.

Off South West Africa, a large slide and a large slump have displaced about 250 km^3 of surficial sediment from the lower continental slope onto the upper continental rise. The slide and slump scars together cover an area of about

6000 km^2; they affect only the upper few tens of meters of the sediment column. A debris flow extends about 250 km downslope from the slide scar, and deformed sediments extend a similar distance downslope from the slump scar. Apparently the slide and the slump were triggered during the late Pleistocene; neither of them gave rise to turbidity currents.

Slides and slumps like these appear to be common on both active and passive continental margins. Their presence in these environments merits careful study in view of deep water exploration and production drilling for oil and gas.

Bornhold, B.D. and **Bonardi, M.**

MAGNETIC SPHERULES IN ARCTIC OCEAN SEDIMENTS; Canadian Journal of Earth Sciences, v. 16, p. 1778-1788, 1979.

Five types of spherule were found in Quaternary sediments from the Canada Abyssal Plain. They include: type A spherules composed of magnetite and hematite surrounding metallic iron cores, exsolution blebs, or veinlets (Ni, Fe, Co); type B, of nearly pure homogeneous magnetite; type C, displaying intergrowths of magnetite and hematite and containing minor Ti (<1%); type D, composed predominantly of magnetite with significant amounts of Ti (up to 4.8%); and type E, consisting of ilmenite and rutile with Ti, Si, Fe, Mn, Al, K, and Mg as major elements and Cr, Ca, and Na as minor elements. Ni and Co were detected only in a small metallic veinlet (with Fe) surrounded by magnetite containing significant amounts of Ti.

Three possible sources are considered: industrial, volcanic, and extraterrestrial. Industrial input is unlikely in view of the great distances to possible sources and the relatively large size of the particles. The high Ti content of most of the spherules suggests a volcanic origin. The five type B spherules are the only possible candidates for a cosmic origin.

On a retrouvé cinq types de sphérules dans les sédiments du Quaternaire de la plaine abyssale du Canada: les sphérules de type A, composées de magnétite et d'hématite enrobant des noyaux de fer métallique, des globules d'exsolution ou des veinules (Ni, Fe, Co); les sphérules de type B, composées de magnétite homogène presque pure; les sphérules de type C, montrant des intercroissances de magnétite et d'hématite et contenant des quantités mineures de Ti (<1%); le type D, composé surtout de magnétite avec des quantités significatives de Ti (jusqu'à 4.8%); et le type E, consistant en ilménite et rutile avec comme éléments principaux Ti, Si, Fe, Mn, Al, K et Mg et comme éléments mineurs Cr, Ca et Na. On a détecté Ni et Co seulement dans une petite veinule métallique (avec Fe) entourée de magnétite contenant des quantités significatives de Ti.

On considère trois sources possibles: industrielle, volcanique et extraterrestre. L'apport industriel est peu probable à cause des grandes distances aux sources possibles et de la taille relativement grande des particules. La teneur élevée en Ti de la plupart des sphérules suggère une origine volcanique. Les cinq sphérules de type B seulement peuvent prétendre à une origine cosmique.

Boyle, D.R.

THE FORMATION OF BASAL-TYPE URANIUM DEPOSITS IN SOUTH-CENTRAL BRITISH COLUMBIA; Canadian Mining and Metallurgical Bulletin, v. 72, no. 803, p. 96, 1979.

Active exploration in the Okanagan region of south-central British Columbia has resulted in the discovery of significant uranium deposits in poorly consolidated basal stream-channel deposits developed in Miocene-Pliocene valleys associated with major fault zones. The uranium mineralization commenced in the late Miocene or early Pliocene time shortly after the inundation of the valleys by the Plateau Basalt Formation, and was probably terminated during a period of Pliocene uplift. The uplift, followed by later glaciation and isostatic rebound, has resulted in the elevation and isolation of linear basaltic bodies representing the valley 'roots' of the Plateau Basalt Formation.

Two deposits in the Okanagan region are now under detailed investigation. The Tyee deposit in the Hydraulic Lake area consists of fine-grained ningyoite associated with marcasite cementing a basal lenticular channel conglomerate that overlies a faulted and highly altered basement complex of Monashee gneisses and Valhalla granitoids. The Blizzard deposit in the Lassie Lake area is mineralized primarily with autunite and uranium-rich organic debris in a basal assemblage of sandstone and mudstone overlying Valhalla granitoids. Remobilization of uranium as the uranyl ion with the Blizzard deposit is evident, whereas the Tyee deposit the element is present in the tetravalent state, no secondary minerals having as yet been identified. Abundant carbonaceous material occurs in both deposits.

The deposits are thought to have formed by infiltration of meteoric waters into a highly fractured and faulted uraniferous basement complex (Valhalla and Coryell granitoids), followed by subsequent entry of these waters into major Miocene-Pliocene fault zones containing highly permeable fluvial channel sediments capped by Plateau Basalts. Stream-water surveys in the Okanagan region indicate the presence of deep-seated, structurally controlled, uraniferous waters flowing within major Holocene fault zones. The location of these fault zones within a distinct uranium province, their proximity and similarities in geological and structural setting to areas of basal-type mineralization, and the chemistry and tritium ages of their associated waters suggest that they are recent analogues of the fault zones in which Miocene-Pliocene mineralization formed.

A model depicting the formation of the deposits is described, based on their mineralogy and geochemistry, the proximity and leachability of source rocks, mechanisms of emplacement involving structure, hydrology and groundwater chemistry, environment of deposition, period of formation, tectonics and preservation.

Based on the formation characteristics of the deposits, exploration parameters and techniques for determining favourable areas in which to carry out detailed exploration in the Canadian Cordillera are proposed.

Cameron, E.M.

EFFECT OF GRAPHITE ON THE ENHANCEMENT OF SURFICIAL GEOCHEMICAL ANOMALIES ORIGINATING FROM THE OXIDATION OF SULPHIDES; Journal of Geochemical Exploration, v. 12, p. 35-43, 1979.

Geochemical studies carried out on the Melville Peninsula, N.W.T. have found strongly anomalous Zn and Ni contents in lake sediments and surface waters draining sphalerite and pentlandite mineralization in graphitic paragneiss. The area is within the zone of continuous permafrost of the Canadian Shield. The levels found are greater than are present near non-graphitic massive sulphide mineralization in similar climatic and topographic settings elsewhere in the northern Shield.

Oxidation of sulphides is an electrochemical process. A sulphide body acts as a conductor immersed in an electrolyte (the groundwater). In permafrost terrain the electrolyte is unfrozen water present as interfacial films in the permafrost and also the water of the summer-thawed, "active layer".

Electrons flow through the body from oxidizing, anodic sites to upper, cathodic zones, where they take part in the reduction of O_2 dissolved in groundwater. The circuit is completed by ion flow within the electrolyte.

As the upper portion of sulphide body is replaced by non-conducting oxidation products, access of O_2 to the cathodic zones is reduced and the rate of oxidation decreases. However, for bodies that contain significant graphite, electron flow is maintained through the oxidized layer to near-surface, oxygen-rich horizons. Thus the rate of oxidation of graphitic base metal sulphides is likely to be greater than for partially oxidized non-graphitic bodies. The rate of oxidation is a factor in determining the flux of mobile base metals carried away from mineralization in solution, and hence the levels of anomalies present in drainage sediments and waters.

Whereas this work has been directed to a permafrost regime, similar principles apply to other environments where graphite connects oxidizing sulphides to levels with higher partial pressures of O_2, up to the water table. Other conductors, such as sulphide minerals relatively resistant to oxidation, may act in a similar fashion to graphite.

Cameron, E.M., Ermanovics, I.F., and Goss, T.I.

SAMPLING METHODS AND GEOCHEMICAL COMPOSITION OF ARCHEAN ROCKS IN SOUTHEASTERN MANITOBA, CANADA; Precambrian Research, v. 9, p. 35-55, 1979.

A 13,000 km^2 area of Archean rocks in southeastern Manitoba has been sampled using a multi-stage statistical model. Some 256 outcrop composite samples were analysed in duplicate for Si, Al, Fe, Mn, Mg, Ca, Na, K, Ti and P. The six levels of the model are: geological regions (domains), rock units, traverse line intersections of rock units, sampling locations (stations) within intersections, outcrops within stations, and duplicate analyses within outcrops. The data provide an estimate of the overall composition of this portion of the Canadian Shield.

The major components of geochemical variation are at the intersection, station, and outcrop levels. There is significantly less variation between geological domains and between the geological units, as defined by field mapping. The smallest component of variation is generally at the analysis level. These data suggest that in the Canadian Shield, or similar geological terrane, extensive subsampling will be required to detect regional geochemical trends or to characterize the composition of rock units.

The relatively low variability between rock units is attributed to the homogenizing effect of high levels of metamorphism, including anatexis, that affected the region.

Card, K.D.

THE CREIGHTON PLUTON, ONTARIO: AN UNUSUAL EXAMPLE OF A FORCEFULLY EMPLACED INTRUSION: DISCUSSION; Canadian Journal of Earth Sciences, v. 16, p. 2181-2182, 1979.

Carson, J.M., Holman, P.B., and **Grasty, R.L.**

8. AIRBORNE GAMMA-RAY SPECTROMETER EXPERIMENTS – INTERCALIBRATION AND VARIATION OF CALIBRATION CONSTANTS WITH ALTITUDE; 1979 Annual Meeting, American Nuclear Society, v. 32, p. 138-139, 1979.

The calibration pads at Uplands Airport, Ottawa, Ontario, have been used by the Geological Survey of Canada (GSC) and other operators of airborne gamma-ray spectrometers since 1968. These five pads measure 7.6 x 7.6 x 0.5 m thick. In 1976 a set of five larger pads, 12.2 x 12.2 x 0.5 m were constructed for the U.S. Department of Energy (DOE) at Walker Field, Grand Junction, Colorado. To compare calibration constants determined at these two facilities, a series of intercalibration experiments was carried out during the period from mid-August 1978 to mid-November 1978. These experiments used the high-sensitivity airborne γ-ray spectrometer on the GSC Skyvan aircraft. In addition, the larger pads at Walker Field were used to study the effect of altitude variations on γ-ray spectrometer calibration constants. The altitude variation experiments used two detector systems [a 152.4- x 101.6-mm NaI(Tl) crystal and a package of 4 prismatic 101.6- x 101.6- x 406.4-mm NaI(Tl) crystals].

Christie, R.L.

THE FRANKLINIAN GEOSYNCLINE IN THE CANADIAN ARCTIC AND ITS RELATIONSHIP TO SVALBARD; in The Geological Development of Svalbard during the Precambrian, Lower Palaeozoic, and Devonian, T.S. Wisnes, ed., Symposium on Svalbard's geology, Oslo, June 1975, Norsk Polarinstitutt, Skrifter Nr. 167, p. 263-314, 1979.

Development of the Franklinian Geosyncline began, perhaps earlier, but certainly by late Proterozoic time, with the deposition of clastic and carbonate rocks in the region of northeastern Ellesmere Island. Sedimentary units thicken northward, away from the exposed Aphebian crystalline basement. Certain metamorphic rocks of the north coast of Ellesmere Island may have been part of this early geosynclinal sequence; both volcanic and sedimentary origins are inferred for granitoid gneisses from which late Proterozoic isotopic ages have been obtained. Cambrian to Late Devonian clastic and carbonate sedimentary rocks subsequently were deposited in the geosyncline. Carbonates and some evaporites and clastic sediments dominated in the southeast, and immature clastic sediments with volcanic rocks, carbonates, and chert in the northwest. The sediments in the northwest evidently were derived from a geanticlinal welt, Pearya, which lay in the present offshore region. A distinctive basin of flysch deposition in the axial region, the Hazen Trough, received sediments from early Middle Ordovician to early Devonian time. From sole markings it is clear that sediment-bearing currents entered the trough from the northwest and were deflected to the southwest, along the trough.

Widespread deposition of clastic sediments in Middle and Late Devonian times was heralded in the Early Devonian by the development of three northerly trending, positive structural belts, of which the Boothia Uplift is the most prominent, with adjacent troughs and basins. Intrusions of ultramafic to granitic and syenitic composition possibly were emplaced in the northernmost region at this (Early) time, judging by K-Ar age determinations.

Tectonic activity in the northern geanticline in Middle and later Devonian time is inferred to have advanced southward to terminate the normal geosynclinal sequence and provide a southward-directed flood of clastic sediments. This, the Ellesmerian orogeny, involved regional folding, metamorphism, local quartz monzonite and quartz diorite intrusion, and widespread region, whereas folding to the south affected both earlier and later, synorogenic clastic beds. Ellesmerian structures conform to the present shape of the craton: a markedly sigmoidal pattern in the Canadian Arctic Islands lies between the related orogenic belts of northern Greenland and north shore, arctic Alaska.

Certain tectonic elements of the orogenic belt, such as the successor, Sverdrup Basin, are younger than Franklinian or Ellesmerian features but are geographically closely

coincident with them. The younger elements thus appear to owe their origin to reactivation of tectonic processes that gave rise to the older features.

A comparison of the sedimentary and tectonic features of the Innuitian region and Svalbard shows that the tectonic histories of the two regions were mainly unlike before Devonian time but distinctly similar during certain periods since then. Taking into account ocean spreading, it appears probable that Svalbard and the Franklinian Geosyncline were once adjacent. A model is proposed for the earliest (Precambrian-late Paleozoic) times, in which rudely matched sedimentary basins were separated by the geanticlinal ridge, Pearya. A linear zone of younger basins formed in Carboniferous and Permian time, and by mid-Tertiary time the region was ragmented by the opening of the Atlantic "neo-Arctic" oceans.

Christie, R.L. and Ineson, J.R.

PRECAMBRIAN – SILURIAN GEOLOGY OF THE G.B. SCHLEY FJORD REGION, EASTERN PEARY LAND, NORTH GREENLAND; in Report on the 1978 geological expedition to the Pearly Land region, North Greenland; Grønlands Geologiske Undersøgelse, Rapport Nr. 88, p. 63-71, 1979.

The G.B. Schley Fjord region is underlain by three and possibly more sedimentary sequences: 1) Precambrian, comprising white quartzite, dark volcanic rocks, and a suite of thin-bedded slates, dolomitic mudstones, and sandstones; 2) late Precambrian (?) or Cambrian to Silurian, beginning with the dolomitic Portfjeld Formation and ending with flysch sandstone; and 3) late Paleozoic and younger sandstones, limestones and shales of the Wandel Sea Basin. The region has been disturbed by flexuring and faulting so that an irregular outcrop pattern results.

Conaway, J.G.

URANIUM ORE CONCENTRATIONS FROM GAMMA-RAY LOGS; Canadian Mining and Metallurgical Bulletin, v. 72, no. 803, p. 96-98, 1979.

In gamma-ray logging for uranium, the recorded gamma-ray intensities are multiplied by a system calibration factor to give radioelement grades. However, this technique is strictly valid only near the centre of completely homogeneous radioactive zones greater than about 1 m thickness. In the more common situations involving thin radioactive zones and complex sequences, it is possible to apply computer processing techniques to maximize the accuracy and resolution of the processed log (the radiometric assay log or RA-Log). Alternatively, one may use the area under the gamma-ray anomaly to determine the total grade-thickness product over the radioactive zone. Although neither the grade nor the thickness is known independently, tonnage calculations over the entire zone will still be valid.

In practice, many factors conspire to degrade the accuracy and resolution of ore-grade calculations made on the basis of the gamma-ray log. Techniques have been established for dealing with most of these factors; unfortunately, these are often ignored. Gamma-ray logging has great potential in uranium exploration and evaluation as a supplement to core assaying. A properly run logging program may reduce the required coring by up to 90%, and may well give significantly improved results. To obtain these advantages, the logger or supervising geologist must ensure that the logging is being done properly using techniques which are appropriate for a given exploration environment.

Currie, K.L., Pickerill, R.K., and Pajari, G.E., Jr.

GEOPHYSICAL EVIDENCE FOR AN EAST-DIPPING APPALACHIAN SUBDUCTION ZONE BENEATH NEWFOUNDLAND: Comment; Geology, v. 7, p. 469-470, 1979.

Pajari, G.E., Pickerill, R.K., and **Currie, K.L.**

THE NATURE, ORIGIN, AND SIGNIFICANCE OF THE CARMANVILLE OPHIOLITIC MÉLANGE, NORTH-EASTERN NEWFOUNDLAND; Canadian Journal of Earth Sciences, v. 16, p. 1439-1451, 1979.

The Carmanville ophiolitic mélange of northeastern Newfoundland forms an olistostrome within a thick succession of Middle to Upper Ordovician flyschoid shale, siltstone, and greywacke. The olistostrome consists of sedimentary, volcanic, and ultramafic olistoliths ranging in size from granules to several kilometres. The matrix appears to have been derived entirely by disaggregation and disintegration of hydroplastic and thixotropic sediments. The matrix was sufficiently fluid for turbulent motion to occur in the lower parts of the olistostrome, yet viscous enough to produce alignment of fragments and a pervasive cleavage, as well as drag folds in the surrounding hydroplastic sediments. The olistoliths have been drawn from a stratigraphic column hundreds, if not thousands, of metres thick, and an area many kilometres across. A small proportion of the olistoliths were deformed and metamorphosed prior to incorporation in the olistostrome.

The Carmanville ophiolitic mélange is tentatively correlated with the Dunnage mélange to define the northern margin of a sheet of ocean floor and island arc obducted toward the southeast onto an accreting continental rise in Llanvirnian-Llandeilian time. Olistostrome formation within this unstable pile commenced in post-Arenigian time, and may have continued intermittently until Llandoverian time. The olistostrome and surrounding rocks were further deformed, metamorphosed, and intruded by granitoid plutons during Silurian and Devonian time.

Le mélange ophiolitique de Carmanville dans le nord-est de Terre-Neuve constitue un olisthostrome à l'intérieur de la succession épaisse des schistes argileux, des siltstones et des grauwackes flyschoïdes de l'Ordovicien moyen à supérieur. L'olisthostrome est constitué d'olistholites de roches sédimentaires, volcaniques et ultramafiques dont la taille varie de celle des granules jusqu'à plusieurs kilomètres. La matrice semble provenir entièrement de la désagrégation et de la désintégration de sédiments hydroplastiques et thixotropes. La matrice était suffisamment fluide pour qu'un mouvement turbulent se produise dans les parties inférieures de l'olisthostrome, mais assez visqueuse pour produire un alignement des fragments et un clivage pénétratif aussi bien que des plis d'entraînement dans les sédiments hydroplastiques avoisinants. Les olistholites proviennent d'une colonne stratigraphique de plusieurs centaines, sinon quelques milliers, de mètres d'épaisseur sur une superficie de plusieurs kilomètres de diamètre. Un petit nombre d'olistholites ont été déformés et métamorphisés avant leur incorporation dans l'olisthostrome.

On tente d'établir une corrélation entre le mélange de Dunnage pour définir la bordure nord d'une couche de fond océanique et d'arc insulaire qui a subi une obduction vers le sud-est sur un glacis continental en accrétion au Llanvirnien-Llandeilien. La formation de l'olisthostrome à l'intérieur de cet empilement instable a débuté après l'Arénigien et a pu se poursuivre par intermittence jusqu'au Llandovérien. L'olisthostrome et les roches avoisinantes ont été ensuite déformées, métamorphisées et injectées par des plutons granitoïdes au cours du Silurien et du Dévonien.

DiLabio, R.N.W.

DRIFT PROSPECTING IN URANIUM AND BASE-METAL MINERALIZATION SITES, DISTRICT OF KEEWATIN, NORTHWEST TERRITORIES, CANADA; in Prospecting in Areas of Glaciated Terrain, 1979, Institute of Mining and Metallurgy, London, p. 91-100, 1979.

The results of detailed sampling of till and other sediments in known mineralized zones in the tundra of central Canada are presented. The project was designed to aid exploration by illustrating glacial dispersal from known sources and by identifying postglacial processes that control drift composition in a zone of continuous permafrost.

At a site of pitchblende-bearing fracture fillings in gneiss, a dispersal train is defined by contouring uranium abundances in the clay-size (<2 μm) fraction of till. Adsorption sites for uranium in this fraction are on phyllosilicate minerals. Sandy marine sediments derived from till and bedrock near the mineralization by wave-washing during offlap are highly enriched in uranium and base metals. Weathering products, mainly organic matter, are identified as the main sites of metal adsorption in the marine sediments.

At a copper-nickel showing, mineralized boulders and metal-rich till define the dispersal due to glaciation in the area down-ice from the mineralized outcrops. Modern lake silts collected from depths of 6-10 m near shoreline outcrops of mineralization and deep water marine silts that fill depressions on the till surface contain low amounts of nickel and copper. The fine-grained marine sediments have a complex provenance. The low metal contents of the modern lake silts are problematical, but this phenomenon has been noted in lakes adjacent to mineralization elsewhere in the southern District of Keewatin.

Detailed sampling of till within the dispersal area of a reconnaissance-scale train of till rich in zinc and copper produced maps of till geochemistry that are dominated by high abundances of zinc and copper. Local anomalies are orientated parallel to the glacial flow direction. The high zinc and copper contents of all the till samples may be related to unknown sources up-ice from the area sampled.

DiLabio, R.N.W. and **Shilts, W.W.**

COMPOSITION AND DISPERSAL OF DEBRIS BY MODERN GLACIERS, BYLOT ISLAND, CANADA; in Moraines and Varves, ed. Ch. Schlüchter, A.A. Balkema, Rotterdam, p. 145-155, 1979.

Debris bands in two glaciers and lateral moraines of five glaciers were systematically sampled on Bylot Island, located off the northeastern tip of Baffin Island. The glaciers sampled drain mountainous terrain underlain by highly metamorphosed Precambrian gneissic and granulitic rocks and flow outward onto unmetamorphosed Proterozoic sediments or onto poorly consolidated, immature Cretaceous and Tertiary shales, sandstones, and coal measures. Provenance of the glacial debris is indicated by elevated trace element contents in clay-size detritus eroded from the Precambrian highlands, by illite-rich, clay-sized detritus from the Precambrian highlands, by the presence of expansible clays from the Cretaceous-Tertiary lowlands, and by distinctive Precambrian lithologies among the coarse clasts.

Using these and other provenance indicators it has been possible to demonstrate (1) basal origin of much detritus in most debris bands, (2) patterns of down-ice dilution of metal-rich Precambrian clays, (3) inadequacy of drawing conclusions about entrainment and transportation history from composition of coarse fractions, (4) distinctly different trace element compositions of glaciers draining different basins, (5) vertical variations in composition of debris bands, and (6) the usefulness of detailed compositional studies in carefully chosen geological settings for determining glacier sedimentation and erosion processes.

Divi, S.R., Thorpe, R.I., and **Franklin, J.M.**

APPLICATION OF DISCRIMINANT ANALYSIS TO EVALUATE COMPOSITIONAL CONTROLS OF STRATIFORM MASSIVE SULFIDE DEPOSITS IN CANADA; Mathematical Geology, v. 11, no. 4, p. 391-406, 1979.

Multiple discriminant analysis is used to identify systematic variations of Cu, Pb, Zn, Ag, and Au grade values in the Canadian massive sulfide deposits with the three geological parameters of age, environment, and composition of volcanic lithology. The deposits have been separated into three groups on each of the three parameter scales and discriminant functions that separated the three groups on the basis of metal grades were then obtained. The results of the analysis indicated that Pb and Cu are the most significant in indicating specific trends along the three geological parameter scales. Pb grade increases in younger deposits with an increase in the sedimentary character of their environments, or with a more felsic nature to their volcanic rocks. On the other hand, Cu grade increases in deposits that occur in volcanic environments and with a more mafic nature to the volcanic host rocks. The results could have useful applications in mineral exploration.

Dixon, James

THE LOWER CRETACEOUS ATKINSON POINT FORMATION (NEW NAME) ON THE TUKTOYAKTUK PENINSULA, N.W.T.: A COASTAL FAN-DELTA TO MARINE SEQUENCE; Bulletin of Canadian Petroleum Geology, v. 27, no. 2, p. 163-182, 1979.

The Aptian to Lower Albian conglomerate and sandstone of the Atkinson Point Formation (new name) were deposited over a limited area on the northwest flank of the Aklavik Arch. An initial regressive depositional phase produced conglomerate-sandstone cycles of braided-stream origin. Laterally these braided-stream deposits grade into marine sandstone, which in turn gives way to shale and siltstone. An Early Albian transgression terminated braided-stream deposition and marine sandstone rapidly overlapped and overstepped earlier deposits. The areally limited distribution of the conglomerate-sandstone cycles, their braided-stream origin, the local source of the conglomerate clasts, and regional paleogeographic trends point to an origin of the cycles on a fan-delta grading laterally into a marine environment.

Duke, J.M.

COMPUTER SIMULATION OF THE FRACTIONATION OF OLIVINE AND SULFIDE FROM MAFIC AND ULTRAMAFIC MAGMAS; Canadian Mineralogist, v. 17, p. 507-514, 1979.

The effect of fractionating variable proportions of olivine and molten sulfide from peridotitic komatiite and ocean-ridge basalt magmas is investigated with the computer model of Duke & Naldrett (1978). Significant differences in the chemical trends of chalcophile elements are predicted in sulfide-saturated as compared with sulfide-undersaturated systems if the molecular olivine/sulfide ratio is less than about 100. The trends of Ni and Co are more sensitive to the olivine/sulfide ratio in the ultramafic compositional range than in basalts. The compositions of magmatic sulfides are

expected to be quite variable depending upon the stage during differentiation at which sulfide segregation occurs and upon the relative proportions of sulfide and silicate material.

On étudie sur ordinateur, au moyen du modèle de Duke & Naldrett (1978), le fractionnement de mélanges, en proportions diverses, d'olivine et de sulfures fondus à partir de deux magmas, l'un komatiitique (péridotitique), l'autre basaltique tel d'une ride médio-océanique. On peut prévoir d'importantes différences d'allure, dans la variation chimique des éléments chalcophiles, entre systèmes saturés et sous-saturés (en sulfures), lorsque le rapport molaire olivine:sulfures est inférieur à ∿100. La variation du Ni ou du Co est plus sensible à la valeur de ce rapport dans le domaine des compositions ultramafiques que dans celui des compositions basaltiques. On prévoit aussi des compositions différentes pour les sulfures magmatiques selon (1) le stade de la différenciation auquel a lieu leur ségrégation et (2) les proportions relatives des sulfures et silicates.

Dyck, W.

URANIUM, RADON AND HELIUM IN WATERS OF THE KEY LAKE AREA, SASKATCHEWAN; Canadian Mining and Metallurgical Bulletin, v. 72, no. 803, p. 96, 1979.

To ascertain the intensity and extent of various geochemical indicators, particularly those of He, Rn and U in lake waters in the vicinity of the Key Lake uranium ore deposits, a series of hydrogeochemical orientation surveys were carried out during 1977.

At a sample density of 1 sample per 8 km^2, only U and Rn in lake-bottom waters gave coherent anomaly patterns in the summer which could be related to the known radioactive boulder fan, although several other elements (He, Ni, As) gave spotty coincident highs. Several coincident weak Rn, He and conductivity highs along a string of lakes in the northwestern part of the surveyed region suggest a linear NNE-trending deeper geological feature.

On a semi-detailed scale, i.e., 3 samples per km^2, U and Rn in lake-bottom waters in the summer confirmed the regional highs in the Seahorse Lake and Zimmer Lake areas, but He was present only in the former and Ni and As were only slightly above background.

A seasonal comparison at the semi-detailed scale over and near the ore zones gave highest He concentrations of nearly four times atmospheric equilibrium concentrations in 2 winter lake-bottom water samples where the sandy overburden extends for some 50 m directly to the ore zone. Rn, U, Ni and As were also anomalous at these sites, but the highest U and Rn values were obtained in Seahorse Lake, about 2 km south of the U ore zone. Of all the elements known to be associated with the ore, only He in winter lake-bottom water samples gave persistently anomalous values in the three lakes known to be underlain by uranium ore deposits.

On a detailed scale of 30 to 50 m between sample sites, the elements U, Rn, He and Ni in summer lake-bottom water samples gave clear indications of the existence of the radioactive boulder train in the south end of Upper Seahorse Lake and the ore zone under Karl Ernest Lake, but a very weak response over the ore zone in Key Lake.

Eisbacher, G.H.

FIRST-ORDER REGIONALIZATION OF LANDSLIDE CHARACTERISTICS IN THE CANADIAN CORDILLERA; Geoscience Canada, v. 6, no. 2, p. 69-79, 1979.

Landslide modes in the Canadian Cordillera are regionalized into eight zones according to the dominance of specific types of failure and mass transport. The Coast Insular Zone is dominated by rock falls, rock avalanches, debris and earth flows; the St. Elias Zone by rock slumps and debris flows; the Plateau Zone by earth flows and rock slumps; the Skeena Zone by rock slumps; the Yukon-Selwyn Basin Zone by rock slumps; the Cassiar-Columbia Zone by deep-seated slope-sagging and gravitational spreading; the Eastern Carbonate Zone by rock avalanches and debris flows; the Foothills Zone by soft-rock slumps and earth flows. Landslide abundance in the Canadian Cordillera is related to the complex interaction of local geology on the one hand and regional factors such as relief, intensity of precipitation, and seismicity on the other. The landslide hazard deserves special attention in the recreational hinterland of Vancouver and Calgary.

Eisbacher, G.H.

MIDDLE AND LATE PROTEROZOIC EVOLUTION OF THE NORTHERN CANADIAN CORDILLERA AND SHIELD: Comment; Geology, v. 7, p. 329, 1979.

Helmstaedt, H., **Eisbacher, G.H.**, and McGregor, J.A.

COPPER MINERALIZATION NEAR AN INTRA-RAPITAN UNCONFORMITY, NITE COPPER PROSPECT, MACKENZIE MOUNTAINS, NORTHWEST TERRITORIES, CANADA; Canadian Journal of Earth Sciences, v. 16, p. 50-59, 1979.

Copper minerals are known from at least five stratigraphic levels above and below an angular unconformity recognized within rocks of the Rapitan Group on and near the Nite copper prospect, Mackenzie Mountains. The main showing on the prospect is structurally controlled and occurs in siliceous dolostone near the top of the folded and faulted Coppercap Formation, directly beneath an unconformity separating two local members of the Sayunei Formation (Rapitan Group). The copper was emplaced in tectonically fractured dolostone, precipitated from solutions that may have descended from copper-bearing conglomerates in the Rapitan Group above the unconformity, or ascended from weakly mineralized carbonates below. Mechanical reworking of older strata-bound copper deposits is indicated by significant copper content in clasts eroded from older rocks of the northeastern Mackenzie Mountains. The ultimate source of copper can probably be sought in basaltic dikes and flows emplaced prior to deposition of Redstone River and Coppercap formations during an early phase of crustal extension in the northern part of the Cordilleran miogeosyncline.

On a reconnu des minéraux du cuivre dans au moins cinq niveaux stratigraphiques au-dessus et au-dessous d'une discordance angulaire observée dans les roches du groupe de Rapitan sur le prospect de cuivre de Nite et dans ses environs dans les monts Mackenzie. L'indice principal de minéralisation du prospect est contrôlé par la structure et se rencontre dans de la dolostone siliceuse près du sommet de la formation faillée et plissée de Coppercap, directement en dessous d'une discordance séparant deux membres locaux de la formation de Sayunei (groupe de Rapitan). Le cuivre a été mis en place dans une dolostone tectoniquement fracturée, précipité à partir de solutions qui ont pu descendre des conglomérats riches en cuivre du groupe de Rapitan au-dessus de la discordance ou encore provenir des carbonates faiblement minéralisés en dessous. Le remaniement mécanique d'anciens dépôts de cuivre stratiformes est indiqué par la teneur significative en cuivre dans les galets érodés de roches plus anciennes dans le nord-est des monts Mackenzie. La source ultime du cuivre pourrait probablement se trouver dans les dykes et coulées basaltiques mis en place avant le dépôt des formations de Redstone River et de Coppercap durant une phase initiale d'extension de la croûte dans la partie nord du miogéosynclinal des Cordillères.

Ermanovics, I.F., McRitchie, W.D., and Houston, W.N.

PETROCHEMISTRY AND TECTONIC SETTING OF PLUTONIC ROCKS OF THE SUPERIOR PROVINCE IN MANITOBA; in Trondhjemites, Docites, and Related Rocks, F. Barker, ed., Elsevier Scientific Publishing Company, New York, Chapter 10, 1979.

The variation of major elements in approximately 850 samples of plutonic and volcanic rocks from the Superior Province in Manitoba is related to their tectonic setting in the English River, Uchi, Berens, and Sachigo provinces. The study distinguishes between an older (pre-Kenoran and early Kenoran) suite of tonalitic rocks spatially related to greenstone belt development, and a younger (Kenoran), unmetamorphosed suite of potassic rocks that characterizes large regions between volcanic belts. AFM, KNaCa, and QAbOr diagrams are utilized to demonstrate trondhjemitic (sodic) or calc-alkaline (potassic) differentiation trends for rock suites from the different subprovinces.

Strong trondhjemitic (Na) differentiation trends are developed in most igneous rocks of the Uchi subprovince, in metaplutonic rocks of the Berens subprovince, and in plutonic and metaplutonic rocks of the Sachigo subprovince. Calc-alkaline trends are defined by volcanic and massive plutonic rocks of the Berens and Sachigo subprovinces. Metamorphic alteration is ruled out as a cause of Na-enrichment except in rocks of the English River subprovince. Supracrustal rocks of the northern portion of this subprovince are related to eugeosynclinal tectonics and the bulk of these rocks may have been the source rock from which both potassic and sodic magmas were derived during metamorphism.

Within the tectonic setting of the western Superior Province, plutonic rocks, characterized by trondhjemitic trends, are seen as high temperature magma varieties related to a thicker 'granitic' crust overlying 'basaltic' crust. In general, the plutonic rocks of the western Superior Province display secular evolution from Na-rich tonalites and granodiorites to tonalites and granite.

Foscolos, A.E. and **Powell, T.G.**

MINERALOGICAL AND GEOCHEMICAL TRANSFORMATION OF CLAYS DURING BURIAL-DIAGENESIS (CATAGENESIS): RELATION TO OIL GENERATION; in International Clay Conference 1978, M.M. Mortland and V.C. Farmer, ed., Elsevier Scientific Publishing Company, Amsterdam, 1979.

The thermal diagenesis (catagenesis) of clays has been investigated in samples from the Panarctic et al. North Sabine H-49 well in the Sverdrup Basin in the Canadian Northwest Territories.

Upon burial of the sediments, the concentration of expandable 2:1 layer silicate, kaolinite and amorphous inorganic material decreases whereas illite increases in concentration in the clay fractions. The first dehydration of the interstratified clays is made permanent by isomorphic substitution of Si^{4+} by Al^{3+} and the ensuing absorption of K^{+} and coincides with the onset of hydrocarbon generation from the sedimentary organic matter. The clay size fraction also decreases with depth due to destruction of the hydrous clay minerals. Both the destruction of inorganic amorphous material and hydrous clay minerals provides water to the pore system but only the destruction of the latter occurs within the hydrocarbon generation zone. The second dehydration step of the interstratified clays occurs below the oil generation zone.

Foscolos, A.E. and **Powell, T.G.**

CATAGENESIS IN SHALES AND OCCURRENCE OF AUTHIGENIC CLAYS IN SANDSTONES, NORTH SABINE H-49 WELL, CANADIAN ARCTIC ISLANDS; Canadian Journal of Earth Sciences, v. 16, p. 1309-1314, 1979.

Authigenic clays in eight sandstone samples from the North Sabine H-49 well in the Sverdrup Basin, N.W.T., have been studied by X-ray diffraction and scanning electron microscopy. The following sequence of authigenic minerals was observed with increasing burial depth: quartz-kaolinite, illitic 2:1 layer silicates, and chlorite. It is suggested that the formation of authigenic clays in sandstones can be considered in the context and as a product of catagenesis of adjacent shales. Upon burial, water is released from the shales by compaction, clay dehydration, and clay destruction. Continuing compaction carries the products of clay transformation to the sandstones where they precipitate to form authigenic clays. The nature of the authigenic clay is directly related to the physico-chemical conditions existing at various depths.

On a étudié les argiles authigènes dans huit échantillons de grès provenant du puits North Sabine H-49 dans le bassin de Sverdrup, T.N.-O., à l'aide de la diffraction aux rayons-X et par microscopie électronique à balayage. On a observé la séquence suivante de minéraux authigènes lorsque la profondeur d'enfouissement augmente: quartz-kaolinite, silicates illitiques avec des couches 2:1, chlorite. D'après ces études, on peut considérer la formation d'argiles authigènes dans les grès dans le contexte et comme le produit de la katagénèse des schistes argileux avoisinants. Lors de l'enfouissement, les schistes argileux libèrent de l'eau en réponse aux processus de compaction, de déshydratation de l'argile ou de destruction de l'argile. Les fluides expulsés par compaction continuent à transporter les produits de transformation de l'argile dans les grès où ils précipitent pour former des argiles authigènes. La nature des argiles authigènes dépend directement des conditions physico-chimiques qui existent aux différentes profondeurs.

Frisch, T. and **Morgan, W.C.**

IVORY GULL COLONIES IN SOUTHEASTERN ELLESMERE ISLAND, ARCTIC CANADA; Canadian Field-Naturalist, v. 93, no. 2, p. 173-174, 1979.

Five Ivory Gull colonies, ranging in population from about 12 to 60 birds, have been discovered in the upland icefields of southeastern Ellesmere Island. The colonies occur on cliff-faces of precipitous nunataks as much as 26 km from the nearest sea coast. One colony is established as a nesting site; the others are probable breeding places.

Fyson, W.K. and **Frith, R.A.**

REGIONAL DEFORMATIONS AND EMPLACEMENT OF GRANITOID PLUTONS IN THE HACKETT RIVER GREENSTONE BELT, SLAVE PROVINCE, NORTHWEST TERRITORIES; Canadian Journal of Earth Sciences, v. 16, p. 1187-1195, 1979.

Regional foliations resulting from two main phases of deformation within the Archean Hackett River greenstone belt are generally steeply inclined, except near some granitoid plutons where one or both structures are shallow dipping. Inclinations decrease near the plutons with little deviation in regional strike. Near other plutons all structures are steep; in some cases steep second phase foliation passes into the granitoid rock. It is suggested that the shallow dips reflect modifications of regional strain induced solely by those plutons that were rising during the phases of regional deformation. From changes in the structural arrangement

along the belt it can be inferred that plutons rose into higher grade metamorphic rocks earlier than into lower grade rocks.

A domal structure in basal gneiss could have formed during a late stage of the second deformation. Shallow dipping foliation within the gneiss may, however, reflect not only strain modification during regional deformation and buoyant uplift, but also the initial configuration of an infrastructure.

Les foliations régionales qui résultent de deux phases principales de déformation dans la zone des roches vertes de Hackett River dans l'Archéen sont en général fortement inclinées sauf à proximité de certains plutons granitoïdes où une ou plusieurs structures ont un faible pendage. Les inclinaisons deviennent moins prononcées près du pluton avec peu de déviation de la direction régionale. Près d'autres plutons, toutes les structures sont abruptes; dans certains cas, la foliation abrupte de deuxième phase passe dans la roche granitoïde. On émet l'hypothèse que les faibles pendages reflètent les modifications des déformations régionales induites seulement par la montée de ces plutons durant les phases de déformation régionale. À partir des changements dans l'arrangement structural le long de la zone, on peut inférer que la montée des plutons s'est faite dans des roches à degré de métamorphisme plus élevé plutôt que dans des roches à degré de métamorphisme plus faible.

Une structure en dôme dans les gneiss de base a pu se former durant un stade tardif de la seconde déformation. La foliation à faible pendage dans le gneiss peut toutefois refléter non seulement une modification de la déformation durant la déformation régionale et un soulèvement par flottement, mais aussi la configuration initiale d'une infrastructure.

Fulton, R.J.

QUATERNARY DEPOSITS OF CANADA; in Quaternary Glaciations in the Northern Hemisphere, International Geological Correlation Programme Project 73/1/24, p. 117-128, 1979.

This paper describes in very general terms the nature of Quaternary geology in each of Canada's six major natural regions. In the Appalachian Region glaciation was characterized by local ice caps that coalesced and interacted with the Laurentide ice moving into the region from the west. Nonglacial Quaternary deposits are very scarce and a formal stratigraphy has been proposed only for the part of the region adjacent to the St. Lawrence Valley.

The St. Lawrence Lowlands was glaciated by Laurentide ice moving off the Canadian Shield but this ice formed several lobes that occupied individual lake basins. Nonglacial Quaternary deposits are present and an integrated stratigraphic framework has been set up.

The Shield Region acted as the gathering area for the Laurentide Ice Sheet and consequently ice moved from centres near the margins of Hudson Bay, outwards. Nonglacial Quaternary deposits are very scarce but in two areas Quaternary stratigraphic frameworks have been constructed.

There is controversy over whether the Innuitian Region was covered by a single ice sheet or by a series of local ice caps. Quaternary deposits /both glacial and nonglacial/ are not common in the region and a stratigraphic framework has not yet been proposed.

The Plains Region was glaciated by ice moving outwards from the Shield and was the terminus area for this ice. Nonglacial Quaternary deposits are locally present and several different stratigraphic frameworks have been set up for the southern part of this region.

The location and physiographic complexity of the Cordilleran Region has resulted in complex patterns of coalescing local ice caps and regional ice sheets. Locally nonglacial Quaternary deposits are abundant and stratigraphic frameworks have been proposed for several different parts of the area.

Gibson, D.W.

THE MORRISSEY AND MIST MOUNTAIN FORMATIONS – NEWLY DEFINED LITHOSTRATIGRAPHIC UNITS OF THE JURA-CRETACEOUS KOOTENAY GROUP, ALBERTA AND BRITISH COLUMBIA; Bulletin of Canadian Petroleum Geology, v. 27, no. 2, p. 183-208, 1979.

Recent work in the Rocky Mountain Foothills and Front Ranges of southwestern Alberta and southeastern British Columbia has demonstrated that the economically important coal-bearing strata between the Jurassic Fernie Formation and the Lower Cretaceous Blairmore Group can be subdivided into three formations, which in ascending order are Morrissey (new), Mist Mountain (new), and Elk. Accordingly, it is proposed to elevate the former Kootenay Formation to group status, and at the same time re-establish the original definition and recognition of the Kootenay by including some older sandstone strata which have been transferred by previous workers into the Fernie Formation.

The type section of the Morrissey Formation is on Morrissey Ridge, Elk River valley, British Columbia. This formation comprises a coarsening-upward sequence of massive, cliff-forming sandstone ranging in measured thickness from 20 m near Moose Mountain to a maximum of 80 m near Mist Mountain and Highwood Pass, southwestern Alberta. The formation can be subdivided into two members, the Weary Ridge (new), and the overlying Moose Mountain. The Weary Ridge Member, with designated type section on Weary Ridge in the upper Elk River valley of southeastern British Columbia, comprises an orange-brown to brownish-grey weathering, very fine to coarse-grained sandstone up to 55 m thick. The Moose Mountain Member, with type locality at Moose Mountain, Alberta, in contrast comprises a medium-grey weathering, fine- to coarse-grained, better-indurated and more massive sandstone, up to 36 m thick.

The Mist Mountain Formation, stratigraphically equivalent to either the combined Adanac, Hillcrest and Mutz Members, or the Coal-Bearing member of the former Kootenay Formation, is proposed for an interbedded sequence of sandstone, siltstone, mudstone, shale and thin to thick seams of bituminous to semianthracite coal, up to 665 m thick. Exposures on a western spur of Mist Mountain near Highwood Pass in southwestern Alberta have been selected as the type section.

The long-recognized Elk Formation extends geographically beyond the Fernie area, to other areas of southeastern British Columbia and southwestern Alberta. It comprises an interbedded succession of sandstone, siltstone, mudstone, shale and, locally, thick beds of chert pebble conglomerate and thin seams of high-volatile bituminous coal. A supplemental reference section is suggested for the formation on Morrissey Ridge south of Fernie, British Columbia.

The Kootenay Group conformably overlies Upper Jurassic strata of the Fernie Formation and in most areas is disconformably overlain by Lower Cretaceous strata of the Blairmore Group. Near Fernie, Highwood Pass and Canmore, the Elk is possibly conformably overlain by the Pocaterra Creek Member of the Cadomin Formation (Blairmore Group). The Kootenay Group grades laterally into strata of the Nikanassin Formation in the vicinity of the North Saskatchewan River.

Grant, A.C.

LATE TERTIARY CRUSTAL MOVEMENTS AFFECTING THE LABRADOR SHELF; Canadian Geophysical Union, Programme with Abstracts, p. 14, 1979.

Results from wells drilled on the Labrador Shelf show that about one-half of the present section of Tertiary sediments was deposited since early Oligocene time, i.e., since seafloor spreading is inferred to have ceased in the Labrador Sea. Contrary to expectations based on plate tectonic models, subsidence curves derived from the well data indicate that the rate of subsidence of the Labrador Shelf has been increasing in late Tertiary time. A review of seismic data from the Labrador Shelf indicates at least one major interruption to this trend of increasing subsidence, in that much of the Labrador Shelf was exposed to subaerial erosion in late(?) Miocene time. Post late(?) Miocene subsidence of the Labrador Shelf increased from south to north by as much as 1.5 km. It is speculated that this subsidence following inferred Miocene uplift might mark the time of decoupling of the Labrador Shelf from the elevated peneplain of the Labrador Peninsula to the west. These results indicate that late Tertiary crustal movements – both positive and negative – have played as large a role in the formation of the Labrador Shelf sedimentary basin as that attributed to plate tectonic processes in late Cretaceous and early Tertiary time.

Grant, A.C.

GEOPHYSICAL OBSERVATIONS BEARING UPON THE ORIGIN OF THE NEWFOUNDLAND RIDGE; in Crustal Properties across Passive Margins, C.E. Keen, ed., Tectonophysics, v. 59, p. 71-81, 1979.

Multichannel reflection seismic profiles extending southward from the Grand Banks show gently dipping reflectors within "basement" features underlying the Newfoundland Ridge. These reflections appear to be from sedimentary strata, indicating that the Newfoundland Ridge is a remnant of a former sedimentary basin, rather than a ridge of oceanic crust as prescribed by plate tectonic models. Probably this feature is underlain, and to some extent surrounded by, continental crust.

Grant, A.C.

THE CONTINENT-OCEAN CRUSTAL BOUNDARY IN THE WESTERN LABRADOR SEA; American Geophysical Union, Transactions, v. 60, no. 18, p. 375, 1979.

Geophysical surveys and exploratory drilling for petroleum on the continental shelf off Newfoundland show that an early Cretaceous unconformity is a principal element of the subsurface geology of that region. This unconformity can be traced as a seismic event northward to the zone of the Grenville Front on the shelf off Labrador. There it is disrupted by Cretaceous and early Tertiary faults that bound a coast-parallel graben underlying the Labrador Shelf to the north, and it is buried deeply by Cretaceous and Tertiary clastic deposits. Multichannel reflection seismic records from the slope and rise between 56°N and 61°N show a strong, smooth reflector that is here interpreted as representing the early Cretaceous unconformity surface along the eastern, seaward side of the coast-parallel graben. This interpretation implies: 1) that pre-early Cretaceous "continental basement" rocks extend considerably to the east of limits proposed on the basis of magnetic, gravity, and refraction seismic data – for example, into areas occupied by magnetic anomalies 26 and 28; 2) that the zone of the Grenville Front on the Labrador Shelf is primarily a zone of differential downwarping during Cretaceous and Tertiary time, rather than a fracture zone with left-lateral displacement as implied by plate tectonic-type models; and, 3) that refraction seismic evidence of "oceanic" depth to mantle off Labrador may not be a sufficient criterion for determining prior origin – oceanic or continental – of crustal material.

Hinz, K., Schlüter, H.-U., **Grant, A.C., Srivastava, S.P., Umpleby, D.,** and **Woodside, J.**

GEOPHYSICAL TRANSECTS OF THE LABRADOR SEA: LABRADOR TO SOUTHWEST GREENLAND; in Crustal Properties across Passive Margins, C.E. Keen, ed., v. 59, p. 151-183, 1979.

In 1977 the Federal Institute for Geosciences and Natural Resources, Hannover, carried out a large scale multichannel reflection seismic survey in the Labrador Sea. This survey provided an opportunity for the direct comparison of the geologic structure of the Labrador and Greenland margins. The seismic records across the Labrador Shelf show a thick, prograding sedimentary wedge consisting of several seismic sequences onlapping an acoustic basement that dips steeply seaward. The surface of the acoustic basement is irregular below the continental slope, indicating Late Cretaceous-Early Tertiary faulting. The thick sedimentary section below the slope is divided by an unconformity, tentatively identified as Late Tertiary in age, into two seismic megasequencies which can be subdivided. The acoustic basement on the Greenland side is also strongly faulted but is overlain, in the south, by a thin sedimentary section. The sediment cover thickens on the Greenland Shelf to the north as the shelf becomes wider.

As with more southerly parts of the western Atlantic margin, a positive free-air anomaly (30-50 mgal) lies landward of the shelf break off Labrador and a smaller negative anomaly follows the base of the slope. Similar, but generally narrower features are observed along the Greenland margin. West of the negative anomaly off the Greenland slope a narrow band of lower amplitude positive anomalies tends to be associated with an acoustic basement high observed in the reflection profiles. A landward negative gradient in the simple Airy isostatic anomaly across this margin suggests that the ocean-continent boundary is related to this high.

Detailed magnetic measurements across the northern Labrador margin show that well-developed oceanic anomalies trending north-northwest lie east of the large Labrador Shelf gravity high, beyond the 2000 m isobath. Landward of these magnetic anomalies is a quiet magnetic zone within which the linear gravity high is parallel to the shelf break and correlates with a deep, sediment-filled basin. It is inferred that oceanic-type crust or greatly-attenuated continental crust underlies this basin, and that continental crust thickens markedly westward of the gravity high over a distance of about 50 km.

Grasty, R.L., Kosanke, K.L., and Foote, R.S.

FIELDS OF VIEW OF AIRBORNE GAMMA-RAY DETECTORS; Geophysics, v. 44, no. 8, p. 1447-1457, 1979.

In planning and interpreting airborne gamma-ray surveys, an important consideration is the relative contribution of surface areas of a homogeneous radioactive source to the detected radiation. Numerical calculations have shown that along a flight line the width of the strip that produces a fixed percentage of the detected radiation is significantly less than the diameter of the circle contributing the same percentage of the radiation detected by a stationary gamma-ray detector. Experimental angular sensitivity measurements of typical sodium-iodide detectors

were incorporated into the calculations and showed that the results were not strongly dependent on the detector configuration. The results are shown to have applications in estimating the count rate from small sources and in the design of an optimum ground survey grid for test strips selected for the calibration of airborne gamma-ray spectrometers.

Haworth, R.T., Lefort, J.-P., and Miller, H.G.

GEOPHYSICAL EVIDENCE FOR AN EAST-DIPPING APPALACHIAN SUBDUCTION ZONE BENEATH NEWFOUNDLAND:REPLY;Geology, v. 7, p. 471-473, 1979.

Herd, R.K. and Dunning, G.R.

THE ANNIEOPSQUOTCH IGNEOUS COMPLEX, SOUTH-WEST NEWFOUNDLAND; Joint Annual Meeting, Geological Association of Canada, Mineralogical Association of Canada, Program with Abstracts, v. 4, p. 57, 1979.

The southwestern end of the Annieopsquotch Mountains exposes a previously undescribed igneous complex containing several major zones typical of the upper portions of intact ophiolite sections. The observed stratigraphy is not repeated by thrust faulting. South of Lloyds River the complex has an exposed thickness of at least 7 km and faces southeast. It grades upwards into volcanic rocks of the Ordovician central volcanic belt; its base is intruded by granite and faulted against granite, granitic gneiss and migmatite north of Lloyds River. It is presumed to be of Ordovician age.

The lowest stratigraphic level of the ophiolite yet recognized is cumulate gabbro and pyroxenite. This is overlain by a transition zone in which gabbro screens occur within sheeted dykes. An extensive sheeted dyke complex forms the next layer, containing mafic dykes of several relative ages and different compositions as seen by cross-cutting relationships, variation in mineralogy, and weathering characteristics. Leucogabbro and plagiogranite dykes brecciate more mafic, older dykes. All dykes strike north-west-southeast, normal to contacts between major layers of the ophiolite. Above the sheeted dyke zone is preserved pillow lava with cross-cutting dykes, which passes into mafic volcanics of the Victoria Lake group.

Geological features of this region are similar to those of Notre Dame Bay. The gabbros and pillow lavas of the ophiolite are potential hosts of base metal mineralization.

Higgins, J.B., Ribbe, P.H., and **Herd, R.K.**

SAPPHIRINE I; Contributions to Mineralogy and Petrology, v. 68, p. 349-356, 1979.

Microprobe analyses of 26 natural sapphirines from 17 localities indicate that the predominant chemical substitutions in this mineral occur along the solid solution join $^{VI}(Mg,Fe)^{2+} + {}^{IV}Si^{4+} = {}^{VI}(Al,Fe)^{3+} + {}^{IV}Al^{3+}$. Chromium and manganese are minor substituents. Evidence for the substitution $Si \leftrightharpoons Al+1/2Mg+1/2$ vacancy is absent within the limits of analytical error.

A partitioning scheme based on electrostatic charge balance considerations has been devised permitting calculation of Fe^{2+} and Fe^{3+} from total iron content. Results are in good agreement with previous Mössbauer studies which indicate Fe^{3+} is sometimes in octahedral and/or tetrahedral coordination.

Distribution coefficients for Fe^{2+}-Mg exchange equilibria between sapphirine-spinel and sapphirine-orthopyroxene are similar for most mineral pairs and suggest that most of the assemblages equilibrated at about the same temperature or that the exchange reactions are insensitive to temperature.

Compositions of synthetic sapphirines as a function of temperature and pressure are qualitatively predictable from crystal chemical considerations. Changes in sapphirine composition along the MgSi=AlAl solid solution join toward more aluminous compositions stabilize the sapphirine structure at high temperatures and low pressures. The limited extent of MgSi=AlAl solid solution observed in natural sapphirines appears to be related to the requirements of geometrical fit among octahedra and tetrahedra in the almost idealized cubic closest-packed anion framework.

Hoffman, P.F.

HAS THERE BEEN AN OCEANIC MARGIN TO WESTERN NORTH AMERICA SINCE ARCHEAN TIME: COMMENT; Geology, v. 7, p. 226, 1979.

Hood, P.J.

MINERAL EXPLORATION: TRENDS AND DEVELOP-MENTS IN 1978; Canadian Mining Journal, v. 100, no. 1, p. 28-69, 1979.

This article reviewed the following topics for the year 1978:

1) New geophysical, geochemical, data recording, and compilation techniques.
2) New airborne and ground instrumentation.
3) New services offered by the survey companies.
4) Anything else which appeared to be of interest to those engaged in exploration for mineral deposits.

In the review for 1978, the characteristics of commercially-available airborne electromagnetic and ground AC and DC resistivity equipment were also tabulated.

Hood, P.J.

GEOSCIENTISTS TAKE TO THE AIR; Science Affairs, Special Edition, p. 13-15, 1979.

Mineral exploration programs utilize techniques that enable mining companies to systematically search relatively large areas of territory. Aircraft equipped with geophysical sensors permit this task to be performed rapidly. Then the search focusses on those areas in which airborne anomalies have been detected, and ground surveys are carried out to further delineate the anomalies and to eliminate, if possible, those anomalies which are caused by geological conditions without economic interest. Finally, to prove the presence of an orebody at depth it is necessary to drill down to and through the body under investigation in order to obtain samples for subsequent assay.

Hood, P.J., Sawatzky, P., Kornik, L.J., and **McGrath, P.H.**

AEROMAGNETIC GRADIOMETER SURVEY, WHITE LAKE, ONTARIO; Atomic Energy of Canada Limited, Technical Record TR-11, 1979.

An introduction is presented of aeromagnetic survey techniques by the Geological Survey of Canada. Results of the first experimental survey with the GSC gradiometer system, carried out near White Lake, Ontario, in 1975, are presented. It is concluded that a vertical aeromagnetic gradiometer system is superior to a single-sensor magnetometer survey, particularly in low-gradient areas found over many granitic bodies.

Howie, R.D.

CARBONIFEROUS EVAPORITES IN ATLANTIC CANADA; Ninth International Congress of Carboniferous Stratigraphy and Geology, Abstracts of Papers, p. 93-94, 1979.

The Paleozoic fold belt in the Atlantic region of Canada forms the northeastern part of the Appalachian region of North America. In a post Orogenic basin subsequent to the Acadian Orogeny (Early to early late Devonian), occur evaporite deposits of two ages. Halite and glauberite were deposited locally in continental Horton Group rocks of late Tournaisian to possible early Viséan age.

The Windsor Group (Viséan) contains the only marine sequence in the Upper Paleozoic rocks in southeastern Canada. Near the close of Horton sedimentation, emergent areas south and east of the main depositional basin caused restricted circulation of the Windsor Sea, which attributed to the deposition of evaporites over a considerable area.

Post depositional uplift and erosion has removed large areas of lower Carboniferous rocks. As the Horton Group evaporites are considered to belong to local playa lake deposits, the original distribution of these salts is unknown. Exploratory drilling has located Horton Group evaporites in four different areas. These deposits are not considered to be of economic importance.

Windsor Group evaporites are preserved as outliers on land or as part of a northeast trending basin under the Gulf of St. Lawrence from northern Nova Scotia to western Newfoundland. Windsor Group halite occurs as bedded deposits or flow structures that vary in thickness from a few inches to over 20,000 feet. In some areas the halite is pure enough to be mined and has potential for underground storage of hydrocarbons.

Jackson, H.R., Keen, C.E., Falconer, R.K.H., and Appleton, K.P.

NEW GEOPHYSICAL EVIDENCE FOR SEA-FLOOR SPREADING IN CENTRAL BAFFIN BAY; Canadian Journal of Earth Sciences, v. 16, p. 2122-2135, 1979.

Geophysical data collected during a detailed survey in Baffin Bay have shown that lineated magnetic anomalies trending north-northwest occupy the deep central region. These anomalies exhibit maximum aplitudes of about 300 nT and can be modelled by a 1-km thick magnetic source layer divided into blocks of normal and reversed polarity. The magnetizations required are comparable with those of oceanic basalts. A striking feature of the gravity field is a 20 mGal gravity low, about 20 km wide, which runs through the centre of the bay with approximately the same trend as the magnetic lineations. The gravity low is associated with a change in crustal structure measured from seismic refraction data and sometimes with a deepening of the sediment-basement interface, reminiscent of a median valley. These results suggest that the magnetic anomalies were produced by sea-floor spreading and that the gravity low marks an extinct spreading centre in Baffin Bay. Comparisons of the magnetic anomaly profiles with a model profile computed for magnetic anomalies 13-24 (38 to 60 Ma), show good correlation between the observed and computed anomalies in the time period represented by anomalies 13-21, with slow spreading rates of about 0.3-0.4 cm yr^{-1} perpendicular to the spreading axis. These results are in reasonable agreement with magnetic anomaly identifications and spreading rates deduced from geophysical data in the Labrador Sea. The direction of plate motion in Baffin Bay is not well defined from the data, but the Labrador Sea data require plate motions at a highly oblique angle to the spreading centre in the bay. Peculiarities of the postulated spreading centre, including the change in crustal structure beneath the gravity low along its strike from south to north, and the decrease in coherence and amplitude of the magnetic anomalies immediately north of the survey area, may be the result of these very low spreading rates, oblique spreading and changes in spreading direction, or the proximity of this area to the junction with a possible major transform fault through the Nares Strait.

Les données géophysiques recueillies au cours d'un relevé dans la baie de Baffin montrent que des anomalies magnétiques linéaires de direction nord-nord-ouest occupent la région centrale profonde. Ces anomalies ont des amplitudes maximum d'environ 300 nT et peuvent être modélisées par une source magnétique formant une couche d'un km d'épaisseur divisée en blocs de polarité normale et inverse. Les aimantations requises se comparent à celles des basaltes océaniques. Une caractéristique frappante du champ de gravité est une dépression de 20 mGal d'environ 20 km de longueur qui suit le centre de la baie avec approximativement la même direction que la linéation magnétique. On associe la dépression à un changement dans la structure de la croûte mesuré à partir des données de sismique-réfraction et quelques fois elle est associée à un approfondissement de l'interface sédiment-roche, comme on l'observerait dans une vallée médiane. Ces résultats suggèrent que les anomalies magnétiques ont été produites par l'expansion du fond marin et que la dépression de gravité marque la position d'un vestige de centre d'expansion dans la baie de Baffin. Les comparaisons des profils d'anomalies magnétiques avec un profil modèle calculé pour les anomalies magnétiques 13-24 (38 à 60 Ma) montrent une bonne corrélation entre les anomalies observées et calculées dans l'intervalle de temps représenté par les anomalies 13-21, avec de faibles taux d'expansion d'environ 0.3-0.4 cm/an perpendiculaires à l'axe d'expansion. Ces résultats s'accordent bien avec les identifications d'anomalies magnétiques et les taux d'expansion déduits à partir des données géophysiques dans la mer du Labrador. La direction de mouvement des plaques dans la baie de Baffin n'est pas bien définie à partir de nos observations, mais les données de la mer du Labrador exigent des mouvements de plaque avec des angles très obliques par rapport au centre d'expansion dans la baie. Les particularités du centre d'expansion postulé, y compris le changement dans la structure de la croûte en dessous de la dépression de gravité le long de sa direction du sud au nord, et la diminution de la cohérence et de l'amplitude des anomalies magnétiques immédiatement au nord de la région étudiée, pourraient résulter de ces taux d'expansion très faibles, de l'expansion oblique et des changements dans la direction d'expansion ou de la proximité de cette région à la jonction avec une faille transformante majeure potentielle à travers le détroit de Nares.

Kamineni, D.C.

METASEDIMENTARY CORDIERITE-GEDRITE ROCKS OF ARCHEAN AGE NEAR YELLOWKNIFE, CANADA; Precambrian Research, v. 9, p. 289-301, 1979.

Archean metasedimentary rocks near Yellowknife comprising metagreywacke and meta-argillite, form broad aureoles around granite plutons. Cordierite-gedrite greywackes constitute an important metamorphic horizon within the aureoles.

The chemical composition of the cordierite-gedrite greywackes, from Yellowknife compare well with greywackes reported from other localities. The cordierite-gedrite rocks and rocks free of these minerals have slight compositional differences which are thought to be of sedimentary origin and are the main controlling factors in the formation of coexisting gedrite and cordierite.

Kamineni, D.C., Jackson, G.D., and **Bonardi, M.**

COEXISTING MAGNESIAN AND CALCIC AMPHIBOLES IN META-ULTRAMAFITES FROM BAFFIN ISLAND (ARCTIC CANADA); Neues Jahrbuch fuer Mineralogie, Monatshefte, H 12, p. 542-555, 1979.

Two metamorphosed ultramafic bodies from south-eastern Baffin Island are characterized by amphiboles coexisting in equilibrium. One body contains anthophyllite-cummingtonite-actinolite, which is believed to be the first three-amphibole assemblage recorded from the Canadian Shield. The anthophyllite and cummingtonite in this assemblage comprise one of the most magnesian pairs yet recorded, and confirm that the miscibility gap in this system can be extended to the Mg-rich side (to Fe/Fe+Mg values as low as 0.19). The second body contains coexisting anthophyllite and tremolite.

Samples from both bodies are devoid of plagioclase, and the anthophyllite-cummingtonite pair plot in the Mg-Fe field previously predicted for plagioclase-free rocks, but based on work carried out on plagioclase-bearing rocks. The partitioning of Mg-Fe for both amphibole assemblages is in agreement with previous work on amphiboles.

Keen, C.E.

THERMAL HISTORY AND SUBSIDENCE OF RIFTED CONTINENTAL MARGINS – EVIDENCE FROM WELLS ON THE NOVA SCOTIAN AND LABRADOR SHELVES; Canadian Journal of Earth Sciences, v. 16, p. 505-522, 1979.

The subsidence histories of the Labrador and Nova Scotian rifted continental margins have been determined from biostratigraphic data for 11 deep exploratory wells off Nova Scotia, for five wells off Labrador, for three wells northeast of Newfoundland, and for one well off the north-east coast of the United States of America. The components of subsidence, due to sediment loading, and when possible due to loading by changes in eustatic sea level, were removed, leaving that part of the subsidence, the tectonic subsidence, caused by cooling of the lithosphere or by other deep seated processes. The thermal cooling model theoretically predicts a linear relationship between tectonic subsidence and $t^{1/2}$, where t is the time since subsidence began. This relationship should be obeyed during the first tens of Ma of subsidence. The slope of this curve depends upon the temperature to which the crust and upper mantle were heated during the initial rifting stage and can be used to derive the temperature-time history within the sediments, the present temperature distribution, and geothermal gradient. The data show that the observed subsidence curves behave in accordance with the thermal cooling model, at least during the first 80 Ma after subsidence began and obey the equation $y = 300(\pm 80)t^{1/2}$ m, where y is the tectonic subsidence. The slopes of the subsidence curves are similar for the Labrador Shelf, the Nova Scotian Shelf, and the shelf off the north-eastern U.S.A. More rapid and variable subsidence occurs northeast of Newfoundland and this may be associated, in a way yet to be established, with the anomalous foundered continental crust near the Orphan Knoll and Flemish Cap micro-continents which lie close to this area. After about 80 Ma, the subsidence appears to depart from the linear $t^{1/2}$ law in a manner similar to the subsidence curves for oceanic crust, but this is not well established by the data. The present temperatures and temperature gradients computed using the slope of the subsidence curves show good agreement with measured values: geothermal gradients of 17.5°C km^{-1} and 26°C km^{-1} are calculated off Nova Scotia and Labrador respectively, and mean values of about 23°C km^{-1} are observed. The computed temperature-time history within the sediments was used to estimate values of vitrinite reflectance, an indicator of the degree of organic metamorphism. These values show reasonable agreement with the measured values and suggest that only the Upper Jurassic and Lower Cretaceous sediments off Nova Scotia and the Paleocene sediments off Labrador are sufficiently mature to be good sources of petroleum. The linear $t^{1/2}$ behaviour of the subsidence, and the good agreement between predicted and observed temperatures support the contention that cooling is largely responsible for the observed tectonic subsidence. The similarity of results from different areas suggests that the usefulness of the method is not restricted to a particular geographical area and may be applied to other rifted continental margins. Comparisons between the subsidence rates, thermal histories, and crustal structure at rifted margins on a worldwide scale may provide insights concerning the processes controlling their development. The temperature-time histories of the sediments estimated from the subsidence may be useful in establishing the potential of a rifted margin area for petroleum generation when little other information is available.

On a déterminé les histoires d'affaissement des bordures continentales effondrées du Labrador et de Nouvelle-Écosse à partir de données biostratigraphiques dans 11 forages d'exploration profonds au large de la Nouvelle-Écosse, cinq forages au large du Labrador, trois forages au nord-est de Terre-Neuve et un forage au nord-est de la côte américaine. Les composantes de l'affaissement causées par l'accumulation de sédiments et, lorsque c'est possible, par les charges résultant des variations eustatiques des niveaux marins ont été soustraites pour laisser cette portion de l'affaissement, l'affaissement tectonique, qui résulte du refroidissement de la lithosphère ou d'autres processus agissant en profondeur. Le modèle thermique de refroidissement prédit une relation linéaire théorique entre l'affaissement tectonique et $t^{1/2}$, où t est le temps écoulé depuis que l'affaissement a débuté. Cette relation devrait être valide durant les premières dizaines de Ma d'affaissement. La pente de cette courbe dépend de la température à laquelle se sont élevés la croûte et le manteau supérieur durant le stade initial de faillage et on peut l'utiliser pour établir l'évolution de la température en fonction du temps dans les sédiments, la distribution actuelle des températures et le gradient géothermique. Les données montrent que les courbes d'affaissement observées se comportent comme le prédit le modèle théorique de refroidissement, au moins durant les premiers 80 Ma après le début de l'affaissement et obéissent à l'équation $y = 300(\pm 80)t^{1/2}$ m, où y est l'affaissement tectonique. Les pentes des courbes d'affaissement sont semblables pour les plate-formes du Labrador, de Nouvelle-Écosse et du nord-est des États-Unis. On observe un affaissement plus rapide et plus variable au nord-est de Terre-Neuve et ceci pourrait être associé, d'une façon qui reste à expliquer, à l'anomalie dans la croûte continentale effondrée près des micro-continents d'Orphan Knoll et de Flemish Cap qu'on retrouve près de cette région. Après il y a environ 80 Ma, l'affaissement semble s'éloigner de la loi linéaire $t^{1/2}$ de façon semblable aux courbes d'affaissement pour les croûtes océaniques mais ceci n'est pas bien établi par les données qu'on possède. Les températures et gradients de température actuels calculés en utilisant la pente des courbes d'affaissement s'accordent bien avec les valeurs mesurées; on a calculé des gradients géothermiques de 17.5°C km^{-1} et de 26°C km^{-1} au large de la Nouvelle-Écosse et du Labrador respectivement alors qu'on observe des valeurs moyennes de 23°C km^{-1}. On a utilisé l'évolution de la température en fonction du temps calculé pour les sédiments pour estimer les valeurs de réflectance de la vitrinite, un indicateur du degré de métamorphisme organique. Ces valeurs montrent un accord raisonnable avec les valeurs mesurées et suggèrent que seulement les sédiments du Jurassique supérieur et du Crétacé inférieur au large de la Nouvelle-Écosse et les

sédiments du Paléocène au large du Labrador sont suffisamment matures pour être de bonnes sources de pétrole. Le comportement linéaire $t^{1/2}$ de l'affaissement et la bonne concordance entre les températures observées et prédites supportent l'hypothèse que le refroidissement est en grande partie responsable de l'affaissement tectonique observé. La similitude des résultats dans deux régions différentes suggère que l'utilité de la méthode n'est pas restreinte à une région géographique donnée et qu'elle pourrait s'appliquer à d'autres bordures continentales effondrées. Les comparaisons entre les taux d'affaissement, les histoires thermiques et la structure de la croûte aux bordures effondrées sur une base mondiale pourrait donner des indications sur les processus qui contrôlent leur développement. L'évolution des températures en fonction du temps dans les sédiments estimée à partir de l'affaissement peut être utile pour établir le potentiel d'une région de bordure effondrée pour la génération du pétrole quand il y a peu d'information disponible d'autres sources.

Keen, C.E. and Hyndman, R.D.

GEOPHYSICAL REVIEW OF THE CONTINENTAL MARGINS OF EASTERN AND WESTERN CANADA; Canadian Journal of Earth Sciences, v. 16, p. 712-747, 1979.

The evolution and geophysical features of the continental margins of eastern and western Canada are reviewed in light of recent plate-tectonic concepts. The two margins are very different in age, structure, and origin. The eastern margins were formed either by rifting or by transform motion during the latest separation of the continents around the Atlantic that occurred from Jurassic to Tertiary times. Studies of these margins centre around a reconstruction of plate motions, the inception of which occurred over 70 Ma ago, and on subsequent processes such as subsidence and sedimentation. The subsidence of the margin is explicable in terms of cooling of the lithosphere and sediment loading. Deep crustal features are inferred from seismic, gravity, and magnetic data. The recognition of the ocean-continent boundary at these margins involves consideration of edge effects, magnetic quiet zones and rifting mechanisms. The western Canadian margins are present active plate boundaries. Recent geophysical studies of these margins centre around the detailed definition of the present plate boundaries and relative plate motions, and those of the recent past (about the past 10 Ma), and involve spreading ridges, transform faults, and subduction zones. The plate convergence predicted by offshore geophysical data has a pronounced effect on the continental crust and upper mantle extending several hundred kilometres inland from the coast. In southwestern Canada patterns characteristic of subduction zones are seen in seismic structure, the gravitational and magnetic fields, heat flow, and deep electrical structure.

On passe en revue l'évolution et les caractéristiques géophysiques des bordures continentales de l'est et de l'ouest du Canada à la lumière des concepts récents de la tectonique des plaques. Les deux bordures sont d'âge, de structure et d'origine différents. Les bordures est se sont formées soit par effondrement soit par mouvement transformant durant la dernière séparation des continents autour de l'Atlantique du Jurassique au Tertiaire. Les études sur ces bordures se concentrent sur la reconstruction des mouvements de plaques qui ont débuté il y a plus de 70 Ma et sur les processus subséquents comme la subsidence et la sédimentation. L'affaissement de la bordure s'explique par le refroidissement de la lithosphère et le poids des sédiments. On déduit les structures profondes de la croûte à partir des données sismiques, gravitationnelles et magnétiques. La reconnaissance de la limite océan-continent le long de ces bordures exige qu'on considère les effets de bordure, les zones magnétiques tranquilles et les mécanismes d'effondrement. Les bordures à l'ouest du Canada sont actuellement des bordures actives de plaques. Les études géophysiques récentes sur ces bordures se concentrent sur la définition en détail des bordures actuelles de la plaque et sur les mouvements relatifs des plaques jusque dans un passé récent (les 10 derniers Ma, environ); ces bordures se caractérisent par des crêtes en expansion, des failles transformantes et des zones de subduction. La convergence des plaques prédite par les levés géophysiques effectués au large a un effet prononcé sur la croûte continentale et le manteau supérieur et on observe cet effet sur plusieurs centaines de kilomètres dans les terres à partir de la côte. Dans le sud-ouest du Canada, on observe les configurations caractéristiques des zones de subduction à l'aide de la structure sismique, des champs gravitationnels et magnétiques, de la structure du flux thermique et des propriétés électriques en profondeur.

Keen, M.J.

EARTH SCIENCE DEPARTMENTS IN THE EIGHTIES: PREPARE FOR THE WORST – YOU MAY BE SURPRISED; Geoscience Canada, v. 6, no. 4, p. 181-184, 1979.

Kerr, J.Wm.

CORNWALLIS LEAD-ZINC DISTRICT; MISSISSIPPI VALLEY-TYPE DEPOSITS CONTROLLED BY STRATIGRAPHY AND TECTONICS: REPLY II; Canadian Journal of Earth Sciences, v. 16, no. 3, p. 615-617, 1979.

Kerr, J.Wm. and Ruffman, A.

THE CROZIER STRAIT FAULT ZONE, ARCTIC ARCHIPELAGO, NORTHWEST TERRITORIES, CANADA; Bulletin of Canadian Petroleum Geology, v. 27, no. 1, p. 39-52, 1979.

Newly interpreted bathymetric data show that Crozier Strait has steep, linear, north-south margins, and depths exceeding 400 m. It probably is a fault zone, a graben, formed in the Cretaceous-Tertiary Eurekan Rifting Episode, and modified by glacial and other erosion.

The suggested graben lies within a Paleozoic structure, the Cornwallis Fold Belt. It appears that the faults forming it were guided partly by the structure of the fold belt, but probably were controlled ultimately by trends in the Precambrian crystalline basement. The suggested graben is in a north-trending anticline, and appears to be a downdropped keystone block. Crozier Strait appears to be part of a major north-trending fault zone that extends for several hundred kilometres.

The stratigraphic column beneath Crozier Strait probably contains Ordovician and Lower Devonian rocks separated by an angular unconformity. Cretaceous-Tertiary sediments probably are absent but, if present, are thin or sporadic.

Lead-zinc deposits occur on both shores of Crozier Strait and there may be others beneath the strait itself. The strait also is being considered as a potential crossing for a gas pipeline.

Killeen, P.G.

RADIOACTIVE DISEQUILIBRIUM AND ITS SIGNIFICANCE IN URANIUM EXPLORATION; in Annual Meeting, Program with Abstracts, Geological Association of Canada – Mineralogical Association of Canada, v. 4, p. 61, 1979.

Unlike the case for other metals, exploration for uranium is facilitated by the fact that uranium broadcasts its own signal, which can be measured by radiation detectors. The detectable gamma radiation however, is actually emitted by the radioactive daughters of uranium.

If uranium and its daughters are in radioactive equilibrium the quantity of parent can be determined by measuring the radioactivity of the daughters. Radiometric exploration techniques for uranium assume that the uranium decay series is in equilibrium. However six basic types of disequilibrium in the decay series have been identified. These can occur in nature to varying degrees depending on geologic environment.

Disequilibrium can occur on a small scale with relative movement of parent and daughter nuclides over only a few centimetres as reported in the Elliot Lake area, or over hundreds of metres as in the "roll front" sandstone-type uranium deposits. Thus the sample volume being analyzed is an important factor. The sample may vary from a few grams for delayed fission neutron assay up to a kilogram for gamma-ray spectrometric lab assay, a few tens of kilograms for an in situ radiometric assay on the ground, to several thousand tonnes for an airborne radiometric measurement.

An understanding of equilibrium/disequilibrium in the uranium decay series is important to the interpretation of gamma ray measurements.

Killeen, P.G.

GAMMA-RAY LOGGING PROBLEMS IN HIGH-GRADE URANIUM ORE ZONES; Canadian Mining and Metallurgical Bulletin, v. 72, no. 803, p. 98, 1979.

Gamma-ray logging as a method to determine the grade and thickness of uraniferous zones in exploration drill holes has become increasingly attractive in Canada in the past few years. This is partly due to the improved quality of slim-hole logging equipment, and partly due to necessity in cases where core recovery is poor in the uraniferous zones of interest. The latter is often the case in the recent discoveries in the Athabasca region of northern Saskatchewan.

It is possible to make quantitative uranium grade and thickness determinations in these zones of lost core if a properly calibrated gamma-ray logging system is used, and if the appropriate correction factors for dead time, casing thickness, borehole size, etc., are made. However, high-grade zones present some special problems which can invalidate the results of the most carefully calibrated system. It is important to be aware of these problems, and modified equipment or procedures can then be used to provide improved results. Of major importance are:

High count rates. All of the commonly used dead time correction formulae are approximations which become increasingly erroneous as count rates increase, requiring larger corrections.

In high-grade ore, the gamma-ray count rate may be higher than can be handled by the ratemeters or counters of the logging equipment. Dead time corrections are of no benefit in this case. The count rate which can be handled by the logging system is dependent on the capabilities of several components of the system, including the detector, the photomultiplier tube, the cable and the electronic counter at the surface. Some solutions to these problems include the use of smaller or more inefficient detectors, graded filters and special pulse handling circuitry.

Self absorption by the ore – the so-called 'Z effect'. The effective atomic number (Z) of the rock is changed significantly by the large quantities of high Z uranium. This causes a shift in the type of gamma-ray interaction which is dominant in the rock, causing the grade vs count rate calibration graphs to become non-linear about 0.5% eU_3O_8. The effective sample volume of a downhole gamma-ray probe will always be much greater than that of diamond drill core, but this volume decreases as the rock density or effective Z increase due to the presence of high-grade uranium ore.

Self-absorption problems can be largely overcome by counting only gamma-rays of energy greater than 400 keV; this paradoxically has the effect of further decreasing the effective sample volume 'seen' by the borehole probe. Gamma-rays below about 400 keV can be rejected by using a properly designed graded filter in the probe, or by using a logging system with an energy threshold greater than 400 keV.

Sobczak, L.W. and **Long, D.G.F.**

GRAVITY PROFILE ACROSS THE BONNET PLUME BASIN (MAP-AREA 106E, NORTHERN YUKON TERRITORY, CANADA): AN AID TO COAL BASIN EVALUATION; Canadian Society of Petroleum Geologists – Canadian Society of Economic Geologists, Joint Convention: "Exploration update '79 – success of the seventies – energy for the eighties", Program and Abstracts, p. 89-90, 1979.

Gravity measurements, recorded along an east-west profile, give Bouguer anomalies which vary from -43 to -81 mGal and place strict constraints on geological models which can be applied to the clastic fill of the Bonnet Plume Basin. Within these constraints the Tertiary-Cretaceous Bonnet Plume Formation can be modelled as an eastward, gently dipping (1-2°) sequence of coal bearing rocks which attains a maximum thickness of between 760 m (minimum estimate) and 2.4 km (maximum estimate) in a region seven kilometres west of its eastern limit. The unconformity of the Bonnet Plume Formation, with underlying Proterozoic rocks, east of this zone dips to the west at between 10° and 22°. Accurate estimates of both the thickness and dip of the sequence cannot be made due to inadequate knowledge of the subsurface distribution of the upper (low density) and lower (higher density) members of the formation. Gravity data suggest that major strike slip faults have a demonstrable vertical throw of 5.4 km, but by way of contrast the Knorr fault, on the eastern margin of the basin has no recognizable gravity effect. Proterozoic rocks which outcrop to the east of the basin, are downthrown to the east by a buried, previously unrecorded, major fault with a throw of about 4.1 km. Inward dipping Paleozoic-Mesozoic sequences (6.2 and 4.1 km maximum thickness, respectively) occur both to the west and east of the Bonnet Plume Basin. Gravity interpretation suggests that they rest on an irregular floor which is probably faulted with vertical displacements of less than 1 km.

Maurice, Y.T.

METHODS OF INTERPRETATION AND FOLLOW-UP OF RECONNAISSANCE LAKE SEDIMENT DATA IN THE NORTHERN CANADIAN SHIELD; in Geochemical Exploration 1978, Proceedings of the Seventh International Geochemical Symposium, p. 117-128, 1979.

A detailed follow-up program was undertaken in 1976 in the Nonacho Lake area, Northwest Territories, to assess the significance of regional lake sediment data obtained the previous year under the Canadian Uranium Reconnaissance Program. The study was primarily aimed at developing interpretation and follow-up techniques.

The Nonacho sedimentary basin exhibits a low geochemical relief but is considered favourable for the occurrence of uranium mineralization because it is adjacent to a uranium enriched basement. Follow-up within the basin should be concentrated over such favourable geological features as the unconformity and associated basal conglomerates, pyritiferous sediments, and major lineaments. Several element associations in basement lakes were found to be indicative of uranium mineralization; these include U-Mo-Cu, U-F, and U-Pb. Principal component analysis was found to be a useful technique for differentiating mineralization-related metal associations from regional element correlations associated with secondary environmental or other factors.

Follow-up investigations were carried out in selected areas. The procedure consisted of sampling all lakes within arbitrary boundaries of regional geochemical anomalies or favourable geological features. Sampling lake waters instead of, or in addition to, lake sediments is recommended because certain chemical conditions, often associated with ore deposits, are found to inhibit fixation of metals in the sediments; high acidity associated with sulphide-bearing rocks, high and variable bicarbonate concentrations in lake waters, and low organic content of lake sediments are particularly significant factors.

The information provided by detailed sampling of lakes is, in many cases, sufficient to allow follow-up to proceed on the ground. However, other semi-detailed techniques, including multiple sampling of individual lakes and airborne geophysics, may be used to further define the geochemical anomalies.

Irving, E. and **McGlynn, J.C.**

PALAEOMAGNETISM IN THE CORONATION GEOSYNCLINE AND ARRANGEMENT OF CONTINENTS IN THE MIDDLE PROTEROZOIC; Geophysical Journal of the Royal Astronomical Society, v. 58, p. 309-336, 1979.

The supracrustal rocks of the Coronation Geosyncline and associated aulacogen contain upwards of 10 000 m of rocks with good stratigraphic control. In this paper new palaeomagnetic poles from four rock units are described, bringing the total from the sequence to 10. The poles are as follows: Seton Formation 02°N, 093°W, A_{93} = 6°, Rb/Sr isochron – 1870 Ma; Douglas Peninsula Formation 17°S, 102°W, A_{95} = 16°; Takiyuak Formation 13°S, 111°W, A_{95} = 8°; Peninsular sill 22°S, 097°W, A_{95} = 7°, Rb/Sr isochron – 1800 Ma. Overprinted magnetizations from the Seton and Douglas Peninsula Formations are described. The poles from the Coronation Geosyncline delineate a polar loop – the Coronation loop. Two previously observed poles from the Stark and Tochatwi do not fall on this loop and new evidence is presented which indicates that they have been affected by local rotations. Comparisons are made with results from Africa and Australia, and it is argued that there is no basis in the palaeomagnetic evidence for the proposition that the continental crust was assembled into a single unchanged pangaea during the whole of the interval -2200 to -1300 Ma.

McKenzie, M.A. and **Bamber, E.W.**

AN OCCURRENCE OF LOWER CARBONIFEROUS FISH REMAINS FROM ALBERTA, CANADA; Canadian Journal of Earth Sciences, v. 16, p. 1628-1631, 1979.

Late Tournaisian? teeth and spines of the chondrichthyan genera **Orodus, Helodus, Deltodus, Leiodus, Petalorhynchus,** and **?Polyrhizodus** are illustrated. The nature of the assemblage and the host limestone (Livingstone Formation, southwestern Alberta) indicates a predominance of durophagous, bottom living chondrichthyans, feeding on hard-shelled invertebrates in a shallow marine, high energy, carbonate bank environment.

On illustre des fragments de dents et d'épines des genres chondrichthyens **Orodus, Helodus, Deltodus, Leiodus, Petalorhynchus** et **?Polyrhizodus** datant de la fin du Tournaisien?. La nature de l'assemblage et du calcaire qui les renferme (formation de Livingstone, sud-ouest de l'Alberta) indique une prédominance de chondrichthyens durophages vivant au fond de l'eau et dont le régime alimentaire comprenait des invertébrés à coquille rigide évoluant en milieu de bancs calcaires marins peu profonds, à haute énergie.

McLean, J. Ross

REGIONAL CONSIDERATIONS ON THE ELMWORTH FIELD AND THE DEEP BASIN; Bulletin of Canadian Petroleum Geology, v. 27, no. 1, p. 53-62, 1979.

The main producing zone, the Fahler Member, in the Elmworth Field of west-central Alberta contains conglomerate beds which can be correlated with similar units in the Foothills of northeastern British Columbia. Equivalent sequences to the north and south in the Foothills are generally finer grained, so that there appears to be less potential for finding similar conglomeratic reservoirs in adjacent areas of the Deep Basin.

The eastern edge of the gas-saturated Deep Basin approximately parallels the trend of the Lower Cretaceous Fox Creek Escarpment, and both may be related to a hinge zone controlled by pre-Cretaceous rocks. Potential for petroleum reservoirs in beds equivalent to the Fahler may be limited by the composition of the sediments, since diagenetic alteration of abundant volcanogenic detritus leads to critical reductions in porosity and permeability to the south and east of Elmworth.

Miall, A.D.

RIVERS SCULPTURE THE EARTH; Geos, Fall 1979, p. 2-5, 1979.

Rivers are among the forces that sculpture the face of the Earth. They can build enormous piles of sediment, on land in great alluvial plains, along the coast as deltas, and offshore in the form of submarine fans. Similar processes have been going on since water first started to flow on the earth's crust, in the Archean era more than 3000 million years ago. The Mississippi River for instance, carries into the Gulf of Mexico about 450 million tons of clay, silt and sand every year, enough to cover an area of one square kilometre to a depth of 220 m. The Mississippi's deposition rates were more than double that at the end of the Pleistocene ice age one million years ago, and rates three times as high have been calculated for the present day sediment discharge of the Ganges and Yellow rivers.

Les fleuves et les rivières sculptent la face de la Terre et peuvent créer d'énormes accumulations de sédiments: sur terre, sous forme d'immenses plaines alluviales; sur la côte, sous forme de deltas et, en mer, sous forme de cônes

sous-marins. Ces mêmes mouvements existent depuis que les eaux ont commencé à couler sur la Terre, à l'ère archéenne, il y a plus de 3000 millions d'années.

Les dépôts fluviaux contiennent les restes fossilisés d'êtres humains et d'autres êtres ayant vécu sur la terre ferme; on y trouve aussi beaucoup de débris d'intérêt économique, par exemple, des combustibles fossiles et des minéraux.

L'étude des dépôts fluviaux fait partie de la sédimentologie. C'est au début des années 1960 que les plus importants progrès ont été accomplis dans ce domaine, grâce à des études quantitatives portant sur le débit et la nature des cours d'eau et de leurs mouvements. Le présent article traite des différents genres de cours d'eau et de leurs dépôts.

Monger, J.W.H. and Price, R.A.

GEODYNAMIC EVOLUTION OF THE CANADIAN CORDILLERA – PROGRESS AND PROBLEMS; Canadian Journal of Earth Sciences, v. 16, p. 770-791, 1979.

The present geodynamic pattern of the Canadian Cordillera, the main features of which were probably established in Miocene time, involves a combination of right-hand strike-slip movements on transform faults along the continental margin, and, in the south and extreme north, convergence in subduction zones in which oceanic lithosphere moves beneath the continent, with consequent magmatism along the continental margin. In the southern Canadian Cordillera, geophysical surveys have outlined the subducting slab and the asthenospheric bulge that occurs beneath and behind the magmatic arc. They also show that there is now no root of thickened Precambrian continental crust beneath the tectonically shortened supracrustal strata in the southern parts of the Omineca Crystalline Belt and Rocky Mountain Belt.

The Rocky Mountain, Omineca Crystalline, Intermontane, Coast Plutonic, and Insular Belts, the structural and physiographic provinces that dominate the present configuration of the Canadian Cordillera, were established with the initial uplift and the intrusion of granitic rocks in the Omineca Crystalline Belt in Middle and Late Jurassic time and in the Coast Plutonic Complex in Early Cretaceous time, and they dominated patterns of uplift, erosion and deposition through Cretaceous and Paleogene time. Their development may be due to compression with thrust faulting in the eastern Cordillera, and to magmatism that accompanied subduction and to accretion of an exotic terrane, Wrangellia, in the western Cordillera. Major right-lateral strike-slip faulting, which occurred well east of but sub-parallel with the continental margin during Late Cretaceous and Paleogene time, accompanied major tectonic shortening due to thrusting and folding in the Rocky Mountain Belt as well as the main subduction-related(?) magmatism in the Coast Plutonic Complex.

The configuration of the western Cordillera prior to late Middle Jurassic time is enigmatic. Late Paleozoic and early Mesozoic volcanogenic strata form a complex collage of volcanic arcs and subduction complexes that was assembled mainly in the Mesozoic. The change in locus of deposition between Upper Triassic and Lower to Middle Jurassic volcanogenic assemblages, and the thrust faulting in the northern Cordillera may record emplacement of another exotic terrane, the Stikine block, in latest Triassic to Middle Jurassic time.

The earliest stage in the evolution of the Cordilleran fold belt involved the protracted (1500 to 380 Ma) development of a northeasterly tapering sedimentary wedge that discordantly overlaps Precambrian structures of the cratonic basement. This miogeoclinal wedge may be a continental margin terrace wedge that was prograded into an ocean basin, but it has features that may be more indicative of progradation into a marginal basin in which there was intermittent volcanic activity, than into a stable expanding ocean basin of the Atlantic type.

La configuration géodynamique actuelle de la Cordillère canadienne dont les traits principaux se sont dessinés probablement au Miocène, comprend une combinaison de décrochements à droite sur des failles transformantes le long de la bordure continentale et, dans le sud et l'extrême nord, la convergence des zones de subduction dans lesquelles la lithosphère océanique plonge sous le continent avec pour conséquence du magmatisme le long de la bordure continentale. Dans la partie sud de la Cordillère canadienne, les levés géophysiques ont esquissé les grands traits de la plaque descendante et du renflement de l'asthénosphère qu'on retrouve en-dessous et en arrière de l'arc magmatique. Ils montrent aussi qu'il n'y a plus maintenant de racine de croûte continentale précambrienne épaissie en-dessous des strates superficielles raccourcies tectoniquement dans les parties sud de la zone cristalline d'Omineca et de la zone des montagnes Rocheuses.

Les zones des Rocheuses, d'Omineca, la zone Intermontagneuse, plutonique Côtière et Insulaire, ainsi que les provinces structurales et physiographiques qui dominent la configuration actuelle de la Cordillère canadienne ont été établies avec le soulèvement initial et l'intrusion de roches granitiques dans la zone cristalline d'Omineca au Jurassique moyen ou supérieur et dans le complexe plutonique Côtier au début du Crétacé et ils dominent les patrons de soulèvement, d'érosion et de sédimentation au cours du Crétacé et du Paléogène. Leur développement peut être du à la compression et aux failles de chevauchement dans la Cordillère orientale, au magmatisme qui a accompagné la subduction et à l'accrétion d'une région exotique, le Wrangellia, dans la Cordillère occidentale. Des failles majeures de décrochement à droite, qui se rencontrent bien à l'est mais sub-parallèles à la bordure continentale à la fin du Crétacé et au Paléogène, ont accompagné un raccourcissement tectonique causé par le chevauchement et le plissement dans la zone des montagnes Rocheuses ainsi que la phase de magmatisme principale rattaché à la subduction(?) dans le complexe plutonique Côtier.

La configuration de la Cordillère occidentale avant le Jurassique moyen est encore une énigme. Les strates volcanogéniques de la fin du Paléozoïque et du début du Mésozoïque forment un collage complexe d'arcs volcaniques et de complexes de subduction qui se sont rassemblés au Mésozoïque. Le changement dans le lieu de dépôt entre les assemblages volcanogéniques du Trias supérieur et du Jurassique inférieur à moyen et les failles de chevauchement dans la Cordillère du nord peuvent enregistrer la mise en place d'une autre région exotique, le bloc de Stikine, de la fin du Trias au Jurassique moyen.

Le stade le plus précoce dans l'évolution de la zone plissée de la Cordillère a été marqué par le développement prolongé (de 1500 à 380 Ma) d'un coin sédimentaire amincissant de direction nord-est qui recouvre en discordance les structures précambriennes du socle cratonique. Le coin miogéoclinal pourrait être une terrasse de bordure continentale qui s'est avancée dans un bassin océanique mais il a des caractéristiques qui indiquent davantage la progradation dans un bassin marginal où il y avait activité volcanique intermittente que dans un bassin océanique stable en expansion de type Atlantique.

Nassichuk, W.W. and **Bamber, E.W.**

MIDDLE PENNSYLVANIAN BIOSTRATIGRAPHY, EASTERN CORDILLERA AND ARCTIC ISLANDS, CANADA – A SUMMARY; in Western and Arctic Canadian Biostratigraphy, C.R. Stelck and B.D.E. Chatterton, ed., Geological Association of Canada, Special Paper 18, 1978.

Middle Pennsylvanian (Atokan and Desmoinesian) rocks and faunas in the eastern Cordillera and Arctic Islands (Sverdrup Basin) represent a significant, but poorly known interval in Late Paleozoic depositional history. They are particularly well developed in the Sverdrup Basin and northern Yukon, where distinctive basinal and shelf facies can be readily identified. Farther south in the eastern Cordillera the Middle Pennsylvanian is represented by thin, discontinuous erosional remnants bounded by unconformities. Over much of the area, particularly in the eastern Cordillera, Upper Pennsylvanian rocks are absent beneath a regional sub-Permian unconformity. Atokan and Desmoinesian foraminifers and ammonoids indicate correlation of the Canadian successions with the Westphalian of western Europe and the upper Bashkirian and Moscovian of the Soviet Union.

Atokan ammonoids in the Sverdrup Basin include **Winslowoceras, Phaneroceras, Neodimorphoceras,** and many other genera, associated with fusulinaceans such as **Profusulinella** and **Pseudostaffella,** as well as smaller calcareous foraminifers that are known from the Atoka Formation in Oklahoma. Comparable fusulinaceans occur in Atokan strata of the eastern Cordillera. Desmoinesian rocks are absent from much of the eastern Cordillera, but are well developed in the northern Yukon and Sverdrup Basin, where the fusulinaceans **Fusulinella, Fusulina,** and **Wedekindellina** occur. These genera are associated with ammonoids such as **Somoholites, Metapronorites,** and **Bisatoceras** in the Sverdrup Basin.

Upadhyay, H.D. and **Neale, E.R.W.**

ON THE TECTONIC REGIMES OF OPHIOLITE GENESIS; Earth and Planetary Science Letters, v. 43, p. 93-102, 1979.

Ophiolites and their associated rocks are examined in terms of field relationships and petrochemistry. Many pre-obduction plagiogranite and dioritic dykes in the ophiolites of southern Quebec, Vourinos, California, Oregon and Newfoundland are judged not to be the end phase of differentiation of tholeiitic magma. Repetitive sedimentary-volcanic formations that overlie many ophiolite suites resemble Cenozoic volcaniclastic sequences of the New Hebrides and Tonga arcs and possibly an analogy may be drawn to the several seismic layers detected in modern marginal basins. Variation diagrams for Ti, Zr, and Cr show that dykes and pillow lavas associated with ophiolite suites from Scotland, Greece, Cyprus and Newfoundland have island arc or calc-alkaline trends. It is difficult to reconcile some of these data with origin at major oceanic ridges. Most evidence indicates proximity to island arcs and origin within marginal basins of western Pacific type. Evolution of such basins was probably initiated by distension along a continental edge resulting in the formation of a graben so that island arcs were formed on break-away continental fragments and the grabens replaced by marginal basins in which komatiitic, calc-alkaline, tholeiitic and other lavas were erupted. The rocks are more diverse than those of major ocean basins due to the interaction of downgoing oceanic plate and adjacent continental margin, the role of subducted sediments and the insulating effect of a thick sedimentary-volcanic cover.

Barnes, C.R., Kennedy, D.J., McCracken, A.D., **Nowlan, G.S.,** and Tarrant, G.A.

THE STRUCTURE AND EVOLUTION OF ORDOVICIAN CONODONT APPARATUSES; **Lethaia,** v. 12, no. 2, p. 125-151, 1979.

Multielement taxonomy was instituted for Ordovician conodonts over a decade ago and probably a majority of the multielement genera have been defined or are well understood. The present systems of notation for elements within apparatuses are inadequate and cumbersome. A new notation scheme is proposed which applies a single-letter code to element morphotypes. The taxonomic status of all known Ordovician conodont genera is reviewed (appendix) using the new notation, and a new scheme to classify conodont apparatuses is presented. Five main apparatus types (I-V) and seventeen subtypes (IA-IC, etc.) are defined. Within these groups, all known Ordovician conodont genera can be accommodated and probably few new groups are required to include all other conodont genera. The apparatus types and subtypes are defined on the basis of symmetry, curvature, and number of the element types, with a clear distinction being made between the first and second transition series. Certain homologous relationships both between and within many apparatus types are noted. The evolution of the five major types, and the subtypes, is traced through the Ordovician. The effect of provincialism is profound; evolution of apparatuses is relatively independent within the North Atlantic and Midcontinent Provinces. The pattern of evolution suggests that the types and subtypes recognized are probably natural biologic groupings. If so, the pattern of apparatus development largely reflects phylogenetic change and the types and subtypes probably equate to natural supra-generic categories. A major advantage of the new notation code is that the description and classification of conodonts is simplified, thus easing communication between conodont specialists and particularly with the paleontologists and stratigraphers.

Wicks, F.J. and **Plant, A.G.**

ELECTRON-MICROPROBE AND X-RAY-MICROBEAM STUDIES OF SERPENTINE TEXTURES; Canadian Mineralogist, v. 17, p. 785-830, 1979.

Studies by microbeam X-ray camera and electron microprobe indicate that the serpentine minerals in retrograde lizardite ± chrysotile ± brucite pseudomorphic textures become progressively more homogeneous and, in most cases, more Mg-rich as serpentinization progresses. Whereas lizardite ± brucite mesh-textures develop in a retrograde environment, the closely related lizardite ± brucite hourglass-textures are probably formed by a mild prograde event. Aluminum is a minor but persistent element in the mesh and hourglass textures, but lizardite-bastites after pyroxenes have distinctly higher Al and Cr contents. During prograde metamorphism, recrystallization of retrograde pseudomorphic textures usually begins in the fine-grained lizardite ± chrysotile mesh-centres. Relict olivine mesh-centres may alter to chrysotile + brucite or, at higher temperatures, to antigorite + brucite. Chrysotiles are usually slightly less Fe-rich, and antigorites either more or less Fe-rich, than the serpentine in the textures being replaced. Compositions tend to become more homogeneous with prolonged recrystallization to prograde nonpseudomorphic textures. However, prograde shearing produces variable Fe contents in the resulting chrysotiles and antigorites. Bastites undergo complex mineralogical and chemical changes during prograde metamorphism. In the simplest case, lizardite-bastites remain more or less unchanged by the development of prograde chrysotile + brucite. The development of

antigorite + brucite may have two effects on lizardite-bastites: they may undergo a drastic loss of Fe and recrystallize directly to antigorite, or they may lose or gain Fe and Al and recrystallize to a chlorite-like mineral + antigorite. The development of antigorite without brucite may or may not produce a loss of Fe and Al from lizardite-bastites, but it may produce a recrystallization to Povlen-type chrysotile, without much visible effect on the bastites. Many of the veins that develop in the various assemblages have compositions closely related to those of the host minerals. However, veins of very different compositions also develop and these may or may not react with the wallrock minerals, depending on conditions at the time of crystallization.

Des études par diffraction X (chambre à microfaisceau) et à la microsonde électronique montrent que les minéraux de serpentine dans les assemblages rétrogrades lizardite ± chrysotile ± brucite à textures pseudomorphes deviennent progressivement plus homogènes et, en général, plus magnésiens à mesure que progresse la serpentinisation. Les textures réticulées de lizardite ± brucite sont caractéristiques d'un milieu en rétromorphose, tandis que les textures en sablier du même assemblage signalent probablement un faible métamorphisme prograde. Toute serpentine, de l'une ou l'autre texture, contient un peu d'aluminium, mais les bastites à lizardite, formées à partir de pyroxènes, ont des teneurs en Al et Cr nettement supérieures. La recristallisation de textures pseudomorphes rétrogrades au cours du métamorphisme prograde débute généralement aux centres des mailles de la texture réticulée de lizardite ± chrysotile. Les reliques d'olivine qui s'y trouvent peuvent se transformer en chrysotile + brucite ou, à températures plus élevées, en antigorite + brucite. Ces chrysotiles sont généralement un peu moins ferrifères que la serpentine en voie de remplacement, tandis que les antigorites sont soit plus, soit moins ferrifères. Les compositions tendent à s'homogénéiser par recristallisation prolongée en textures progrades non-pseudomorphes, mais le cisaillement prograde produit une teneur en Fe variable dans les chrysotiles et antigorites. Les bastites subissent des modifications minéralogiques et chimiques compliquées pendant le métamorphisme prograde. Dans le cas le plus simple, les bastites à lizardite restent quasi inchangées durant la formation prograde de chrysotile + brucite. Lors de la cristallisation d'antigorite + brucite, les bastites à lizardite peuvent soit subir une perte énorme de Fe pour donner de l'antigorite, soit perdre ou recevoir Fe + Al pour donner un minéral chloritique + antigorite. La formation d'antigorite sans brucite peut ou non être accompagnée d'une perte en Fe et Al dans les bastites à lizardite, mais elle provoque la recristallisation d'un chrysotile de type Povlen, sans grand effet sur les bastites. Nombre de veinules qui se forment dans les divers assemblages ont une composition en relation étroite avec celles des minéraux encaissants. On trouve pourtant aussi des veines de composition totalement différente, qui peuvent ou non réagir avec les minéraux des épontes, selon les conditions lors de la cristallisation.

Purcell, L.P., **Rashid, M.A.**, and **Hardy, I.A.**

GEOCHEMICAL CHARACTERISTICS OF SEDIMENTARY ROCKS IN SCOTIAN BASIN; American Association of Petroleum Geologists Bulletin, v. 63, no. 1, p. 87-105, 1979.

The Sable and Abenaki subbasins, within the Scotian basin, have been areas of active and continuous deposition since Triassic time. Mesozoic-Cenozoic sedimentary rocks in excess of 12,000 m (40,000 ft) accumulated without major unconformities. Present temperatures are therefore believed to be the maximum, and threshold levels required for the generation of hydrocarbons probably were reached in the Cretaceous.

The organic carbon is sufficient (1 to 3%) to have generated significant amounts of hydrocarbons, but the organic matter type (dominantly terrestrial) and the time and temperature relations appear responsible for the absence of good source rocks.

Organic matter coloration and type, light gas analyses, and C_{15+} extract data all suggest that the Sable and Abenaki subbasins are thermally immature. As a result there is a marginally mature zone about 2,000 m thick which is characterized by shows of gas, condensate, and light oils. The presence of condensates, in particular, above the mature zone, is in contrast to the normal sequence of hydrocarbons in mature petroleum provinces.

Richardson, K.A. and **Killeen, P.G.**

CALIBRATION FACILITIES FOR GAMMA-RAY SPECTROMETERS MADE BY THE GEOLOGICAL SURVEY OF CANADA; The Northern Miner, March 8, 1979, p. C2, 1979.

For portable gamma-ray spectrometers and scintillometers, calibration facilities are presently located at Bell's Corners near Ottawa, and at the Institute of Sedimentary and Petroleum Geology in Calgary. A third facility is being planned for York University, Toronto. Airborne systems can be calibrated at Uplands Airport, Ottawa, and calibration facilities for borehole logging systems are located at Bell's Corners and Fredericton, N.B.

Cumming, G.L. and **Rimsaite, J.**

ISOTOPIC STUDIES OF LEAD-DEPLETED PITCHBLENDE, SECONDARY RADIOACTIVE MINERALS, AND SULPHIDES FROM THE RABBIT LAKE URANIUM DEPOSIT, SASKATCHEWAN; Canadian Journal of Earth Sciences, v. 16, p. 1702-1715, 1979.

Uranium-lead and lead isotopic studies have been made on different types of pitchblende, on secondary Pb-rich and Pb-poor uranium-bearing minerals, and on sulphides (radiogenic galena and pyrite) from the Rabbit Lake uranium deposit in northern Saskatchewan. Most specimens have been selected on the basis of their mineralogy and Pb/U ratios as determined by electron microprobe analyses. The Pb/U ratio varied between 1/2 and 1/665 as a result of diverse episodes of crystallization, differential losses of uranium and radiogenic lead, recrystallization of remobilized uranium and lead in different proportions in secondary radioactive minerals, and possible loss or enrichment of radon gas.

All concentrates yielded discordant ages. Six samples contained an excess of radiogenic lead and yielded Pb/U ratios above the concordia curve. P-1 (primary) pitchblende samples were found to be depleted of radiogenic lead, thus grading into the Pb-depleted pitchblende of type P-2, and the data on even the "best" material can, thus, only be interpreted in terms of a discordia line which yields intersections at about 1281 and 440 Ma.

A second discordia intersects the concordia curve at 1085 Ma and was obtained on concentrates containing several types of pitchblende including some samples difficult to distinguish in polished section from those of the 1281-440 Ma line, and secondary Pb-rich and Pb-poor uranyl-bearing aggregates that fell above, and at the lower end of, the concordia curve. This discordia intersection agrees well with previously published ages.

The important event related to the replacement of pitchblende by sulphides, selenides, and arsenides, accompanied by marked losses of radiogenic lead and mobilization of uranium from the partly-resorbed "primary" pitchblende of type P-1, took place at a time no greater than

800-900 Ma ago. Reactions between remobilized uranium and altered silicates, and between the uranium and silica to form uraniferous phyllosilicates and coffinite, occurred 440 and ca. 200 ma ago. Crystallization of hydrous uranyl-bearing aggregates, including precipitation of amorphous crusts in fractures of argillized rocks, continues at the present time.

The Rabbit Lake deposit has been affected by superimposed alterations and recurring fracturing leaving fragments of partly resorbed and Pb-depleted pitchblende as the only remnants of the original intensive and widespread uranium mineralization.

On a effectué des études isotopiques des rapports uranium-plomb et du plomb de différents types de pechblende, de minéraux secondaires uranifères riches et pauvres en Pb et de sulfures (galène radiogénique et pyrite) provenant du dépôt d'uranium de Rabbit Lake dans le nord de la Saskatchewan. On a choisi la plupart des échantillons sur la base de leur minéralogie et des rapports Pb/U déterminés par analyse à la microsonde électronique. Les rapports Pb/U varient de 1/2 à 1/665 dûs à différents épisodes de cristallisation, à des pertes différentielles d'uranium et de plomb radiogénique, à la recristallisation de minéraux radioactifs secondaires de l'uranium et du plomb remobilisés en proportions différentes et à la perte ou à l'enrichissement possible en gaz radon.

Tous les concentrés ont donné des âges discordants. Six échantillons contenaient un excès de plomb radiogénique et ont donné des rapports Pb/U au-dessus de la courbe de concordia. On a trouvé que les échantillons de pechblende P-1 (primaires) étaient appauvris en plomb radiogénique pour devenir de la pechblende de type P-2 pauvre en Pb; même les données sur les "meilleurs" échantillons ne peuvent être interprétées qu'en termes d'une ligne Discordia qui donne des intersections à 1281 Ma et 440 Ma.

Une seconde ligne Discordia intersecte la courbe Concordia à 1085 Ma; on l'a obtenue sur des concentrés contenant plusieurs types de pechblende, y compris quelques échantillons de pechblende difficiles à distinguer en sections polies de ceux de la ligne 1281-440 Ma et sur les agrégats secondaires porteurs de l'ion uranyle riches ou pauvres en Pb qui se situent au-dessus et à la limite inférieure de la ligne Discordia. Cette intersection de la ligne Discordia correspond aux âges déjà publiés.

L'événement important relié au remplacement de la pechblende par les sulfures, les sélénides et les arsénides, accompagné par des pertes marquées en plomb radiogénique et la mobilisation de l'uranium à partir de la pechblende "primaire" partiellement résorbée de type P-1 s'est produit à une époque pas plus ancienne que 800-900 Ma. Les réactions entre l'uranium remobilisé et les silicates altérés et entre l'uranium et la silice pour former des phyllosilicates uranifères et de la coffinite se sont produites il y a 440 Ma et autour de 200 Ma. La cristallisation des agrégats hydratés porteurs de l'ion uranyle, y compris la précipitation de croûtes amorphes sur les fractures de roches argilisées se poursuivent encore.

Le dépôt de Rabbit Lake a été affecté par des altérations superposées et par la récurrence de fracturation pour laisser des fragments de pechblende partiellement résorbés et appauvris en Pb comme seuls vestiges de la minéralisation d'uranium originellement importante et répandue.

Ruzicka, V.

OVERVIEW OF THE MAIN TYPES OF URANIUM DEPOSITS WITH PARTICULAR REFERENCES TO MAJOR CANADIAN DEPOSITS, CONCEPTS OF RESOURCE EVALUATION AND RESOURCE ESTIMATES IN BRITISH COLUMBIA RELATIVE TO OTHER PLACES; Royal Commission of Inquiry into Uranium Mining in British Columbia, Exhibit 167, 1979.

The uranium resources of the world are assigned to six types of deposits according to a classification adopted by the Organization for Economic Co-operation and Development Nuclear Energy Agency and the International Atomic Energy Agency. These are: (1) Quartz-pebble conglomerate deposits; (2) Proterozoic unconformity deposits; (3) disseminated magmatic, pegmatitic and contact deposits in igneous and metamorphic rocks; (4) vein deposits; (5) sandstone deposits; (6) other types of deposits. Major Canadian uranium deposits belong to the first, second and fourth types.

Terms and definitions used to classify Canadian uranium resources are compatible with those used in the joint Nuclear Energy Agency/International Atomic Energy Agency appraisals of world uranium resources.

Uranium resources of British Columbia represent: (a) Reasonably Assured Resources: 1.7 per cent of Canadian and 0.2 per cent of world resources; (b) Estimated Additional Resources: 0.3 per cent of Canadian and 0.1 per cent of world resources; (c) Speculative Resources: 4.5-4.6 per cent of Canadian and 0.4-0.7 per cent of world resources.

Ruzicka, V.

ESTIMATION OF UNDISCOVERED URANIUM RESOURCES IN CANADA; in Evaluation of Uranium Resources, International Atomic Energy Agency, Vienna, p. 253-273, 1979.

Estimation of undiscovered uranium resources as conducted by the Uranium Resources Evaluation Section of the Geological Survey of Canada is based: (a) on geological analyses of areas containing known uranium deposits, their past production and identified reserves; (b) on an assumption that economic geological features of known or control areas can be extrapolated to areas with similar geological environments; and (c) on conceptual genetic models simulating processes leading to formation of specific types of uranium mineralization. Several computation methods, such as volumetric, geostatistical and MIMIC (Mining Industry Model for Inventorization and Cost Evaluation) are used routinely with various degrees of completeness, or have been experimentally applied to selected areas. Two basic computerized files are used for storage and retrieval of economic geological parameters: (1) Uranium CANMINDEX, comprising information on location, character and references of individual uranium occurrences and (2) URE-3 file, containing information on geology and uranium mineralization of selected areas in Canada. The undiscovered uranium resources are classified into two categories: (1) Prognosticated Resources which comprise estimated undiscovered uranium tonnages in known uranium districts beyond specific limits established for inferred ore and (2) Speculative Resources which comprise estimated tonnages in areas where only occurrences are known or in virgin areas.

Lang, A.H. and **Ruzicka, V.**

SOME GEOLOGICAL SIDE-EFFECTS OF THE SEARCH FOR RADIOACTIVE MINERALS IN THE CANADIAN SHIELD; in History of Concepts in Precambrian Geology, W.O. Kupsch and W.A.S. Sarjeant, ed., Geological Association of Canada, Special Paper 19, 1979.

Priorities for funds and personnel to provide field and laboratory work related to finding and evaluating radioactive deposits, mainly those of uranium, also led directly and indirectly to greatly increased knowledge of the general geology of the Canadian Shield. The paper outlines some of the main advances made in these ways, as well as some minor ones. The latter are included to make the coverage as complete as possible with regard to the geology of the Shield, rather than to discuss the results for uranium.

Main examples are: the acceleration of geological mapping and special studies of stratigraphy, structure and other aspects of several large parts of the Shield, including the Archaean-Proterozoic boundary; the acquisition of modern equipment capable of making large numbers of isotope age determinations, which was soon applied to general problems in the Shield, including revision of its regional provinces and sub-provinces and the subdivision of Proterozoic time; the obtaining of modern equipment for X-ray identification of minerals and for several kinds of rock and mineral analyses, which soon allowed more advanced and more extensive mineral, petrological and trace element studies of various parts of the Shield and a general study of metallogenic provinces, illustrated by metallogenic maps, which stemmed from a metallogenic map for uranium. The development of Geiger counters and other detectors is outlined because of their relation to the map for uranium and so to aeroradiometric surveys. By 1960, 26 producing uranium mines had been developed from an estimated 12,000 occurrences carrying more than 0.05% U_3O_8 equivalent. Current activities of the Geological Survey of Canada for radioactive minerals are summarized for whatever hints this may provide regarding further indirect effects.

Because this is essentially an historical paper it deals with steps in development of various topics rather than with details of these topics; reference to detailed and 'summary' publications are cited.

Sangster, D.F.

EVIDENCE OF AN EXHALATIVE ORIGIN FOR DEPOSITS OF THE COBAR DISTRICT, NEW SOUTH WALES; Australian Bureau of Mineral Resources, Geology on Geophysics, v. 4, no. 1, p. 15, 1979.

Evidence is presented to show that a strong mineralogical/chemical zoning exists in seven deposits of the Cobar-Nymagee area. Characteristically, the within-deposit zoning, perpendicular to bedding, consists of a siliceous chalcopyrite-pyrrhotite eastern side with diffuse contacts against adjacent siltstone-shale host rocks, and a relatively massive sulphide, banded, pyrite-sphalerite-galena western side with sharp contacts against host rocks. Features such as these are typical of those in exhalative deposits in volcanic terrain and are taken here to indicate a similar origin in this essentially non-volcanic environment.

The deposits are contained in distal turbidite facies of the Devonian Cobar Supergroup, deposited in a meridional trough bounded on its eastern flank by a possible penecontemporaneous growth fault separating the trough from an adjacent shelf area on which were deposited shallow-water marine sediments and terrestrial and marine volcanics. This volcanism and the Cobar sedimentary-exhalative deposits may be related through rifting in the area which produced the proposed growth faults and the subsequent Cobar Trough.

The deposits, now in 20° discordancy to bedding, are considered to have been transposed into the prominent regional cleavage during post-ore deformation.

Using the syn-sedimentary exhalative concept, two mineralised horizons and a possible tight syncline may be recognized in the CSA mine.

Sangster, D.F.

PLATE TECTONICS AND MINERAL DEPOSITS: A VIEW FROM TWO PERSPECTIVES; Geoscience Canada, v. 6, no. 4, p. 185, 1979.

Virtually all recent attempts to relate plate tectonics and mineral deposits have adopted a similar approach whereby major plate boundary regimes (e.g., spreading, subducting, transform faults, continental collision, etc.) are first described in broad terms. This is followed, or accompanied by, descriptions of the mineral deposits considered to be associated with each plate tectonic regime. A conventional approach such as this produces a list of plate-related deposits impressive in number and diversity. Closer examination of these documentation attempts, however, reveals that apart from porphyry coppers, volcanogenic massive sulphides and perhaps carbonatites, the deposit-types so considered are relatively small and inconsequential.

A different perspective is attained when instead of examining mineral deposits from the plate tectonic viewpoint (the conventional approach), plate tectonics are examined relative to a list of major deposit-types. When this is done, it is evident that many deposits cannot readily be assigned to plate tectonic regimes or processes (e.g., sandstone Cu-U-V; Precambrian banded iron-formations; Kupferscheifer Cu, etc.). Part of the problem is that many major deposit-types occur in the Precambrian for which plate tectonic processes can be documented only with difficulty, if at all. Some major Precambrian deposit-types apparently unrelated to modern-style plate tectonics would be: banded iron-formation, layered gabbroic (Sudbury) and komatiitic (e.g., Western Australia) Ni deposits, anorthosite Ti, layered mafic complexes (Cr, Pt), and conglomerate U-Au. Other deposits occur in stable regimes and, indeed, seem to require the absence of plate tectonics (e.g., sandstone Cu-U-V; Mississippi Valley Pb-Zn; stratiform barite and phosphorite). Thus correlation of plate tectonics and mineral deposits is hampered by: a) the difficulty in "pushing" plate tectonics into the oldest rocks where many of the world's major deposits occur, and/or b) the fact that many major deposit-types occur on the (continental) plate, not at the margins, and therefore must be considered the antithesis of plate tectonic-related deposits. With all these difficulties, one can only conclude, from the perspective of a spectrum of the world's major deposit types, that plate tectonic theory is of limited use in understanding the origin and distribution of mineral deposits.

Sangster, D.F.

CARBONATE-HOSTED LEAD-ZINC OCCURRENCES IN NORTHEASTERN BRITISH COLUMBIA WITH EMPHASIS ON THE ROBB LAKE DEPOSIT: DISCUSSION; Canadian Journal of Earth Sciences, v. 16, p. 2063-2066, 1979.

Carter, **L., Schafer, C.T.,** and **Rashid, M.A.**

OBSERVATIONS ON DEPOSITIONAL ENVIRONMENTS AND BENTHOS OF THE CONTINENTAL SLOPE AND RISE, EAST OF NEWFOUNDLAND; Canadian Journal of Earth Sciences, v. 16, p. 831-846, 1979.

Sedimentologic, biologic, and morphologic criteria permit recognition of four depositional environments on the continental slope and rise, east of Newfoundland. The 'upper slope' (300-700 m) has a hummocky substrate with a mantle of terrigenous, gravelly muddy sand which is a mixture of ice-rafted detritus and sediment reworked from underlying glacial drift deposits. Reworking presumably took place during the last major lowering of sea level and it is continuing today under the influence of the Labrador Current and other oceanographic and biologically-related forces. The featureless bottom of the 'middle slope' (700-2000 m) is the principal depositional site of Recent mud. Fines, reworked from shelf and upper slope sediments, settle out together with fines transported to the area by the southeast-flowing Western Boundary Undercurrent (WBU). Compared to the upper slope this deeper environment receives less ice-rafted clasts, supports a richer macrofauna, and has a higher total species diversity of foraminifera. The 'lower slope' (2000-2500 m) is characterized by higher amounts of gravel and sand mixed with the mud, increasing numbers of current bedforms, and a more diverse foraminiferal assemblage, all of which correlate with the increasing power of the WBU with depth. The gravel was ice rafted probably at the end of the late Wisconsin to early Holocene and its presence on the seabed reflects the power of the WBU to inhibit deposition of Recent mud. The 'rise' (2500 to >3000 m) is heralded by a subtle break in slope at about 2500 m. A high speed core of the undercurrent is situated in this area as indicated by the coarseness of the sediments (gravelly muddy sand) and the observed current bedforms. A marked increase in the numbers of benthonic and planktonic foraminifera is related primarily to the winnowing capacity of WBU. Numerous arenaceous deep sea forms first occur between 2500 and 3000 m and appear to reflect the reduced salinity, low temperature, high dissolved oxygen characteristics of the watermass that is associated with this depth interval.

Des critères sédimentologiques, biologiques et morphologiques permettent de reconnaître quatre milieux de dépôt sur la pente continentale et le glacis à l'est de Terre-Neuve. Le "talus supérieur" (de 300-700 m) a un substratum bosselé recouvert d'un manteau de sable boueux et graveleux d'origine terrigène; ce dépôt est un mélange de débris amenés par des glaces flottantes et de sédiments remaniés à partir des matériaux glaciaires sous-jacents. Le ramaniement a probablement eu lieu au cours du dernier épisode d'abaissement du niveau marin et il continue aujourd'hui sous l'influence du courant du Labrador et d'autres forces d'origine océanographique ou biologique. Le fond monotone du "talus moyen" (700-2000 m) constitue le lieu principal du dépôt des boues récentes. Les particules fines, provenant du remaniement des sédiments de la plate-forme et du talus supérieur, sédimentent avec d'autres particules fines transportées par le courant de fond de Western Boundary (WB) s'écoulant au sud-est. Par comparaison avec le talus supérieur, ce milieu plus profond reçoit moins de matériaux clastiques transportés par les glaces flottantes, il supporte une macrofaune plus riche et il possède un plus grand nombre d'espèces de foraminifères. Le "talus inférieur" (de 2000-2500 m) est caractérisé par des quantités plus grandes de gravier et de sable mélangés à la boue, un nombre croissant de formes de lits façonnés par les courants et un assemblage de foraminifères plus diversifié; tous ces caractères sont en corrélation avec la puissance accrue du courant de fond WB avec la profondeur. Le gravier a été transporté par les glaces flottantes probablement à la fin du Wisconsinien ou au début de l'Holocène, et sa présence sur le fond marin reflète la puissance du courant WB pour inhiber le dépôt du boue récente. Le "glacis continental" (de 2500 à plus de 3000 m) est marqué par un faible changement de pente à environ 2500 m. Un faisceau à haute vitesse du courant de fond circule dans cette région comme l'indique la grosseur des particules (sable graveleux et boueux) et la forme des lits façonnés par le courant. On attribue l'augmentation marquée du nombre de foraminifères benthiques et planctoniques surtout à la capacité de tamisage du courant de fond. Les nombreuses formes arénacées de mer profonde ne se rencontrent qu'à partir de 2500 à 3000 m et semblent refléter une salinité réduite, une température basse, des masses d'eau avec teneur élevée en oxygène dissous qu'on associe avec cet intervalle de profondeur.

Shilts, W.W., Cunningham, C.M., and Kaszycki, C.A.

KEEWATIN ICE SHEET – RE-EVALUATION OF THE TRADITIONAL CONCEPT OF THE LAURENTIDE ICE SHEET; Geology, v. 7, p. 537-541, 1979.

Patterns of dispersal of distinctive Proterozoic and Paleozoic erratics across terrain formed on Archean and Aphebian crystalline rocks indicate that (1) ice never flowed from Hudson Bay into Keewatin in the region from the Manitoba border (lat. 60°N) northward at least to lat. 65°N; (2) westward-southwestward flow out of the bay, probably from a Labradorean dispersal center, interfaced with southward- and southeastward-flowing ice from the Keewatin dispersal center somewhere between Nelson River and Churchill; and (3) at least 300 km of dispersal of distinctive erratics observed from the vicinity of the last position of the Keewatin Ice Divide to the present coast of Hudson Bay required considerably more time than the 1,000 to 3,000 yr that the divide has traditionally been thought to have existed. In fact, the Keewatin Ice Divide and its precursors represent the centers of an independent, land-based ice sheet that probably existed throughout the period of Wisconsin Glaciation.

Snowdon, L.R.

ERRORS IN EXTRAPOLATION OF EXPERIMENTAL KINETIC PARAMETERS TO ORGANIC GEOCHEMICAL SYSTEMS; American Association of Petroleum Geologists Bulletin, v. 63, no. 7, p. 1128, 1979.

Activation energy, a chemical kinetic parameter calculated for high-temperature pyrolysis reactions, cannot be extrapolated to low-temperature geologic systems via the Arrhenius equation, $k = Ae^{-E/RT}$, for several reasons. The assumption of temperature independence of A and E is valid only over a short temperature range. Multiple reaction mechanisms may be competing with one reaction controlling the kinetics in one thermal regime while a different reaction may be controlling in a different thermal regime. Temperature dependence of diffusion, and transition-state reversibility may also result in different kinetic parameters being applicable to a given reaction at different temperatures. Therefore, the observed lower activation energy of a geologic system (compared with laboratory simulations) may be due to theoretical, chemical, and physical variables and cannot be attributed solely or even significantly to clay catalysis. Estimation of geologic temperatures and other geologic parameters from pyrolysis kinetics data is similarly and equally perilous.

Snowdon, L.R. and **Powell, T.G.**

FAMILIES OF CRUDE OILS AND CONDENSATES IN THE BEAUFORT-MACKENZIE BASIN; Bulletin of Canadian Petroleum Geology, v. 27, no. 2, p. 139-162, 1979.

Crude oils and condensates from the Beaufort-Mackenzie Basin have been analyzed chemically in order to establish a genetic classification scheme. The chemical properties of crude oils and condensates are a function of thermal and biological processes as well as the type of source organic matter. By examining many chemical parameters, the effects of biodegradation and primary or secondary thermal alteration have been circumvented as much as possible.

The analytical data used include the following: 1) fractionation into saturates, aromatics, NSO's and asphaltenes; 2) pristane/phytane ratio; 3) C_{15}+n-alkane distribution; 4) $\delta^{13}C$ of saturate and aromatic fractions; 5) distribution of 26 compounds in the gasoline range (C_5-C_8); and 6) distribution of groups of aromatic compounds. The results of the chemical analyses indicate that several oils (Imnak, Kugpik and Mayogiak) belong to one family and were derived from the Boundary Creek/Smoking Hills Formation. The gasoline-range data indicate that the Tertiary condensates from Taglu, Niglintgak and Kumak are related and have properties similar to those of the Lower Cretaceous Parsons/Siku condensates. The similarity of these two groups of condensates may be due to higher land-plant (herbaceous) debris being the main source organic-matter type in both cases. That they do in fact have separate sources is supported by the stable carbon isotope data. Another group consists of the Ivik oils, which may have a distinctive source or may be internally correlative because of the extensive biological alteration they have undergone. On the basis of the aromatic data, the Taglu and Kumak oil samples tended to group with the Ivik oils and, to a lesser extent, with the Adgo oils, suggesting a common Tertiary source followed by extensive biodegradation of the latter two groups.

Bevier, M.L., Armstrong, R.L., and **Souther, J.G.**

MIOCENE PERALKALINE VOLCANISM IN WEST-CENTRAL BRITISH COLUMBIA – ITS TEMPORAL AND PLATE-TECTONICS SETTING; Geology, v. 7, p. 389-392, 1979.

The 600-km-long Anahim volcanic belt of upper Miocene-Quaternary alkalic and peralkalic volcanic centres trends east-west along approximately lat. 52°N in British Columbia, in contrast to the Miocene Pemberton volcanic belt of calc-alkalic centers and the Pliocene-Quaternary Garibaldi volcanic belt of calc-alkalic centers, which follow the northwest-trending continental margin. Anahim belt rock types range from alkali basalt and nephelinite, found as small cinder cones and flows, to oversaturated (and undersaturated) peralkalic varieties found in evolved central volcanoes and in their erosion-exposed roots. In contrast to the usual subduction-related calc-alkaline volcanism in the Pemberton and Garibaldi belts, volcanic activity in the Anahim belt has been linked with lithospheric fracturing above the northern edge of the subducted Juan de Fuca plate or interpreted as an edge effect of the subducted plate in the mantle. Available isotopic ages from the oldest centers in the Anahim belt become younger eastward at a rate of 2 to 3.3 cm/yr, suggesting that volcanic activity there may well be related to a mantle hot spot beneath British Columbia. Volcanic chemistry and isotopic composition do not distinguish between either a rift or a hot-spot setting.

Thompson, R.I.

A STRUCTURAL INTERPRETATION ACROSS PART OF THE NORTHERN ROCKY MOUNTAINS, BRITISH COLUMBIA, CANADA; Canadian Journal of Earth Sciences, v. 16, p. 1228-1241, 1979.

The northern Canadian Rocky Mountains, as exemplified by the Halfway River map-area (94B) in British Columbia, consists of a rugged and mountainous structurally complex Foothills subprovince of large amplitude box and chevron-style folds in rocks of late Paleozoic and Mesozoic age, and a structurally diverse Rocky Mountain subprovince with open folds and apparently inconspicuous thrust faults in upper Precambrian to upper Paleozoic rocks; separating them is a narrow topographically subdued and heavily vegetated 'transition interval' comprising more penetratively folded and faulted shales and thin-bedded carbonate rocks of late Devonian and Mississippian age.

Flat thrust faults, with displacements in the order of 10 km, which occur under the eastern margin of the Rocky Mountain subprovince (mountain front) extend across the 'transition interval' and beneath the western margin of the Foothills subprovince. These faults terminate within a décollement along the Devonian and Mississippian Besa River shale, as the displacement on them is transformed into disharmonic kink-type box and chevron folds in overlying units and into tectonic thickening within the Besa River shale. Because most of the major thrust faults along the Rocky Mountains are 'blind' and cannot be traced to surface exposures, one is left with the erroneous impression that very little lateral displacement (foreshortening) has occurred in the northern Canadian Rocky Mountains.

The basic change from a well organized thrust-fault terrane in the southern Rockies to a more diverse fold terrane with few large mappable thrusts in the north is consistent with changes in the stratigraphic character of the rock prism that was deformed: the proportion of thick incompetent shale units increases northward, and major lateral carbonate to shale facies transitions traverse the eastern margin of the Rocky Mountain subprovince.

Despite the differences in structural style from south to north, strain patterns within the northern Rocky Mountains are consistent with the lateral eastward movement of a detached prism of sedimentary rocks, and support the basic tenets of thin-skinned tectonics.

La partie nord des montagnes Rocheuses canadiennes, telle qu'on l'observe dans la région cartographique de Halfway River (94B) en Colombie-Britannique, comprend la sous-province des Avant-monts, accidentée, montagneuse et de structure complexe avec ses plis coffrés et en chevrons de grande amplitude datant de la fin du Paléozoïque et du Mésozoïque, et la sous-province des montagnes Rocheuses de structure plus variée avec des plis ouverts et des failles de chevauchement peu apparentes à première vue dans les roches du Précambrien supérieur et du Paléozoïque supérieur; entre ces deux zones, on rencontre un "intervalle de transition" étroit, d'expression topographique atténuée et masqué par une végétation très dense, qui comprend une plus grande quantité de shales et de carbonates à lits minces faillés et plissés pénétrativement qui datent du Dévonien et du Mississippien.

Des failles de chevauchement plates avec des déplacements de l'ordre de 10 km qu'on rencontre sous la bordure est de la sous-province des Rocheuses (front montagneux) s'étendent à travers l'"intervalle de transition" et en dessous de la bordure ouest de la sous-province des Avant-monts. Ces failles se terminent avec un décollement le long du shale de Besa River du Dévonien et du Mississippien, alors que le déplacement sur les shales se

transforme en plis dysharmoniques coffrés de type kink ou en chevrons dans les unités au-dessus et en épaississement tectonique dans le shale de Besa River. Parce que la plupart des failles majeures de chevauchement dans les Rocheuses sont "aveugles" et qu'on peut à peine les retracer en affleurements, on reste avec la fausse impression qu'il y a eu très peu de déplacement latéral (rétrécissement à l'avant) dans la partie nord des Rocheuses canadiennes.

Le changement principal à partir d'une région bien organisée avec des failles de chevauchement dans la partie sud des Rocheuses à une région plus diversifiée, plissée avec des failles de chevauchement majeures en nombre restreint au nord s'accorde bien avec les changements dans le caractère stratigraphique du prisme rocheux qui a été déformé: la proportion d'unités de shale épaisses non compétentes augmente vers le nord et les transitions latérales majeures dans les faciès des carbonates aux shales traversent la bordure est de la sous-province des Rocheuses.

En dépit des différences de style structural du sud au nord, les patrons de déformation dans la partie nord des Rocheuses s'accordent avec le mouvement latéral vers l'est d'un prisme détaché de roches sédimentaires et supporte les principes de base de la tectonique des couches minces.

Macqueen, R.W. and **Thompson, R.I.**

CARBONATE-HOSTED LEAD-ZINC OCCURRENCES IN NORTHEASTERN BRITISH COLUMBIA WITH EMPHASIS ON THE ROBB LAKE DEPOSIT: REPLY; Canadian Journal of Earth Sciences, v. 16, p. 1643-1644, 1979.

Macqueen, R.W. and **Thompson, R.I.**

CARBONATE-HOSTED LEAD-ZINC OCCURRENCES IN NORTHEASTERN BRITISH COLUMBIA WITH EMPHASIS ON THE ROBB LAKE DEPOSIT: REPLY; Canadian Journal of Earth Sciences, v. 16, p. 2067-2068, 1979.

Tozer, E.T.

THE SIGNIFICANCE OF THE AMMONOIDS **PARATIROLITES** AND **OTOCERAS** IN CORRELATING THE PERMIAN-TRIASSIC BOUNDARY BEDS OF IRAN AND THE PEOPLE'S REPUBLIC OF CHINA; Canadian Journal of Earth Sciences, v. 16, p. 1524-1532, 1979.

Chinese geologists have correctly interpreted the sequence in south China as including the youngest known marine Permian (Changxingian Stage), followed by earliest Triassic, strata with **Otoceras** (Griesbachian Stage, Gangetian Substage). Most of the Changxingian ammonoids are known only from China but one recently described species, **Shizoloboceras fusuiense,** is evidently congeneric with **Paratirolites vediensis,** which characterizes latest Permian (Dorashamian) beds of the south U.S.S.R. and Iran. This indicates that the youngest Permian beds of Iran and China are correlative. Alternative correlations which have been suggested, namely with Changxingian including beds younger than Dorashamian, and Gangetian correlative with Dorashamian, are rejected. Below the Changxingian is the Lopingian (or Wuchiapingan), characterized by a variety of early otoceratacean. Lopingian is more or less correlative with Dzhulfian.

South China is the only known place where ammonoids of Dzhulfian (=Lopingian), Dorashamian (=Changxingian), and Gangetian (lowermost Triassic) ammonoids occur in a formational sequence. It does not necessarily follow that the Changxingian-Gangetian interval was one of faunal continuity and continuous deposition. Paleozoic-type brachiopods that locally occur in the basal metre of the Triassic formations do not establish that the relationship between the Permian and Triassic formations is transitional. The boundary between these formations is distinct. Probably, these brachiopods are derived from the subjacent Permian strata and are not natural members of the Triassic fauna.

Les géologues chinois ont correctement interprété la séquence du sud de la Chine en suggérant qu'elle contient les terrains Permiens marins les plus jeunes qu'on connaisse (étage du Changxingien) recouverts par les strates du tout début du Trias contenant **Otoceras** (étage du Griesbachien, sous-étage du Gangétien). La plupart des ammonoïdes du Changxingien n'ont été reconnus qu'en Chine, mais une espèce découverte récemment, **Shizoloboceras fusuiense,** est de toute évidence un congénère de **Paratirolites vediensis** qui caractérise les lits de la fin du Permien (Dorashamien) dans le sud de l'U.R.S.S. et en Iran. De ce fait, les lits les plus récents du Permien d'Iran et de Chine seraient corrélatifs. On rejette les corrélations alternatives, en particulier avec le Changxingien en incluant des strates plus jeunes que le Dorashamien et la corrélation entre le Gangétien et le Dorashamien. En dessous du Changxingien, on retrouve le Lopingien (ou Wuchiapingien) caractérisé par une variété d'otocératacéens primitifs. Le Lopingien est plus ou moins corrélatif avec le Djoulfien.

Le sud de la Chine est le seul endroit connu où des ammonoïdes du Djoulfien (=Lopingien), du Dorashamien (=Changxingien) et du Gangétien (base du Trias) se retrouvent dans une séquence de formations. Il ne s'ensuit pas nécessairement que durant l'intervalle Changxingien-Gangétien, il y ait eu continuité dans la faune et dans le dépôt de sédiments. La présence de brachiopodes de type paléozoïque qu'on retrouve localement dans le premier mètre à la base des formations du Trias n'établit pas que cette relation entre les formations du Permien et du Trias soit transitionnelle. La limite entre ces formations est distincte. Ces brachiopodes proviennent probablement des strates du Permien sous-jacent et ne font pas naturellement partie de la faune du Trias.

Trettin, H.P. and **Balkwill, H.R.**

CONTRIBUTIONS TO THE TECTONIC HISTORY OF THE INNUITIAN PROVINCE, ARCTIC CANADA; Canadian Journal of Earth Sciences, v. 16, p. 748-769, 1979.

The Innuitian Tectonic Province contains the record of a Phanerozoic mobile belt in northern Greenland and the Canadian Arctic Archipelago. Two fundamentally different phases in its development were separated by the Devonian-Carboniferous Ellesmerian Orogeny. The first contribution focuses on the early Paleozoic history of a key area, the second summarizes the Carboniferous to Cenozoic history of most of the Canadian part of the province.

(1) The early Paleozoic architecture of the mobile belt is apparent only in Ellesmere Island, where exposures extend from the Canadian Shield through Arctic Platform and Franklinian basin into the Pearya orogenic welt. The Franklinian basin comprised the deep but ensialic Hazen Trough and two unstable shelves bordering it on the northwest and southeast. The northwestern shelf was a site of felsic to intermediate volcanism, mainly in the Ordovician Period. Pearya, a site of granitic plutonism in the Devonian Period, supplied much of the clastic basin fill. Its core consisted of a metamorphic complex, about 1.0 Ga old, exposed in basement uplifts in northernmost Ellesmere Island. Both basin and welt essentially formed part of the North American Plate, although rifting, evident from mafic and ultramafic intrusions, probably occurred in Early Devonian (or latest Silurian) time. The history of this part of the province is tentatively interpreted as response to the opening and closure of an ocean, connected with Iapetus, that

separated northern Ellesmere Island and Greenland from the sialic crust of the present Lomonosov Ridge and Barents Shelf. The Lomonosov Ridge still seems to be attached to the shelf off northeasternmost Ellesmere Island.

(2) Deep subsidence and filling of Sverdrup Basin dominated the Innuitian region from Early Carboniferous through Late Cretaceous time. Large halokinetic diapirs and mafic dikes and sills intruded axial parts of the basin succession through Mesozoic time. Steep faults along the northwestern margin of the basin are Middle Cretaceous and older. Part of the northwestern rim of Sverdrup Basin sagged in latest Cretaceous time, becoming part of the Arctic continental terrace. In the Late Cretaceous and early Tertiary a system of large grabens developed through the southern part of the Innuitian region, linking Canada Basin with Baffin Bay; about the same time, uplift formed some large arches in the northeastern part of the region. Middle Eocene and older rocks were laterally compressed by a phase of pre-Miocene folding and faulting. Some uplift took place in Oligocene or Miocene time on Axel Heiberg Island. The distribution of recent earthquakes does not indicate the presence of modern active plate margins.

La province tectonique Innuitienne est le témoin de la présence d'une zone mobile au Phanérozoïque dans le nord du Groënland et dans l'Archipel arctique canadien. L'orogénèse d'Ellesmere du Dévonien au Carbonifère a séparé deux phases fondamentalement différentes de son développement. La première partie de l'étude décrit l'histoire d'une région clé au début du Paléozoïque et la seconde résume l'histoire, du Carbonifère au Cénozoïque, de presque toute la partie canadienne de cette province.

(1) L'architecture de la zone mobile au début du Paléozoïque ne s'observe bien que dans l'île d'Ellesmere où les affleurements s'étendent du Bouclier canadien à travers la plate-forme arctique et le bassin de Franklin jusque dans la zone orogénique de Pearya. Le bassin de Franklin comprenait la fosse de Hazen, profonde mais ensialique, et deux plate-formes instables qui la bordaient au nord-ouest et au sud-est. La plate-forme au nord-ouest a été le site de volcanisme felsique à intermédiaire durant l'Ordovicien surtout. Pearya, un site de plutonisme granitique au Dévonien, a fourni la plus grande partie du matériel clastique de remplissage du bassin. Son noyau consistait en un complexe métamorphique d'environ 1.0 Ga exposé par les soulèvements du socle dans l'extrême nord de l'île d'Ellesmere. Le bassin ainsi que sa bordure faisaient essentiellement partie de la plaque de l'Amérique du Nord quoique l'effondrement évident à partir des intrusions mafiques et ultramafiques s'est probablement produit au début du Dévonien (ou à la toute fin du Silurien). On interprète provisoirement l'histoire de cette partie de la province comme une réponse à l'ouverture et la fermeture d'un océan, en connexion avec l'Iapetus, lequel a séparé le nord de l'île d'Ellesmere et le Groënland de la croûte sialique de la crête actuelle de Lomonosov et de la plate-forme de Barents. La crête de Lomonosov semble encore rattachée à la plate-forme qui se trouve au large de l'extrême nord-est de l'île d'Ellesmere.

(2) L'affaissement en profondeur et le remplissage du bassin de Sverdrup ont affecté la région innuitienne du début du Carbonifère à la fin du Crétacé. D'immenses diapirs halocinétiques et des sills ou dykes mafiques ont envahi les parties axiales de la séquence du bassin au cours du Mésozoïque. Les failles abruptes le long de la bordure nord-ouest du bassin datent du Crétacé moyen ou avant. Une partie du côté nord-ouest du bassin de Sverdrup s'est affaissée à la fin du Crétacé pour devenir partie de la terrasse continentale de l'Arctique. À la fin du Crétacé ou au début du Tertiaire, un système de grands grabens s'est développé dans la partie sud de la région innuitienne pour relier le bassin du Canada avec la baie de Baffin; à peu près à la même époque, le soulèvement à produit de grandes voûtes dans la partie nord est de la région. Les roches de l'Éocène moyen et plus anciennes se sont comprimées latéralement durant une phase de plissement et de faillage avant le Miocène. Un peu de soulèvement s'est produit durant l'Oligocène ou au Miocène sur l'île d'Axel Heiberg. La distribution des tremblements de terre récents n'indique pas la présence de bordures de plaques modernes actives.

Veillette, J.J. and **Thomas, R.D.**

ICINGS AND SEEPAGE IN FROZEN GLACIOFLUVIAL DEPOSITS, DISTRICT OF KEEWATIN, N.W.T.; Canadian Journal of Earth Sciences, v. 16, p. 789-798, 1979.

Icings resulting from spring water, presumably flowing through taliks in permanently frozen granular deposits, were observed at four locations within a portion of north-central Keewatin in 1976. Three icings leave remnants persisting throughout the summer. The remnants exhibit morphological and tonal characteristics that permit their identification on airphotos at a scale of 1:60 000. In this continuous permafrost environment, the presence of taliks acting as subpermafrost water conduits is suggested by field observations at two of the four locations. At one location spring discharge was observed in February, March, May, and July, unusually high permafrost temperatures were recorded at a depth of 3 m above a suspected talik, and "wet sand", beneath a permafrost cover, was revealed by drilling.

Des aufeis résultant de la résurgence d'eaux souterraines qui, vraisemblablement, coulent à l'intérieur de taliks dans des dépôts granulaires gelés (pergélisol), furent rapportés à quatre endroits d'une partie du Keewatin nord-central en 1976. Trois aufeis persistent durant tout l'été et peuvent, grâce à leurs caractéristiques morphologiques et leur tonalité, être décelés sur des photographies aériennes à l'échelle de 1:60 000. Des observations de terrain à deux des quatre endroits suggèrent la présence de taliks permettant l'écoulement des eaux souterraines sous un couvert de pergélisol. À l'un de ces endroits le déversement d'eaux de source en surface fut observé en février, mars, mai et juillet; des températures exceptionnellement élevées à une profondeur de 3 m dans le pergélisol furent observées au-dessus d'un talik présumé et des forages ont indiqué la présence de sable humide sous un couvert de pergélisol.

Hillaire-Marcel, C. and **Vincent, J-S.**

HOLOCENE STRATIGRAPHY AND SEA LEVEL CHANGES IN SOUTHEASTERN HUDSON BAY, CANADA; Guidebook, Hudson Bay Field Meeting of International Geological Correlation Program Project 61 (Sea Level Changes), and the INQUA Commissions on Shorelines, the Holocene, and for Neotectonics, 177 p., 1979.

The first part of the guidebook deals with such general aspect as, the sequence of Holocene glacial events, shoreline development and glacio-isostatic rebound in the area east and southeast of Hudson Bay.

The second part is concerned with the regional geology and presents a detailed itinerary for each of three regions visited: the area southeast and east of James Bay from Matagami to LaGrande River, the area around Great Whale River and the Richmond Gulf area.

Wall, J.H.

LATE CRETACEOUS MICROFOSSILS OF THE KANGUK FORMATION, EASTERN QUEEN ELIZABETH ISLANDS, CANADIAN ARCTIC ARCHIPELAGO; in 1979 Annual Meeting, Geological Society of America, San Diego, Abstracts with Program, 1979.

Subsurface and surface investigations of the 60 to 216 m (200 to 720 ft.)-thick Kanguk Formation on west-central Ellesmere Island and the adjoining coastal area of eastern Axel Heiberg Island have yielded foraminifers, diatoms, radiolarians and algal (?) cysts useful for biostratigraphic correlation.

The upper half to two thirds of the formation is dated Campanian by a combination of diatom and foraminiferal data. The pyritized diatoms, especially species of **Actinoptychus** and **Lepidodiscus**, are identical to those from the upper Campanian Bearpaw Formation of southern Alberta, and the foraminifers include ten or more species in common with Campanian strata in the Western Canada sedimentary basin.

The lower half to one third of the formation may represent a condensed interval with a minimum-maximum range of early Campanian-late Turonian, as shown by the succession of foraminifers and the occurrence of radiolarians, chiefly spongsdiscids.

Although macrofossils younger than late Santonian-early Campanian have not been reported from the formation, the assumption of a marine connection in the late Campanian between the Canadian Arctic Islands and the Western Interior region seems justified by the microfossil occurrences in the upper Kanguk.

Wanless, R.K., Bridgwater, D., and Collerson, K.D.

ZIRCON AGE MEASUREMENTS FOR UIVAK II GNEISSES FROM THE SAGLEK AREA, LABRADOR; Canadian Journal of Earth Sciences, v. 16, p. 962-965, 1979.

Three different zircon size fractions, prepared from a single sample of Uivak II gneiss, yielded highly discordant lead-uranium isotopic ratios. The data define a discordia chord which intersects concordia at 3760 ± 150 Ma and about 2500 Ma. The upper intersection is interpreted as the time when the rocks were metamorphosed while the lower intersection records a major episodic lead loss event coincident with the youngest granitic activity in the area.

Trois différentes fractions de zircons établies d'après leur taille et préparées à partir d'un seul échantillon du gneiss d'Uivak II ont donné des rapports isotopiques plomb-uranium très discordants. Les données définissent une ligne de discordance qui recoupe une ligne de concordance à 3670 ± 150 Ma et à environ 2500 Ma. On interprète l'intersection supérieure comme le temps où les roches ont été métamorphisées alors que l'intersection inférieure serait le témoin d'un épisode majeur de perte de plomb coincidant avec l'activité granitique la plus récente de cette région.

Yorath, C.J., Bornhold, B.D., and Thompson, R.E.

OSCILLATION RIPPLES ON THE NORTHEAST PACIFIC CONTINENTAL SHELF; Marine Geology, v. 31, p. 45-58, 1979.

Oscillation ripples occur at depths of between 80 and 105 m on the northeast Pacific continental shelf. They are supported by coarse sand composed of volcanic rock fragments and carbonate shell hash. Their amplitudes vary between 15 and 30 cm and their wavelengths from 30 to 100 cm. Their mean trend is parallel with the coast of Vancouver Island and they are believed to be generated by storm-derived swell originating in the open Pacific Ocean to the southwest. Waves with periods of between 12 and 14 sec and maximum probable wave heights of 4.5-9.0 m are believed to be optimal for the construction of the observed ripples.