GEOLOGICAL SURVEY OF CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA

PAPER 75-4

ABSTRACTS OF PUBLICATIONS IN SCIENTIFIC JOURNALS BY OFFICERS OF THE GEOLOGICAL SURVEY OF CANADA, APRIL 1974 TO MARCH 1975

1975

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ABSTRACTS OF PUBLICATIONS IN SCIENTIFIC JOURNALS BY OFFICERS OF THE GEOLOGICAL SURVEY OF CANADA, APRIL 1974 TO MARCH 1975

This report contains titles, citations and in most cases abstracts of most of the papers prepared by officers of the Geological Survey (or in a few cases by other staff members who directed authorized projects) for publication in scientific journals and books. The reporting period is April 1, 1974 to March 31, 1975. The material is arranged alphabetically and in the case of multiple authorship, only the name of the Survey officer is underlined. The abstracts are as published by the original journal. The list is based on copies of separates submitted by Survey officers to the Chief Scientific Editor in April 1975 supplemented by a search of the monthly acquisition list prepared by the Library of the Geological Survey.

Agterberg, F.P.

GEOMATHEMATICS MATHEMATICAL BACKGROUND AND GEO-SCIENCE APPLICATIONS; 596 p., Elsevier Scientific Publishing Company, 1974.

Geomathematics outlines the types of geo-science problems solvable by employing mathematics. Principles of calculus, matrix algebra, geometry, probability and statistics are reviewed for geologists. More advanced methods of mathematical statistics are exemplified by applying them to problems from petrology, sedimentology, stratigraphy and structural geology. Special attention is given to topics of ore reserve evaluation and the probabilistic estimation of regional mineral resource potential.

Agterberg, F.P.

AUTOMATIC CONTOURING OF GEOLOGICAL MAPS TO DETECT TARGET AREAS FOR MINERAL EXPLORATION; Math. Geol., v. 6, no. 4, 1974.

Various statistical methods for predicting mineral potential from geological maps are reviewed. It is pointed out that, if the features are coded in more detail for relatively small cells, several new problems arise because of the dichotomous nature of the resulting variables.

The objective of this paper is to present a method for the automatic contouring of both discovered and undiscovered deposits of a given type in terms of the geological framework. It is based on the assumption that the probability of occurrence of a deposit is fully determined by a combination of functions of the mappable geological attributes in a region.

Application of the logistic model is proposed for the situation in which relatively few deposits of a given type are known to exist in the study region.

Anderson, T.W.

THE CHESTNUT POLLEN DECLINE AS A TIME HORIZON IN LAKE SEDIMENTS IN EASTERN NORTH AMERICA; Can. J. Earth Sci., v. 11, p. 678-685, 1974.

Chestnut [*Castanea dentata* (Marsh.) Borkh.] was a dominant tree of the upland forests of eastern North America until its elimination by the blight fungus, *Endothia parasitica* Anders. The blight originated in New York City in 1904, and within 50 years, it spread throughout the entire range of *Castanea dentata.* The chestnut destruction is documented in lake sediments by a corresponding decline of chestnut pollen as illustrated in examples from Lakes Ontario and Erie, and Woodcliff Lake, New Jersey. According to the data from Woodcliff Lake, the decline can be assigned an age equivalent to the time of the chestnut die-out for the area. Thus, dates of 1930 A.D. and 1935 A.D. are taken to represent times of the chestnut pollen decline in Lakes Ontario and Erie, respectively. The *Castanea* pollen decline provides an excellent and very recent time horizon (above the *Ambrosia* pollen boundary) for determining sedimentation trends since the time of European settlement as well as recent sedimentation rates.

Anderson, T.W. and Lewis, C.F.M.

CHRONOLOGY AND PALEOECOLOGY OF AN HOLOCENE BURIED PLANT DETRITUS BED IN LAKE HURON; Abstracts, 17th Conference on Great Lakes Research, August 12-14, Hamilton, Ontario, 1974.

Piston cores collected from western Lake Huron intersect an extensive bed of buried plant detritus underlying an area of at least 20 sq. km, 17 km east of the Michigan shoreline at latitude 44°30'N where the water depth is approximately 51 m. The organic beds, consisting of plant detritus gyttja and basal silty clay, range up to 70 cm thick and overlie varved glacial lacustrine sediments in a depression between morainic (?) ridges of glacial till. Within the depression, which opens southeasterly into the main Huron basin, the organic sediments are overlain by up to 40 cm of silty clay mud and sand. The plant detritus and gyttja represent sediment accumulation in a marsh, lagoon and/or shallow lake environment.

This is the first known occurrence of buried plant detritus indicating an episode of extremely low-water levels in the Huron basin. It is correlated with the post-Algonquin Lake Stanley stage, when water levels lowered significantly by drainage through the North Bay outlet and down the Mattawa-Ottawa valley. Four radiocarbon dates have been obtained on the detritus bed from three separate cores. The oldest date at the base of the peat is 9370 ± 180 years (GSC-1935) and the youngest date is 8460 ± 180 years (GSC-1966) on overlying silty clay gyttja.

Pollen, seeds, leaves, needles, mosses, insect remains, ostracodes and molluscs have been extracted from the peat and silty clay above and below the peat. The *Picea* (spruce) – *Pinus* (pine) pollen transition (estimated at approximately 10 600 years) occurs in the silty clay below the peat and provides a minimum age for the initial draw-down to low-level Lake Stanley. The retreat of lake levels from this site is well supported by significant increases of pollen and seeds of shallow water plants. The dominant vegetation at this time consisted of Characeae (algae), Cyperaceae (sedges), Gramineae (grasses), *Juncus* (rushes) and *Typha* (cattails) which gradually changed to a sedge marsh of rushes, bullrushes, *Equisetum* (horsetails), *Salix* (willow) and *Alnus* (alder) at 9370 years ago. *Larix* (tamarack) needles dominate throughout the peat and a tamarack-sedge marsh vegetation is thus inferred. Silty clay with a trace of sand overlies the peat and contains abundant ostracodes. The silt deposition represents deepening lake conditions and flooding of the marshy habitat about 8800 years ago by transgressing lake levels rising towards the Nipissing stage.

Balkwill, H.R., Roy, K.J., Hopkins, W.S. and Sliter, W.V.

GLACIAL FEATURES AND PINGOS, AMUND RINGNES ISLAND, ARCTIC ARCHIPELAGO; Can. J. Earth Sci., v. 11, p. 1319-1325, 1974.

Evidence of widespread glaciation of Amund Ringnes Island includes: northwestward-striking grooves and striations in bedrock at three widely separated localities and at elevations of about 60 m, 150 m, and 230 m; and abundant striated erratics, including granite and gneissic rocks. Isolated, sinuous deposits of boulder gravel may be eskers. Dated barnacle shells at approximately 30 m and 35 m above sea level indicate that significant rebound has occurred in the last 8000 to 8500 years, following removal of the ice load.

A cluster of small, but well-developed pingos lies on a nearly flat, featureless plain in the central part of the island.

Barnett, D.M., Edlund, S.A. and Hodgson, D.A.

SENSITIVITY OF SURFACE MATERIALS AND VEGETATION TO DISTURBANCE IN THE QUEEN ELIZABETH ISLANDS: AN APPROACH AND COMMENTARY; Arctic, v. 28, no. 1, March 1975.

A geobotanical approach to assessment of sensitivity of surface materials and vegetation to disturbance is advocated. This includes gathering information on surface materials, topography and landforms, geomorphic processes, drainage, vegetation, soil moisture and wildlife. These attributes must be considered in combination to adequately assess the sensitivity to disturbance (environmental impact).

A critical evaluation of a paper by Babb and Bliss is made, and concern is expressed over several of their findings. In particular they imply a correlation between susceptibility (sensitivity) and vegetation cover, and they assert that a simple relationship exists between ground ice content and vegetation cover. Our own fieldwork does not support either position but suggests much more complex relationships prevail.

The basis for, and suitability of scale of, their susceptibility map units is questioned. Our mapping experience from Ellesmere and Melville Islands suggests considerably different units from those shown on Babb and Bliss's map.

Barrett, D.L. and Keen, C.E.

LINEATIONS IN THE MAGNETIC QUIET ZONE OF THE NORTHWEST ATLANTIC; Nature, v. 253, p. 423-425, 1974.

A magnetic and seismic reflection survey in the Quiet Magnetic Zone shows that basement topography and magnetic anomalies are lineated parallel to the Quiet Zone boundary. Two zones of reversed polarity are identified. The results imply that the Quiet Zone boundary is an isochron separating a period of sea floor spreading in which rapid geomagnetic reversals occurred from a period in which few reversals occurred.

Blake, W., Jr.

STUDIES OF GLACIAL HISTORY IN ARCTIC CANADA. II. INTERGLACIAL PEAT DEPOSITS ON BATHURST ISLAND; Can. J. Earth Sci., v. 11, no. 8, p. 1025-1042, 1974.

Sixteen radiocarbon age determinations on peat deposits and buried organic layers at 10 localities within the Queen Elizabeth Islands have resulted in ages between >30 000 and >51 000 years. Similar results have been obtained from the southern Arctic islands, and as yet only one meaningful finite date in the 50 000 to 25 000 year-range has resulted from the dating of driftwood or *in situ* terrestrial organic materials in the entire archipelago.

On Bathurst Island, where two dates of >50 000 years have been obtained, evidence from the assemblages of mosses, vascular plants, and insects in peat and organic layers indicates that climatic conditions were somewhat more favourable than at present when these deposits were forming. The available data are such that all deposits cannot necessarily be related to the same non-glacial interval, but the extensive deposits along the Stuart River are hereby assigned to the Stuart River Interglaciation.

The lack of organic materials dating between 50 000 and 25 000 years in the Queen Elizabeth Islands may be because: (1) the area was ice-covered throughout Wisconsin time; (2) any mid-Wisconsin non-glacial interval was too short or had too severe a climate for deposits to accumulate; (3) organic deposits relating to this interval have been eroded; or (4) deposits of this age do exist but they have not been collected.

Boyle, R.W.

THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS;

Can. Inst. Min. Met. Bull., v. 67, p. 61, 1974.

Gold is a member of Group 1B of the periodic table, which includes copper, silver and gold. In its chemical reactions gold resembles silver in some respects, but its chemical character is markedly more noble. The principal oxidation states of gold are +1 (aurous) and +3 (auric). These states are unknown as aquo-ions in solution, the element being present mainly in complexes of the type $[Au(CN)_2]^-$, $[Au\,Cl_2]^-$, $[Au(OH)_4]^-$ and $[Au\,Cl_4]^-$. There is only one naturally occurring isotope of gold: Au^{197}.

In nature, gold occurs predominantly in the native state or as a major constituent of various alloys containing mainly silver, copper or platinoid metals. Several gold and gold-silver tellurides are known, of which the most common are sylvanite, calaverite, petzite, krennerite and nagyagite. The antimonide, aurostibite, $AuSb_2$, occurs as a hypogene mineral in some auriferous deposits, and there is also a bismuthide, maldonite, Au_2Bi, which is fairly well differentiated. The principal ore minerals of gold are the native metal and the various tellurides.

The abundance of gold in the upper lithosphere is about 0.004 ppm, and the Au/Ag ratio is about 0.05. The average gold content of igneous type rocks, in parts per million, is: ultrabasic (0.003), gabbro-basalt (0.004), diorite-andesite (0.004) and granite-rhyolite (0.003). The average gold content of sedimentary rocks, in parts per million, is: sandstone and conglomerate (0.06), normal shale (0.02), limestone (0.005), and anhydrite and gypsum (<0.001). Certain graphitic shales, sulphide schists, phosphorites, and some types of sandstones and conglomerates may contain up to 1.3 ppm Au or more.

The average gold content of soils is about 0.005 ppm, and the average for natural fresh waters is about 0.00003 ppm. Sea and ocean waters contain an average of 0.000017 ppm Au. Gold is a trace constituent of many plants and animals. Some coals are slightly enriched in gold, with 0.05 to 0.1 ppm Au in the ash.

Gold is won both from deposits mined essentially for the element and as a by-product of the mining and treatment of nickel, copper, zinc, lead and silver ores. The following types of primary deposits, exploited mainly for gold, can be distinguished:

1. Auriferous pegmatites, coarse-grained granitic bodies, and porphyry dykes and sills.
2. Auriferous skarn-type deposits.
3. Gold-silver and silver-gold veins, stockworks, lodes, mineralized pipes, and irregular silicified bodies in fractures, faults, shear zones, sheeted zones and breccia zones essentially in volcanic terranes.
4. Auriferous veins, lodes, sheeted zones and saddle reefs in faults, fractures, bedding-plane discontinuities and shears, drag folds, crushed zones and openings on anticlines essentially in sedimentary terranes; also replacement tabular and irregular bodies developed near faults and fractures in chemically favourable beds.
5. Gold-silver and silver-gold veins, lodes, stockworks, silicified zones, etc., in a complex geological environment, comprising sediments, volcanics, and igneous or granitized rocks.
6. Disseminated and stockwork gold-silver deposits in igneous, volcanic and sedimentary rocks.
   (a) Disseminated and stockwork gold-silver deposits in igneous bodies.
   (b) Disseminated gold-silver occurrences in volcanic flows and associated volcaniclastic rocks.
   (c) Disseminated gold-silver deposits in volcaniclastic and sedimentary beds:
   (1) deposits in tuffaceous rocks and iron formations; and (2) deposits in chemically favourable sedimentary beds.
7. Gold deposits in quartz-pebble conglomerates and quartzites.

The quartz-pebble conglomerate deposits provide the bulk of the world's production of gold, almost 67 per cent. The other deposits, mainly the various vein and disseminated types, and eluvial and alluvial placers, now provide the remaining 33 per cent.

The oxidation processes in gold deposits are complex and depend essentially on the Eh and pH. Colloidal and coprecipitation phenomena also play a large part. Iron and manganese minerals and carbonates

in the gangue and ore greatly influence the reactions that lead to the secondary enrichment of the element. Gold is not easily solubilized in nature, and its soluble forms are readily reduced to the metal by a great variety of natural materials. The result of this behaviour is that the only gold mineral found in the oxidized zones of auriferous deposits is the native metal. In this form it ultimately collects in both eluvial and alluvial placers, which have been exploited throughout the world since time immemorial.

Practically all the geochemical methods of prospecting are applicable in the search for auriferous deposits. The most effective methods appear to be those based on the sampling of stream sediments and soils, analyzing these materials directly or analyzing heavy-mineral separates obtained from them. The most specific indicator (pathfinder) elements for gold are Ag, As, Sb and Te.

Boyle, R.W.

THE USE OF MAJOR ELEMENTAL RATIOS IN DETAILED GEOCHEMICAL PROSPECTING UTILIZING PRIMARY HALOS; J. Geochem. Explor., v. 3, no. 4, p. 345-369, 1974.

Chandler, F.W.

LOWER HURONIAN SANDSTONES; CORRELATION PROBLEMS AND URANIUM; MORIN TOWNSHIP AREA, ONTARIO; Can. J. Earth Sci., v. 12, p. 237-251, 1975.

Huronian feldspathic sandstones 30 km north of Thessalon (the Morin Township area) rest nonconformably upon Archean rocks and are overlain by the Huronian Gowganda Formation. They contain uraniferous pyritic quartz-pebble orthoconglomerate, similar to the uraniferous conglomerate ore of the Elliot Lake-Blind River area. The sandstones also contain paraconglomerate units at several stratigraphic levels which are lithologically similar to the Ramsay Lake and Bruce Formations.

Trends in Huronian stratigraphy on the North Shore of Lake Huron suggest that in the Morin Township area the Quirke Lake Group is absent and the McKim and Pecors Formations, which contain much argillite, are likely to be very thin or absent. Thus the feldspathic sandstones of the Morin Township area are assigned to the Matinenda and the Mississagi Formations. The most continuous paraconglomerate unit might be correlated with the Ramsay Lake Formation.

Huronian feldspathic sandstones lying nonconformably upon Archean rocks 16 km northeast of Sault Ste. Marie (the 'Soo Series') and 50 km north of Sudbury, have many features in common with the sequence of the Morin Township area. Stratigraphic subdivision of these two sequences and finer delimitation of potential uraniferous units may be aided by using paraconglomerates such as the Ramsay Lake Formation as marker units. Such subdivision however will be uncertain until the number, exact stratigraphic position and the areal continuity of these paraconglomerates can be assessed better.

Clague, John J.

THE ST. EUGENE FORMATION AND THE DEVELOPMENT OF THE SOUTHERN ROCKY MOUNTAIN TRENCH; Can. J. Earth Sci., v. 11, p. 916-938, 1974.

The Tertiary history of the southern Rocky Mountain Trench is inferred from a study of the distribution, stratigraphy, fabric, lithologic composition, structure, and palynology of the Miocene St. Eugene Formation in southeastern British Columbia.

The St. Eugene Formation consists of flood-plain and fan facies and represents the upper part of up to about 1500 m of sediments which accumulated in the proto-Rocky Mountain Trench upon cessation of Laramide deformation and after initiation of extension and block faulting in the eastern Cordillera during Eocene or early Oligocene time. Deep Tertiary basins in the southern Rocky Mountain Trench are bounded on the east and west by high-angle faults parallel to the Trench margins and on the north and south by faults transverse to the trend of the Trench. Block faulting of a half-graben style was probably contemporaneous with sediment deposition, but at least 600 m of displacement on the east boundary fault postdates deposition of the St. Eugene Formation. Although there is no present seismic activity along the Rocky Mountain Trench north of latitude 49°N, Holocene fault scarps and earthquakes in a zone along the Rocky Mountains of the United States attest to the continuation of block faulting south of 49°N.

The St. Eugene microflora includes at least 39 genera of ferns, gymnosperms, and anthophytes. Phytogeographic reconstruction based upon the habitats of extant counterparts indicates floral elements growing on poorly drained lowlands, adjacent slopes, and montane uplands; thus, there was moderate to high relief in southeastern British Columbia during St. Eugene time. The climate apparently was temperate, with warm summers, mild winters, and abundant, uniformly distributed precipitation. This contrasts with the present climate of the southern Rocky Mountain Trench which is semiarid with hot summers and cold winters, and suggests that the mountain barriers which presently restrict cool, moist, Pacific maritime air masses to the coast were lower during the Miocene, or that the polar seas were relatively warm.

Collett, L.S., and Brown, R.J.E.

PROCEEDINGS OF A SYMPOSIUM ON PERMAFROST GEOPHYSICS, 27 AND 28 FEBRUARY 1974; Nat. Res. Council, Can., Tech. Memo. No. 113, 105 p. plus appendix, 1974.

Collett, L. S.

GEOPHYSICAL PARAMETERS OF PERMAFROST; Nat. Res. Council, Can., Tech. Memo. No. 113, p. 1-16, 1974.

Copeland, M. J., and Bolton, T. E.

MEMORIAL TO JOHN FLETCHER CALEY 1903-1971; Geol. Soc. Am. Memorials, v. 3, p. 53-56, 1974.

Copeland, M. J.

LATE ORDOVICIAN TO MIDDLE SILURIAN PALAEOCOPE FAUNAS FROM ANTICOSTI ISLAND, QUEBEC, CANADA; *in* Symposium on the Palaeocope ostracodes, Visby, Sweden, Aug. 26-30, 1975; Organized under the auspices of UNESCO and IUGS-IPA as part of the Baltic-Scanian Silurian Project.

The approximately 2800 feet (850 m) of strata exposed on Anticosti Island, Quebec comprise the Upper Ordovician (Maysvillian-Richmondian: Ashgill) Vauréal and Ellis Bay Formations and the Lower and Middle Silurian (Alexandrian-Niagaran: Llandovery-Wenlock?) Becscie, Gun River, Jupiter and Chicotte Formations. More than 150 species of ostracodes are known to occur in these beds, of which 60 per cent are palaeocopes, 35 per cent are podocopes and 5 per cent are leperditicopes. Undoubtedly, more species are present and field work during 1974 is expected to provide another complete section across the mid-eastern part of the Island from which additional ostracode faunas will be sought.

Because they are well preserved, plentiful and widely distributed on Anticosti Island, palaeocopid faunas have provided one of the most rapid and accurate means of establishing a local and regional biostratigraphic zonation. This relatively unbroken succession of Late Ordovician to Middle Silurian palaeocopes is unique in the Appalachian Structural Province and provides much of the basic data from which correlation within eastern North America is derived.

A single Late Ordovician palaeocope fauna, typified by *Jonesites semilunatus* (Jones), occurs throughout the Vauréal and Ellis Bay Formations. Drepanellacea (Bolliidae and Aechminidae) and Hollinacea (Tetradellidae and Eurychilinidae) are most distinctive Ordovician elements and represent nearly half of the ostracode species. Only two podocope and, questionably, one leperditicope species have ranges that extend into the overlying Silurian strata.

The abrupt flourishing of Beyrichiacea, accompanied by the brachiopod *Virgiana*, in the upper half of the Becscie Formation marks the commencement of Middle Silurian, Niagaran time. Lower Silurian (Alexandrian) palaeocopes have not yet been found in the lower dolomitic limestone of the Becscie Formation but their presence is postulated. By far the most prominent elements on the upper Becscie and succeeding formations are the zygobolbid and craspedobolbinid palaeocopes. They occupy the three lower Niagaran *Zygobolba* zones of Ulrich and Bassler; only the lowest (*Zygobolba erecta*) zone in the Becscie and Gun River Formations on Anticosti Island does not contain its elusive nominal species. The two upper *Zygobolba* zones (*Z. anticostiensis* and *Z. decora*) extend throughout the Jupiter Formation and terminate, on Anticosti Island, in basal beds of the Chicotte Formation. No beyrichiids have been found in dense crinoidal limestone of the upper Chicotte Formation and ostracode zonation is accordingly lost; the presence of the coral *Paleocyclus*, however, may indicate the Middle Niagaran (lower Wenlock?) equivalence of these beds.

The Late Ordovician palaeocope faunas of Anticosti Island are relatively unknown elsewhere in eastern North America. They represent the last remnant of a once widespread Mohawkian (Caradoc) fauna, containing *Tetradella*, that occupied much of northern and central North America. The rapid demise of this flourishing fauna has been postulated as due to glacio-eustatic conditions, but, whatever the cause, it was abrupt and, on Anticosti Island, serves as an excellent criterion on which to base the Ordovician-Silurian systematic boundary. The succeeding zygobolbid fauna became established only in early Middle Silurian time. This occurrence in the earliest Niagaran is widespread in northeastern North America but was of short duration except in the Appalachian Structural Province. In Anticosti Island, this fauna developed rapidly during the Lower Niagaran, but its greatest development, in Middle Niagaran time, is not known to occur in eastern Canada.

Copeland, M. J.

BIOSTRATIGRAPHIC ZONATION OF DEVONIAN AND MISSISSIPPIAN OSTRACODA FROM CANADA: A SUMMARY ACCOUNT; *in* International Symposium on Micropaleontological Limits, Namur, Belgium, Sept. 1-10, 1974.

No established biostratigraphic zonation of Ostracoda is presently applicable to Devonian and Mississippian strata throughout Canada. In general, three major areas of Canada (Western, Central, Appalachian) may be discussed, each bearing relatively independent ostracode faunas of local stratigraphic importance. USSR-eastern European ostracode assemblages dominate throughout Western Canada, a mid-continental North American assemblage is pre-eminent in Middle Devonian faunas of Central Canada, and eastern North America and western European faunas predominate throughout Appalachian Canada.

Cranston, R. E.

GEOCHEMICAL INTERACTION IN THE RECENTLY INDUSTRIALIZED STRAIT OF CANSO; *in* Proc. Int. Conf. Transport of Persistent Chemicals in Aquatic Ecosystems; Ottawa, 1974.

A multidisciplinary, environmental impact study of the Strait of Canso, a deep and narrow channel between the Nova Scotia mainland and Cape Breton Island, was completed in the fall of 1973. Biological, physical, geological and chemical parameters were measured at over 200 locations to determine the effects that recent urban and industrial activities have had on this nearshore marine environment.

In an attempt to identify the influences of water circulation on geochemical interactions in the Strait, the salinity, trace metal content, total suspended matter, turbidity, particulate and dissolved organic carbon and bacterial content of the water were examined. To pinpoint the long term effects of urban and industrial activity, the organic content, the metal concentrations (total and available) and the benthic organisms of the sediments were examined.

The anomalous concentrations (greater than 2X background) of trace metals, turbidity, particulate carbon and bacteria are related to an industrial point source. The organic carbon in the sediments and the concentrations of metals such as Fe, Mn, Pb and Zn (measured from weak-acid leach analyses of the sediments) have similar distribution patterns. Residence times for the anomalous species are postulated, based upon an evaluation of the chemical, physical and geological processes of removal.

Cumming, L.M. and Romaniuk, A.S.

THE 1st AND 76th MEETINGS OF THE CANADIAN INSTITUTE OF MINING AND METALLURGY; Can. Inst. Min. Met. Bull., v. 67, no. 744, p. 31-32, 1974.

The first annual meeting of the Canadian Mining Institute was held in the Club Room of the Windsor Hotel, Montreal, on Wednesday, Thursday and Friday, the 1st, 2nd and 3rd of March, 1899. The attendance, particularly of Members from a distance, was distinctly good. Among those present, besides parties of students of mining from McGill University and the School of Mining, Kingston, and mining engineers and managers from Rossland and Greenwood, B.C., were:

Dr. George M. Dawson, the renowned exploration geologist, who predicted the discovery of gold in the Klondike and in whose honour Dawson City, Yukon was named.

Dr. Robert Bell, the medical doctor and geologist whose explorations had contributed more than 3000 new place names to Canadian maps.

H.W. Whitney, a founder of the Dominion Coal Company, for whom Whitney Pier, the industrial complex at Sydney, Cape Breton, was named.

R.W. Brock, later to be chairman to the Geology Department at U.B.C. and director of the Geological Survey.

Professor Willet G. Miller, later to become Ontario's first Provincial Geologist.

R.W. Robb, founder of the engineering works which manufactures mining equipment at Amherst, Nova Scotia.

When this meeting was held, Canada's population was 5 370 000 and the value of her mineral production was $50 000 000. Most people then remembered Confederation as we now remember the beginning of World War II. Today, Canada has a population of 21 700 000 and a mineral production, including gas and oil, valued in 1973 at $8 238 102 000. In terms of unadjusted dollars, this is one hundred and sixty-five times the value of production at the turn of the century.

The origin of The Canadian Institute of Mining and Metallurgy centered around the reorganization, in 1898, of the Federated Canadian Mining Institute, which had been formed in Montreal in 1896. This "Federated Institute" itself represented a welding together of five provincial organizations:

1. The Gold Miners Association of Nova Scotia, formed in 1887.
2. The Quebec General Mining Association, formed in 1891.
3. The Mining Society of Nova Scotia, formed in 1892.
4. The Ontario Mining Institute, formed in 1894.
5. The British Columbia Association of Mining Engineers, formed in 1895.

The Canadian Mining Institute later became The Canadian Institute of Mining and Metallurgy (CIM for short).

The CIM is an organization of "Canada's mining people". Present-day active membership is 9500. These people each play a vital role in guiding Canada's vast mineral industry. Collectively they have made Canada eminent in the mineral-industry world. Collectively they possess generations of experience in operating mines and in the research, exploration and technical improvements which are vital to the mineral economy.

Currie, K.L.

A NOTE ON THE CALIBRATION OF THE GARNET – CORDIERITE GEOTHERMOMETER AND GEOBAROMETER; Contrib. Mineral. Petrol., v. 44, no. 1, p. 35-44, 1974.

Dawson, K.M. and Sinclair, A.J.

FACTOR ANALYSIS OF MINOR ELEMENT DATA FOR PYRITES, ENDAKO MOLYBDENUM MINE, BRITISH COLUMBIA, CANADA; Econ. Geol., v. 69, no. 3, p. 404-411, 1974.

Sixty-seven pyrite samples from in and near the Endako molybdenum mine were analyzed for 11 minor elements (Ag, Ba, Bi, Co, Cu, Mn, Ni, Pb, Sn, Sr, and Zu) by quantitative emission spectrography. All elements were found to have density distributions closely approaching a log-normal model or a mixture of two log-normal populations. Studies of individual elements did not appear to provide adequate insight into their significance. However, Q-mode factor analysis produced a three-factor model that could be integrated easily with existing geological knowledge of the deposit. These three factors account for more than 94 per cent of the variance in the data. Factors 1 and 2 correlate spatially with the ore zone and a southerly pyrite zone, respectively, and are interpreted as reflecting the variable chemical nature of mineralizing fluids during high temperature (ore) metallization and lower temperature (pyrite zone) metallization, respectively. This interpretation is consistent with independent data on wall rock alteration and temperature of filling of fluid inclusions in vein quartz. Factor 3 is interpreted as a background feature relating to the host. The first three factors of an R-mode analysis correspond with Q-mode results but the overall R-mode model is less acceptable for statistical and subjective reasons.

The results appear to have practical potential in the economic evaluation of large areas containing scattered outcrops mineralized with pyrite and other minerals.

Dyck, A.V., Becker, A. and Collett, L.S.

SURFICIAL CONDUCTIVITY MAPPING WITH THE AIRBORNE INPUT SYSTEM; Can. Inst. Min. Met. Bull., v. 67, no. 744, p. 104-109, 1974.

The Geological Survey of Canada has undertaken to assess the airborne, time-domain EM system, INPUT, in terms of its usefulness as a surficial conductivity mapping tool. In 1967, on 11-channel, minimum-coupled INPUT system was used to obtain airborne data from a small survey area near Hawkesbury, Ontario. As shown by ground DC resistivity data, the area is characterized by an electrical conductivity distribution dominated by the Champlain Sea clay.

A method of quantitative interpretation has been developed using theoretical INPUT decay responses to various two-layer conductivity models. The average transient amplitude and the transient decay time are two quantities which are representative of the decay curve and are most diagnostic of the subsurface parameters. These, therefore, form the basis of the interpretation chart which is used to interpret the field data.

In the Hawkesbury survey it is apparent that the INPUT response is sensitive to changes in thickness (which ranges from zero to very thick) and conductivity (about 0.5 mho/m) of the highly conducting clay layer. Over a test profile the INPUT results show good agreement with the ground resistivity measurements and provide much more detailed and continuous coverage.

Eckstrand, O.R.

THE DUMONT SERPENTINITE: A MODEL FOR CONTROL OF NICKELIFEROUS OPAQUE MINERAL ASSEMBLAGES BY ALTERATION REACTIONS IN ULTRAMAFIC ROCKS; Econ. Geol., v. 70, p. 183-201, 1975.

Various distinctive nickel-rich minerals are commonly encountered in barren and weakly mineralized ultramafic rocks. The minerals include awaruite, heazlewoodite, pentlandite, millerite, and violarite but few, if any, iron sulfides. Using the Dumont ultramafic body in northern Quebec as an example, it is demonstrated that certain assemblages of these opaque minerals tend to be spatially associated with particular types of alteration, namely, serpentinization and talc-carbonate alteration. An analysis of nickeliferous opaque mineral assemblages on the one hand and alteration reactions on the other leads to a general model in which the former are controlled by the latter through Fe-related redox mechanisms. The model predicts that incipient serpentinization which generates H_2 should be accompanied by reduced assemblages characterized by low-sulfur minerals such as awaruite and heazlewoodite, while carbonate alteration which generates O_2 should be accompanied by oxidized assemblages characterized by high-sulfur minerals such as millerite. The general applicability of the model was tested by compiling bulk mineral assemblages from many locales, as reported by numerous investigators; the results showed a gratifying confirmation of the model.

Extension of the model to consider higher sulfur contents was explored in order to explain the common assemblages found in conventional nickel deposits. These sulfide-rich occurrences, in contrast to the barren or weakly mineralized ultramafic rocks, consist mainly of iron sulfides (pyrrhotite ± pyrite) in addition to pentlandite, and lack awaruite and heazlewoodite. The difference in assemblages can be explained by the model. Because of greater sulfide content and hence higher sulfur, (1) the sulfide assemblages are self-buffered with respect to oxygen and sulfur, therefore remaining largely unaffected by alteration reactions; and (2) the assemblages are required by compatabilities at high S:Ni ratios to include iron sulfides.

An important consequence of the model is that serpentinization, by converting some silicate nickel into a sulfide form, may be economically significant in the case of low-grade deposits.

Eisbacher, G.H.

EVOLUTION OF SUCCESSOR BASINS IN THE CANADIAN CORDILLERA; Soc. Econ. Paleontol. Mineral., Spec. Publ. no. 19, p. 274-291, 1974.

Emslie, R. F.

THE HARP LAKE COMPLEX, LABRADOR, AND THE MORIN COMPLEX, QUEBEC: EXAMPLES OF IGNEOUS AND META-IGNEOUS ANORTHOSITIC COMPLEXES IN THE EASTERN CANADIAN SHIELD; *in* Centenaire de la Société Géologique de Belgique Géologie des Domaines Cristallins, Liège, 1974.

The Harp Lake complex underlies about 10 000 km^2 in central Labrador. Approximately 75 per cent of the complex comprises leucotroctolites, leucogabbros, leuconorites and anorthosite. Layered structures are widespread in these rocks but do not define a simple structural entity. Younger pyroxene and olivine-bearing adamellites make up most of the remainder of the complex. Olivine gabbros, gabbros and diorites are present at the margins of the anorthositic rocks and occur as dikes and small intrusive masses within the complex. Analyzed pyroxenes and feldspars form continuous solid solution series from the anorthositic rocks through rocks of intermediate composition to the adamellites. Orthopyroxenes range from En_{74} to En_{21} and plagioclases from An_{72} to An_6.

The Morin meta-igneous complex in Quebec comprises an anorthositic massif (chiefly anorthosite and leucogabbro) that underlies about 2500 km^2 together with a similar area of closely spatially associated pyroxene quartz monzonites with lesser proportions of gabbro and pyroxene monzodiorite. Dikes of pyroxene monzodiorite cut only anorthositic rocks and dikes of pyroxene quartz monzonite cut both anorthositic rocks and pyroxene monzodiorites. Measured pyroxene and feldspar compositions form continuous solid solution series from the anorthositic rocks through pyroxene monzodiorites to pyroxene quartz monzonites. The range of orthopyroxenes is from En_{77} to En_{36} and plagioclases from An_{57} to An_{24}. The lower degree of iron enrichment in the pyroxenes by comparison with Harp Lake is in accord with a greater abundance of oxide minerals in the rocks and numerous oxide mineral deposits suggesting higher oxygen fugacities in equilibrium with the Morin magmas.

The mineral chemistry of both complexes implies the operation of continuing magmatic processes during their evolution. The unmetamorphosed Harp Lake complex permits some useful constraints to be placed on possible models for its magmatic evolution. The mineral chemistry of the metamorphosed Morin complex, as well as reflecting its prior igneous history, allows an understanding of the nature of the metamorphism of the complex following its crystallization.

Irving, E., Emslie, R. F. and Ueno, H.

UPPER PROTEROZOIC PALEOMAGNETIC POLES FROM LAURENTIA AND THE HISTORY OF THE GRENVILLE STRUCTURAL PROVINCE; J. Geophys. Res., v. 79, no. 35, p. 5491-5502, 1974.

Paleomagnetic poles from the Precambrian shield of North America (Laurentia) for the interval -1500 to -600 m.y. are reviewed. The results are best explained by assuming that the path(s) of apparent polar wander had the form of a sequence of loops with amplitudes of about 60° and period of 200-300 m.y. It is possible that such polar paths are the signature of the Wilson cycle, the cycle of opening and closing oceans. The presence of such loops does not imply that this cycle necessarily operated but only that their presence is consistent with its operation during the later Proterozoic. Many pole determinations are now available from medium- to high-grade metamorphic terrain of the Grenville structural province, and the poles from that part of the province (Grenvillia) not immediately adjacent to the Grenville front are statistically distinct from the poles from the remainder of Laurentia (Interior Laurentia). Three hypotheses have been invoked to explain this fact, and a fourth is added here. Only hypotheses 1 and 2 adequately explain the paleomagnetic data. Hypothesis 2 requires rapid drift of Laurentia at rates of 20 cm/yr for about 200 m.y. Hypothesis 1 requires that at -1150 m.y., Grenvillia was displaced 5000 km from Interior Laurentia and approached and became sutured to it at about -1000 m.y., the Laurentian shield as we know it today being formed.

Irving, E., Park, J.K. and Emslie, R.F.

PALEOMAGNETISM OF THE MORIN COMPLEX; J. Geophys. Res., v. 79, no. 35, p. 5482-5490, 1974.

Metamorphosed (high amphibolite to granulite facies) anorthosites and leucogabbros of the Morin complex in the province of Quebec have two magnetizations often coexisting in the same specimens. The magnetization with high remanent coercive force has a mean direction of 266.2°, -76.8° (24 sites, 117 samples, $\alpha_{95} = 5.3°$) with respect to the present horizontal and a corresponding pole at 42.4°S and 139.3°E. It has blocking temperatures between 550° and 650°C, remanent coercivities chiefly between 1000 and 3000 Oe, and is due to hematite with a few percent of ilmenite in solid solution. It is suggested that this high coercive force (hcf) magnetization was acquired during cooling immediately following high-grade regional metamorphism during the Grenvillian orogeny at about -1124 ± 27 m.y. The other magnetization has remanent coercivities mostly between 100 and 1000 Oe and is referred to as the medium remanent coercive force (mcf) magnetization. This magnetization has a mean direction of 114°, +38° (13 sites, 45 samples, $\alpha_{95} = 10°$) and a corresponding pole at 0°, 164°E. It has blocking temperatures mostly in the range 100°-400°C, and we suggest that it was acquired later during the last stages of regional uplift at about -1000 m.y. The poles for the hcf and mcf components of magnetization define the limits of the Grenville polar track and provide for the first time tentative estimates of its age. There is

no systematic deflection of the magnetization due to anisotropy. The close agreement between the pole for the hcf magnetization and similar poles derived from the Allard Lake anorthosite and basic gneisses near Haliburton, localities spaced over 1200 km apart, indicates that the present horizontal is the proper reference plane for the analysis of these magnetizations.

Fillon, Richard H.

DEGLACIATION OF THE LABRADOR CONTINENTAL SHELF; Nature, v. 253, February 1975.

It has long been inferred from studies of glacial features on land that the North American Quaternary glaciers extended far out on the Atlantic continental shelf. Only within the last ten years, however, have offshore studies on the Scotian Shelf convincingly demonstrated the presence of a system of submarine moraines. This study, which used 1100 km of deep-towed 3.5 kHz sparker profiles, 1200 km of side-scan sonar records, 2000 km of echo sounding profiles and 165 bottom sediment samples collected during cruises of CSS Dawson and CFAV Sackville has identified moraines and other relict glacial land forms on the outer Labrador Shelf.

Foscolos, A.E. and Kodama, H.

DIAGENESIS OF CLAY MINERALS FROM LOWER CRETACEOUS SHALES OF NORTH EASTERN BRITISH COLUMBIA; Clays Clay Miner., v. 22, p. 319-335, 1974.

Clay minerals from shale outcrops of the Lower Cretaceous Buckinghorse Formation (4250 ft. thick) were investigated in order to assess their degree of diagenesis and their oil-generating potential. Crystallinity index, sharpness ratio, per cent of illite which is the 2M polymorph and presence of discrete minerals have been studied in the whole clay fraction, while the very fine clay fraction has been subjected to X-ray diffraction, differential thermal, thermogravimetric, differential thermogravimetric, i.r. spectroscopy, surface area and chemical analyses. With information derived from these studies and from published data, a classification scheme was devised which relates variation of clay mineralogy to diagenetic stages and burial depth.

Data on the <2 μm size fraction show that the crystallinity index decreases while the sharpness ratio and per cent of illite which is the 2M polymorph increase with burial depth. Results on the <0-08 μm fraction reveal that a three-component interstratified clay mineral exists. In addition, Fourier transform calculations and chemical and physiochemical analyses indicate that both the ratio of the amounts of non-hydrated clays (illite) to hydrated clays and the K_2O content of clays increase with burial depth; cation exchange capacity and surface area decrease with burial depth.

Based upon a classification scheme, which was devised by combining criteria and data derived from the studies of Weaver (1961a), Kubler (1966), Burst (1969) and Dunoyer de Seconzac (1970), the upper and middle parts of the formation (upper 3250 ft.) fall within the middle stage of diagenesis whereas the lower part (1000 ft.) is allocated to the beginning of late diagenesis. In terms of Burst's (1969) work, the upper 3250 ft. are transitional between the stability and dehydration zones indicating that, prior to uplift, hydrocarbons may have been in the process of migration. The lower 10 000 ft. of the formation are in the restricted dehydration zone, indicating that hydrocarbon migration should have been completed.

French, H.M.

MAN-INDUCED THERMOKARST, SACHS HARBOUR AIRSTRIP, BANKS ISLAND, NORTHWEST TERRITORIES; Can. J. Earth Sci., v. 12, p. 132-144, 1975.

The disturbed terrain adjacent to the airstrip at Sachs Harbour is an example of man-induced thermokarst processes operating within the High Arctic environment. An irregular topography of mounds and linear depressions has appeared and evidence indicates preferential subsidence along ice wedges. The underlying sands and gravels are ice-rich with approximately 20-35% excess ice and natural water (ice) contents of between 50 and 150%. Examination of air photographs indicates that the terrain developed within three years of the initial disturbances. Detailed levelling in 1972 and 1973 suggests that subsidence and permafrost degradation is still active, over 10 years later. Gullying of the airstrip is a problem partly associated with the thermokarst activity. A comparison is made with man-induced thermokarst terrain in Siberia.

Fritz, W.H. and Mountjoy, E.W.

LOWER AND EARLY MIDDLE CAMBRIAN FORMATIONS NEAR MOUNT ROBSON, BRITISH COLUMBIA AND ALBERTA; Can. J. Earth Sci., v. 12, p. 119-131, 1975.

Five formations and part of a sixth were examined in order to resolve conflicting reports as to their age and lateral relationship. The formations are redescribed at their type sections and equivalent strata are described at a control section. It is concluded that the Lower Cambrian Mural, Mahto, and Hota Formations and the Middle Cambrian Chetang Formation are valid and that the Tah (= Mural) and Adolphus (= Hota) Formations should be suppressed. The boundary between the *Nevadella* and *Bonnia-Olenellus* Zone falls within the middle unit of the Mural. The Lower-Middle Cambrian boundary is located at or very near the contact between the Hota and overlying Chetang Formation. This is a sharp lithologic contract, but no physical evidence of an unconformity was noted.

Sinha, A. K. and Frisch, Thomas

WHOLE-ROCK Rb-Sr AGES OF METAMORPHIC ROCKS FROM NORTHERN ELLESMERE ISLAND, CANADIAN ARCTIC ARCHIPELAGO. I. THE GNEISS TERRAIN BETWEEN AYLES FIORD AND YELVERTON INLET; Can. J. Earth Sci., v. 12, p. 90-94, 1975.

The first Precambrian ages from the Northern Ellesmere Fold Belt are reported. Six rocks from the largest gneiss terrain in northern Ellesmere Island yield a Late Precambrian age (minimum 742 ± 12 m.y.) of regional metamorphism. Relatively high initial $^{87}Sr/^{86}Sr$ suggests that the rocks were derived from crustal materials.

Gabrielse, H. and Reesor, J.E.

THE NATURE AND SETTING OF GRANITIC PLUTONS IN THE CENTRAL AND EASTERN PARTS OF THE CANADIAN CORDILLERA; Pacific Geol., v. 8, p. 109-138, 1974.

Granitic plutons in the central and eastern parts of the Canadian Cordillera are mainly of Late Triassic to Early Tertiary age. They underlie more than 35 000 square miles (90 000 km^2), of which more than one half comprises plutons of Early to Mid-Cretaceous age. The rocks show a well defined trend in composition from quartz diorite and granodiorite in the oldest plutons to granite and quartz monzonite in the youngest.

Each age group of granitic rocks has a distinct tectonic setting that was probably the fundamental cause of compositional changes with time. Upper Triassic and Lower Jurassic plutons are restricted to an island-arc environment within the Intermontane Belt. The Mid- to Upper Jurassic plutons may have been related to an evolving arc complex. Granitic rocks of Early to Mid-Cretaceous age occur almost entirely within the distal part of a miogeoclinal wedge along the western margin of the Late Proterozoic and Early Paleozoic North American craton. The youngest plutons, of Late Cretaceous to Early Tertiary age reflect the development of widespread tensional conditions in the western Cordillera, west of the Eastern Fold Belt.

Garrett, R. G.

MERCURY IN SOME GRANITOID ROCKS OF THE YUKON AND ITS RELATION TO GOLD-TUNGSTEN MINERALIZATION; J. Geochem. Explor., v. 3, no. 3, p. 277-289, 1974.

Grant, D. R.

LATE-WISCONSIN ICE CAPS ON THE CONTINENTAL SHELF, EASTERN CANADA; Geol. Soc. Am., Abs. with Programs, November 1974.

Recent studies give clear evidence of at least two ice sources centred offshore. One, south of Nova Scotia, that flowed northward over most of Cape Breton Island up to 400 m, is inferred from numerous directional striations on summits. The event is referred to the last glacial maximum because it spread a till containing shell fragments dating 32 000 y, and because it scoured and shaped outcrops, unlike the light striation of later movements. Given the observed landward extent and elevational reach, the Paterson equation places the southern margin halfway across the shelf. Postglacial eustatic flooding of the shelf shifted the ice divide onshore and into the Bras D'Or Lake basin where a readvance occurred less than 10 300 y B.P. On Burin Peninsula, southeast Newfoundland, a comparable ice mass left similar north and west markings, as well as disjunct limits of marine overlap. Crosscutting striae indicate the Burin was crossed first by inland ice, than by a flow from Placentia Bay. Again, sea-level rise relocated the ice shed onto the peninsula. More than isolated oddities, these are regarded as low-level manifestations of a regional tendency to create and maintain local ice domes, many of which have already been mapped. This revised model of glacial style in northern Appalachia begins to dispel the notion of an all-pervasive Laurentide ice flood.

Grant, D. R. and Prest, V. K.

THE CONTRASTING STYLES OF LATE-WISCONSINAN LAURENTIDE AND APPALACHIAN GLACIATION: NEW ENGLAND AND THE ATLANTIC PROVINCES; Geol. Soc. Am., Abs. with Programs, v. 7, no. 1, p. 66, 1975.

Two themes are developed – a concept of local glaciation of the Appalachians and a sequence of recessional ice margins. The glacial model devolves from field evidence in key areas, and is the basis for inferred deglacial positions that account for glacial features throughout the region. In essence, Laurentide (Labradorean) ice penetrated only locally into Appalachia where numerous ice centres coalesced as a complex at the maximum, and later separated into shifting remnantal ice caps. Evidence of Labradorean incursion is limited to northernmost Newfoundland, northern Gaspé Peninsula, and the Matapedia, St. John and Hudson River valleys. The inland ice flood was stemmed by deep leads in Gulf of St. Lawrence, topographic impediments along the Appalachian axis, and mushrooming local ice caps in western Newfoundland, Cape Breton Island, the Atlantic Upland of Nova Scotia, and the New Brunswick – New England highlands.

At maximum extension the outer limit of the Appalachian complex was not far offshore, except for two centres on the shelf off Cape Breton and Newfoundland. Ice failed to override Magdalen Islands implying limited ice in Gulf of St. Lawrence. Rapid deglacial calving into the Gulfs of Maine and St. Lawrence divided the glacier complex into an ice sheet

over Newfoundland, and one over New Brunswick – New England that built coastal moraines on its north and south flanks in Maine and Quebec about 13 000 y B.P. Later readvances are dated at 12 500 and 11 000 y in Newfoundland, at ca 10 000 y in Cape Breton, at 12 700 y in Maine, and at 11 200 y into Champlain Sea. Ice receded to fourteen separate areas in Newfoundland, four in Nova Scotia, one off Prince Edward Island, at least one in New Brunswick, and three in Quebec. Comparable information is unavailable from New England, but three areas of late ice are inferred.

Thomas, Martin L.H., Grant, D.R. and de Grace, Marius

A LATE PLEISTOCENE MARINE SHELL DEPOSIT AT SHIPPEGAN, NEW BRUNSWICK; Can. J. Earth Sci., v. 10, p. 1329, 1973.

Twenty species of marine invertebrate shells from a gravelly sand deposit close to the present shore at Shippegan, New Brunswick, were identified and shown to be typical of a shallow-water association formed soon after glacial retreat. One specimen yielded a radiocarbon date of 12 600 ± 400 yr. This evidence strengthens previous conclusions on the date of Pleistocene deglaciation and on postglacial sea-level changes in this area.

Hacquebard, P.A. and Donaldson, J.R.

RANK STUDIES OF COALS IN THE ROCKY MOUNTAINS AND INNER FOOTHILLS BELT CANADA; Geol. Soc. Am., Sp. Paper 153, p. 74-94, 1974.

Discussed in this study are regional and stratigraphic variations in the rank of coals in the Rocky Mountain region, as determined from vitrinite reflectance measurements. For the regional changes, the Kootenay coals of the Crowsnest Pass area have been examined; they show a progressive westward increase in rank. The variations in rank with stratigraphic position are illustrated in ten coal-bearing sections of Jurassic-Cretaceous age, situated between the Crowsnest field in the south and the Peace River canyon in the north. Both studies indicate preorogenic coalification, because the rank increases regularly with stratigraphic position, but not with geologic age, depth of mining, or degree of tectonic disturbance.

For each of the ten curves plotted, the coalification gradient is calculated in terms of percent reflectance (Ro) change per 100 m increase in depth. By relating this gradient to that of a known curve (the Peel curve of the Netherlands) a reference for comparison is obtained, which is expressed as the Peel rank ratio. Different ratios were obtained, which probably are related to variations in the temperature gradients. The lowest ratio was found in the Peace River canyon area, and the highest occurs in the Canmore coalfield.

The coalification gradient affects the availability of coking coals of most favourable rank, that is, the medium-volatile coals. With a low gradient (and corresponding steep curve), medium-volatile coals occur over a greater stratigraphic interval, with the possibility of a larger number of seams, than with a high gradient. Within limited areas of the same coalfield, the rank as determined from vitrinite reflectance can be used for correlating coal seams, provided a high coalification gradient is present. This method has been employed successfully in the Canmore coalfield on seams that lie not less than 120 ft. apart stratigraphically.

Haworth, R.T.

GRAVITY AND MAGNETIC NATURAL RESOURCE MAPS (1972), OFFSHORE EASTERN CANADA; PHILOSOPHY AND TECHNIQUE IN PREPARATION BY COMPUTER; Int. Hydro. Rev., v. LI, No. 1, January 1974.

The final product of a recent data processing contract issued by the Atlantic Geoscience Centre was a suite of 72 Natural Resource maps published by the Canadian Hydrographic Service representing the most comprehensive published collection of marine gravity and magnetic data on the eastern Canadian continental shelf. Because of the techniques employed, the charts have a style different from that employed on previous charts in the series. The method of preparation of the charts is described together with consideration of the basic limitations of a contour chart used as a source of data. Deficiencies in the data collection and processing and chart preparation techniques are discussed.

Haworth, R.T. and Loncarevic, B.D.

INVERSE FILTER APPLIED TO THE OUTPUT OF AN ASKANIA Gss-2 SEA GRAVIMETER; Geophysics, v. 39, no. 6, p. 852-861, 1974.

The internal damping of the Askania gravimeter introduces both phase lag and attenuation into its measurements. Without adequate signal restoration, correlation between data collected on adjacent survey lines is misleading. A simple weighting function of either five or six terms, depending upon the data-recording method used, can adequately restore both amplitude and phase and also recover data apparently lost while the gravimeter settles down after course or speed changes or meter adjustments.

Heffler, D.E.

A TIMING CORRECTION FOR REAL TIME SEISMIC SIGNAL PROCESSING. IEEE PUBLICATION 74 CHO873-0 OCC. IEEE INTERNATIONAL CONFERENCE ON OCEAN 74, Engineering in the Ocean Environment, v. II, p. 212-217, 1974.

A small signal processing computer has been interfaced with to the single channel seismic reflection system in use at Atlantic Geoscience Centre (AGC). In this way real time dereverberation, stacking and display of data, particularly in the deep ocean and on the continental slopes can be carried out. Time corrections applied to the signal make bottom reverberations nearly periodic. This dramatically improves the effectiveness of the simple Backus filter. Examples of data before and after processing are presented.

Hoffman, Paul

SHALLOW AND DEEPWATER STROMATOLITES IN LOWER PROTEROZOIC PLATFORM – TO – BASIN FACIES CHANGE, GREAT SLAVE LAKE, CANADA; Am. Assoc. Pet. Geol. Bull., v. 58, no. 5, p. 856-867, 1974.

Hood, Peter J.

MINERAL EXPLORATION: TRENDS AND DEVELOPMENTS IN 1974; Can. Min. J., v. 96, no. 2, p. 191-229, 1975.

This article reviewed the following topics for the year 1974:

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 addition in the review for 1974, the characteristics of commercially-available drill-logging and induced polarization equipment were tabulated together with airborne geophysical surveys offered as a contract service.

Hunter, J.A.M. and Hobson, G.D.

A SEISMIC REFRACTION METHOD TO DETECT SUBSEA BOTTOM PERMAFROST; Nat. Res. Council, Can. Tech. Memo. No. 113, p. 65-66, 1974.

Irish, E.J.W.

ROCK FRAGMENTS ON FILE; Geos, Winter 1974, p. 18-20.

Riding, Robert and Jansa, L.F.

URALOPORELLA KORDE IN THE DEVONIAN OF ALBERTA; Can. J. Earth Sci., v. 11, p. 1414-1426, 1974.

The first record of *Uraloporella variabilis* Korde outside the Carboniferous of Eurasia is made from the Givetian-Frasnian of Alberta, Canada. This problematic tubiform calcareous microfossil occurs in the subsurface Swan Hills Formation of west-central Alberta and in the Cairn Formation exposed in the Rocky Mountains of southwest Alberta. It is always fragmentary and occurs in shelf-shoal facies of the interior of carbonate platforms, usually in peloid packstones and wackestones associated with calcispheres and dendroid stromatoporoids. Locally it is very common. The specimens differ from the original diagnosis by exhibiting septa and rare branching. The presence of septa is confirmed in the type material from Russia and the genus is amended accordingly. A dasycladacean affinity is excluded and the assumed algal nature of the genus is questioned.

Jansa, L.F.

TRACE FOSSILS FROM THE CAMBRO-ORDOVICIAN COW HEAD GROUP, NEWFOUNDLAND, AND THEIR PALEOBATHYMETRIC IMPLICATION; Palaeogeog., Palaeoclimatol., Palaeoecol., v. 15, p. 233-244, 1974.

U-shaped burrows identified as the trace fossil *Arenicolites* occur in the Cambro-Ordovician Cow Head Group, a series of thin-bedded limestones interbedded with graptolitic shale and thick beds of limestone breccia and conglomerate. The lithology, limestone petrography, and trace fossils indicate deposition on a submarine slope of a slowly submerging carbonate platform. The limestone bed containing *Arenicolites* probably represents a period of slow deposition. The steeply inclined U-shaped burrows are assumed to have been formed by polychaete worms of the family Mochtyellidae which thrived in an argillaceous carbonate mud bottom of a carbonate platform slope, in depths exceeding 200 m. Although *Arenicolites* is believed to denote a shallow-water environment, its presence in the Cow Head extends the ecological niche of the *Arenicolites*-producing organisms into the outer shelf and continental slope. The domichnia of suspension feeders thus extends from shallow- to deep-water environments.

Jeletzky, J.A.

JURASSIC-CRETACEOUS TRANSITION BEDS IN CANADA; Colloque du Jurassique, Luxembourg, 1967. Mém. B.R.G.M., Fr., n° 75, 1971. Publié avec le concours de l'Institut grand-ducal sect. sci. nat. phys. math., p. 701.

This paper attempts to summarize briefly the information now available about the zonal sequence and interregional correlation of the Jurassic-Cretaceous transition beds of western and Arctic Canada. Although reasonable in the light of the information now available, some of the conclusions offered may possibly have to be revised later when the rocks and faunas concerned shall be studied in a greater detail.

Fossil-rich, marine uppermost Jurassic (upper Tithonian or upper Volgian) and basal Cretaceous (Berriasian or Infravalanginian) rocks occur in the following depositional basins of western and Arctic Canada indicated by numbers accompanying palaeogeographical map (Fig. 1):

1. Sverdrup Basin in the Canadian Arctic Archipelago.
2. Intracratonic trough of Richardson and Barn Mountains in Northern Yukon and Mackenzie District of Northwest Territories;
3. Geosynclinal (= eugeosynclinal) troughs of Western Cordillera of British Columbia; and
4. Depositional basin of Peace River Foothills and Plains in northeastern British Columbia.

Only the rocks of the first three depositional basins shall be considered in this paper as the partly non-marine and mostly poorly fossiliferous uppermost Jurassic and basal Cretaceous rocks of north-eastern British Columbia are too poorly known at present.

In all of the first three above mentioned depositional basins sections are known in which the uppermost Jurassic rocks grade imperceptibly into the basal Cretaceous rocks. Ammonite, Belemnite and *Buchia* (= Aucella) faunas of these sections are connected by many transitions. This indicates the complete development of the uppermost Jurassic and basal Cretaceous rocks and the persistence of high marine regime at least in the central part of these basins. This circumstance alone makes these sections valuable interregional standards of reference. The value of these sections for the purposes of regional and interregional correlation of the Jurassic-Cretaceous transition beds is, however, further increased by the circumstance that the first two basins contain typical boreal Ammonite and *Buchia* faunas while the third contains several faunas characterized by a rather unusual association of Tethyan (mostly Andean or Indo-Pacific) Ammonites with the well known boreal Ammonites, Belemnites and Buchias. This permits the clarification of time-relationships between several classical upper Tithonian and Berriasian Ammonite zones of the Tethyan realm and the equally well known Ammonite and *Buchia* zones of the upper Volgian and early Neocomian (Infravalanginian) stages of the boreal realm.

Keen, C.E., Keen, M.J., Ross, D.I. and Lack, M.

BAFFIN BAY: SMALL OCEAN BASIN FORMED BY SEA-FLOOR SPREADING; Am. Assoc. Petrol. Geol. Bull., v. 58, no. 6, Part II of II, p. 1089-1108, 1974.

Geophysical and geologic observations in Baffin Bay indicate that the origin of the bay may be ascribed to sea-floor spreading. The bay lies between Greenland and Canada, bounded on the north by the Sounds of the Canadian Arctic Archipelago and on the south by the sill of Davis Strait which separates it from the Labrador Sea. Seismic refraction observations show that the deeper waters of the bay are underlain by oceanic crust. The continent-ocean boundary can be delineated by gravity and magnetic anomalies. The magnetic anomaly at the transition can be explained as an edge effect. The Sounds of the Arctic Archipelago are in general faulted sedimentary basins. Tertiary basalts, known on land east and west of Davis Strait, also are extensive offshore from western Greenland, and in some places cover older sediments. These basalts have characteristics similar to those which some workers believe to be typical of products of hot spots. The opening of the bay can be represented geometrically by the combination of two motions, a rotation about a pole in the Arctic Archipelago, and a translation along Nares Strait. Indirect evidence from the Labrador Sea, the Innuitian province of the Archipelago, and the Tertiary volcanism suggests that the bay attained its present configuration during the Late Cretaceous and Tertiary, but evidence for timing from the bay itself is poor. The timing suggested does however agree with the idea that sediments eroded from the Innuition province during the Cretaceous and Tertiary were channeled through a fluvial system which occupied the Sounds, and were deposited in northern Baffin Bay where the present gradient of the continental slope is gentle.

Keen, C.E. and Keen, M.J.

THE CONTINENTAL MARGINS OF EASTERN CANADA AND BAFFIN BAY; *in* Geology of Continental Margins; ed. C.A. Burke and C.L. Drake; Springer-Verlag.

Canada's eastern continental margin extends over some 40 degrees of latitude from Georges Bank to Ellesmere Island. This account describes only a few of the features of this extensive continental margin, illustrative of the variations in geologic style. Full accounts have been written recently by a number of investigators; consequently we have not put detailed references throughout this text.

The margin off Nova Scotia south of the Grand Banks is a rifted margin, according to the plate tectonics model, formed at a rather early stage in the history of the modern Atlantic Ocean. The margins of Labrador Sea and Baffin Bay also formed by rifting, but at a later time. The Nova Scotia margin and the Labrador Sea margin are separated from each by the Grand Banks, whose southern edge formed by transform faulting. Baffin Bay is separated from the Labrador Sea by a sill in the Davis Strait, which may have been a "hot-spot" in the early Tertiary. Baffin Bay terminates at its northern end in a series of fault-bounded, inter-island channels, much as the Red Sea terminates in the Gulf of Aquaba and the Gulf of Suez.

Keen, C.E.

SOME GEOPHYSICAL MEASUREMENTS ON THE NORTHERN SHELF OF BAFFIN BAY; Prog. 1973, Nat. Conv., Can. Soc. Exp. Geol., 1974.

Geophysical crossings of some of the main features of the northern Baffin Bay shelf are described. The data consist of seismic reflection, seismic refraction, gravity and magnetic measurements. The results show that the deep sedimentary basins of Melville Bay and Lancaster Sound have not experienced significant deformation within the upper 2 km of the sedimentary column which is likely to be of Cenozoic age. The areas to the north exhibit considerable normal faulting, which may be related to tensional stress developed when the Baffin Bay basin was forming to the south. Jones Sound is not a deep sedimentary basin as is Lancaster Sound, for example, and the sediments within it are terminated near its entrance by Precambrian basement. A deep sedimentary basin in Smith Sound trends northwest-southeast and may be related to the grabens on land in the Thule area. It is truncated to the west by a basement high. It is therefore tempting to speculate that the basement highs, terminating Jones Sound and the Smith Sound basin, mark the zone once occupied by a transform fault through Nares Strait which allowed the Baffin Bay basin to form.

Killeen, P.G., Carson, J.M. and Hunter, J.A.

OPTIMIZING SOME PARAMETERS FOR AIRBORNE GAMMA-RAY SPECTROMETRIC SURVEYING; Geoexploration, v. 13, p. 1-12, 1975.

The desired target of an airborne gamma-ray spectrometric survey will determine the dimensions (wavelengths) of anomalies which must be recognizable in the resulting radiometric profiles. An optimum relationship exists between aircraft velocity, spectrometer sampling time, altitude, and upper limit of anomaly wavelength resolution. This relationship is discussed, along with comparisons of measured ground and airborne gamma-ray spectrometric data. Theoretical airborne radiometric profiles based on the ground data in two test areas are calculated and compared to measured airborne data from these areas.

Killeen, P.G. and Heier, K.S.

RADIOELEMENT VARIATION IN THE LEVANG GRANITE-GNEISS, BAMBLE REGION, SOUTH NORWAY; Contrib. Mineral. Petrol., v. 48, p. 171-177, 1974.

An investigation of the distribution of thorium, uranium and potassium across the Levang granite-gneiss shows a significant increase in thorium and uranium from north to south. Although the mean thorium and uranium concentrations are comparable to average granitic values quoted in the literature, potassium is lower. The relative enrichment of thorium and uranium thus appears to be related to Sveconorwegian metamorphism recorded in the rocks of the adjacent Portør Peninsula to the south. The Levang granite-gneiss has recorded only the Svecofennian metamorphic event of approximately 1616 m.y.

King, L.H., Hyndman, Roy D. and Keen, C.E.

GEOLOGICAL DEVELOPMENT OF THE CONTINENTAL MARGIN OF ATLANTIC CANADA; *in* Geoscience Can., v. 2, no. 1, 1975.

The continental margin of Atlantic Canada was formed by the rifting of continental masses in some areas and by the strike slip motion between continental blocks in others. These motions imparted different structural characteristics to the basement. The subsequent development of the margins was controlled by thermal contraction and sediment loading which caused subsidence. These processes led to the formation of the East Coast Geosyncline. The geosyncline is divisible into a miogeocline encompassing the Mesozoic-Cenozoic succession underlying the continental shelf, and a eugeocline comprising strata of similar age underlying the continental rise and abyssal plain. The boundary between the miogeocline and eugeocline is in many areas represented by the modern and ancient continental slope.

Beginning in the Late Precambrian and continuing throughout Paleozoic time the rocks of Atlantic Canada were deformed, metamorphosed, and intruded by granites as a result of the convergence of two major lithospheric plates.

Lambert, M.B.

THE MIGHTY VOLCANIC DRAMA IN ICELAND; Can. Geogr. J., v. 89, no. 1, p. 4-11, 1974.

Lambert, M.B.

EVIDENCE OF VOLCANISM IN CANADA AND PROSPECTS FOR GEOTHERMAL ENERGY; Can. Geogr. J., v. 89, no. 1, p. 12-13, 1974.

Leech, G.B.

METALLOGENY OF CANADA – THE GEOLOGIC SETTING; Min. Eng., v. 26, no. 12, p. 75, 1974.

Onshore Canada comprises three Phanerozoic orogens, the Cordilleran, Innuitian and Appalachian, bounded on one side by oceans and on the other by platforms, the Interior, Arctic and St. Lawrence respectively, which lap onto the core structure, the

Canadian Shield. Canada's metallogeny reflects this framework.

The Cordillera is metallogenically zoned, with relative concentrations of deposit-types as follows: skarn Fe and FeCu on the Pacific fringe, massive sulphides inward from them, then porphyry Cu and Mo and, in the east, stratiform PbZn. The PbZn belt, partly volcanic-hosted but mostly sediment-hosted, is the site of important recent discoveries.

The Innuitian Orogen in the Arctic is dominantly sedimentary but contains flows and sills of several ages and, in the north, granitic intrusions. Evaporite diapirism is distinctive. The possibilities for strata-bound metals are uncertain.

The Appalachians, like the Cordillera an active laboratory for plate tectonic studies, contain a full complement of deposits related to their tectonic development. Most volcanogenic massive sulphides, Silurian (?) and older, have calc-alkaline associations but some have ophiolite affinities. The possibility of economic porphyry Cu deposits is an active consideration. The metallogeny of the Carboniferous is particularly significant, with clastic-hosted Cu and Pb, evaporites and associated celestite and the recent discovery, near one of Canada's oldest settlements, of important PbZn in reefoid carbonates of Mississippian age.

The Devonian of the Interior Platform and Ordovician of the Arctic and St. Lawrence Platforms contain major carbonate-hosted PbZn. The Interior Platform contains major reserves of Devonian potash and other evaporites.

The Canadian Shield's seven geological provinces have distinctive metallogenies. The Superior Province, for example, is characterized by Archean volcanogenic polymetallic massive sulphide and oxide-facies iron deposits, several types of Au deposits and has Ni associated with ultramafic flows; the Churchill has Archean and Proterozoic (?) massive sulphides, Proterozoic sediment-hosted base metal deposits, several types of U deposits and the Thompson Ni belt; the Bear is characterized by Proterozoic U-Ag veins; the Grenville by deposits associated with anorthosites and pegmatites.

Lutenauer, John L.

GEOLOGY; *in* The Fraser River Estuary – Status of environmental knowledge to 1974; eds. L.M. Hoos and G.A. Packman, Environment Canada, Sp. Estuary ser. no. 1, 1974.

Monahan, David and Macnab, R.F.

MESO-MORPH MAP. THE MAPPING OF MEDIUM-SCALE MORPHOLOGY FROM ECHOGRAMS; Proc. Thirteenth Annual Canadian Hydrographic Conference, 1974.

Contoured bathymetric maps have long been the accepted method of portraying sea-floor morphology. These maps are limited by contour intervals and the distances between sounding lines, which set bounds to the resolution of sea-floor features. However, many features are delineated in profile on the echograms themselves, and it is possible to categorize bottom topography from these records. From classification, it is a simple step to map the occurrence of features along ships' tracks. The result is a "meso-morph map", a presentation that subdivides the sea-floor into zones characterized by their medium-scale morphology. Meso-morph maps combine physical description with spatial distribution and are of considerable benefit to under-takings concerned with the bottom of the ocean.

To develop the technique and evaluate its usefulness, data from past surveys over the Flemish Cap and Flemish Pass have been subjected to this analysis. A few highlights of the resultant map are pointed out as illustrations of the potential uses of this type of information.

Mackay, J. Ross and MacKay, D.K.

SNOW COVER AND GROUND TEMPERATURES, GARRY ISLAND, N.W.T.; Arctic, v. 27, no. 4, p. 287-296, 1974.

Field measurements of the influence of snow on ground temperatures, at a depth of 90 cm, were carried out during 1968-73 at Garry Island, N.W.T. The results show that the ameliorating effect of snow can be expressed by a regression equation. The side slopes tend to have the highest mean annual temperatures; the flats the lowest; and the ridges intermediate. At Garry Island, where permafrost is thick, variations in snow cover are probably not reflected in the position of the bottom of permafrost. By contrast, in the nearby alluvial islands of the Mackenzie Delta, where permafrost is thin, the effects of snow on the position of the lower permafrost surface are probably considerable.

Mackay, J. Ross and Mathews, W.H.

MOVEMENT OF SORTED STRIPES, THE CINDER CONE, GARIBALDI PARK, B.C., CANADA; Arct. Alp. Res., v. 6, no. 4, p. 347-359, 1974.

Field studies have been carried out on the movement of sorted stripes at The Cinder Cone area, Garibaldi Park, B.C., since 1958. The investigations were designed to separate, insofar as possible, the process which, it was thought, might be important in the downslope movement of the sorted stripes, viz.: frost heave, displacement by needle ice, surface wash, and drag from snowcreep. Deep frost heave was found not to occur, surface wash proved unimportant, and the drag from snowcreep caused minimal differential transfer of fines versus coarse material. The principal

downslope movement appears to be caused by the growth and ablation of needle ice. The progressive downslope shift results more from toppling of the needle ice columns with sliding and rolling of the superincumbent pebbles, than from vertical gravity settling. For the period 1958 to 1968, the coarser material moved, on the average, about 15 cm yr^{-1} and the finer material about 35 cm yr^{-1}. The mass transport amounted to a "layer" of loose material, about 0.5 cm thick, moving downslope at about 25 cm yr^{-1}.

Mackay, J. Ross

RETICULATE ICE VEINS IN PERMAFROST, NORTHERN CANADA; Can. Geotech. J., v. 11, p. 230-237, 1974.

A reticulate ice vein network is of common occurrence in many lake and marine clays, glacial tills, and mudflow deposits in permafrost areas of northern Canada. The ice vein network may grade downward into high ice content soils at depth. Field observations suggest that the reticulate ice veins grew in vertical and horizontal shrinkage cracks, with much of the water being derived from the adjacent clay, in a semi-closed freezing system, rather than from an upward migration of water in an open system. The three-dimensional geometry of the ice vein network is a factor to be considered in drill hole sampling, thaw-consolidation studies, and differential settlement estimates.

Mackay, J. Ross

ICE-WEDGE CRACKS, GARRY ISLAND, NORTHWEST TERRITORIES; Can. J. Earth Sci., v. 11, p. 1366-1383, 1974.

Observations made on winter ice-wedge cracks at Garry Island, N.W.T., for the 1967-73 period show that cracking tends to occur between mid-January and mid-March. On the average, nearly 40% of the ice wedges crack in any given year. The crack frequency varies inversely with snow depth. Medium sized ice wedges, about 1 m wide, crack more often than smaller or larger wedges. Ice wedges crack preferentially near the center and often year after year at nearly the same place. The cracks average about 1 cm wide at the surface and taper downwards to depths which may exceed 5 m. The cracks partially close in spring before a new ice veinlet forms in them. Evidence provided by multiple wedges suggests that cracking may be initiated at times within the wedge rather than at the ground surface, and thus the cracks propagate both upwards and downwards.

Matthews, J.V., Jr.

QUATERNARY ENVIRONMENTS AT CAPE DECEIT (SEWARD PENINSULA, ALASKA): EVOLUTION OF A TUNDRA ECOSYSTEM; Geol. Soc. Am. Bull., v. 85, p. 1353-1384, 1974.

Unconsolidated sediments at Cape Deceit near Deering, Alaska, range in age from latest early Pleistocene to Holocene. Plant and insect fossils from these sediments, as well as certain sedimentary features, provide evidence for documenting evolution of the terrestrial ecosystem at Deering.

A tundra ecosystem functioned at Deering for most of the time represented by the Cape Deceit sedimentary sequence. The regional tundra environment of northern Seward Peninsula during early Pleistocene time was similar to that of the present; however, the local environment at Cape Deceit was quite different, being only scantily vegetated. Starting in the middle Pleistocene, the tundra of northern Seward Peninsula evidently became more grassy, a trend culminating with steppe-tundra by latest Wisconsin time.

Former periods of warmer climate at Deering are indicated by evidence for westward movement of tree line. The last time forest or forest-tundra existed at Deering was no later than the penultimate interglacial. Spruce tree line probably stood closer to but not at Deering during the Sangamon interglacial. At least once, during latest early Pleistocene time, tree line at Deering was composed of larch instead of spruce.

Except for the mammalian component, most ecosystem evolution at Cape Deceit during the last 400 000 yrs or more has apparently involved little in situ evolution of taxa. The maximum degree of phyletic evolution to be documented here is reduction of the flight wings of the tundra beetle species, *Tachinus apterus*. Most of the phylogenetic splitting that has given rise to pairs or groups of closely related arctic species (especially among the beetles) probably occurred well before the early Pleistocene during initial formation of the lowland tundra realm.

Matthews, J.V., Jr.

WISCONSIN ENVIRONMENT OF INTERIOR ALASKA: POLLEN AND MACROFOSSIL ANALYSIS OF A 27 METER CORE FROM THE ISABELLA BASIN (FAIRBANKS, ALASKA); Can. J. Earth Sci., v. 11, p. 828-841, 1974.

Information on the Wisconsin environment of interior Alaska has been obtained from study of pollen as well as the plant and animal macrofossils contained in sediments of a 27 m core at Isabella Creek, near Fairbanks, Alaska. The pollen assemblages indicate three major zones.

Zone A (35 000 to 32 000 BP) represents a mid-Wisconsin interstadial during which spruce treeline was lower in elevation than at present though not nearly as low as during early and late Wisconsin time. Zone B represents a late Wisconsin interval of severe arctic climate. Forests disappeared from interior Alaska or were greatly diminished and much of the region was characterized by steppe-tundra vegetation. Steppe conditions may have been favoured by rapid deposition of primary and reworked loess. Zone C shows that spruce forests and some of the associated boreal biota had returned to interior Alaska by 8500 years BP. A fluctuation of alder percentages within Zone C may result from mid-Holocene warming.

Plant macrofossils from the Isabella sequence show that some species now having a boreal or taiga distribution survived the late Wisconsin of interior Alaska in a steppe-tundra environment. Other plants that were growing at Isabella during mid-Wisconsin time apparently became extinct in Alaska during the late Wisconsin.

Porter, J.W. and McCrossan, R.G.

BASIN CONSANGUINITY IN PETROLEUM RESOURCE ESTIMATIONS; *in* Methods of Estimating the Volume of Undiscovered Oil and Gas Resources; Alta. Assoc. Pet. Geol., Res. Symp., 1974.

Any estimating technique, no matter how detailed, should have a regional framework within which the data, concepts and principles related to petroleum occurrence can be organized. The sedimentary basin is an entity that can be identified with a minimum amount of information early in the exploration history of a region, and is capable of yielding a very tangible indication of hydrocarbon potential and its mode of occurrence.

There is no single ideal method of estimating resource potential. The method selected should be that best suited to the purpose of the study, the technical resources, and data bases available. Thus, for a world-wide assessment of resources including studies of unexplored regions or basins, one must select a method based on higher order characteristics before attempting any detailed approach.

In classifying the Canadian basins of the Phanerozoic for assisting in estimating petroleum resources, it was found that their evolution in both time and place was orderly relative to generally accepted principles of continental drift. There is clearly an evolution in basin styles through time with corresponding distinctive families of trapping configurations in each basin class.

The basin classification is placed in a chronogenetic framework through studying basin evolution in four major stratigraphic slices called megasequences. An examination of giant oil and gas fields of the world within this basin classification framework demonstrates distinctive modes of occurrence in time (megasequence) and space (crustal position).

Deroo, G., Tissot, B., McCrossan, R.G. and Der, F.

GEOCHEMISTRY OF THE HEAVY OILS OF ALBERTA; *in* Oil Sands Fuel of the Future, Can. Soc. Pet. Geol., Mem. 3, 1974.

Fifty-eight oil samples, extracted from cores of Lower Cretaceous sandstones and from some Devonian carbonates just below the pre-Cretaceous unconformity in eastern Alberta, show a gradational change in composition northeastward towards the shallower part of the Western Canada Sedimentary Basin. Conventional pooled oils, also included in the study, fit into the same picture. Three stages of degradation are recognized departing from a normal oil: type "a" with a decrease in normal alkanes and an apparent increase in phytane and pristane; type "b" with the disappearance of the normal alkanes leaving only pristane and phytane; type "c" in which even the isoprenoids have disappeared leaving only other isoalkanes and cycloalkanes. The heavy oils, including those of the Athabasca deposits, are very similar in their cycloalkane content to the conventional Lower Cretaceous oils of the Western Canada Sedimentary Basin indicating a common origin. A study of the aromatic and thiophenic compounds reinforces that interpretation.

It is concluded that biodegradation and water washing with some possible inorganic oxidation are responsible for the progressive alteration of normal Lower Cretaceous oil migrating updip, where it encounters fresh water invading the basin from the outcrop area along the shield edge.

McGlynn, J.C. and Irving, E.

PALEOMAGNETISM OF EARLY APHEBIAN DIABASE DYKES FROM THE SLAVE STRUCTURAL PROVINCE, CANADA; Tectonophysics, v. 26, p. 23-38, 1975.

Early Aphebian dykes (lowermost Proterozoic) intrude the Archean terrain of the Slave Structural Province of the Canadian Shield and paleomagnetic results from them are reported. The Dogrib dykes, with an Rb/Sr age of 2692 ± 80 m.y., have directions of magnetization directed toward the NW without reversals (16 sites; 309, +37; $\alpha_{95} = 4^{o}$; pole 35S, 050W). The Indin dykes, with an Rb/Sr age of 2093 ± 86 m.y., have magnetization directed toward the SE with reversals (13 sites; 131, +58; $\alpha_{95} = 8^{o}$; pole 19N, 076W). Other, less well-documented data from a third dyke swarm (the "X" dykes) and a basic sill (the Duck Lake Sill), are also presented, and a very tentative polar path for the Slave Province in the earlier Proterozoic is given. This path is not greatly different from a similar very tentative early Aphebian polar path from the Archean Superior Province, considering the uncertainties in the paleomagnetic and age determinations. We interpret this to mean either that the intervening Hudsonian Structural Province (~1850 m.y.) was not the

site of a wide plate-style opening and closing ocean, or if it was, the two bounding Archean cratons returned approximately to their original relative position.

McKeown, D. L. and Grant, A. C.

THE OCEAN '74 CONFERENCE; Geoscience Can., v. 2, no. 1, February 1975.

Ocean '74, the fifth IEEE International Conference on Engineering in the Ocean Environment, was held in Halifax, Nova Scotia, August 21 to 23, 1974, under the chairmanship of O. K. Gashus of Nova Scotia Technical College. This was the first time that the annual conference was held outside the USA. 529 people from many different countries attended: 125 papers by authors from 10 different countries were presented.

The major portion of the work presented was oriented toward electrical and electronic engineering but the Technical Program Committee did seek papers from other disciplines to exemplify the multidisciplinary nature of oceanography. The work in temperate and Arctic waters was the main emphasis of the conference and the largest session dealt with "Engineering and Physics of Sea Ice". Other subject areas included:

1. Seismic reflection methods and geological instrumentation and techniques,
2. Positioning at sea,
3. Acoustic applications, techniques, instrumentation, and scattering,
4. Data acquisition, communications, telemetry, and signal processing,
5. Instrumentation, sensing in the ocean environment, and pressure tolerant electronics,
6. Pollution monitoring, fish monitoring and counting, and deep-water fishing technology,
7. Tidal power and tidal measurements in the open ocean,
8. Buoys, manned submersibles and diving technology, ship behaviour and handling, and mechanical engineering.

The conference proceedings were made available prior to the conference and this appeared to stimulate discussion periods after each paper.

Miall, A. D.

MANGANESE SPHERULITES AT AN INTRA-CRETACEOUS DISCONFORMITY, BANKS ISLAND, NORTHWEST TERRITORIES; Can. J. Earth Sci., v. 11, p. 1704-1716, 1974.

Concretions ranging from 10 to 700μ in diameter form a marker zone between the Christopher Formation (Albian) and the Kanguk Formation (Cenomanian to Maastrichtian) in three wells in western Banks Island. The concretions contain in excess of 30% rhodochrosite ($MnCO_3$), plus minor quantities of dolomite, and iron and manganese oxides. Quartz sand and silt, clay, and sparry dolomite comprise the matrix between the concretions. The concretion zone ranges up to 40 ft. (12 m) in thickness and is tentatively assigned to the Kanguk Formation.

Manganese was probably derived by decomposition of contemporaneous volcanic rocks, possibly located offshore west of Banks Island. The metal was concentrated by ionic or molecular diffusion processes acting immediately below the sediment-water interface.

Subsequent diagenetic recrystallization allowed for further manganese concentration and the development of a strong radial-fibrous crystal texture as the surrounding sediments were passively replaced. Concentric laminations were caused by further partial expulsion of impurities, probably including organics and iron and manganese oxides.

Miall, A. D.

PALEOCURRENT ANALYSIS OF ALLUVIAL SEDIMENTS: A DISCUSSION OF DIRECTIONAL VARIANCE AND VECTOR MAGNITUDE; J. Sed. Petrol., v. 44, no. 4, p. 1174-1185, 1974.

A tabulation of recent work on current indicators in modern rivers shows that directional variance increases with decreasing structure scale, in fairly close agreement with the structure hierarchy concept of Allen.

Fluvial currents are vectors, definable by direction and magnitude, but most paleocurrent studies ignore magnitude. It is proposed that azimuth readings be weighted according to the cube of current structure thickness, this being a volume measure corresponding to the distance in all three dimensions over which a local flow vector might reasonably be assumed to maintain the same direction. It is also a measure of the quantity of sediment moved by the flow vector.

Examples are presented in which the proposed weighting factor is applied to data from the fluvial Isachsen Formation (Cretaceous) and deltaic Eureka Sound Formation (Cretaceous-Tertiary) of Banks Island, Arctic Canada. It is shown that the use of the weighting factor can differentiate flow patterns on the basis of sedimentary structure size, leading to interpretations of channel size, sinuosity, and other parameters of sedimentological importance. The weighting factor also provides an important check on calculations of vector mean.

Mott, R. J.

PALYNOLOGICAL STUDIES OF LAKE SEDIMENT PROFILES FROM SOUTHWESTERN NEW BRUNSWICK; Can. J. Earth Sci., v. 12, p. 273-288, 1975.

Lake sediment cores from two lakes yielded pollen profiles which reflect vegetational and climatic changes since deglaciation. Radiocarbon dates from specific

levels outline the chronology. Correlation of pollen zones between the two profiles indicate the degree of error in the anomalously old dates from one of the sites. Total absolute pollen frequencies are used to aid in interpretation.

Following deglaciation a tundra environment prevailed until about 12 000 radiocarbon years B.P. This was followed by a transition zone in which *Betula* and *Populus* were abundant. About 12 000 years B.P. *Picea* increased markedly and remained a dominant part of the vegetation until 9500 years B.P. when *Pinus* and *Quercus* became prominent. *Tsuga* and various hardwood genera predominated after 6500 years B.P. An increase in *Picea* and decline in *Tsuga* and some hardwood genera produced the forests which prevailed when the area was settled.

Muller, J.E., Wanless, R.K. and Loveridge, W.D.

A PALEOZOIC ZIRCON AGE OF THE WESTCOAST CRYSTALLINE COMPLEX OF VANCOUVER ISLAND, BRITISH COLUMBIA; Can. J. Earth Sci., v. 11, p. 1919-1922, 1974.

Zircons from the Westcoast Crystalline Complex near Tofino, Vancouver Island, have yielded the following ages: $^{206}Pb/^{238}U = 265 \pm 7$ m.y.; $^{207}Pb/^{235}U = 263 \pm 7$ m.y.; and $^{206}Pb/^{207}Pb = 244 \pm 20$ m.y. A K-Ar date of an amphibolized dike from the same outcrop yielded 192 ± 9 m.y. This is the first supporting isotopic evidence that the 'basement' complex is derived from late Paleozoic Sicker volcanic rocks and was ultimately migmatized during the major Jurassic plutonic event of Vancouver Island.

Strimple, H.L. and Nassichuk, W.W.

PENNSYLVANIAN CRINOIDS FROM ELLESMERE ISLAND, ARCTIC CANADA; J. Paleontol., v. 48, no. 6, p. 1149-1155, 1974.

Pennsylvanian crinoids are reported from the Sverdrup Basin on Ellesmere Island as follows: *Anchicrinus planulatus* Moore and Strimple of probable Bloydian (Kayalian) age from the Otto Fiord Formation; *Oklahomacrinus ellesmerensis* n. sp., *Cydonocrinus quinquilobus* n. sp., and *Calycocrinus* sp. of late Bloydian (Morrowan) or early Atokan age from the Hare Fiord Formation; *Oklahomacrinus canyonensis* n. sp., *Cromyocrinus* sp., and *Calycocrinus* sp. (Middle Pennsylvanian age) from the top of the Canyon Fiord Formation.

Norris, D.K.

STRUCTURAL GEOMETRY AND GEOLOGICAL HISTORY OF THE NORTHERN CANADIAN CORDILLERA; Proc. 1973 Nat. Conv.; Can. Soc. Exp. Geophys., 1974.

The deformed rocks of the Canadian Cordillera northeast of the Tintina Fault in Yukon Territory and northwestern District of Mackenzie can be divided into ten tectonic elements, each characterized by specific structural or stratigraphic attributes or trends. The region is flanked on the east by the generally flat-lying, eastward-tapering miogeoclinal wedge of sediments of the northern Interior Platform. On the west some of these elements continue into northern Alaska. Beneath are the crystalline rocks of the Hudsonian and older basement which are not exposed but which may have been melted to constitute local, lower Paleozoic, granitic intrusions. All Phanerozoic Systems as well as Proterozoic rocks are represented in this part of the orogenic system and they contain regional unconformities. Two major events are identified in the stratigraphic sequence, the one marking the end of stable shelf deposition by the close of the Paleozoic, and the other marking the fundamental reorganization of distribution of land and sea in the Late Jurassic and the Early Cretaceous.

A relatively flat gravity field in the Interior Platform contrasts with the steep gradient and curvilinear trends of the Bouguer anomalies paralleling the eastern flank of the orogenic system and identifying a thickening of the sedimentary sequence there. The free-air gravity map has a positive high paralleling the outer edge of Beaufort Shelf and is explained in the literature as a thinning of the sedimentary cover and a ridge in the basement rocks.

The problem of the origin of the Canada Basin and of the source of sediments for the Canadian Arctic Archipelago and for the mainland west of Mackenzie Delta in the middle and late Paleozoic has been answered in the literature by variations of two fundamentally different concepts. The first is that Canada Basin was closed prior to the Mesozoic so that the mainland was juxtaposed with the Archipelago and an upland between shed sediments bilaterally. The second is that Canada Basin is a geologically ancient feature antedating Atlantic rifting and the source of middle and late Paleozoic sediments was from the continental shelf and adjacent margins. The writer favours the second concept and considers the first with all its ramifications as unfounded in scientific fact. The Atlantic separation of the North American and Eurasian plates with concomitant reduction in the size of the Pacific plate was accomplished on the one side through drift from the Mid-Atlantic and Gakkel Ridges, and on the other through drift, collision in Siberia, longitudinal buckling and finally transcurrent faulting, first on the Kaltag Fault in the Late Cretaceous and then on the DeGeer transform in the Tertiary. There was no Alaskan Orocline, no associated pivot points within the North American continental plate and no Arctic Sphenochasm so that Canada Basin is an ancestral feature, at least in existence since the early Paleozoic.

Pelletier, B.R.

BEAUFORT SEA PROJECT INTERIM REPORT: PROJECT F-4 – SEDIMENT DISPERSAL IN THE SOUTHERN BEAUFORT SEA; publ. by Beaufort Sea Project, 512 Federal Building, 1230 Government St., Victoria, B.C. V8W 1Y4.

Beaufort Sea sediments have been obtained by means of bottom grabbers and cores from ship-borne and helicopter-supported operations since 1970. A total of 1100 samples has been collected and all have been texturally analyzed. In this report the 98 grab samples obtained from CSS HUDSON in 1970 are described, and inferences on their texture, distribution and origin are given.

Both bathymetry and geography have been considered, but lacking is a fuller appreciation of ocean dynamics. As these companion studies progress on other projects, then can utilization of such data be realized for the sedimentary and coastal studies. What is known, however provides a reasonable framework for the sedimentary model in the Beaufort Sea. Sediment discharged from the Mackenzie River and is transported seaward to the north and east. A major sediment site is present in the Mackenzie Canyon and the adjacent shelf area to the east. Although coarser sediments on the eastern shelf suggest erosion, which may in part be true, they also represent relic sediments that are presently being obscured and buried by sediments being discharged from the Mackenzie River.

Other areas such as the coastal zone also appear to be sites of vigorous sedimentary processes, and may be providing considerable material to the sedimentary system. Although many of these areas have been sampled and the related sediments texturally analyzed, the data have not been examined to the point at which they could support this report. This will be forthcoming.

Studies on clay mineralogy, carbonate, total carbon and organic carbon have recently been initiated. From various surveys, 244 representative samples have been selected and it is expected that the results of such studies will provide baseline data for projects affecting the environment of sedimentary deposition. Also, the sedimentary model may be further deduced and most certainly valuable data will be on hand in determining the main factors of the environment.

Additional studies are proposed, more for ancilliary projects than for the present one. Any environmental study is multi-disciplinary in scope and because much of man's future activity will be connected with the sea-floor, it is only reasonable to expect that the focus of a multi-disciplinary environmental study will be in the area of marine geology.

Hogarth, D.D., Chao, G.Y., Plant, A.G. and Steacy, H.R.

CAYSICHITE, A NEW SILICO-CARBONATE OF YTTRIUM AND CALCIUM; Can. Mineral., v. 12, p. 293-298, 1974.

Caysichite, $(Y, Ca)_4Si_4O_{10}(CO_3)_3 \cdot 4H_2O$, occurs in granite pegmatite at the abandoned Evans-Lou feldspar mine, 22 miles north of Ottawa. The mineral is normally present as a coating on fractures or as incrustations up to 2 mm thick with a divergent columnar structure. Terminated crystals are rare. Caysichite is colourless to white, more rarely yellow or green. $H = 4\frac{1}{2}$, D(obs) = 3.03 and D(calc) = 3.029 g/cm^3. For the colourless variety, $\alpha = 1.586$, $\beta = 1.614$, $\gamma = 1.621$, $2V_x = 53^\circ$, $X = b$, $Y = a$, $Z = c$, with positive elongation; yellow crystals have somewhat higher refractive indices and larger optic angle. The mineral is orthorhombic: $Ccm2_1$ or $Ccmm$ with $a = 13.282$, $b = 13.925$, $c = 9.727$ Å (crystal elongation); $Z = 4$. Strongest lines (Cu$K\alpha$) are 6.93 (020, 111) (100), 4.38 (130) (60), 4.22 (310) (60), 3.48 (040) (60), 3.32 (400) (90). IR absorptions occur at 3700-2600 cm^{-1} (H_2O), 1700-1240 cm^{-1} (CO_3) and 1200-900 cm^{-1} (SiO_4). On heating, dehydration is followed by two distinct stages of decarbonation. The DTA product (1120°C) has an apatite structure. Caysichite may have been derived from hellandite through low temperature solution and precipitation.

Dence, M.R., von Engelhardt, W., Plant, A.G. and Walter, L.S.

INDICATIONS OF FLUID IMMISCIBILITY IN GLASS FROM WEST CLEARWATER LAKE IMPACT CRATER, QUEBEC, CANADA; Contrib. Mineral. Petrol., v. 46, p. 81-97, 1974.

Glass from the West Clearwater Lake hypervelocity impact crater contains numerous spheroids, 10 to 500 μm across, which appear to have formed at high temperatures as fluids immiscible in the enclosing melt. The spheroids are distinguished from small, normal, largely void gas vesicles, which are also present, by being completely filled in all cases; by having fillings which vary in composition from spheroid to spheroid, even between spheroids in close association; and by indications that the present fillings are representative of the contents present before the matrix melt chilled. Most of the spheroids are classified petrographically into three types. Type I, the most numerous, includes all spheroids >100 μm and are filled with uncommon pale brown to yellow montmorillonites with an unusual structure intermediate between dioctahedral montmorillonite and saponite. Type II, brown and green, are filled with Fe-rich montmorillonites, while Type III are alumina-rich montmorillonites crystallized into mica-like sheaves. Rare, small spheroids are filled with calcite or silica. In a few cases one spheroid encloses another of similar or different type. Electron microprobe analyses indicate that with few exceptions Types I and III spheroids belong to a Mg series of montmorillonites in which the main chemical variation is the substitution of Mg for Al. A second Fe-K series includes Type II and a few Type I spheroids and shows substitution of Fe by Al, relatively high K_2O and, in the alumina-rich members, low SiO_2. The close association of

spheroids with deformed, embayed lechatelierite inclusions indicates that they formed while the latter were liquid, i.e. at temperatures above 1700°C, as rapidly moving impact melt engulfed highly shocked inclusions of quartz-bearing country rock. The preservation of spheroids in the West Clearwater Lake glass is attributed mainly to the position of the glass masses within the breccias lining the crater floor. It is considered that the glass in this location did not achieve free flight but, as part of a large mass, cooled relatively slowly through the high temperature regime in which the spheroids were generated, and then, when detached, chilled rapidly to preserve a record of this transient stage in their history.

Grieve, R.A.F., Plant, A.G. and Dence, M.R.

LUNAR IMPACT MELTS AND TERRESTRIAL ANALOGS: THEIR CHARACTERISTICS, FORMATION AND IMPLICATIONS FOR LUNAR CRUSTAL EVOLUTION; Proc. Fifth Lunar Conf.; Supp. 5, Geochim. Cosmochim. Acta, v. 1, p. 261-273, 1974.

A suite of impact melt products ranging from glasses to crystalline poikilitic and subophitic rocks has been recognized in breccias 66035, 3 and 68115, 4 and in soil 65702, 1. The textural range is equivalent to that observed in terrestrial impact melts from craters 20-60 km in diameter. The lunar impact glasses show a wide spread in composition, but can be subdivided into high-Ca-Al, high-Mg, granitic and intermediate groups corresponding to known or postulated lunar rock types: anorthosite-highland basalt, spinel troctolite, granite, and low-high K Fra Mauro basalt respectively. The crystalline impact melts have a smaller compositional spread and the majority have compositions within the intermediate group of the glasses. Rare examples of crystalline impact melt with compositions corresponding to spinel troctolite and anorthosite are also present.

The textural similarities between lunar and terrestrial impact melts are particularly strong in terrestrial craters where one of the bedrock lithologies is anorthosite, e.g. Mistastin Lake, Labrador and Manicouagan, Quebec. We propose that both terrestrial and lunar impact melts were created in the same manner by the total melting of crystalline target rocks. Inclusions represent xenocrystal material from less strongly shocked parts of the target swept up by the melt during its movement along the crater floor. Partial melting is a minor process, the result of partial assimilation of xenocrystal material, and occurs only during consolidation of the impact melt.

This model of formation and the composition and texture of the lunar impact melts require that the upper highlands crust contained not only anorthosite, but also sizable bodies of granite and more mafic rocks such as spinel troctolite. The impact melts of intermediate, including Fra Mauro, composition do not correspond to lunar samples with igneous or primary textures but rather to breccias. Compositions within this field are probably the result of mixing and melting from impacts onto heterogeneous targets with compositions at least as diverse as the extremes of the impact melt products. The primary lunar rocks formed early in lunar history when normal processes of igneous differentiation were dominant over the mixing effect of repeated bombardment.

Rashid, M.A.

DEGRADATION OF BUNKER C OIL UNDER DIFFERENT COASTAL ENVIRONMENTS OF CHEDABUCTO BAY, NOVA SCOTIA; Estuarine Coastal Marine Sci., v. 2, p. 137-144, 1974.

The results given in this paper tend to indicate that the extent of degradation of spilled oil in marine areas depends, in a large measure, upon the environmental conditions of coastal areas. The degradation is rapid in the high energy environment but is relatively slow in protected areas. Bacterial as well as oxidative processes appear to alter the composition of oil.

Oils exposed to high energy shoreline environments lose *n*-alkanes more rapidly. This loss is probably due to bacterial degradation because no other known physical or chemical process can account for this. With weathering the saturated and aromatic hydrocarbons decrease with a corresponding increase in the non-hydrocarbons, particularly in resins and NSO compounds. These changes which are possibly due to microbial and oxidative degradation processes are prominent in the oils of high energy environment. The rates of degradation of saturated and aromatic fractions appear to be the same.

The specific gravity increases with an increase in degradation of oil. The viscosity values show a marked increase with weathering. The increased viscosity of the oil residues in the high energy environment has reduced its mobility.

The data suggest that the residual oils present in varying amounts on nearly all contaminated beaches of the protected areas of low and moderate energy environments will persist for several years. In high energy environments the residual oils are substantially altered due to the loss of *n*-alkanes and a parallel increase in resins and NSO compounds. The resulting residues are highly viscous and remain adhering to sand and pebble substrate.

Rashid, M.A.

ABSORPTION OF METALS ON SEDIMENTARY AND PEAT HUMIC ACIDS; Chem. Geol., v. 13, p. 115-123, 1974.

Humic acids isolated from marine sediments were found to be effective in absorption of various metal ions through chelation, cation exchange and surface adsorption. The quantities of metal ions complexed varied from 40 to 205 mg/g of organic matter. In the presence

of equal concentrations of Co, Cu, Mn, Ni and Zn in the reaction media, humic acid and peatmoss, a rich source of humic compounds, showed preferential absorption for Cu. Copper constituted more than 50% of the metal ions complexed by organic matter. As compared with the other metal ions, its bonding strength was very firm because it could not be displaced by ferric ion or cation exchange reagents.

Peatmoss, a rich source of humic acid, was found to absorb significant quantities of various metal ions. Under laboratory conditions each kg of peat absorbed about 1500 mg of various metal ions from solutions containing equal concentrations of Co, Cu, Mn, Ni and Zn. However, in the field trials with sea water, absorption of metals was limited to Zn (28.7 mg/kg), Cu (3.66 mg/kg) and Fe (2.0 mg/kg). Under-saturation of sea water for transition metals and super-saturation for alkali and alkaline earth metals appears to be a bottleneck in the effective utilization of peat as a means of recovery of metals from sea water.

Picklyk, D.D. and Ridler, R.H.

COMPUTER GRAPHICS – AN INTERACTIVE APPROACH TO VOLCANIC GEOCHEMISTRY AND STRATIGRAPHY: ILLUSTRATED BY DATA FROM THE KIRKLAND LAKE AREA; Can. Min. Met. Bull., v. 68, p. 1-8, February 1975.

A system is described for the interactive retrieval of rock geochemical and geological data through a graphics terminal. Ease of user operation is emphasized.

The graphic system is designed around a Tektronix Model 4002A terminal operating with a Digital Equipment Corp. PDP 10/50. Data are selected by specifying a geologically logical criterion such as rock type, stratigraphic age, geographic location or sample number. Geochemical data can be selected by applying various limiting criteria, in particular by the selection of clusters revealed by the contouring of variation diagrams. Facilities are provided for plotting the selections on a ternary or variation diagram or geological map. Areas of interest may then be re-selected for further consideration.

Tests using a partial data file for the volcanic rocks of the Kirkland Lake area and a user with no previous experience have been successful. The cost of producing a given diagram is a fraction of the cost of using a drum plotter.

Subtle geochemical signatures revealed and applied by this technique may be useful in correlation.

Ridler, R.H.

THE GOLD METALLOGENY OF ARCHEAN EXHALITES; Min. Eng., v. 26, no. 12, p. 75, 1974.

Exhalites are a class of chemical sediments of predominantly volcanic origin. They may be classified not only *chemically*, into anion facies or cation subfacies, but also *geologically* into proximal and distal varieties with respect to the volcanic source. Exhalites exhibit diverse geological associations suggesting variations in water depth, distance from source, proportions of volcanic to non-volcanic detritus, and so forth. *Any* species of Archean exhalite may be enriched in gold relative to background. However, a sulfide mineral phase characteristically accompanies such anomalies and may be present in any proportion of the exhalite mineralogy. Complex deformation histories affect Archean exhalites. Thus original syngenetic distribution patterns are converted in varying degrees to real or apparent epigenetic geometries, many of which are being produced from today. Exhalite origin and distribution are discussed with reference to the Abitibi greenstone belt and its ore deposits.

Ridler, R.H. and Shilts, W.W.

MINERAL POTENTIAL OF THE RANKIN INLET; Can. Min. J., v. 95, no. 7, p. 32-36, 38-40, 42, 1974.

A detailed study of the Rankin Inlet-Ennadai belt by the Geological Survey of Canada has turned up evidence of a wide variety of mineralization of possible economic potential.

Rimsaite, J.

EFFECT OF RB-METASOMATISM Rb/Sr AND $^{87}Sr/^{86}Sr$ RATIOS IN PEGMATITIC MINERALS AND HOST ROCKS.

Studies of chemically analysed feldspars and micas, and of their host rocks, indicate that potassium-bearing minerals are favourable hosts for rubidium and unfavourable hosts for strontium. Thus, in common crystalline rocks, the rubidium occurs in potassic minerals and the strontium in Ca-Na-minerals.

To test this observation, pegmatitic minerals and host rocks were chosen for the study of Sr and Rb isotope distribution in an area affected by K, Na and Rb metasomatism. It was found that secondary micas formed during the late pegmatitic-hydrothermal stage of high Rb-activity contain very little or no common Sr. Micas and microcline formed during the main pegmatitic stage of high K-Be-Li-activity, which also affected the host rocks of the pegmatite, contain a few ppm common Sr; and the "old" Ca-Na-feldspar contains the most abundant common strontium. Plots of $^{87}Sr/^{86}Sr$ vs $^{87}Rb/^{86}Sr$ constructed from isotopic data obtained in the pegmatitic minerals and related rocks show five different slopes resulting from the increased quantity of K and Rb. The steepness of the slope increases with the increasing Rb-content and decreasing common Sr-content of rock-forming minerals in the following order:

1. for granodioritic rocks, composed mainly of Ca-Na-feldspars (shallow slope);
2. for adamellite the slope becomes steeper with increasing amount of microcline;
3. for the "pegmatite rocks" the steepness of the slope increases with Rb% of mica;
4. for the pegmatitic minerals of the "main pegmatitic stage" (slope increases);
5. hydrothermal muscovite and lepidolite provide the steepest slope.

Based on K/Ar and Rb/Sr ages of minerals, the following chronological order of geological events is suggested for the Malartic Val d'Or area, Quebec:

2.8 b.y.: minimum age for the deposition of the "greywacke" (rock-unit 2; Dawson, 1966);
2.7 - 2.6 b.y.: emplacement of granitic rocks of the batholith (rock-units 5-8; *ibid.*);
2.6 - 2.5 b.y.: main pegmatitic activity; K-metasomatism; Be-Cs-Nb-Ta-Li-mineralization;
2.5 - 2.35 b.y.: increased Rb-Mn-F-metasomatism in the portion of the pegmatite grading into the hydrothermal stage. Mo-mineralization, crystallization of uranophane and hydrothermal alteration of Be-Li-ore minerals and biotite.
2.4 - 1.5 b.y.: continuing sodium activity, albitization and perthitization.

(This abstract published in part in Geol. Surv. Can., Paper 74-4.)

Rimsaite, J.

MINERAL ASSEMBLAGES AND LOW-GRADE METAMORPHIC-METASOMATIC ALTERATIONS IN AN ARCHEAN GREENSTONE BELT, MALARTIC, QUEBEC; Can. Mineral., v. 12, p. 520-526, 1974.

The metamorphosed volcanics, sediments and basic intrusives of the Archean Greenstone Belt are composed of secondary minerals amphibole, mica, chlorite, serpentine, accessory epidote, apatite, sphene, calcite and sulphides, and variable quantities of interstitial quartz and feldspar. The greenschists are locally sheared, brecciated and affected by metasomatic and hydrothermal alterations which produce local recrystallization and diverse chemical and mineralogical changes. Chemical analyses of minerals from selected relatively fresh and altered rock and massive sulphides were made in an attempt to study chemical changes during progressive alteration of silicates. The analytical results infer the following chemical changes:

With progressive chloritization, the biotite loses more Si, Al^{VI}, Ti, K, Na, F, and Cl and gains Al^{IV}, Mg and OH.

With progressive bleaching and recrystallization, the amphibole changes from hornblende to actinolite and tremolite whereby Fe, Al, K and Ti decrease and Si, Mg and Ca increase.

Colour and texture of serpentine are correlative with chemical composition. Serpentine granules which retain the original olivine textures contain more iron than the white fibres from late serpentine veins, and coloured granules contain more Fe and Ni than colourless granules.

Fractured serpentinites are affected by subsequent low-grade metamorphism whereby fine-grained serpentine alters to coarse-grained talc and/or chlorite, and recrystallizes to long fibres which grow perpendicular to fracture walls or fill the fractures with felty aggregates. Secondary serpentine veinlets contain thin seams of calcite and magnesite.

Roddick, J.A. and Hutchison, W.W.

SETTING OF THE COAST PLUTONIC COMPLEX, BRITISH COLUMBIA; Pacific Geol., v. 8, p. 91-108, 1974.

The Coast Plutonic Complex forms a long (1700 km), narrow (96 km), complex plutonic zone dominated by intermediate and basic granitic rocks. The flanking strata consist mainly of Mesozoic volcanic and sedimentary rocks, although Lower Paleozoic rocks occur in southeastern Alaska and from small areas in the San Juan Islands and adjacent northern Cascade Mountains, and Upper Paleozoic rocks are known on Vancouver Island, in southeastern Alaska, the northern Cascades and along the east flank of the Coast Mountains. The Coast Plutonic Complex was the site of scattered plutonic activity in pre-Mesozoic time, but the nature of the belt then is not known. Triassic time was one of major basaltic volcanic activity from Vancouver Island in the west to the Interior Plateau in the east. A significant change occurred in the Early Jurassic when basaltic volcanism gave way to andesitic volcanism on Vancouver Island. Although adjacent areas indicate plutonism and uplift in the northern part of the Coast Plutonic Complex in Upper Triassic time, the first major burst of intrusive activity came in the Jurassic and the belt became a major positive feature flanked on the east by two troughs which later (in mid-Jurassic time) broke into three successor basins. They display a gradual transition from marine deposition in the Jurassic to nonmarine deposition in the mid-Cretaceous accompanied by an increasing volume of granitoid debris derived from the Coast Plutonic Complex. Plutonic activity reached its height in the Cretaceous and continued into the early Tertiary, but was followed by minor intrusion, at least up to the end of Miocene time.

The Coast Plutonic Complex consists essentially of a complex matrix of migmatite and gneisses (high grade in the core of the central Coast Mountains), and foliated

intermediate and basic (locally migmatitic) plutonic rock with minor zones of schists. Within this matrix are discrete and partly discrete plutons of various sizes and composition but within the range of composition of the matrix.

Seismic and gravity data in the vicinity of the Prince Rupert area indicate that the base of the crust descends from an oceanic depth of 11 km in two steps, the first at the continental slope where it sinks to 27 km, and the second at the western margin of the Coast Mountains where it passes below 35 km. Across the southern Coast Mountains gravity results are similar, but the seismic data are conflicting.

The petrographic nature of the Coast Plutonic Complex is characterized by an unusually high concentration of modal points in the diorite and basic quartz diorite fields. Rocks more acid than mid-quartz monzonite (adamellite) are rare. Limited chemical data from the region bounded by latitudes 54° and 55°N, however, indicate a strong calc-alkaline trend with a decrease in potash from southwest to northeast.

The Coast Plutonic Complex has a setting in time that is difficult to delineate but may extend from the Precambrian to latest Miocene (8 m.y.). Gneisses, just south of the Canadian border in the northern Cascades contain zircons 1400 to 2000 million years old. None of that age have been found yet in the Canadian part of the Coast Plutonic Complex, although correlative rocks appear to be present. The main period of plutonism in the Coast Mountains began in the Late Triassic but most of it was concentrated in the Cretaceous and Eocene. Between latitudes 53° and 55°N K-Ar dates are grouped into three northwest-trending belts, with Early Cretaceous on the west, Late Cretaceous in the center and Eocene on the east side. It has not been established whether these dates represent sequential west to east unroofing or intrusion or both, but the consistency of age irrespective of rock type within each belt suggests that unroofing was an important factor. Eocene plutonism on the east side of the Coast Mountains is matched by coeval volcanism.

Sangster, D.F.

CANADIAN STRATABOUND LEAD-ZINC DEPOSITS IN SEDIMENTARY ENVIRONMENTS; Min. Eng., v. 26, no. 12, p. 75, 1974.

Although volcanic-hosted massive sulphide deposits are the predominant source of zinc and lead in Canada (80% and 55% respectively, of 1972 production), significant deposits of these metals are also known to occur in sedimentary rocks. At the present time, three types of sedimentary host rocks, each representing different depositional environments, can be recognized: 1) coarse-grained clastics such as quartzite, sub-arkose, arkose, and conglomerate formed in continental or familic environments adjacent to basement highs of sialic composition, 2) fine-grained clastics such as argillites, siltstones, and shales, possibly of deep-water regime, and 3) platformal and/or shallow-water carbonates with little or no silicate detritus. Deposits found in rocks of the first two of these environments are characteristically stratiform; the third type contain stratiform deposits as well, but most commonly they occur as structurally-controlled stratabound bodies.

Schwartz, E.J.

MAGNETIC FABRIC IN MASSIVE SULFIDE DEPOSITS; Can. J. Earth Sci., v. 11, p. 1669-1675, 1974.

The magnetic anisotropy of oriented sulfide samples from four massive sulfide ore (Ni-Cu) deposits associated with the Sudbury Irruptive and two sulfide deposits near Timmins, Ontario, is commonly well above 10%. This indicates that the anisotropy is mainly due to preferred orientation or to thin layering of random crystals of the strongly anisotropic magnetic pyrrhotite type Fe_7S_8 which occurs in all deposits sampled. The directions of the principal susceptibilities show patterns for most of the deposits indicating a consistent magnetic fabric within these deposits. The directions of the principal susceptibilities show varying degree of scatter, suggesting local modifications of the general patterns. In general the standard errors on the principal susceptibilities are only a few (<5) degrees indicating that the magnetic fabric is of single origin and did not result from superimposed anisotropies. It is emphasized that in most cases, the magnetic fabric differs from deposit to deposit in the Sudbury area, suggesting that the fabric depends strongly on the geological environment of the deposits.

Scott, W.J. and Hunter, J.A.

SEISMIC AND ELECTRICAL METHODS IN PERMAFROST DETECTION; Nat. Res. Council, Can., Tech. Memo., no. 113, p. 48-49, 1974.

Scott, W.J., Campbell, K.J. and Orange, A.S.

EM PULSE SURVEY METHOD IN PERMAFROST; Nat. Res. Council, Can., Tech. Memo. no. 113, p. 92-96, 1974.

Scott, W.J. and Collett, L.S.

SYMPOSIUM ON PERMAFROST GEOPHYSICS; Geoscience Can., v. 2, no. 1, p. 51-54, 1975.

Sellmann, P.V., McNeill, J.D. and Scott, W.J.

AIRBORNE E-PHASE RESISTIVITY SURVEYS OF PERMAFROST; Nat. Res. Council, Can., Tech. Memo. no. 113, p. 67-69, 1974.

Shilts, W.W.

THE WEALTH THE GLACIERS LEFT BEHIND; Geos., Fall 1974, p. 8-9.

Shilts, W.W.

GLACIAL DISPERSAL OF ROCKS, MINERALS, AND TRACE ELEMENTS IN WISCONSINAN TILL, SOUTHEASTERN QUEBEC, CANADA; Geol. Soc. Am., Mem. 136, p. 189-219, 1974.

Slaney, V.R.

SATELLITE IMAGERY APPLIED TO EARTH SCIENCE IN CANADA; Proc. Comm. VII, Int. Soc. Photogrammetry, Banff, 1974.

The problems of interpreting monochrome ERTS imagery are considered and compared with the two types of colour image produced in Canada. For interpretation purposes, colour prints are considered to be far more informative than monochrome material.

ERTS imagery has aroused the interest of many geologists, but with few exceptions, specific applications are not being recognized as easily as had been expected. ERTS has been accepted as an educational tool. In mosaic form ERTS imagery will be used for broad regional studies and also as topographic map underlays for geophysical data. It is generally recognized that there is a need in Canada for small scale imagery to assist geologists in mapping programmes, particularly at 1: 250 000 scale. Because of its limited ground resolution, it appears probable that ERTS imagery will be only partially satisfactory for this purpose.

Soregaroli, A.E.

GEOLOGY AND GENESIS OF THE BOSS MOUNTAIN MOLYBDENUM DEPOSIT, BRITISH COLUMBIA; Econ. Geol., v. 70, p. 4-14, 1975.

The Boss Mountain molybdenum deposit is about 225 miles north-northeast of Vancouver. It is in granodiorite phases of the composite Upper Triassic Takomkane Batholith near a Cretaceous quartz monzonite body, the Boss Mountain Stock. Molybdenite occurs in economic concentrations in collapse breccias and in single and multiple vein systems.

Eight ages of fractures, many of which are filled with quartz-sulfide veins, are recognized. Rock alteration produced six distinct mineral assemblages including: 1) garnet-hornblende, 2) biotite, 3) quartz-sericite-pyrite-potash feldspar-chlorite, 4) chlorite-talc, 5) epidote-chlorite, and 6) zeolite-calcite-clay. Three pulses of molybdenum introduction were contemporaneous with biotite, potash feldspar, and/or sericite alteration.

The sequence of events genetically related to ore formation includes rhyolite dike emplacement, breccia formation, fracture development, alteration, and mineralization. These events are directly related to oscillatory magmatic activity within the Boss Mountain Stock, which also was the source of the ore.

Soregaroli, A.E.

GEOLOGY OF THE BRENDA COPPER-MOLYBDENUM DEPOSIT, BRITISH COLUMBIA; Can. Min. Met. Bull., v. 67, no. 750, p. 76-83, 1974.

The Brenda copper-molybdenum deposit is 14 miles northwest of Peachland, British Columbia. The deposit is entirely within the Brenda Stock, a composite quartz diorite body of Jurassic age which intrudes Upper Triassic sedimentary and volcanic rocks of the Nicola Group. Pre-mineral, intermineral, and post-mineral dykes with widely divergent compositions cut the stock.

Primary mineralization, predominantly chalcopyrite and molybdenite with minor pyrite and magnetite in a gangue of quartz, potash feldspar, epidote, calcite, and/or biotite, generally is confined to fracture fillings (veins). Disseminated sulphides are rare. Grade is a function of fracture density and mineralogy of the filling material.

Several chronological stages of veins with specific attitudes and mineralogy formed as a result of east-west regional compression. Intermineral trachyte porphyry dykes were emplaced after the earlier veins were formed, but prior to development of the later veins.

Hydrothermal alteration is notably weak in and around the deposit. Potassic alteration (potash feldspar and biotite), which occurs as envelopes adjacent to mineralized veins, is directly related to sulphide mineralization. Argillic and propylitic alteration appear less important.

Surface weathering leached significant molybdenum from the upper part of the orebody with concomitant development of limonite and minor quantities of other secondary minerals.

Cochrane, N.A. and Srivastava, S.P.

TIDAL INFLUENCE ON ELECTRIC AND MAGNETIC FIELDS RECORDED AT COASTAL SITES IN NOVA SCOTIA, CANADA; J. Atmos. Terrestrial Physics, v. 36, p. 49-59, 1974.

Large M_2 period (12·42-hr) periodicities in the terrestrial electric field at Morden and Dartmouth, Nova Scotia are ascribed to ocean tidal dynamos in the Bay of Fundy and Atlantic Ocean, respectively. Theoretical models permit crude estimates of gross earth conductivity from observed tidal electric amplitudes in the Fundy region. Similar tidal influences are not clearly resolved in magnetic recordings along the Atlantic coastline compared to similtaneous recordings 500 km

inland. Possible *D* component magnetic gradients associated with the Bay of Fundy dynamo are also undetectable in a short stretch of simultaneous recording between Morden and Dartmouth.

Srivastava, S.P. and Folinsbee, R.A.

MEASUREMENT OF VARIATIONS IN THE TOTAL GEOMAGNETIC FIELD AT SEA OFF NOVA SCOTIA; Can. J. Earth Sci., v. 12, p. 227-236, 1975.

Measurements of temporal variations in the total geomagnetic field were made at sea on the Abyssal Plain off Nova Scotia, Canada, during 1972 and 1973 from specially designed magnetometers housed in moored surface buoys. Comparison between the simultaneous recordings from sea and land stations shows enhancement in the land recordings from 10 min to 2 h periods with a maximum value around 30 min period. The trend of this enhancement is similar to that observed between Sable Island and Dartmouth and supports the previous interpretation of the presence of a high conductivity structure under the continental shelf. Comparison between the recordings made at sea and on land during the total solar eclipse of July 10, 1972 shows a phase lag of 11 min in the recordings at sea. This phase seems to agree with the eastward migration of the totality during this time.

Steacy, H.R., Plant, A.G. and Boyle, R.W.

BRANNERITE ASSOCIATED WITH NATIVE GOLD AT THE RICHARDSON MINE, ONTARIO; Can. Mineral., v. 12, p. 360-363, 1974.

Brannerite associated with native gold is described from two specimens collected nearly a century ago at the Richardson Mine, Eldorado, Ontario. The minerals occur in a carbonate matrix with muscovite, tourmaline and pyrite. Minor uraninite, in both thorium-rich and thorium-free varieties, is intimately associated with the brannerite. Microprobe analysis of the more homogeneous brannerite gave (wt. %): U 45-50; Ti 19.5-22.0; Th 1.2-2.2; Ca 3.0-3.4; Fe 1.5-2.0, with U and Ti varying antipathetically. The gold has a uniform composition (Au 99.8, Ag 0.2) and is late in the paragenetic sequence. The gold-brannerite association is believed to be the first recognized in Canada.

Steacy, H.R. and Grant, D.R.

TIDAL MUDS REVEAL MINERAL CURIOSITY; Can. Geogr. J., v. 88, no. 1, p. 36-38, 1974.

A rare, unique Canadian mineral form, similar to jarrowites and glendonites, occurs in intertidal salt-marsh mud 40 feet below high tide near Fort Beauséjour at the head of Bay of Fundy. The double-ended arrowhead form of calcite, for which the popular descriptive term "fundylites" is proposed, is found in mud burying a submerged forest radiocarbon dated at 4010 years B.P. Fundylites are sometimes twinned, rhombohedral in cross-section, with corrugated surfaces and serrated edges suggesting a zig-zag axis, and have a granular interior. They are thought to be authigenic pseudomorphs, perhaps localized by conditions related to the subjacent peat, and to the karst that is developing in the underlying carbonate rocks.

Steacy, H.R.

OUR BEAUTIFUL, LITTLE KNOWN GEMSTONES; Can. Geog. J., v. 89, no. 6, p. 4-13, 1974.

Descriptions, manner of occurrence, principal localities and historical notes are provided for Canada's important gemstones, including such well-known ones as labradorite, jade, agate, amethyst, hessonite, sodalite and rhodonite. Many are illustrated in colour.

Stott, D.F.

LOWER CRETACEOUS COAL MEASURES OF THE FOOTHILLS OF WEST-CENTRAL ALBERTA AND NORTHEASTERN BRITISH COLUMBIA; Can. Min. Met. Bull., v. 67, no. 749, 1974.

Lower Cretaceous coal-bearing beds outcrop extensively along the Foothills of Alberta and northeastern British Columbia between Mountain Park and Prophet River, a distance of 400 miles. Although thin coal seams are found in the Minnes Group of latest Jurassic to earliest Cretaceous age, the major coal deposits in this region occur in overlying beds. To the south, the strata are included in the dominantly continental Blairmore Group. To the north, the coal seams occur in a complex sequence of alluvial-deltaic to marine sediments included in the Bullhead and Fort St. John groups.

In recent years, widespread exploration in this region has provided additional information of use in outlining the occurrence and distribution of coal zones. Coal is known to occur in the Gething Formation just above the Cadomin conglomerate between Kakwa River and Monkman Pass, and in the upper part of the Gething Formation in the vicinity of the Sukunka, Pine and Peace rivers. Major seams are recognized above marine sandstone overlying the marine Moosebar shale at Luscar, Grande Cache and Torrens River. Seams within the succession vary in thickness from a few inches to several tens of feet and include major deposits of low- to medium-volatile bituminous coal, some considered to be of excellent coking quality.

Sutherland, Doreen M. and LaHam, Mary T.

GEOSCIENCE DOCUMENT DISTRIBUTION IN CANADA; Geosci. Inform., v. 4, p. 75-83, 1974.

Sweet, A.R. and Hills, L.V.

A DETAILED STUDY OF THE GENUS *AZOLLOPSIS*; Can. J. Botany, v. 52, p. 1625-1642, 1974.

Five species of *Azollopsis* Hall, 1968, are described from strata of Campanian to Paleocene age. The spores were recovered from the Belly River and Edmonton Groups of central Alberta, Canada.

The genus *Azollopsis* is emended to include forms with circinate glochidia. Two subgenera, *Spiralopsis* subg. nov. and *Azollopsis* subg. nov., are erected to encompass the seven known species of *Azollopsis*. Two new species, *Azollopsis pusilla* and *A. intermedia*, are described, and enlarged descriptions are given for *A. tomentosa* Hall, 1968, *A. cocoides* Hall, 1968, and *A. pilata* (Snead, 1969) comb. nov. *Salvinia spinata* Hall and Bergad, 1971, is formally transferred to *Azollopsis* (*Spiralopsis*).

A possible ancestral relationship between *Azollopsis* and *Ariadnaesporites* Potonié, 1956, emend. Tschudy, 1966, is proposed. The phylogenetic relationships between the species of *Azollopsis* are discussed.

Hills, L.V., Chi, B.I. and Sweet, A.R.

THE GENUS *OCKSISPORITES* CHALONER; Rev. Palaebot. Palyn., v. 19(2), p. 101-115, 1975.

The genus *Ocksisporites* Chaloner is emended to include only spores which are isosceles triangular in shape and which may bear fluke-tipped echinae. Two new species *O. connatispinosus* and *O. rugulatus*, are erected and the type species is emended. The present evidence suggests that the genus is widely distributed in Frasnian rocks in northern Canada. The genus *Ocksisporites* can be differentiated from *Ancyrospora* on the basis of possessing ornament on both the proximal and distal surfaces of the megaspore whereas the latter possesses ornament only on the distal surface.

Murray, J.W. and Tiffin, D.L.

PATTERNS OF DEFORMATION SEDIMENTATION AND TECTONISM, SOUTHWESTERN CANADIAN CONTINENTAL MARGIN; Annales Soc. Geol. Belgique, T. 96, 12 p., 1974.

Dredging and seismic profiling on the Western Canadian continental margin has revealed two distinct Tertiary sedimentary basins separated by a submerged tectonic feature, the Kyuquot Uplift - Brooks Fracture Zone. The northerly Winona Basin was initiated in Early Miocene time and contains an estimated thickness of 4 kms of mudstone, sandstone, conglomerate and minor coal. The Tofino Basin, to the south, however, was initiated in Late Eocene time and contains an estimated 3.2 kms of sediment, principally mudstone. In the Winona Basin, homoclinally dipping strata rest undisturbed on the shelf, but are disrupted by large scale faulting on the continental slope. Beyond the continental slope, however, northwesterly trending folds are present, associated with a northwesterly striking fault system. Southeast of the Kyuquot Uplift on the Tofino Basin continental shelf, northwesterly striking folds, associated with mudstone diaprism, are present. Here the continental slope lacks large scale faulting characteristically developed in the Winona Basin and is commonly underlain by northwesterly trending folds.

Deformation has created considerable topography in the basin which has had a pronounced effect on sedimentation. This deformation was at least partly contemporaneous with deposition.

The tectonic depositional feature observed appeared to be related to present and earlier configurations of nearby offshore spreading centres, plates and transform faults.

Chase, R.L., Tiffin, D.L. and Murray, J.W.

THE WESTERN CANADIAN CONTINENTAL MARGIN; Can. Soc. Pet. Geol., Sp. Mem. no. 1, 1974.

The current state of knowledge on the tectonics of the Canadian Pacific continental margin is summarized. This is an active area of the earth's crusts marking the juncture of the Pacific, America and Juan de Fuca plates. Major tectonic and physiographic features of the area are described. A bathymetric compilation of the Canadian continental margin is presented and further illustrated by continuous seismic profiles over typical areas. A change in velocity and direction of the Juan de Fuca plate about 5 m.y. B.P. has resulted in a change in movement of the triple junction along the continental margin between the periods 10 to 5 m.y. B.P., and 5 m.y. B.P. to the present.

Frebold, Hans and Tipper, H.W.

UPPER CALLOVIAN AND LOWER OXFORDIAN AMMONITES FROM SOUTHEASTERN BOWSER BASIN, BRITISH COLUMBIA; Can. J. Earth Sci., v. 12, p. 145-157, 1975.

Ammonites of the Late Callovian Lamberti zone and of the Early Oxfordian Mariae and Cordatum zones are described from sedimentary sections on the south and southeastern margins of the Bowser Basin. They date a regressive sequence of Hazelton Group sedimentary rocks older than the main clastic sediments of the Bowser Basin. This is the first record of Upper Callovian rocks in Canada.

van der Linden, Willem J.M.

MESOZOIC AND CAINOZOIC OPENING OF THE LABRADOR SEA, THE NORTH ATLANTIC AND THE BAY OF BISCAY; Nature, v. 253, January 31, 1975.

A reinterpretation of magnetic anomaly and basement trends suggests that the Labrador Sea opened in two stages. During a first phase, most likely in the late Jurassic-early Cretaceous, the opening was coupled, by way of a triple junction off Spain, to spreading in the central Atlantic and Bay of Biscay. A second phase of seafloor spreading in the Labrador Sea occurred between 60 and 47 Myr ago and was connected through a triple junction south of Greenland to spreading in the northern and central Atlantic.

van der Linden, Willem J.M. and Norris, R.M.

STRUCTURE AND QUATERNARY HISTORY OF KARAMEA BIGHT, SOUTH ISLAND, NEW ZEALAND; New Zealand J. Geol. Geophys., v. 17, no. 2, 1974.

Seismic reflection profiles across Karamea Bight establish the structure and development of the western shelf of central New Zealand. The Karamea continental shelf consists of an inner platform cut in Tertiary folded strata during Pleistocene periods of low sea level, and an outer delta plain which consists of sediment fans built seaward during the Pleistocene. Pleistocene sea levels were as much as 110 m below present sea level. Present day sedimentation is restricted mainly to the inner shelf where sandy muds are distributed in long narrow belts by longshore drift and nearshore wave action.

Vilks, Gustavs, Rashid, M.A. and van der Linden, Willem J.M.

METHANE IN RECENT SEDIMENTS OF THE LABRADOR SHELF; Can. J. Earth Sci., v. 11, p. 1427-1434, 1974.

Methane was found in Recent sediments of two basins on the Labrador continental shelf. These basins are carved in what are believed to be Tertiary and Mesozoic strata resting on Precambrian and possibly Paleozoic rocks. Geochemical and foraminiferal analyses of sediments from one piston core indicate that the gas is a product of anaerobic fermentation of organic matter. Mildly anaerobic conditions existed in subsurface sediments, which were deposited under marine conditions shortly after the retreat of the last Pleistocene glaciation.

Walker, D.A., Linton, A.E. and Schafer, C.T.

SUDAN BLACK B: A SUPERIOR STAIN TO ROSE BENGAL FOR DISTINGUISHING LIVING FROM NON-LIVING FORAMINIFERA; J. Foram. Res., v. 4, no. 4, p. 205-215, 1974.

Heated acetylated or heated saturated Sudan Black B solutions are two stains that are more accurate and penetrative than conventional rose Bengal for distinguishing living from non-living foraminifera. Of the 62 test specimens stained with heated acetylated Sudan Black B, 96.8 percent stained blue-black; in each of the 61 specimens stained with a heated saturated solution of Sudan Black B, 95.1 percent stained. In contrast, only 70.3 percent of the 64 specimens stained with rose Bengal. Washing and heating prior to staining removed the algal detritus that usually adheres to test surfaces, and that obscures results if stained in conjunction with protoplasm, as in the case for rose Bengal. Test surfaces were minimally stained by either solution when compared with rose Bengal: 4.0 percent of the test surfaces stained with heated acetylated Sudan Black B, 5.5 percent with the heated saturated Sudan Black B, and 28.1 percent with rose Bengal.

Wanless, R.K. and Eade, K.E.

GEOCHRONOLOGY OF ARCHEAN AND PROTEROZOIC ROCKS IN THE SOUTHERN DISTRICT OF KEEWATIN; Can. J. Earth Sci., v. 12, p. 95-114, 1975.

Rb-Sr and U-Pb dating techniques have been utilized to identify and date Archean supracrustal rocks within the Churchill structural province in regions where K-Ar age determinations have recorded only the effects of younger Hudsonian orogeny. The age of emplacement of Archean granodiorite has been established at 2550 m.y., a determination that also provides a minimum age for volcanic rocks intruded by the granodiorite.

The overlying Proterozoic Hurwitz Group volcanic rocks have been dated for the first time at 1808 ± 35 m.y. (Upper Aphebian). A post-Hurwitz Group quartz monzonite pluton intruded the granodiorite gneiss at 1772 ± 22 m.y. and the age of the post-tectonic Nueltin Lake Granite has been established at 1700 ± 16 m.y. (Paleohelikian).

It is concluded that the Hurwitz Group cannot be correlated with the Huronian succession in Ontario as the Hurwitz Group rocks are 300 to 400 m.y. younger than the Huronian strata.

Wanless, R.K. and Reesor, J.E.

PRECAMBRIAN ZIRCON AGE OF ORTHOGNEISS IN THE SHUSWAP METAMORPHIC COMPLEX, BRITISH COLUMBIA; Can. J. Earth Sci., v. 12, p. 326-332, 1975.

Pb-U age determinations carried out on zircon from granodiorite gneiss of the core zone of Thor-Odin gneiss dome have provided isotopic evidence for involvement of Proterozoic basement rocks in the Mesozoic structures of the Shuswap Metamorphic Complex. The study has revealed that the zircons originally crystallized 1960^{+35}_{-45} m.y. ago and suffered an episodic loss of lead 175^{+73}_{-81} m.y. ago.

Williams, G.L. and Lentin, J.K.

RANGES OF SELECTED LATE CRETACEOUS DINOFLAGELLATES; *in* Am. Assoc. Stratigr. Palynol. Contrib. Ser., no. 4, 1975.

The stratigraphic range of 96 dinoflagellate species is plotted against the standard European stages. Each species is fully illustrated. The data permit recognition of distinctive suites of dinoflagellates which characterize each stage of the Late Cretaceous.