

The Atlantic Geoscience Society Colloquium on Current Research in the Atlantic Provinces

Volume 20, Number 2, Summer 1984

URI: https://id.erudit.org/iderudit/ageo20_2abs01

[See table of contents](#)

Publisher(s)

Maritime Sediments Editorial Board

ISSN

0843-5561 (print)

1718-7885 (digital)

[Explore this journal](#)

Cite this document

(1984). The Atlantic Geoscience Society Colloquium on Current Research in the Atlantic Provinces. *Atlantic Geology*, 20(2), 83–119.



**THE ATLANTIC GEOSCIENCE SOCIETY
COLLOQUIUM
on
Current Research in the Atlantic Provinces**

ABSTRACTS

The 1984 meeting on current research in the Atlantic Provinces was held in the Wandlyn Motel, Amherst, Nova Scotia in January. The colloquium was dedicated to the late Rupert MacNeill and attracted over fifty presented papers, twenty poster sessions and well over a hundred participants. Laing Ferguson is to be congratulated on both the content and organization of the meeting, abstracts of which are presented overleaf.

The Cape Breton granitoid pluton project: another progress report

*Sandra M. Barr, Department of Geology,
Acadia University, Wolfville, N.S. B0P 1X0*

Granitoid rocks in Cape Breton Island, Nova Scotia, are the focus of continuing mapping and petrological studies. The purpose of this project, begun in 1978, is to describe the lithology, chemical characteristics, age and mineralization of the granitoid and associated rocks, and hence to interpret petrogenesis and tectonic implications. The studies to date have documented wide variation in age (Hadrynian to Carboniferous), composition (mafic to highly felsic), petrologic features ("I-type" and "S-type"), and depth of emplacement (mesozonal to subvolcanic). Significant differences appear to exist between northern and southern Cape Breton Island. The north is characterized by large Hadrynian to Ordovician (?) tonalitic to dioritic bodies with local occurrences of such rocks as trondhjemite and peralumi-

nous granite, and widespread Devonian-Carboniferous plutons. Granitoid rocks in the south generally occur in large composite dioritic to leucogranite plutons of Late Hadrynian to Cambrian age, with few Devonian-Carboniferous intrusions. Cape Breton granitoid rocks, especially those in the south, appear to have some petrological features in common with granitoid rocks in northern mainland Nova Scotia, but contrast markedly with typically peraluminous Devonian-Carboniferous intrusions in the Meguma Zone of southern Nova Scotia. Best exploration targets in Cape Breton Island are high-level intrusions which may have preserved porphyry-type or skarn Cu-Mo-W-Bi-Ag mineralization; such intrusions are apparently of both Late Hadrynian-Early Cambrian and Devonian-Carboniferous ages.

Ordovician intracratonic sediments in the Lac-St-Jean and Chicoutimi areas, Quebec

R.K. Pickerill, T.L. Harland and D. Fillion*

*Department of Geology, University of New Brunswick, Fredericton, N.S. E3B 5A3
Poroperm Laboratories Ltd., Chester, CH4 8RD, England

Ordovician outliers in the Lac-St. Jean and Chicoutimi areas, Quebec, consist of 30-40 m of variable limestones overlain by 35 m of dark brown or grey shales and further limestones. We focus attention on the basal limestone sequences, which are of late Trenton (Middle Ordovician) age and overlie Precambrian gneisses and anorthosites with marked unconformity.

The transgression of the Ordovician sea into the present-day Lac-St-Jean and Chicoutimi areas produced an intracratonic basin within which a variety of sediments were deposited in a number of environments. Nearshore sediments of the basin formed a complicated suite of clastics, derived from the adjacent rugged coastal hinterland, and intertidal and shallow subtidal carbonates with variably admixed clastics. Further from shore, in sheltered bays or lagoons partly enclosed by offshore shoals and bars of skeletal lime sands, fine-grained carbonates with coral-algal-bryozoan

thickets accumulated. Variations in sedimentation rate and also the development of periodically exposed banks of sediment resulted in numerous submarine hard- or firm-grounds and subaerial microkarstic surfaces. The offshore skeletal shoals and bars, which were composed mainly of pelmatozoan debris but included patches of incipient reef growth, provided an incomplete barrier to circulation. Offshore subtidal sediments consisted of mixed carbonate and argillaceous muds. Sudden increased rates of transgression, probably related to isostatic movements, resulted in the drowning of this palaeogeographic distribution of sediments and the deposition of dark coloured argillaceous shales in significantly deeper water. These shales are partly of latest Utica and mainly Lorraine in age and it is likely that the initial drowning of this part of the Laurentian Shield was much later than that in the St. Lawrence Lowland.

Carboniferous Basins in eastern Cape Breton Island - Near but yet so far?

R.C. Boehner

Nova Scotia Department of Mines and Energy, Halifax, N.S. B3J 2X1

The Sydney, Glengarry, and Loch Lomond structural basins are situated in eastern Cape Breton Island and are bounded on one or more sides by major faults and preCarboniferous basement rocks in the Kellys Mountain, East Bay and Fourchu Blocks. The major structures in the basins have a pronounced northeasterly trend with the larger Sydney Basin (synclorium) containing three major synclines with interveing arches formed by preCarboniferous rocks of the Coxheath and Boisdale Hills. The Glengarry and Loch Lomond Basins in contrast are relatively simple half graben basins with a common northwest border fault. All three basins appear to represent part of formerly more extensive basins that have been dislocated by faulting.

The stratigraphic successions within the Sydney Basin and the Glengarry Half Graben - Loch Lomond Basin range in age from Early to Late Carboniferous but are distinctly different in most respects - particularly in the Late Carboniferous.

The two principal differences (ignoring thickness and minor facies variations) are: (1) the absence of recognizable Early Carboniferous Horton Group and the earliest Windsor Group in Loch Lomond - Glengarry and; (2) the presence of a major hiatus (regional unconformity) in the early part of the Late Carboniferous in the Sydney Basin. These two features are particularly useful in interpreting the paleogeographic structural and depositional histories of these two areas, which are now in close proximity, but have distinctive stratigraphic records.

This disparity may be attributed to 1) juxtaposition of two distinct areas through lateral motion on the major transcurrent Lennox Passage - Bateston Fault, 2) very localized and dramatically differing subsidence-uplift history related to block faulting, or 3) a combination of 1) and 2). The combination alternative with transcurrent faulting predominant is the favoured explanation.

A study of the Fisset Brook Formation at Lake Ainslie, western Cape Breton Island

A.A. Huard and H.C. Teng, Department of Geology, St. Francis Xavier University, Antigonish, N.S.

The Fisset Brook Formation is a Carboniferous sequence of volcanic and minor intercalated continental clastic sedimentary rocks. At Lake Ainslie, the study area in western Cape Breton, it nonconformably overlies Precambrian basement and is conformably overlain by clastic sedimentary rocks of Carboniferous Horton Group.

Petrographic, petrochemical and field studies show that the volcanic rocks are bimodal with respect to silica and consist of interlayered rhyolites and basalts. The petrochemical study shows that the basalts are transitional, with both tholeiitic and alkalic characteristics. It also illustrates that the rhyolites could not have been derived from the same source as the basalts

by fractional crystallization or fractional melting. The proposal that the rhyolites are anatectic melts of continental crust is supported by new isotopic data for the Fisset Brook Formation.

Regional implications are evaluated. The model developed involves the activation of faults in response to a middle Carboniferous megashear environment. Related elements are local extension, mantle upwelling and basaltic volcanism, using the faults as conduits to the surface. Thermal energy related to mantle upwelling and basaltic volcanism caused the crustal anatexis to form the rhyolitic magma. Further development of the basin involved the deposition of continental sediments.

The development (depositional) history of New Brunswick peatlands*D. Keys**Three-D GeoConsultants Limited, Fredericton, N.B. E3A 5G9*

A comprehensive evaluation of peat and numerous localities. In the Sackville area peatland resources has recently been carried out by the New Brunswick Department of Natural Resources. The data compiled by this inventory program was used to delineate regional variation in the peatlands. By grouping peatlands with similar stratigraphy, seven regions were recognized. Factors such as climate, post-glacial sea level fluctuations, surface morphology and drainage, vegetation, and bedrock geology were evaluated in the interpretation of the development history in each of the seven regions.

Raised (or domed) ombrotrophic peatlands are the most common type in the province. On the Carboniferous Platform development of these peatlands commonly began in shallow depressions, often on the divide between river systems. Along the east coast the peatlands developed over marine sediments on emergent coastal plains. The coastal climate probably contributed to the rapid development of peat layers which exceed 8 m in thickness. Coastal submergence and the resulting erosion of the peatlands has produced 4 m high peat cliffs at

peatlands have also developed over marine sediments with 2-3 m deep ombrotrophic bogs surrounded by shallow marshes. Interbedded clay and silt layers are common in basal peat layers. Along the Bay of Fundy coast small, topographically confined, ombrotrophic bogs have developed in bedrock depressions following coastal emergence. The relatively few peatlands which occur in the northwest of the province are generally thin ombrotrophic bogs which originated near small brooks or by forest paludification.

In the southwest of the province peatlands developed in association with slow-moving streams or by in-filling of lakes. Basal ooze or marl layers are common. While most of the accumulated peat layers are of minerotrophic origin, thin ombrotrophic layers can be found on the surface of many deposits. Extensive swamps and marshes associated with the Saint John and Oromocto Rivers have variable peat depths. Interbedded silt and clay bands and high ash contents have resulted from periodic flooding.

BIOSTRAT: son of Rangefile

M.S. Barss, E.H. Davies and G.L. Williams, Atlantic Geoscience Centre, Geological Survey of Canada, Bedford Institute of Oceanography, Dartmouth, N.S.

BIOSTRAT, a sophisticated biostratigraphic data base at the Atlantic Geoscience Centre, helps the paleontologist to: obtain computer range plots immediately after loading of analysis data; produce well reports with details of individual sample analysis plus an alphabetic listing of all taxa with author; develop and refine zonations; integrate biostratigraphic data on all wells analyzed; develop quantitative stratigraphic correlations; provide plots of species assemblages, associations, and groupings; produce time-slice maps of species, a necessary phase of paleoenvironmental, paleoecologic, and provincial studies; integrate the biostratigraphy with

other geological data bases.

BIOSTRAT is a development of RANGE-FILE, a data base conceived in the early seventies when analysis sheets of a standard format were adopted. A unique feature of BIOSTRAT is the taxon dictionary. This provides updated taxonomy regardless of load format, so that inconsistencies are eliminated. Future development will witness greater application of quantitative approaches to biostratigraphy, as well as interfacing with other data bases. Also being considered is the direct input of data, either through a local terminal or by using the voice print approach.

A model of the Late Wisconsin Newfoundland ice sheet with applications to mineral exploration

T. E. Day

Day and Associates Glacial Geologists, 961 South Bland St., Halifax, N.S. B3H 2S6

Techniques of ice sheet modelling developed over the past few years are potentially of great value in drift exploration. The modelling of glacial flow lines can put theoretical constraints upon the source of ore indicators where geological evidence of

ice flow patterns is sparse or absent. The likely basal thermal regime of an ice sheet can be modelled so that the length and geometry of dispersal trains can be predicted.

Surficial geology as a tool in mineral prospecting - a till sampling project in the Long Lake area, New Brunswick

Toon Pronk

Department of Natural Resources, Halifax, N.S. B3J 2T3

The Quaternary deposits in the Long Lake area can be divided into two major groups; one related to the actual movement of the ice (basal till), the other to the wasting-retreat of the ice (ablation deposits). There are other minor deposits which will not be discussed here.

In sketching the Quaternary history of the area at hand it should be noted that major structural phenomena such as fault and joint patterns in the greater eastern part of the area are more or less oriented 120°, while in the western part of the area the pattern shows a more N-S oriented direction (bedding).

Regional ice movement during the main Wisconsin glaciation was in a 120° direction. Already existing valleys, directions of which were partially structurally controlled, determined the local ice movement in the area. Nevertheless, there are two ice movement directions registered in the area in the form of striae and basal till fabric. One group of striae indicates an ice movement direction of 120° and probably represents the main glacial movement of the Late Wisconsin. Another group of striae and till fabric analyses indicate an ice movement of approximately 100° which represents a retreat-surge phase of the Renous flow pattern.

During the main phase the area was covered with cold based ice, which means no basal till was deposited. Thus the basal till must have formed during an early retreat-surge phase when basal melting occurred on the stoss side of mountains. The

till fabric analyses that was done suggests a basal till deposited by the Renous River flow pattern.

The transportation of pebbles seems to have been in an east-southeast direction. Directly down ice from a geological boundary, only a few pebbles of a newly encountered unit occur, but about 2 km down ice maximum values are found. The number of pebbles of the unit slowly decreases down ice after crossing a subsequent geological boundary, but traces can still be found for many kilometres, depending on their composition.

A later retreating phase is responsible for the great amount of ablation material deposited in the area. According to drill-hole data the ablation material is locally 80m thick. The ablation moraine (also referred to as ground moraine) is characterized by a hummocky topography, kettle holes and the presence of ice contact stratified deposits, such as eskers and kames. The ablation moraine is, in some places, overlain by outwash deposits.

The eastern part of Long Lake was ice-dammed for a brief period of ice retreat during which some glaciolacustrine deposits were formed. Drainage during deglaciation was reversed probably during a part of the later retreat phase when stagnant ice blocked the northwest and west drainage towards the Tobique River. During this period drainage was towards the east (Miramichi River) and later to the southwest (Gulguac River).

Till samples were taken on a 1 km grid eastward for 20 km from the western granite boundary in the north and Costigan Mountain in the south to detect zones of mineralization. Two zones are known to be present in the area and are associated with Cu, Zn, Pb, Ag, Au, and U stream sediment anomalies.

B-horizon samples were taken for Ni, Zn, Fe, Mg, Cu, Pb, Ag, CO, Mo, and U analyses and C-horizon samples for Au analyses and pebble lithology study. The latter were taken in 12 litre buckets and sieved ($\frac{1}{2}$ inch) for pebbles. The $\frac{1}{8}$ inch fraction was panned in the field to obtain the heavy minerals without clay or pebble contamination.

The sample spots were indicated on a 1:50,000 topographic map and plotted on aerial photographs. The sample was selected from the best location within a circle of 150m around the plotted spot. Recent logging operations have increased the accessibility of the area greatly over the past four years. Road cuts and lake banks made ideal spots for sampling.

The geochemical results of this till sampling project and the geological maps of the area will be released in a report in 1984. In this report, mineral and pebble anomalies will be discussed in relation to each other, ice movement directions and surficial and bedrock geology.

Continuing investigations in the Miramichi earthquake region of New Brunswick

*K.B.S. Burke and J.J. Chandra**

Department of Geology, University of New Brunswick, Fredericton, N.B. E3B 5A3

**Mineral Resources Division, Department of Natural Resources, Fredericton, N.B.*

During 1983, further investigations were carried out in the Miramichi Earthquake Region, where aftershock activity continues nearly two years after the main event. Ground magnetic and radiometric measurements and VLF-EM surveys have been completed and a radon gas monitoring program established for 17 drillholes in the area. Stripping of overburden in selected areas has yielded information on the nature of surficial fracturing and the identity of VLF-EM anomalies.

Modelling of gravity anomalies shows that the North Pole Stream Granite, which is the main geological body in the region, extends to a depth of 8 km and has its edges covered by a relatively thin wedge (0-1 km) of metasedimentary and older plutonic rocks. Since nearly all of the reported aftershocks have their focal depths in the 1 to 7 km range, it is concluded that the earthquake activity is confined to the pluton. Small diorite bodies with areal extents of a few square kilometres and thicknesses of 1 to 2 km occur within the granitic rocks of the pluton, but do not appear to be related spatially to the earthquakes. The heterogeneous nature of the pluton is confirmed by the magnetic and radiometric measurements.

Stripping of overburden in the area of a crack previously thought to be seismogenic revealed that movement was of limited extent and is more likely related to either glacial unloading or the release of tectonic stress. The stripping operation also led to the identification of a pop-up feature that is probably associated with a higher than normal horizontal stress.

A nearby VLF-EM conductor was trenched and found to be due to a highly weathered fault zone with a trend of 140 degrees. This fault zone is the only major structural feature recognized within the epicentral area. There is no conclusive evidence of post-glacial movement along this fault; however, features in the vicinity of the breccia zone can be related to glacial and possibly post-glacial phenomena.

The present earthquake activity may be taking place in a granite that has been considerably weakened by earlier stages of deformation and is now less resistant to stress than the surrounding rocks. No evidence has been found for major fault zones suggested by the fault plane solutions of the seismological records.

Gold in till

Ian J. MacEachern

Department of Geology, Dalhousie University, Halifax, N.S. B3H 3J5

In an effort to aid gold exploration in Nova Scotia, till geochemistry studies were conducted at two former gold mines in the province. The Fifteen Mile Stream and Forest Hill gold districts were chosen for study because of the excellent till profiles exposed in trenches which are cut to bedrock and oriented perpendicular to the strike of both the veins and host strata of the deposits.

The purpose of the Fifteen Mile Stream study was to document the distribution, character and composition of gold in the till overlying the deposit. Twenty-one sample sets of A, B and C horizon material were collected at 10 m intervals along two trenches which are in an echelon formation and directly over the deposit.

Geochemical analyses for gold, silver, lead and arsenic were performed on samples of the B horizon and four(4) size fraction of the C horizon. Samples of the A horizon were analyzed for gold only.

The <250 micron fraction of the C horizon with a mean gold content of 217 ppb contains higher concentrations of gold than other size fractions and horizons analyzed.

The gold occurs as foliated flakes which are morphologically similar to gold particles from the tailings of the mine. That the gold is not far travelled is evident from the lack of surface striations or other deformation features indicative of abrasive transport.

Microprobe analyses of gold from the till gave unexpected compositions which differed significantly from those of the presumed source. Gold from the till has an average composition of 69% copper, 10% gold, 9% zinc and 1% silver as compared with gold from the mine tailings which

average 91% gold and 9% silver. This discrepancy in composition is thought to be due to a hydromorphic redistribution of gold in the till.

The purpose of a more comprehensive study in progress at Forest Hill is to develop and refine effective geochemical tools for gold exploration in Nova Scotia. It consists of an integrated survey involving the correlation of bedrock, till and soil geochemistry. The till was systematically profile-sampled at 1 m intervals at each station. Stations were located at 25 m intervals along 9 trenches totalling 3.5 km in length. The till stratigraphy and gold distribution (in till) was extensively studied. A thorough understanding of the glacial and post-glacial history of the study area will allow us to illustrate the 3-dimensional dispersal of gold from known auriferous veins and enable us to predict patterns exploration geologists can expect.

The till stratigraphy is very complex, with three depositional events being indicated. The oldest unit is a washed and poorly cemented gravel. This is overlain by two tills which are separated by a reddish-brown zone interpreted to be a paleosol. The lower till is an olive brown, moderately compact unit. Fabric measurements imply that it was formed by a regionally south-eastward ice movement. The upper till is a yellow-brown sandy and loose unit which has a fabric indicating formation during a southwestward ice movement.

The gold dispersal from known auriferous veins appears to reflect the south-eastward ice flow direction. Several other areas of gold-rich drift may be indicative of post-glacial processes or dispersion from undiscovered auriferous veins.

Quaternary sediments of southeast Baffin Shelf

D. B. Praeg and B. MacLean

Atlantic Geoscience Centre, Geological Survey of Canada, Bedford Institute of Oceanography, Dartmouth, N.S. B2Y 4A2

Quaternary sediments of the southeastern Baffin Island continental shelf have been mapped using a combination of geophysical profiling systems (655 cm³ single channel

and Huntec high resolution seismics, echosounder, sidescan sonar) and samples obtained by Van Veen and Norwegian clam shell grabs, piston and gravity cores.

Four main units have been delineated and informally named:

1) Baffin Shelf Drift: poorly sorted unstratified sediments up to 130m thickness interpreted to have been deposited directly under grounded ice during the Pleistocene;

2) Cumberland Silt: moderately to poorly sorted sediments up to 30m in thickness interpreted to have been variably deposited in ice proximal and ice distal environments during the Mid to Late Wisconsin. On acoustic profiles these sediments vary from well stratified to unstratified. The lack of stratification is due to extensive disruption by grounding icebergs;

3) Kaxodluin Silts and Clays: moderately sorted sediments in Frobisher Bay and Cumberland Sound up to 30m in thickness, stratified on acoustic profiles, deposited

during the Late Wisconsin-Holocene;

4) Lady Franklin Sand and Gravel: moderately sorted, acoustically unstratified, coarse sediments that form a thin veneer over bedrock or locally over till, interpreted to represent erosional lag deposits.

The presence of morainal and multiple till deposits indicate that grounded glacial ice extended onto the continental shelf during one or more intervals during the Pleistocene. Repeated advances and retreats occurred in some localities. Northeast of Resolution Island the till laterally interfingers with the Cumberland Silt indicating, in part contemporaneous deposition. The present seabed sediment surface reflects modification due to current winnowing and scouring by grounded icebergs.

A petrochemical study of the Carboniferous volcanic rocks in the Chance and Dipper Harbour area, southern New Brunswick

*H.C. Teng, Department of Geology,
St. Francis Xavier University, Antigonish, N.S. B0H 1C0*

In Chance and Dipper Harbour area, the Carboniferous volcanic rocks consist of the Namurian-aged Meadow Cove Volcanics and the Westphalian A-aged Retreat Lake Volcanics. The volcanic rocks are dominantly felsic and consist of basal laharc mudflows and/or lithic tuffs, succeeded by a thick sequence of ash-flow and crystal tuffs with minor interlayered basalt flows and sediments.

The mafic volcanic rocks are basaltic in composition and characterized by low SiO_2 and Al_2O_3 . AFM diagram shows that the basalts are tholeiites. The ash-flow tuffs are generally rhyolitic in composition and characterized by high SiO_2 , molecular $\text{K}_2\text{O} + \text{Na}_2\text{O}/\text{Al}_2\text{O}_3 < 1$, variable $\text{K}_2\text{O}/\text{Na}_2\text{O}$ (due to alteration) and very low CaO , MgO and Fe_2O_3 .

Geochemical studies on the distribution of Zr, Ti, Y, Sr and SiO_2 show that the volcanic rocks are bimodal and the mafic rocks are continental tholeiites occurring in a "within-plate" extensional, possible rifting tectonic regime. The $\text{Fe}_2\text{O}_3/\text{MgO}$ ratio and the REE abundances are consistent with this setting and that Meadow Cove Volcanics are more differentiated

than the Retreat Lake Volcanics.

The felsic and mafic volcanic rocks are contemporaneous. The felsic volcanic rocks are probably derived from partial melt of the crust and mafic volcanic rocks are derived from the mantle and the petrogenesis may be explained by the thermogravitational convection diffusion model. They were extruded to its present level probably through an extension tectonic regime. Field relationships, thin-sections and geochemical studies on the Chance Harbour granite suggest a genetic relationship to the ash-flow tuffs.

The juxtaposition of orogenic and non-orogenic suites of the Carboniferous volcanic rocks in the study and adjacent Saint John area to the east may be explained by the tectonics provided by the "megashield environment" model. In view of the recent discovery of precious metals in southern New Brunswick in rocks of a similar magma-type and tectonic environment the study will have important implications for the genesis of mineral deposits and is therefore of great interest, for mineral exploration.

Depositional environment of the Westphalian B Cumberland Basin coals of Springhill, Nova Scotia

J.H. Calder

Nova Scotia Department of Mines and Energy, Halifax, N.S. B3J 2T3

The Westphalian B coals of Springhill are part of a sequence of non-marine, largely fluvial sediments reaching a maximum thickness of 1100 m which comprises the lower fine facies of the Cumberland Group. A depositional model first proposed in 1980 has been significantly refined and expanded. Elongate coal swamps with an approximate width of 5 km flourished between a controlling trunk fluvial system and alluvial fans of the lower coarse Cumberland facies. The mature fans over which the coal measures progressively onlap contributed rogue ephemeral streams which invaded the southern margin of the coal swamps. Megascopic and microscopic coal petrography indicate a forest swamp environment. Regional three-dimensional geometry of the controlling fluvial system is known through extensive diamond-drilling while much insight into the specific fluvial subenvironment has been gained through

exposures within the Novaco open-pit mine on the Rodney seam. A modified meandering system is envisaged with extensive channeling by chutes of point bars, transitional to complete excision of bars resulting in a bradied configuration within a meandering bed.

Incorporation of this model into tentative basin fill patterns suggests early dominantly transverse flow with fluvial deposition from a semi-mature alluvial plain and the presence of a subordinate lacustrine-megaflood basin near the present axis of the Cumberland coal basin. Subsequent deposition and basin infilling gave rise to dominantly longitudinal fluvial systems paralleling mature fans bordering the Cobequid highlands. Bivalve-associated coals of the Joggins-Chignecto, Saltsprings, and Roslin coal districts may correspond to the transverse flow model.

The Wisconsinan Glaciation, of the southeast Canadian Continental Shelf

G.B. Fader, Atlantic Geoscience Centre,

Geological Survey of Canada, Bedford Institute of Oceanography, Dartmouth, N.S.

A major ice sheet advanced across the Maritime Provinces, the Gulf of Maine, the Scotian Shelf and the Grand Banks of Newfoundland (with the exception of the Tail of the Banks) during Early-Middle Wisconsinan time approximately 65,000 years ago. Surficial sediments previously deposited on the continental shelf were eroded during this advance and were reworked and incorporated into the glacial debris of the ice sheet. At 46,000 years B.P. (radiocarbon years before present) the ice sheet began to lift off the ground surface in the region of the deep basinal depression of the central shelf area. A succession of parallel discrete narrow ridges of till, herein termed lift-off moraines were deposited during the initial stages of ice flotation. During the subsequent 12,000 years the ice remained locked in position by the topography of the bedrock surface and grounded on the outer

banks and inner shelf area but was floating, in a manner similar to present day ice shelves, over the basinal areas and troughs.

Sequences of rhythmically banded subglacial sediments up to 80 m in thickness were deposited over the basal till beneath the floating ice. At the grounding line of the ice shelves which encircled the basinal and trough areas, wedge shaped deposits of till, herein termed till tongues, were developed. These deposits of till were interbedded with the subglacial sediments at the same seismostratigraphic horizons on the flanks of the basins across distances of over a hundred kilometres. Local changes in ice thickness, coupled with relative changes in sea level brought about by isostatic and eustatic fluctuations, produced complex sequences of till and glaciomarine sediment. These sediment sequences were formed as a result of vertical changes ac-

accompanied by little or no horizontal movement within the ice shelves.

By approximately 30,000 years B.P. the ice shelves had degenerated by melting and proglacial marine sediments were deposited across vast areas of the shelf. The previously deposited till was heavily furrowed by floating icebergs in shallow areas. This environmental setting prevailed on the Scotian Shelf and Grand Banks until 16,000 years B.P. (23,000 years B.P. in the Laurentian Channel) at which point in time the ice had completely receded from the entire shelf area.

Sea level lowering to -110 m below present sea level and subsequent marine transgression during Late Wisconsinan and Holocene time have modified the glacial sediments within the zone of transgression. The present distribution pattern of well sorted sands and rounded gravels reflects this sorting. In the deeper basins and troughs of the shelf the glacial sediments were partially covered by post glacial silty clay eroded from the transgressed bank and shallow areas.

***Surficial hydrogeological investigations involving solid waste landfilling:
A case study***

Ole P. Lund

Porter & Associates, Engineers, Halifax, N.S.

Over the past two decades, landfilling has become a popular means of disposing domestic solid wastes. Factors that must be considered in evaluating potential solid waste disposal sites include: (1) available land area, (2) impact of processing and resource recovery, (3) haul distance, (4) soil conditions and topography, (5) climatological conditions, (6) surface water hydrology, (7) geologic and hydrogeologic conditions, and (9) potential ultimate uses for the completed site. Final selection of a disposal site usually is based on the results of a preliminary site survey, results of engineering design and cost studies and an environmental impact assessment.

Aside from the socio-economic factors in site selection, the geologic and hydrogeologic

settings ultimately determine the location. The surficial geologic material must be workable and of the type not to result in the contamination of surface and groundwaters from placement of a landfill.

Thickness, lateral extent, topography, slope permeability, density, water table levels, underlying geologic material, direction and rates of movement of the shallow groundwater flow system are important considerations.

To illustrate the importance of surficial geologic investigations, a solid waste disposal case study will be used. Methodology and findings will be described. These will be related to the overall design of a landfill at this particular site.

***Composition and depositional environment of the Albert Formation oil shales,
New Brunswick***

W.D. Smith, Department of Geology,

Dalhousie University, Halifax, N.S. B3H 3J5

The predominantly lacustrine Albert Formation (late Devonian to ?early Viséan in age) consists mainly of grey sandstones and shales and contains oil, gas, albertite, oil shale, and salt. Our present level of understanding of the Albert oil shales has been attained largely from boreholes. Conventional core-logging techniques recognize oil shale units on a scale of metres. Bulk samples are taken at regular 1.0 - 1.5 m

intervals and analyzed for their mineralogy and oil yield. This approach does not consider the variability of the oil shales (commonly on the order of 5-10 cm).

Detailed logging of three cores (Petro-Canada Dover No. 1 and 2, Can. Oxy. Albert Mines No. 5) and preliminary XRD and maceral analyses of core samples indicate four types of oil shale; with increasing amounts of organic matter:

Oil Shale D (marginal to very low grade)

Feldspar-rich rocks with lesser amounts of quartz, clays and analcite. Dolomite is usually absent or less than 5% of the mineral matter. Exinitic organic matter forms a small proportion and consists mainly of liptodetrinite with sporinite and some thin, discontinuous bands of lamalginite.

Oil Shale C (Low grade)

Feldspar-rich rocks, with quartz and clays; analcite is absent and dolomite forms 5-15% of the mineral matter. Exinitic matter consists largely of liptodetrinite with lamalginite, telalginite, and sporinite. Distinct organic-rich laminae are developed as lamalginite content increases.

Oil Shale B (Medium grade)

Clay-rich rocks (clay percent equal to or greater than feldspar), with quartz, and about 10% dolomite. Exinitic organic matter consists largely of lamalginite with

telalginite and sporinite. Lamalginite forms thick accumulations of thin, fine bands such that distinct organic-rich and inorganic-rich laminae are present. Fusinite occurs locally.

Oil Shale A (high grade)

Dolomite-rich rocks, with minor clays, feldspar and quartz. Organic content is high with lamalginite forming thick accumulations of fine bands and giving organic-rich laminae which alternate with inorganic-rich laminae on a fine scale. Telalginite, sporinite and minor liptodetrinite and fusinite are also present.

The transition from oil shale D to oil shale A is inferred to reflect nearshore to offshore deposition in a lacustrine environment. In nearshore settings, clastic sediment with detrital organic matter (liptodetrinite) predominates, while further offshore, carbonate production and algal growth (lamalginite) are important.

***Meandering river deposition in the Morien Group at Alder Point,
Sydney Basin***

*M.R. Gibling, Department of Geology,
Dalhousie University, Halifax, N.S. B3H 3J5*

The Morien Group at Alder Point (Westphalian D to Stephanian) comprises nearly 60% sandstone and siltstone, 38% mudstone and 2% coal. The strata are interpreted as meandering river deposits, and show three distinct associations which represent geomorphic regions of the alluvial plain:

1. (25% of strata): **Trough cross-bedded sandstone**, medium grained, in units 3-5 m thick and up to 18 m thick where multistoreyed. The units are laterally continuous, fine up locally to rippled fine-grained sandstone, and show large-scale epsilon cross-stratification. The association is interpreted as channel and point bar deposits.

2. (25% of strata): **Coarsening-up sandstone**, mainly fine-grained, in units averaging 2.7 m. Features include ripple cross-lamination, lenticular bedding and small-scale channels, and *in situ* tree trunks and roots. Some units show carbonate lenses, bivalves and abundant leaves in the lower parts. The association is interpreted as levee complexes and fluvio-lacustrine sequences.

3. (50% of strata): **Green and red mudstone**,

with interbedded fine-grained sandstone, coal and limestone. Sandstones are rippled and lineated, and desiccation cracks, roots and a few tree trunks are present. The association is interpreted as floodbasin deposits.

Paleocurrent data indicate northeastward transport for the channel sandstones, with high variability reflecting the high sinuosity system. Paleoflow for the levee sandstones was at right angles to this trend, suggesting that floodwater funnelled through small channels into the floodbasin. Floodbasin sandstones show northwestward paleoflow, suggesting that flow in the floodbasin was down the paleoslope.

Several lines of evidence, including the distribution of coals, limestones and carbonate nodules in the red and green mudstones, indicate that the colour of the mudstones was a primary or early diagenetic feature. Peat swamps grew on floodbasin, and terminated by flooding, the advance of levees, or the avulsion of major channels across the swamps.

Digital mapping in the geosciences*J. J. Chandra and R. Mullin***Mineral Resources Division, Department of Natural Resources, Fredericton, N.B.***Universal Systems Ltd., Fredericton, N.B.*

At present, most geoscientific data is produced in map form at various scales and cartographic projections. Because of this, earth scientists find it very difficult to store, retrieve, update and manipulate such information. Analyzing such information takes considerable effort and invariably some data is either misinterpreted or generally neglected altogether. The end result is that explorationists do not have a complete data base with which to work.

With the advent of computer technology, more and more earth scientists have turned to this media to store, retrieve and display their information. Geophysicists and geochemists who deal with numerical data were the first to take advantage of the new technology. Geologists, until recently, tended not to make use of computers for mapping purposes because most geologic data could not be adequately stored in a manner that is readily accessible.

The development of digital mapping systems have now made it more practical for geologists to take advantage of computer technology. Digital mapping systems have been available in Canada for some time.

Two of these systems are the Canadian Geographic Information System and the Canadian Hydrographic Service. Such systems led to the creation of digitally stored topographic maps. Several such maps have been created for New Brunswick and are available from the National Digital Topographic Data Base at Surveys and Mapping, E.M.R.

The Computer Aided Resource Information System (C.A.R.I.S.), a digital mapping system, has been adopted by the Land Registration and Information Services (L.R.I.S.) to produce digitally all topographic base maps for the Maritimes. Availability of such maps is the first step in making digital mapping of geoscientific data practical. The Mineral Resources Division of the New Brunswick Department of Natural Resources has just completed a feasibility project of using C.A.R.I.S. to store, retrieve, manipulate and display geoscientific data. The project was successful and the Mineral Resources Division is proposing to implement the system to handle all provincial geoscientific data.

Development of an electric rock core drill for deep ocean use - present status and future possibilities*P. J. C. Ryall, Department of Geology,
Dalhousie University, Halifax, N.S. B3H 3J5*

Over the past five years, the Bedford Institute Rock Core Drill has been developed from a continental-shelf tool into a tool capable of operating on mid-ocean ridges in depths to 3500m. In that period, the drill has seen trials/use off the Azores, twice on the Mid-Atlantic Ridge, off Bermuda and most recently on the Juan de Fuca Ridge. Cores recovered on these cruises have:

- (1) Shown the subsidence history of a guyot west of Flores, Azores,
- (2) Shown a complicated pattern of mag-

netization in the basalts of the upper few metres of ocean crust,

- (3) Been analyzed to work out the differentiation of lavas with time on a large submarine volcano, and

- (4) Provided fresh insight into the fragile and cavernous structure of very young (<10,000 years) crust on the Juan de Fuca Ridge.

After further trials to refine the drill-mounted T.V. off Bermuda, it will be used again on the Juan de Fuca Ridge in an attempt to drill cores of polymetallic sulphide.

Transgressive seismic stratigraphy of the Eastern Shore, Nova Scotia

R.K. Hall and R. Boyd

Centre for Marine Geology, Dalhousie University, Halifax, N.S. B3H 3J5

The geomorphology of acoustic basement and the seismic stratigraphy of overlying sediments have been used to determine glacial history and to investigate transgressive sedimentation along an estuarine barrier coastline composed of glacial sediments. This study is based on 400 line kilometers of high resolution seismic data, (uniboom subbottom profiler, side-scan sonar, 3.5 kHz bottom profiler and fathometer), from the Eastern Shore of Nova Scotia, between Hartlen Point and Jeddore Cape.

Where acoustic basement is overlain by sediment, its seismic signature has smooth to rounded features. Where it outcrops, the signature of the acoustic basement is more angular. This variation in the seismic signature is caused by attenuation and/or a gravel lag overlying the outcrop. The overlying sediments have been divided into lower, middle and upper stratigraphic-acoustic units. The lower unit directly overlies the acoustic basement and has a thickness of several meters. In the nearshore area, this lower unit shows a strong internal reflector which is not present offshore. The

top reflector of the lower unit can vary from fairly flat where it outcrops to a hummocky surface where it is overlain by the middle unit. This middle unit has an average thickness of a few meters and shows some internal reflectance where it is draped over irregular surfaces. This unit is acoustically transparent where it becomes a channel fill. Where the upper unit occurs offshore it is seen as a thin layer in-filling basins and channels. Close to shore the upper unit occurs in two distinct layers with a prominent horizontal reflector underlying a low angle wedge-shaped sediment body that thickens toward shore.

The stratigraphy of the study area is similar to the onshore Quaternary sequence found on the Eastern Shore. The acoustic basement is composed of Cambro-Ordovician metasediments of the Meguma Group. The lower and middle stratigraphic-acoustic units appear to represent glacial sediments deposited during the Wisconsinan ice advance. The upper sediment unit is composed of reworked sands and gravels resulting from sea level transgressing over the glacial deposits.

Upper Carboniferous strata of the east half of the Tatamagouche syncline, Cumberland Basin, Nova Scotia

*Contract 19SR, 23233-3-0393 and R.J. Ryan**

Contribution to Canada-Nova Scotia Co-operative Mineral Program 1981-84,

**Department of Geology, University of New Brunswick, Fredericton, N.B. E3B 5A3*

Present address: Department of Geology, Saint Mary's University, Halifax, N.S.

The Upper Carboniferous strata of the eastern Tatamagouche Syncline area consist of fining upward cycles of conglomerates to mudstones. The strata can be divided into seven map units, in ascending order: Millville Formation, Boss Point Formation, Cumberland Group, Pictou Group grey beds, Pictou Group lower red beds, Pictou Group middle redbeds, and the Pictou Group upper redbeds. Regularly interbedded lacustrine limestone marker beds facilitate definition and correlation

of the upper units.

Alluvial fans developed in the south from pre-Carboniferous rocks in the present day Cobequid Highlands. Towards the north, sand and mud were deposited along low sinuosity, anastomosing rivers. Strongly unimodal paleocurrent measurements indicate flow to the north-northwest.

Copper, uranium and recently discovered lead occurrences are associated almost exclusively with carbon-rich channel lag conglomerate and sandstone.

Precambrian rocks in the Trousers Lake area, Miramichi Highlands

*L.R. Fyffe, Mineral Resources Branch,
Department of Natural Resouces, Fredericton, N.B. E3B 5H1*

The presence of Precambrian rocks in the Miramichi Highlands of New Brunswick has long been an issue of debate. In the late 1800's, Ells considered deformed and metamorphic volcanic and sedimentary rocks extending along the upper part of the Nepisiguit River southeastward to the Little Southwest Miramichi River to be Precambrian because of their similarity to some of the Hadrynian volcanics in southern New Brunswick. He also included massive volcanics on the Nepisiguit Lakes within this group.

Shortly thereafter, Bailey mapped metamorphic rocks and massive volcanics in the Trousers Lake area as a southwestward extension of Ells' Precambrian. Late in the early 1900's, Bailey demonstrated that the massive volcanics mapped by Ells dipped rather gently and were, therefore, probably Silurian. (They are now known to be Early Devonian). However, he did not preclude the existence of Precambrian rocks in the area.

Mapping in the 1930's led Alcock to favour a mid-Ordovician age for much of the deformed volcanic complex along the Nepisiguit River, but at the same time, Shaw thought some of the metamorphic rocks in the Little Southwest Miramichi area to be as old as Cambrian. Recently, O'Brien and Rast have proposed that high grade metamorphic rocks of the central Miramichi Highlands are probably Precambrian.

Rocks exposed on the southeastern end of Trousers Lake are an interlayered sequence of dark green amphibolite, pink granitic gneiss and grey psammite. They are intruded by an elongated, concordant body of foliated granite containing rounded alkali feldspar megacrysts with rapakivi mantling. A Devonian granite pluton separates these Precambrian rocks from greenschist grade Cambrian quartzite and phyllite to the north of the lake.

Cone-in-cone investigations

*E. Spatz DiVeto
Department of Geology, University of New Brunswick
Fredericton, N.B. E3B 5A3*

Cone-in-cone structures in the Lower Ordovician, Halifax Formation of southern Nova Scotia are the subject of this study. These structures occur in discoid to ovoid shaped lenses up to 6m in diameter and 15 cm in thickness, although the average ones found measure about 50cm by 5cm. The lenses are made up of stacks of cones radiating outward from a massive core. The underside of each lenticular unit has a characteristic collar that parallels the outer edge and can be used as a right-way-up criterion. The individual stacks display an increase in cone diameter from a few millimeters at the base to 10mm diameter at the outer boundary. The outer surface of each stack of cones displays a series of concentric ridges representing the surface intersections of the cones below.

The cone-in-cone lenses are not randomly distributed through the slates but ap-

pear confined to specific horizons. They show a consistent diminution in size from west to east; the significance of which is not yet known.

The cone-in-cone structures in the Halifax slates are not calcareous. Mass spectrographic analysis has so far failed to detect any carbon.

Cone-in-cone structures have previously been attributed to either brittle failure, Hills, E.S. (1972) or to stresses set up in the rocks as a result of volume expansion following recrystallization of carbonate minerals, Bonte, Maillot (1984). Morphological differences between cone-in-cone structures described in the literature and those presented here will be discussed. The origin of the cone-in-cone structures in the Halifax slates is not yet fully known.

A.G.S. geological highway map of New Brunswick

*L. Ferguson, Chairman, A.G.S. Map Committee
Mount Allison University, Sackville, N.B.*

A Geological Highway Map of New Brunswick is currently being prepared. The intention is to have the map published in time for the Geological Association of Canada and Mineralogical Association of Canada's 1985 Annual Meeting which will be held in Fredericton, N.B. just as the Society's Geological Highway Map of Nova Scotia was ready for the 1980 Halifax meetings of GAC/MAC.

The map will be of a similar style to the one of Nova Scotia in that, as far as possible the colour scheme will be compatible, the scales will be almost identical (622,000:1 as opposed to 63,360:1) and the general format will be similar. However, since New Brunswick is a bilingual province there will be two versions of N.B. map - an English version and a French version (rather than one bilingual map).

A "Mock Up" of the proposed map is on display at the Colloquium along with some details of the initial specifications and a list of sites of general interest which may be utilized for the illustrative material which will be in the various panels on the back of the map.

It is hoped that members of the society will take the opportunity of offering suggestions regarding sites which should (in their opinion) be featured on the map.

It is also hoped that those who are familiar with such sites will be moved to offer to prepare material suitable for inclusion in such panels. This material will have to be compiled over the summer of 1984 so that final preparation of the material can be accomplished by Maritime Resource Management Services in Amherst, N.S. in time for the GAC/MAC Meetings.

The other side of computing

*Aubrey Fricker
Atlantic Geoscience Centre, Dartmouth, N.S. B2Y 4A2*

Biostratigraphic databases developed at AGC vividly illustrate that not all scientific computing is number-crunching. The modelling heyday of the late 60s and early 70s is being replaced by a return to more systematic and observational use of data. Analyses at the microscope are checked and included in the database in about 1 week. Statistical and regional comparisons can be made, using all the data from 13 years' work. The total compilation effort to produce a variety of range-plots for a modern exploratory well has been reduced

from man-years to man-days. The scientist has the combination of a filing-cabinet, a typist, a calculator and a draftsman at his fingertips. The work in hand is stratigraphic regional correlation and expansion of the Quaternary biostratigraphic use. Future plans include greater graphic capability such as fence diagrams and isopach of the Quaternary biostratigraphic use. Future plans include greater graphic capability such as fence diagrams and isopach maps at short notice.

Mineral resources information data bases in the Nova Scotia Department of Mines and Energy

*N.A. Lytle, Mineral Development Division,
Nova Scotia Department of Mines and Energy, Halifax, N.S. B3J 2T3*

The Mineral Inventory group of the Nova Scotia Department of Mines and Energy maintains several computerized and manual mineral resources data bases concerned with aspects of the geoscience of Nova Scotia.

Bibliographic information is maintained through GEOSCAN, the national data base for bibliographic, geological information. At present, the following NSDME records are held in GEOSCAN: 3,000 NSDME assessment

reports; 900 NSDME publications; 510 NSDME open file reports; 290 theses and 280 journal literature references. A variety of NSDME Indexes (Reports 81-4, 81-5, 81-6, 81-7, 82-2, 83-2, 84-2 (in press) and 84-3 (in press) have been published on these GEOSCAN records, and two specialty indexes are presently under preparation, namely: an Index to Information on Gold in Nova Scotia and an Index to Geoscience Maps on Nova Scotia.

The drillhole data base is a computerized information storage, retrieval and map plotting system designed to provide data on the drillholes cited in NSDME Report 81-7 Index to Drillhole and Well Data 1862-1980. Drillhole information can be searched and retrieved on any combination of 28 data

fields, and drillhole location maps can be plotted at various scales. To date, the data base contains records for over 6,000 drillholes, drilled largely for the purpose of on-land mineral exploration.

Information has been compiled on approximately 1,600 metallic and industrial mineral occurrences in Nova Scotia. This information is available in the form of publicly-accessible, manual card files, organized on the basis of the NTS map system. The metallic mineral occurrences have been plotted on eight, 1:250,000 NTS maps with geological bases, covering Nova Scotia, and released as Open File Report 454; the industrial mineral occurrences have also been plotted on eight, 1:250,000 NTS maps and released as Open File Report 431.

***Mineralization associated with St. Anns Mountain Pluton,
Cape Breton Island, Nova Scotia***

A.S. Macdonald and S.M. Barr

Department of Geology, Acadia University, Wolfville, N.S. B0P 1X0

During the summer of 1983, the porphyry-type Cu-Mo occurrence on St. Anns Mountain was mapped and sampled in detail, including drill core previously abandoned on the property. Morphology, distribution, and orientation of veining and alteration with which the mineralization is associated were defined. Mapping and sampling were extended into surrounding rock units as far north as Indand Brook to better define lithologies and superimposed vein and alteration patterns. This mapping also showed that volcanic rocks which host vein-type Cu-Pb-Zn-Ag mineralization at Price Point and Elders

Brook and which were previously interpreted to be Devonian in age are intruded by and hence older than the Lower Cambrian granitoid rocks hosting the porphyry-type mineralization. Mineralized quartz-calcite veins from both the volcanic and the granitoid rocks were found to have essentially the same orientations and hence are now considered, in light of the age relations of their host rocks, to be cogenetic. Follow-up studies in progress include K-Ar dating of micas from mineralized veins, fluid inclusions in vein minerals, ore petrology, and microprobe analyses of alteration minerals.

***Terrestrial glacial and nonglacial events in Atlantic Canada: correspondence
with offshore sediment cycles and with oxygen-isotope temperature variations***

D.R. Grant

Geological Survey of Canada, Ottawa, Ont. K1A 0E8

Lithostratigraphic correlation of sedimentary sequences in several areas reveals a broadly parallel series of four glacial advances of varying provenance and vigour. These are manifest offshore as red/grey alternations on seamounts where a record extends to Stage 13. There the oxygen-isotope variations correlate with deep sea standard which thus provides independent chronometric control.

On land, Nova Scotia is the type area where the Late Quaternary sequence is founded on a littoral marker horizon referred to the earlier sea level maximum of the last interglacial. Associated organic beds at 21 sites relate to two separate warm phases which from amino acid data seem to span the 60,000 year duration of Stage 5. An intervening cool phase when small ice caps reformed is inferred from

regression, weathering, periglacial deposits and locally thin tills. The succeeding Wisconsin Stage is represented by three tills produced by separate glacial advances of declining vigour. The first related to a regional, deeply-erosive, marine-based ice sheet that spread widely a thick red drift. A feature of this phase was the appearance of three satellitic ice domes on the emergent shelf. The ice sheet then shrank from high and distal areas, as marked by weathering contrasts, and reorganized as a complex of upland ice caps which expanded in Middle(?) and Late Wisconsinan time to produce two thinner local drifts. Separate New Brunswick glaciers had a similar three fold sequence. The Newfoundland ice mass behaved comparably except that its Wisconsinan maximum was evidently attained in the last stage. Two much earlier glacials left higher trimlines on coastal highlands. The region was deglaciated by 13 Ka B.P., though remnant ice

caps readvanced as late as 10 Ka B.P.

Offshore, temperature conditions and glacial action is inferred from microfauna and terrigenous input. Thus the Wisconsin pulses are seen as muddy interruptions of foram-nanno accumulation. However, the greatest cooling and deepest glacial erosion in the Late Quaternary was during Stage 6 as marked by a thick red layer derived from inland sources.

All events correspond in position and degree to temperature variations seen in northwestern Atlantic core V30-97 beginning with the strong cooling in Stage 6, two warm events with higher sea level and an intermediate periglacial interval during a lengthy Stage 5, and three glacial-degree coolings during Stages 4, 3 and 2. The correlation supports the hypothesis of a 23,000 year cycle with strong coupling between northwestern Atlantic and eastern North America.

RALPH Observations of shoreface sedimentation processes at Martinique Beach

*Don Forbes, D.E. Heffler and Ron Boyd**

*Atlantic Geoscience Centre, Geological Survey of Canada,
Bedford Institute of Oceanography, Dartmouth, N.S. B2Y 4A2*

**Department of Geology, Dalhousie University, Halifax, N.S. B3H 3J5*

Nova Scotia's Eastern Shore is a moderate to high energy, wave-dominated environment that follows the well-defined cycle of summer sediment accretion and winter erosion.

In order to characterize summer accretion, the RALPH data acquisition system was deployed in 11 metres depth on the shoreface seaward of Martinique Beach, recording wave height, current velocities at 30 cm and 100 cm above the bed, light transmission, and time lapse photography at 30-minute intervals. This deployment was intended to characterize fairweather sediment dispersal in terms of wave climate, near-bottom velocity field, bedforms and their migration patterns.

Low energy background conditions persisted for much of the deployment and were characterized by wave heights of less than 0.5 metres and maximum oscillatory current velocities at 1 metre of 20 cm per second, low suspended sediment concentration and relatively stable bedform patterns. Three moderate energy events

during the deployment were characterized by r.m.s. wave heights up to 1.2 metres and maximum current velocities of 65-80 cm per second. Bursts of suspended sediment accompanied the passage of large wave groups during periods of bedform reorganization. Bed configurations developed in the fine sand at the site included a relatively stable pattern of short-crested long-wave length ripples; a sinuous short-crested pattern; short- and long-wave length bifurcated ripples; and linear long-crested ripples with wave lengths ranging from 6-21 cm. The bedform pattern was observed to migrate primarily in a landward direction and only under the long-crested short-wave length ripple configuration. This behaviour was associated with higher velocities during the moderate energy storm events.

This data set indicates that fairweather beach and near shore bar accretion results from active sediment transport across the shoreface by adjustment of the inner-shelf equilibrium profile.

Sedimentology of Goldenville Formation, Eastern Shore, Nova Scotia

*L.R. Jensen and J.W.F. Waldron
Saint Mary's University, Halifax, N.S. B3H 3C3*

The Goldenville Formation forms the lower part of the Cambro-Ordovician Meguma Group which underlies most of southern mainland Nova Scotia. Stratigraphic sections have been measured along well exposed coastal areas west of Sheet Harbour primarily within the south limb of the Sober Island Syncline, and correlated by means of matching vertical magnetic gradient profiles. This correlation identifies major lateral facies changes occurring over the approximately 15 km eastwest strike length studied. Principally thick (50-100 m) sandstone-dominated units interdigitate with more shaley facies, with some cases showing cross-cutting erosional contacts at their

bases. A preliminary classification of the sediments into eight facies has been adopted based on their grain size, bed thickness and sedimentary structures.

The vertical sequences (showing both thinning and thickening upward trends) and the range of sedimentary facies found can be accommodated best in the midfan area of deposition in a submarine-fan model.

Detailed analysis of the thickness variation and lateral changes of the vertical sequences from section to section is presently underway and should lead to an improved understanding of this depositional system.

The glacial and post glacial history of the Labrador Shelf, Hopedale Saddle

*H.W. Josephans and J. Zevenhuizen
Atlantic Geoscience Centre, Geological Survey of Canada, Dartmouth, N.S. B2Y 4A2*

Hopedale Saddle, situated on the central Labrador Shelf is interpreted as a glacially overdeepened river valley (urstromtal). This northeast-southwest trending saddle has a maximum depth of 800 m at its western end, a width of 100 km, and terminates at the shelf edge, 150 km from the coastline. Seismostratigraphic evidence suggests that large quantities of material have been eroded and transported from the saddle. Interpretation of a regional grid of high resolution seismic reflection data defines the extent of at least three superimposed,

laterally continuous till sheets. Four piston cores from widely separate areas within the saddle ground truth this stratigraphic sequence. These cores define marked differences in textural and geotechnical character between the uppermost till and overlying post glacial marine sediments. Carbon ¹⁴ ages from three of the sites correlate well and suggest an approximate age of 25,000 years B.P. for deposition of the upper till sheet and 22,000 year B.P. for ice lift off and the onset of pro and post glacial marine conditions.

Discussion of models for the formation of Mississippi Valley type deposits as they may apply to the Carboniferous Basins of Nova Scotia

*C. Ravenhurst, Department of Geology,
Dalhousie University, Halifax, N.S. B3H 3J5*

Deposits of the Mississippi Valley Type (MVT) are spatially and genetically associated with carbonate rocks located at the periphery of, and in arches separating, sedimentary basins. In Nova Scotia, the Gays River Pb-Zn deposit has been grouped with the MVT, but together with the Walton barite-polymetallic deposit and a number of smaller prospects and occurrences around the Carboniferous Shubenacadie and Windsor

basins, these deposits show many similarities to the Irish Pb-Zn-Ba deposits, which are excluded from compilations of MVT. Genetic hypotheses ranging from early diagenetic, exhalative syngenetic, through epigenetic related to basinal brine expulsion, to epigenetic related to intrusions, have been proposed in the literature for the Nova Scotia deposits. The proposed age of mineralization for individual members of

the group thus ranges from Viséan to Mesozoic. The purpose of my study is to restrict the possible genetic hypotheses for the Nova Scotia deposits and to formulate a best possible quantitative model using computer modelling.

One of the hypotheses being tested is one recently proposed for Gays River; that the deposit could have been generated by hot connate brines that migrated out of the Windsor and Shubenacadie basins both during initial compaction of the sediments and during dehydration of gypsum to anhydrite. Preliminary calculations suggest that if all the sulphates were originally gypsum, if the brines carried 10 ppm Pb+Zn, and if a large proportion of the fluids were chan-

nelled through the deposit area, the Gays River orebody could have formed by fluids expelled during dehydration of the gypsum in the Shubenacadie basin. Alternatively, fluids could have been generated farther into the Windsor basin, and then migrated a long distance under the evaporite seal.

An assessment of the various genetic hypotheses, by restrictions on the relative and absolute timing of mineralization, and on the source of the metals and the fluids is being sought through isotopic and other methods, including fission track dating of suitable minerals. A fluid-flow model using a two-dimensional finite element method is being constructed.

Plutonism of the Loch Lomond-Irish Cove area, Cape Breton Island, Nova Scotia

*D.W. McMullin, Department of Geology,
Acadia University, Wolfville, N.S. B0P 1X0*

Plutonic rocks in the Loch Lomond-Irish Cove area include the Loch Lomond plutonic complex in the east and the Irish Cove pluton in the west. Field, petrographic, and geochemical data indicate that the Loch Lomond plutonic complex consists of seven different intrusive units which were emplaced during at least two time intervals. The northeastern portion is composed of rhyolite porphyry of Devonian-Carboniferous age (Rb-Sr whole-rock isochron, 365±30Ma) and a small body of monzodiorite which is considered to be of similar age due to its resemblance to the monzodiorite at nearby Gillis Mountain (384±10Ma). The southern portion consists of quartz monzodiorite, granodiorite, mafic granodiorite, leucodiorite, and diorite. The diorite in-

truded the granodiorite and mafic granodiorite and hence is younger, but its absolute age is not known. The other four units are probably Late Hadrynian to Early Cambrian, based on a Rb-Sr whole-rock isochron age of 544±21 Ma for samples from the granodiorite and cross-cutting felsite dykes.

The Irish Cove pluton is, in general, more felsic than the Loch Lomond complex and consists of granodiorite and monzogranite. It becomes gradationally more felsic towards its eastern and northern extremities. There are no age data for the pluton but because of similarities to both the Loch Lomond plutonic complex and the Huntington Mountain pluton to the north, it is also considered to be of Late Hadrynian-Early Cambrian age.

Benthic foraminiferal assemblages on the Continental Margin off Nova Scotia: their response to oceanography

*M.A. Williamson, Atlantic Geoscience Centre,
Geological Survey of Canada, Bedford Institute of Oceanography, Dartmouth, N.S.*

Two hundred and fifty grab samples from the continental margin off Nova Scotia were examined for total (live+dead) foraminiferal content. One hundred and twenty species were recognized, seventy-five of which occur with an abundance greater than 3% in any one sample. Q-

Mode factor analysis of the raw abundance data (total population) determined 8 shelf and 4 slope factor assemblages, accounting for 87.5% and 77% of the original raw data respectively. Comparison of the live data with the factor assemblages enabled the detection of anomalous assem-

blages which are un-representative in respect to present day environments.

In the northeast of the study area (around Misaine, Canso and Banquereau) an exclusively agglutinated assemblage dominated by *Adercotryma glomerata* occupied both banks and basins. In the La-Have and Emerald Basins of the central shelf, a predominantly calcareous assemblage occurs with maximum amounts of *Globobulimina auriculata* and *Nonionellina labradorica*. Transitional between these two shelf assemblages is an agglutinating assemblage dominated by *Saccamina atlantica*. Consistently present along the shelf edge is a *Trifarina angulosa* assemblage. Present in Chedabucto and Gaberous Bays and in a few samples near Sable Island is an agglutinating *Eggerella advena* assemblage. A relict and in some areas a transport affected assemblage is recognized in the southwestern approaches to Emerald Basin on the Scotian Gulf; this is dominated by *Elphidium excavatum*. Occupying the hard, rough bedrock, and sandy/gravelly areas of the inner shelf and outer bank regions is a *Cibicides lobatulus* assemblage.

Four assemblages lie seaward of the shelf break. An upper slope assemblage is dominated by *Bulimina exilis*, with a local variation dominated by *Trifarina occidentalis*. A low slope assemblage is dominated by *Uvigerina peregrina*. Also present in

slope regions is another *Elphidium excavatum* assemblage which is thought to be the down slope equivalent of the shelf assemblage.

The statistical relationship of these defined assemblages to various aspects of the marine environment (depth, temperature, salinity, percent gravel, sand and mud) were investigated through multiple regression techniques. This indicates that the present foraminiferal distribution patterns off Nova Scotia are mainly a response to the prevailing hydrography. The *Adercotryma glomerata* assemblage is influenced by the presence of cold, less than normal salinity waters of arctic, Labrador current origin. The central basin assemblage (*G. auriculata*) is related to warmer more saline waters of slope origin. The transition between these two bottom waters is marked by the *Saccamina atlantica* assemblage. Preferred substrate character possibly determines the occurrence of *Cibicides lobatulus*, *Islandiella islandica* and *Eggerella advena* assemblages.

Although the surficial sediments on the Nova Scotian Shelf are largely the product of reworking of glacial deposits during late glacial and Holocene times, all foraminiferal assemblages, with the exception of the *E. excavatum* f. *clavata* assemblage appear to be in equilibrium with modern oceanographic regimes.

The deglaciation of Atlantic Canada and the postglacial relative sea level record

*G. Quinlan, Department of Earth Sciences,
Memorial University of Newfoundland, St. John's, Nfld. A1C 3X7*

The mass of late Wisconsinan age ice sheets deformed the surface of the earth isostatically. At the same time this ice mass distorted the geoid and hence the surface of the glacial stage oceans. The volume of these oceans was of course reduced because much of the water that would normally be resident in the oceans was tied up in the continental ice sheets. The unloading of the oceans by removal of this water volume deformed the ocean floor isostatically. All of these effects were reversed following deglaciation. Relative sea level indicators provide the most direct observational record of the progress of

these interactions.

A numerical model incorporating all of the above effects has been constructed and used to analyse the relative sea level record of Atlantic Canada. The model can be used to calculate the relative sea level record that would result from the melting of any arbitrary ice distribution according to any arbitrary timetable. The extent to which the calculated and observed relative sea level records agree is one measure of the validity of the ice reconstruction. The model for Atlantic Canada and its implications for the regional glacial history will be discussed.

***Stratigraphy, deformation and metamorphism of the Meguma Group,
southwest Nova Scotia***

R.P. Raeside, H.D. Rogers and C.E. White

Department of Geology, Acadia University, Wolfville, N.S. B0P 1X0

The Meguma Group of Shelburne and southern Yarmouth counties has been subdivided into three major units. The oldest appears to be the Goldenville Formation, a sequence of moderately aluminous psammites and semipelites. Overlying the Goldenville Formation is a muscovite-rich phyllite or schist which has locally developed coarse-grained metamorphic minerals. A biotite-rich pelite occupies an uncertain stratigraphic position, probably above, but possibly below, these units.

The area has undergone two phases of deformation. The first phase, D₁, involved large scale repeated near-isoclinal folding and is responsible for the map pattern of repeated psammitic and pelitic units. The foliation is oriented north to northeast and

is parallel to that of the foliated Bald Mountain, Shelburne and Barrington Passage plutons. The margins of these plutons are not affected by the folding, indicating that intrusion occurred late in the first deformation phase. D₂ involved the development of a crenulation cleavage in more mica-ceous lithologies.

Metamorphic grade rapidly increases from chlorite grade in the west and biotite grade in the north, through a broad zone of andalusite + staurolite assemblages, into an andalusite + biotite + garnet zone. The Barrington Passage pluton is intruded into a 20 km wide zone of sillimanite-bearing psammites and migmatized semipelites and pelites. The migmatization was produced by a combination of anatexis and igneous injection.

***Acoustic-stratigraphy of quaternary slope and rise sediments,
Labrador Sea***

Robert Myers

Dalhousie University, Halifax, N.S. B3H 3J5

Multichannel and single-channel seismic data sets, including industry and research institute lines, are being examined to determine the thickness of glacial-age sediments and to characterize the style of deep-water Quaternary sedimentation in the Labrador Sea. Two prominent reflectors, termed the upper and lower reflectors, and several "acoustic facies" are recognized on the type section BGR-77-21, a SW (Labrador Shelf) - NE (Greenland Shelf) seismic line which crosses the Labrador Sea at Latitudes 58°N to 61°N. The lower reflector can be traced regionally in water depths greater than 2500 m. A preliminary pick of this reflector as marking the onset of glaciation suggests a Plio-Pleistocene deep-water section varying in thickness from 200 m to 1000 m. Regional correlation of the upper reflector is difficult due to its truncation by erosional features associated with the mid-ocean canyon system.

Four acoustic-facies are recognized by

variation in reflector type, quality and geometry:

1. Continuous flat-lying reflectors (probably representing interbedded ice rafted and pelagic sediment with distal spill-over deposits from density flows);

2. Wavy, discontinuous and overlapping reflectors (common found on the upper rise off Labrador and probably associated with deposition and reworking of sediment by the Western Boundary Undercurrent);

3. Irregular and incoherent reflectors with associated hyperbolics (several possible origins, including burial of large sediment waves, paleo-erosional surfaces, and discontinuous sand bodies which may be channel-fills); and

4. Erosional cuts and associated wedge shaped reflector packets (present day mid-ocean canyon system and older equivalents possibly extending to the base of the Pleistocene). Mapping of these acoustic facies is in progress.

Sand or gravel waves and mass failures generated by the 1929 Grand Banks earthquakes: a SeaMARC I survey

D. J. W. Piper, A. Shor and J. Farre*

**Atlantic Geoscience Centre, Geological Survey of Canada, Dartmouth, N.S. B2Y 4A2
Lamont-Doherty Geological Observatory of Columbia University, Palisades, N.Y. 10964*

A SeaMARC I side-scan sonar₂ survey, covering 90% of the upper 5000 km² of the Laurentian Fan (CSS HUDSON, June 1983), shows dramatic evidence of the 1929 Grand Banks Earthquake. The survey includes ten swaths, from the slope break to a water depth of 3000 m, across the Eastern Valley of the Laurentian Fan. The valley floor in water depths of 400 to 2000 m is a chaotic deposit of coalesced sediment slides. Individual slide scars at the slope break are 5 to 10 m deep and several hundred metres across. East of the valley, slides and debris flows in surficial sediments are widespread down to water depths of at least 3000 m. West of the valley, an erosional ridge-valley terrain (300-400m relief) shows little evidence of catastrophic mass wasting.

A field of asymmetric sand or gravel waves in the axis of the Eastern Valley broadens from the first wave appearance

near 1500m water depth to more than 10 km wide at 3000m. These sand/gravel waves are clearest on the deepest lines. Although variable, bedform wavelengths are typically 50-100m and heights are 2-5m. The crest line continuity is variable, and the steep (lee) slopes face down-valley. Sand and gravel were recovered in the region of the sand/gravel wave field in 1953 (VEMA 2-2). Within the wave field are "streaks" with low acoustic reflectivity that are 100-500m wide and up to 25 km long and parallel the valley trend. The streaks lack relief and may overlie the sand/gravel waves. We believe that most of the surface features of the valley floor and eastern valley wall originate from the 1929 earthquake, with sand/gravel waves formed by turbidity current flow. We are unaware of analogous bed forms elsewhere in the deep sea.

Quaternary mapping and stratigraphic studies in northern mainland Nova Scotia

R. R. Stea

Nova Scotia Department of Mines and Energy, Halifax, N.S. B3J 2X1

In the Carboniferous-Triassic lowland terrane of Nova Scotia south of the Minas Basin, two and sometimes three tills are found in superposition. The basal till unit (East Milford Till) is generally 2 to 10 m in thickness and contains basaltic and granitic erratics derived from the North Mountain and Cobequid Highlands to the north and northwest. Striated rock underneath this till records a southeastward flow and the till fabric is aligned with the striation trend. Overlying the East Milford Till are the Hants, Bennett Bay and Rawdon Tills. The Hants Till has an upper and lower unit; unit I has a high percentage of basaltic erratics succeeded by unit II in which local clasts and granitic and granodioritic erratics transported from the south become abundant. These data suggest that the Hants Till was formed during a period of changing ice divides from

ice flowing directly south, to ice flowing north and northeast from mainland Nova Scotia. The Bennett Bay Till was formed by the northward ice flow across the North Mountain cuesta into the Bay of Fundy. It is correlative with unit II of the Hants Till. Westward trending striations, fluting, and eskers attest to a late westward flow of ice into the Minas Basin from a centre east of Truro. The Rawdon Till was formed during this flow and it overlies the Hants Till along the Minas Basin.

The Cobequid Highlands are mantled by thin, autochthonous tills. In the western part bedrock is generally weathered, showing few signs of glacier erosion. The eastern half, however, is extensively scoured. Two predominant directions of flow have been mapped, southward and north-northeastward. The northeastward flow has been

traced from the lowlands south of the Highlands onto the lowlands north of the Cobequids.

The reference section for the northern lowlands is a 25m bluff near Joggins. Three till units are exposed; the lowest till (McCarron Brook Till) is characterized by reddish hues, New Brunswick-derived clasts and an east-southeast striking fabric, which is concordant to underlying bedrock striations. The immediately overlying Joggins Till has a greyish cast, and is dominated by local lithologies, including coal and limestone whose sources are to the north and northeast. The Joggins Till exhibits a strong southwest-striking fabric aligned with the main southwest striation trend in this area. The Shulie Lake Till, at the

top of the sequence, is yellowish in colour and has a high percentage of local grey sandstone clasts. The Shulie Lake Till has been traced to its apparent limit south of the Cobequid Highlands.

The east-southeast ice movement that formed the East Milford and McCarron Brook Tills affected all of northern mainland Nova Scotia. This ice flow has not been dated directly, but tills formed during this event overlie nonglacial beds dated at >50,000 years B.P. The subsequent till-forming events are believed to encompass Middle to Late Wisconsinan time. Marine deposits, that overlie the Bennett Bay and Shulie Lake Tills relate to an extensive phase of marine submergence dated elsewhere at 14,000 years B.P.

Thermal history of the southwestern Meguma Zone, and Hercynian mineralization: an Argon Age Study

*P.H. Reynolds, M. Zentilli, P.N. Elias and G.K. Muecke
Department of Geology, Dalhousie University, Halifax, N.S. B3H 3J5*

Mafic intrusions at Forbes Point and at the Birchtown quarry yield hornblende ^{40}Ar - ^{39}Ar ages of around 400 Ma, a value which is not significantly different from the time of regional metamorphism, as suggested by our previous study of low-grade slates from the Halifax Formation to the northeast. However, biotites from these same two rocks and also from surrounding schists all appear to be only about 350 Ma old. Intrusion of these mafic bodies essentially contemporaneously with regional metamorphism was perhaps an early precursor to the major event responsible for the intrusion of the South Mountain Batholith about 30 Ma later. The difference in apparent age between hornblendes and biotites most likely reflects the time it took the

region to cool from the hornblende closure temperature (about 500°C) to the biotite value (about 300°C).

Late Carboniferous plutonic and hydrothermal activity is documented by ^{40}Ar - ^{39}Ar and K-Ar ages on several stocks from the southern coastal region and especially by the 295 ± 3 Ma age obtained for muscovites from the greisese which are associated with the tin mineralization at East Kemptville. This age coincides with a time of intense hydrothermal activity in the Carboniferous basins of Nova Scotia, and is consistent with the age of tin mineralization in Cornwall, England and Panasqueira, Portugal, thus emphasizing the importance and extent of the Hercynian metallogenic epoch throughout the orogen.

Relative sea level changes in Atlantic Canada - observed vs. theoretical

*D.B. Scott and F.S. Medioli
Department of Geology, Dalhousie University, Halifax, N.S. B3H 3J5*

To date we have obtained relative sea level curves from 14 locations in eastern Canada. We have attempted to cover the broad spectrum sea level environments encountered in a former ice margin area.

Quinlan and Beaumont (1981) have proposed an earth model that would predict

relative sea level changes following deglaciation. In an ice margin area such as eastern Canada, they propose 4 sea level "zones": Zone A - emergence only, Zone B - emergence followed by late submergence, Zone C - early emergence followed by submergence, and Zone D - submer-

gence only. These zones are based on movement of a peripheral forebulge resulting when the ice load forced mantle material to the ice margin area. When the ice disappears this forebulge decays in a wave-like fashion causing the above zones with Zone D being the farthest from the ice center and outside the bulge and the other zones occurring progressively inward as the bulge migrates with time inwards.

To translate these zones into what we observe, Quebec, which has experienced only emergence subsequent to deglaciation, is in Zone A. The Zone A-B boundary probably occurs at the Gaspé Peninsula where virtually no change in RSL is presently occurring. Zone B is represented here by S.W. New Brunswick and western P.E.I., and possibly all the curves from the Bay

of Fundy - it appears that emerged features occur all around the Bay of Fundy. Zone C is represented by Chebogue, eastern shore (where we have evidence of early emergence), and eastern P.E.I. Sable Island is the only curve we could obtain that represents a Zone D area - most Zone D areas will occur offshore and are therefore difficult to obtain curves for.

Quinlan and Beaumont suggest two possible configurations - a maximum ice model (from Peltier and Andrews, 1976) and a minimum ice model (from Grant 1977). Our observations suggest that neither is correct, with the boundaries occurring between the two limits; however, the maximum model (modified by Quinlan and Beaumont) appears to align most closely with the observations.

An example of structural deformation of the Halifax Formation in the Whitehead area, Meguma terrane, eastern Nova Scotia

Jeff Poole

St. Francis Xavier University, Antigonish, N.S. BOH 1C0

An example of the structural style is presented from a detailed analysis of a restricted area near Whitehead. The map area (350m by 200m) consists primarily of andalusite-bearing schists with thinly interbedded meta-sandstone members (≈ 2 cm in thickness) of the Cambro-Ordovician Halifax Formation. To the east and west are granitic plutons which are Devonian-Carboniferous in age and which define a minimum age for the deformation.

Polyphase folding is observed in both the schists and sandstones with at least three phases being identified. In the schists this style is dominated on a mesoscopic scale by a steeply dipping E-W trending foliation. In the sandstone beds, minor S and Z folding are E-W upright isoclinal and generally shallowly and easterly plunging. In the study area at least two approximately coplanar isoclinal phases of deformation (F_A and F_B) define a composite axial planar foliation. Fold phases may only be unequivocally distinguished at the hinge zones of a similar later phase of folding which rotates earlier structures. The S and

Z structures are thought to be related to F_A . From these S and Z structures macroscopic fold structures of wavelength ≈ 40 m are apparent. They are locally redistributed about F_B . A third phase (F_C) of deformation is NE-SW trending upright, steeply plunging and has a well developed planar fracture cleavage. Quartz veins cross cutting the area are generally parallel to this fracture, and are folded indicating emplacement before or during F_C .

In comparison with other studies in eastern Nova Scotia, these rocks appear to be more complexly deformed though similar E-W trends are dominant. For example, in the Shelburne area (Smith 1981) the structural style is dominated by open, upright gently east plunging folds. Deformation in the Whitehead area bears more similarity to the structural style displayed in the Guysborough-Country Harbour area. The regional extent of the deformation displayed in the Whitehead area requires further analysis, but the study may provide constraints for the structural evolution of the Meguma in eastern Nova Scotia.

Quartz grain surface features and diagenetic fabric associated with Carboniferous strata in the western Minas Basin

A.M. D'Orsay and H.W. van de Poll, Department of Geology, University of New Brunswick, Fredericton, N.B. E3B 5A3

Examination of quartz grain features by scanning electron microscopy combined with x-ray analysis and thin section petrology can reveal much valuable information of paleoenvironmental significance. The relative abundance of feature associations and the recognition of relict textures can aid in the recognition of specific depositional environments and earlier evolutionary episodes of the quartz grains. Processes operating within diagenetic environments may, unfortunately, lead to the obliteration of earlier formed features rendering the history of the quartz grains uncertain. Five distinct assemblages of quartz surface textures and diagenetic fabrics can be recognized within the Carboniferous sequence bordering the north shore of the Minas Basin. These assemblages, and their associated lithostratigraphic units, are reviewed below:

AGE	FORMATION/GROUP	ASSEMBLAGE	PALAEOENVIRONMENTAL DIAGNOSIS
(1) Late Westphalian B	*Fowler Head Fm./ (Morien Group)	subangular - angular outline, chonchoidal fractures; straight steps, arcuate steps, solution precipitation surfaces, silica globules, scaling, stepped cleavage	grains originated from a tropical - subtropical environment "fresh" fracture surfaces suggest short transport distance
Early Westphalian C			
(2) Late Namurian	Parrsboro Fm./ (Riverdale Group)	abundant, coalescing quartz overgrowths, calcite infilling of porosity and fractures	subsurface diagenesis
(3) Late Viséan	(A) Sand Grains	surrounded - round outline; euhedral quartz grains, silica pellicles, silica plastering, silica flowers, silica rosettes, stepped cleavage, fractures, percussion pits; solution pits	igneous/metamorphic quartz fragments with (?) aeolian grains in a high-energy saline, alkaline, aqueous environment
Early Namurian	West Bay Fm./ (Canso Group)		
	(B) Clay/Mudstone	microcrystalline dolomite (red facies); microcrystalline pyrite (gray-green facies with microcrystalline calcite	alternating, oxidizing and reducing environments
	West Bay Fm./ (Canso Group)		
(4) Viséan	Subzone C?/ (Windsor Group)	angular-subangular outline, stepped cleavage, etch patterns, solution pitting, chemical scaling	high energy, saline, alkaline, aqueous environment

* Previously unrecognized lithostratigraphic unit

Biom mineralization and deposition of gold in Lower Proterozoic paleoplacers

D. J. Mossman

Mount Allison University, Sackville, N.B. E0A 3C0

The geochemically most influential life processes in the biosphere have always been carried on by microorganisms. Numerous life forms, advertize their existence past or present, through the phenomenon of biomineralization. The term biomineralization includes processes whereby metals and/or metal compounds are accumulated in living systems. The lower Proterozoic was the age of prokaryotes, single celled microbacteria lacking cell nuclei, able to precipitate minerals through "biologically-induced" processes. Present day prokaryotes are capable of actively concentrating gold to the extent of several percent. A similar gold concen-

trating process evidently functioned during the formation of the South African Witwatersrand gold-bearing conglomerates. There, kerogen derived in part from prokaryotic microorganisms accounts for a substantial portion of that country's gold production. The results of preliminary work indicate that thucholite, a kerogen-like substance of possible syngenetic origin from the Huronian Supergroup of Canada, is also commonly anomalously enriched in gold. The likelihood of discovering Witwatersrand-type paleoplacer gold in Canada is thus increased.

Possible earthquake-induced sediment remobilization and syn-sedimentary faulting in the Tynemouth Creek Formation (Lower Pennsylvanian) of southern New Brunswick

A.G. Plint, Department of Geology,

University of New Brunswick, Fredericton, N.B. E3B 5A3

Braided river, sheetflood and playa lake sediments in the Tynemouth Creek Formation exhibit evidence of post-depositional sediment remobilization and syn-sedimentary faulting. Sediment remobilization structures include sinuous, branching sandstone dikes, sandstone 'pillows' and mud intrusions. These structures cross-cut strata for over 1m but show no evidence of extrusion at the ground surface. Sediment intrusion took place in several stages during very early

and later burial and was the result of rapid, ?earthquake-induced water expulsion. Twenty-one metres above the intrusion structures, a paleosol is offset 1.5m by two, syn-sedimentary faults. Sediments were initially deposited on the downthrown side of the faults but later sediments blanket both sides with no evidence of displacement. Faulting must therefore have been syn-sedimentary and probably earthquake-induced.

Quaternary geology in New Brunswick: an historical perspective

J. J. Thibault, Mineral Resources Branch,

New Brunswick Department of Natural Resources, Fredericton, N.B.

Quaternary geology studies in New Brunswick began in earnest in the late 1800's with the pioneering surveys of Matthew and of Chalmers. While working for the Geological Survey of Canada, Chalmers published several reports of investigation accompanied by surficial geology maps covering most of the Province. Based on his field observations, he developed a concept of local ice caps to explain the glacial features found in New Brunswick.

A fifty years hiatus followed these early

studies during which the continental glaciation theory became the dominant theme amongst Quaternary geologists in North America. Chalmer's concept was abandoned and forgotten as influential geologists such as J.W. Goldthwait and R.F. Flint tended to support and promote the concept of a massive regional radial flow of Laurentide Ice across the Maritime Provinces.

In the 1950's, proposed development of the hydroelectric potential of the Saint John River sparked new interest in the

Quaternary geology of New Brunswick. When H.A. Lee undertook a major mapping project along the Saint John River valley, the concept of Laurentide glaciation of New Brunswick was still an established "fact"; this may explain why Lee did not recognize field evidence for northward moving ice in the Edmundston area of northwest New Brunswick.

Ten years later, Prest and Grant re-

examined field data available for the Maritime Provinces-Gulf of St. Lawrence region and concluded that Laurentide ice had not been as active in this area as was previously believed. Extensive mapping of the province in the last fifteen years by Gadd, Gauthier, Rampton and by geologists of the New Brunswick Department of Natural Resources has confirmed the validity of Chalmer's original concept.

Dinoflagellate and pollen records of glacial cycles in Baffin Bay during the past 0.3 Ma

*P. J. Mudie and A. E. Aksu**

Geological Survey of Canada, Atlantic Geoscience Centre, Dartmouth, N.S. B2Y 4A2

**Department of Geology, Dalhousie University, Halifax, N.S. B3H 4J1*

Understanding of the relationship between long-term changes in Northern Hemisphere ocean circulation and climate relies mainly on accurately dated proxy-climatic evidence, including deep sea foraminifera, pollen and microplankton. Oxygen isotope studies of a 10 m core from Davis Strait, southern Baffin Bay show a continuous record of sediment deposited during the glacial and interglacial stages of the past 0.3 Ma. Calcareous planktonic foraminifera in this core show evidence of carbonate dissolution cycles, however, which limits

their usefulness for paleoclimatic studies. In contrast, dinoflagellate cysts show changes in abundance and species composition that are correlated with diatom productivity and indicate increased flow of North Atlantic water into Baffin Bay during interglacial stages. Cycles of boreal tree pollen influx suggest that shifts in the position of the Atlantic-Arctic air front over Baffin Bay is the driving mechanism behind the glacial-interglacial changes in ocean circulation.

Goldenville Formation, Nova Scotia: Lateral tracing of sandstones by magnetic gradiometer

J. W. F. Waldron and L. R. Jensen

Saint Mary's University, Halifax, N.S. B3H 3C3

Previous sedimentary studies in the Goldenville Formation have been hampered by the lack of marker horizons, in the thick sequence of monotonous sandstones and slates. Stern and Henderson (1983) carried out a magnetic survey at ground level of a part of the formation, and showed that measurements of the vertical gradient of the total field could define stratigraphically controlled anomalies with sufficient resolution to permit tracing of individual sand packages along strike. We have used this method to subdivide and correlate with a package about 3km thick on the south limb of the Sober Island syncline. The correlation has so far been extended about 15km along strike between Salisbury and Baltee Islands. We have also

correlated this package with outcrops to the north of the Sober Island syncline.

Throughout the area, large positive gradients are clearly associated with packages of thickly bedded sandstone. This supports Stern and Henderson's (1983) attribution of the magnetic anomalies to a detrital component (magnetite) in the sandstones. Sandstone packages are found to interdigitate with shalier units when traced laterally over distances of several kilometres.

The disappearance of a conspicuous interval of negative gradients west of Phoenix Island is almost certainly the result of localized erosion prior to the deposition of a large lenticular sand body. The larger sand packages are therefore interpreted as submarine channel-fills.

The studies of magnetic anomalies over Davis Strait

*Wu Mingxian, Department of Geology,
Dalhousie University, Halifax, N.S. B3H 3J5*

Magnetic data collected during several cruises in Davis Strait have shown that lineated magnetic anomalies trending north-south occupy most of Davis Strait area. The central positive magnetic band coincides well with a striking feature of gravity low. These results suggest that magnetic anomalies were produced by sea-floor spreading and the gravity low marks an extinct spreading center in Davis Strait area. Comparison with paleomagnetic time scale allows some of these anomalies to be identified as anomaly 20-26 and anomaly 13. The anomaly features suggest that in Davis Strait sea-floor spreading is asymmetrical and spreading rates are getting slower from

south to north. Several fracture zones have been delineated, suggesting oblique spreading about the ridge axis. The distinct northeast-southwest anomaly zone is interpreted to be the expression of faults, which were formed due to vertical crustal movement because of volcanic activity rather than due to horizontal crustal movement by sea-floor spreading. The magnetic anomalies off Cape Dyer are proposed to have a different origin than the anomalies striking in a northeast-southwest direction. The former are interpreted to be formed 58 m.y. ago, the latter is interpreted as being younger than the former.

Origin of compositional variation in basalts from Mount Glooscap Map at 36°35'N: successful use of a submersible drill

*J. A. Walker, P. J. C. Ryall and M. Zentilli
Department of Geology, Dalhousie University, Halifax, N.S. B3H 3J5*

Mount Glooscap, a large peak in the crestral mountains of the Mid-Atlantic Ridge at 36°25'N, south of the FAMOUS area and about 16km west of the AMAR rift valley, was sampled with the submersible electric rock core drill developed by BIO. Twenty-eight basalt samples from seven drilling stations have been analyzed for major and trace elements. Many of the samples come from flows lying under a cover of carbonate rocks and therefore could not have been sampled by a submersible or a dredge.

The ca. 2 Ma old Mount Glooscap basalts are similar to AMAR basalts but quite distinct from 0-age FAMOUS area basalts: they are pyroxene-phyric instead of olivine-phyric, have lower contents of MgO, higher Al₂O₃ and CaO and lower contents of TiO₂ and Zr than many

FAMOUS basalts at equivalent MgO values and are LREE-enriched. Most of the in- and between-hole compositional variation can be accounted for by low-T alteration, accumulation of phenocrysts, and low-P relatively low-T fractional crystallization. A comparison is made with Mont de Venus, the largest active volcano in the FAMOUS area. If Mount Glooscap can be interpreted as a single volcano, it may be that lavas become progressively more differentiated with time at mid-ocean ridge volcanoes as they commonly do at subduction zone volcanoes.

The density of sampling and the type of data sought during this study begin to approach the scale and requirements of the submarine fieldwork that may be needed in the reconnaissance study of poly-metallic sulphide deposits on the ocean floor.

Geology of the Ingonish River area, Cape Breton Island, Nova Scotia

*S. M. Barr, R. P. Raeside and W. Jong, Department of Geology,
Acadia University, Wolfville, N.S., B0P 1X0*

The eastern Cape Breton Highlands are characterized by metamorphosed and deformed miogeoclinal rocks, gneisses and

tonalitic plutons, and continued emplacement of granitoid plutons. Three north-south trending belts are recognized. A

western belt, in the central Highlands, is composed of monotonous interlayered ortho- and paragneisses which have undergone at least two phases of penetrative deformation. A central belt is composed of a package of pelitic, semipelitic and calcareous sedimentary rocks, with interbedded tuffaceous and basaltic layers, which are tentatively correlated with the Hadrynian George River Group. Metamorphic grade ranges from chlorite to sillimanite and includes relatively low pressure sillimanite + staurolite assemblages. Isoclinal folds with 5 km amplitudes, outlined by a series of marbles and quartzites, represent the core of a major anticlinorial structure, plunging to the SSW. The contact between the western and the central belts is a major mylonite zone, 50 to 600 m wide, parti-

ally recrystallized in the greenschist facies.

An eastern belt consists entirely of varied granitoid rocks. Most westerly is a strongly foliated micaceous diorite which intruded the metasedimentary units of the central belt. It is separated to the east from a complex of largely medium grained dioritic rocks by large bodies of coarse-grained variably foliated tonalite and granodiorite. The easternmost granitoid unit is biotite granite of the Cape Smoky pluton which has given an Ordovician to Silurian isochron age. The youngest intrusions in the area occur in the north and include megacrystic granites and aplite and pegmatite dykes which are inferred to be Devonian in age.

Paleobotanical succession in Sydney Coalfield, Cape Breton, Nova Scotia

*E.L. Zodrow, Department of Geology,
The University College of Cape Breton, Sydney, N.S. B1P 6L2*

An outline of succession of paleobotanical events for the Morien Group of Sydney Coalfield is given. By way of interpreting the successive floral events, a Westphalian D/lower Stephanian boundary is positioned between the Hub and the Lloyd Cove seams at Point Aconi. Basal Westphalian D is retained in the roof of the Tracy seam as further support for this placement has

been received from the recent study of *Bivalvia* (non-marine). Distinct floral change-overs are indicated at the Emery and the Mullins seams which collectively are interpreted as mid-Westphalian D events. Correlation with similarly-recognized European events (South Wales) is difficult at this juncture owing to the differences of the order of first occurrences.

Elphidium excavatum (Terquem): paleobiological and statistical investigations of infraspecific variation

*A.A.L. Miller, Department of Geology,
F.S. Medioli, Centre for Marine Geology,
D.C. Hamilton, Department of Mathematics, Statistics, and Computing Science,
Dalhousie University, Halifax, N.S. B3H 3J5*

Detailed study of large sympatric populations and fossil assemblages of the highly variable species *Elphidium excavatum* (Terquem) collected from 20 widely spaced locations indicates that a variety of morphotypes of *Elphidium* can be linked to one another in a number of interlocking intergradational series. Ten morphotypes are recognized and grouped as formae (ecophenotypes) of *Elphidium excavatum* (Terquem); these morphotypes were previously considered as 22 independent taxa by various authors.

To test the hypothesis that these ecophenotypes are distinct morphologically, the ten ecophenotypes were separated into groups based on differences in external morphology; 15 of the characters by which the groups are distinguished were measured and or scored on 721 individuals (11-163 per forma). Discriminant and classification functions were calculated from these character measurements using the SPSS computer program DISCRIMINANT. To illustrate the derivation of these functions, two examples (2 groups and 2 variables; 3 groups and

variables), were calculated and explained step by step using the MINITAB interactive statistical package.

Fifteen analyses, using either one sample or split sample approaches, and simultaneous or stepwise analytic methods, classify 84-90% of the specimens into the subjectively defined formae to which they were assigned. Either morphotype (forma) or location was treated as the dependent variable. The analyses showed that there is no

strong relationship between formae and geographic location, thus strengthening the subjective conclusion that these are ecophenotypes and not subspecies.

Although all of these formae belong to the same species, it is suggested that the distinction among them should be retained because of their potential as a valuable interpretive tool in paleo-ecological and biostratigraphic studies of Holocene and Pleistocene sediments.

Apparent crystal fractionation trends due to $X(H_2O)X(CO_2)$ variations in a gabbroic melt

*J.B. Murphy and A.J. Hynes**

St. Francis Xavier University, Antigonish, N.S. B0H 1C0

**McGill University, Montreal, Que. H3A 2A7*

A late Precambrian intrusion of water-rich gabbroic (appinitic) magma, in the Antigonish Highlands of Nova Scotia, was contaminated by reaction with the host rock marbles and basalts. This resulted in variations in (XCO_2) in the melt, and in chemical exchange between the melt and host-rock basalts. Resulting chemical trends closely mimic those expected from crystal fractionation. The intrusive rocks are enriched in Si, Na, K, Rb and Zr and are depleted in Ti, Fe, Mg, Ca, Ni, and Cr. Alteration trends in the host rock basalt have almost the opposite polarity. Elemental mobility in the intrusive suite may be attributed to the interaction of, and variable partitioning between, an H_2O rich

silicate melt, a CO_2 rich silicate melt and a CO_2 rich vapour. The extent of host rock alteration defines the edge of the transport system. Similar exchange processes may account for the formation of felsic dykes and veins near the contact zone and may also be important in the genesis of an adjacent alaskite stock. In general super-solidus mobility due to variations in XCO_2 in magmas may be an important fractionation mechanism that is easily overlooked in other areas. This type of mobility may result in compositional gradients in silicic magma chambers any may be especially significant in the genesis of some bimodal or mixed alkalalic-tholeiitic suites.

Geology of the Gillanders Mountain intrusive complex and satellite pluton, Lake Ainslie-Whycocomagh area, Cape Breton Island, Nova Scotia

V.A. French, Department of Geology,

Acadia University, Wolfville, N.S. B0P 1X0

The Gillanders Mountain intrusive complex consists of two main units: highly deformed and altered diorite and monzogranite, and a relatively undeformed, fresher syenogranite which is in part granophyre. Two new Rb-Sr isochrons indicate that emplacement occurred during two distinct periods of epizonal activity - an early Devonian diorite-monzogranite sequence and an early Carboniferous syenogranite-granophyre subvolcanic series.

The oldest country rocks are metasedimentary rocks, at least in part belonging

to the Hadrynian George River Group, which are unconformably overlain by a sequence of Devonian-Carboniferous volcanic and continental sedimentary rocks (Fisset Brook Formation). These are in turn unconformably overlain by a sequence of Carboniferous cover rocks belonging to the Horton and Windsor Groups. Contact relations with the granitoid rocks are obscure, and where exposed appear to be nonconformities or high-angle faults. Dyke rocks include pink aplite and porphyritic felsite which cut the diorite, and dark green, re-

latively unaltered basalts which cut the syenogranite; these basalts appear to be the youngest intrusive rocks in the area and may be related to Fisset Brook volcanism.

The satellite plutons are composed predominantly of diorite and granodiorite and where exposed are highly fractured to intensely sheared. Barite, fluorite, and minor Cu sulphides are locally associated with

these plutons. Diamond drilling has encountered a subsurface, coarse-grained syenogranite with associated barite which may be Carboniferous in age and related to the main syenogranite body. The Whycomomagh Mountain granite porphyry intruded George River Group metasedimentary rocks and has associated copper skarns hosted in calc-silicate rocks derived from George River marbles.

Contrasting types of hydrothermal alteration associated with the late-magmatic stages of the South Mountain Batholith

*J. Logothetis, Department of Geology,
Dalhousie University, Halifax, N.S. B3H 4J1*

The mineralogical and geochemical changes associated with late-magmatic hydrothermal alteration of granitoid rocks from the South Mountain Batholith are described. The following types of metasomatism (and accompanying mineralization) were found to be spatially related to shear zones and fractures in the roof-zone of granite intrusions: greisenization (Sn \pm W \pm Mo \pm Zn \pm Cu), fluoritization (Zn), hematization, and episyenitization (U). The chemical changes during greisenization reflect to a large degree the dominance of desilication and silication reactions. Contrasting trace element and REE compositions of F-poor (barren) and F-rich (mineralized) greisens may be related to the role

of F-rich hydrothermal fluids. The episyenites, comprised essentially of albite-K feldspar-chlorite with associated U-phosphates, represents a new type of metasomatic rock not previously documented from the SMB. Mass balance calculations indicate the greisenization and episyenitization involved considerable addition and subtraction of major (e.g. Si, K, Na, Ca, Fe, Mn, Ti and F) and trace elements (e.g. Li, Rb, Cs, Sn, W, Mo, Cu, U and REE's). The results of this investigation have direct implications with respect to the practicality of using geochemical and mineralogical indicators for the exploration of granophile (Sn-W-Mo-U) type deposits in the South Mountain Batholith.

Geochemistry and geochronology of York River Formation volcanic rocks and associated intrusive of the Gaspé Peninsula, Quebec

*C. LaRocque and R. Doig**

Department of Geology, St. Francis Xavier University, Antigonish, N.S. B0H 1C0

**Department of Geology, McGill University, Montreal, Que. H3A 2A7*

The Lower Devonian York River Formation and Lemieux Dome porphyritic rhyolite intrusive are found within north-central Gaspé Synclinorium in the Gaspé Peninsula, Quebec. Preliminary results indicate the York River Formation consists of a bimodal volcanic sequence of silica-undersaturated alkali basalt and oversaturated rhyolite tuffs with alkalic tendencies. The mafic volcanic rocks are interbedded with shallow marine arkoses (upper Siegenian to lower Emsian age, Boucot et al. 1967). Previous geological interpretation of the volcanic

rocks have been based on field mapping in the area.

Major and trace elements describe an olivine controlled crystal fractionation path for the alkali basalt. Geochemistry of the rhyolite tuff shows alteration involving alkalis; however concentrations of MgO, CaO, TiO₂, Nb, Zr, Y are comparable to saturated comendites. The major element geochemistry of an associated porphyritic rhyolite intrusive shows similar SiO₂, TiO₂, Fe₂O₃, CaO, and MgO concentrations to the York River Formation rhyolite tuffs.

Rb-Sr geochronological analysis of the York River volcanic succession provides an age of 380 ± 3 ma with an $^{87}\text{Sr}/^{86}\text{Sr}_i$ of 0.7041 ± 0.0003 . The Rb/Sr isotopic data suggest a time association between mafic and felsic volcanic and implies a cogenetic relationship. However strong major element contrasts argue against crystal fractionation as a viable mechanism for the rhyolite genesis.

A well constrained Rb/Sr isochron on the Lemieux Dome porphyritic rhyolite gives

an age of 381 ± 4 ma with an $^{87}\text{Sr}/^{86}\text{Sr}_i$ ratio of 0.7087 ± 0.0003 . The high initial 87/86 Sr ratio of the Lemieux Dome intrusive indicates incorporation of radiogenic crust in its genesis.

This study, when incorporated with regional analysis (by Carbonneau, C., 1959) indicates that the York River Formation volcanic rocks probably lie on the northern side of a pull-apart basin (the eastwest trending Berry Mountain Synclinorium).

Preliminary classification of carbonate breccias Newfoundland zinc mines, Daniel's Harbour, Newfoundland

*T.E. Lane, Department of Earth Sciences,
Memorial University of Newfoundland, St. John's, Nfld. A1B 3X5*

Zinc ore at Newfoundland Zinc Mines is stratabound in dolomites within the upper third of the Lower Ordovician Catoche Formation (St. George Group) of the Humber Zone in western Newfoundland. Five types of breccias associated with zinc ore are distinguished in a preliminary classification.

Intraformational breccias, stratabound units of the Aguathuna Formation, represent disconformities or early diagenetic dissolution surfaces associated with the transition from subtidal to supratidal lithofacies. Fine rock matrix breccias associated with pre-

Middle Ordovician structural depressions are divided into two types: **Oligomictic breccias** - formed by stratabound dissolution and **poly-mictic breccias** - accumulated in vertical dilation openings along the margins of structural depressions. **White spar breccias** that host the zinc ore are characterized by open fracture and cavity systems filled with megacrystalline white dolomite. **True spar breccias** occur where strata are broken by faulting, veining, or dissolution. Elsewhere, **pseudobreccia** represents in situ replacement by white dolomite.

Goldenville Formation, Eastern Shore, Nova Scotia: stratigraphic correlation and sedimentology

*J.W.F. Waldron and L.R. Jensen
Saint Mary's University, Halifax, N.S. B3H 3C3*

The Cambro-Ordovician Goldenville Formation consists of repetitively interbedded slates and metamorphosed poorly sorted sandstones, and has resisted previous attempts at stratigraphic subdivision. Measurements of vertical magnetic gradient at 2-3 metres above ground level, over well-exposed sections allow recognition of marker horizons which can be traced laterally. We have subdivided a 3km-thick package into 16 units traced about 15km along strike and across the Sober Island syncline.

Measured sections in the correlated units show major lateral facies changes, including cross-cutting erosional contacts beneath

thick sandstone packets. Vertical sequences show both thinning and thickening upwards trends. A preliminary classification of sediments into seven facies has been adopted. They are: (1) Intraclast-conglomerates, consisting of slate clasts in a sandstone matrix; (2) Internally scoured sandstones, characterized by flute-like scours filled by cross-bedded sandstone; (3) Laminated to massive sandstone; (4) Muddy sandstone, with slate intraclasts and slump folds; (5) Graded sandstones, with "Bouma sequence" structures; (6) Cross-laminated slate and siltstone; and (7) Laminated to homogeneous slates.

A dissected Mississippian caldera in southwestern New Brunswick

*S.R. McCutcheon, Mineral Resources Division,
Department of Natural Resources, Sussex, N.B. EOE 1P0*

The pre-middle Viséan Piskahegan Group, host rocks to the Mount Pleasant Caldera, is divisible into intra- and exo-caldera sequences. The intra-caldera sequence is further divisible as to whether the rocks are pre- or post-mineralization and alteration. The exo-caldera sequence from base upward consists of interbedded mafic lavas and felsic pyroclastics, a fining upward redbed unit, and felsic pyroclastics, and is best developed to the east in the Mill Settlement area. Post-mineralization caldera fill rocks comprising felsic pyroclastics, congl-

merate and a mafic lava lie along the northern edge of the triangular "M_s Unit" on the geologic map of New Brunswick. Pre- to syn-mineralization rocks comprising interbedded mafic lavas and sharpstone conglomerate, felsic pyroclastics, and intrusive porphyries occupy over three-quarters of the same triangular "M_s Unit". A tentative correlation has been made between the rocks in the exo-caldera and pre- to syn-mineralization sequences but it remains to be verified by petrographic and chemical data.

Gold-bearing structures in the Bay of Fundy coastal zone of southern New Brunswick

*A.A. Ruitenbergh, Mineral Resources Division,
Department of Natural Resources, Sussex, N.B. EOE 1P0*

Gold-bearing quartz ± carbonate veins and stockworks occur in the Cape Spencer and Musquash Harbour area, respectively, east and west of Saint John.

In the Cape Spencer and Beveridge Cove areas, the hostrocks are hydrothermally altered equivalents of Uppermost Precambrian or Lowermost Cambrian, purplish grey slate, siltstone and sandstone that are intruded by fine-grained, very siliceous granite. The fine-grained sedimentary rocks have a well-developed penetrative cleavage (S₁) mostly subparallel, but locally at a high angle to bedding. In places, a second cleavage (S₂) and a third cleavage (S₃) can be recognized. S₂ is related to thrust faults and S₃ to younger steeply dipping faults.

The oldest gold-bearing quartz impregnations are gently plunging, crudely lens-shaped bodies that occur where overturned F₂ folds and the associated S₂ cleavage are

prominently developed. The thickest part of the mineralized lenses commonly occurs in the axial region of F₂ folds. Hematite-rich quartz veins and stockworks cut across and are usually richer in gold than the lens-shaped quartz impregnations. Thin gold-bearing quartz-carbonate veins are the youngest mineralized structures at Cape Spencer.

In the Musquash Harbour area, gold-lead-zinc-copper-bearing quartz veins and stockworks occur within or along the contacts of Carboniferous or older, intensely fractured, very siliceous granitic intrusions that cut across Precambrian or younger granodiorite. Along Little Dipper Harbour, farther to the southwest, gold-lead-zinc-copper-bearing quartz veins cut across Carboniferous or older sandstones and conglomerates. The veins occur along the southern limb of an overturned anticline.

The petrography of pyrite in some Maritime coals

*J.A.R. Stirling and R. Gilders
Research and Productivity Council, Fredericton, N.B. E3B 4J7*

The pyrite reduction of several Maritime coals is being investigated by the New Brunswick Research and Productivity Council (RPC) and the Technical University of Nova Scotia (TUNS). The beneficiation

studies are being done at TUNS and the characterization of the pyrite is being studied at RPC. Overall, the study is to determine the optimum grain size and density media for the separation of the pyrite

from the coal, and to determine what effect the type of pyrite has on its removal. The petrography and liberation of the pyrite will be investigated with the optical microscope and with an image analyzer (Quantimet at CANMET).

Pyrite can occur in several different forms, sizes and distributions. Marcasite is also present. The forms include framboids, crystal aggregates, individual cry-

stals, spheres of radiating crystals, and massive aggregates. These forms may occur in selected macerals, fractures, "bedding planes", and cellular infillings. Their size may range from sub micron for individual grains to several millimetres for large framboids. The size, shape and distribution (liberation) of the pyrite can be quantitatively determined with the image analyzer.

Morphology and gravitational processes on the Canadian Beaufort Continental Slope

*P.R. Hill, K. Moran, S.M. Blasco and R.A. Harmes
Geological Survey of Canada, Atlantic Geoscience Centre,
Bedford Institute of Oceanography, Dartmouth, N.S. B2Y 4A2*

Hydrographic and high resolution seismic surveys of the Beaufort slope have revealed the presence of two characteristic slope morphologies. A 50 km length of the slope is characterized by a prominent shelf-edge escarpment and hummocky seabed morphology with numerous hyperbolic reflectors. This part of the slope has suffered large-scale gravity sliding, possibly as a single, very large mass-movement. The slope to the east of this escarpment is characterized by a smooth seabed morphology, unusually high acoustic penetration revealing well-stratified sub-bottom reflectors and areas where seabed and sub-bottom reflectors are disrupted by dipiric features. From detailed studies of this eastern slope area, several lines of evidence suggest the importance of relatively slow, but continuous creep of the slope sediment pile. Part of the upper slope has been downfaulted into

a narrow graben, indicating a regional tensional regime. Diapirs are preferentially located along the bounding graben faults. Downslope of the graben, numerous small normal growth-faults are associated with syn-sedimentary folding. Some faults show evidence for later reverse movements along normal growth-fault planes. These data indicate that both tensional and compressional forces have been active and support the model of creep deformation. The 40 cm thick stratified sequence is thought to have moved slowly downslope over a basal chaotic zone. The stepped-nature of the basal zone, reminiscent of the décollement zones of thrust sheets suggests that the deformation occurred in part during the creep movement. Creep is an important process because it may lead to premature failure under loading such as by earthquakes or storm waves.

Clay mineral distribution in Cretaceous and Tertiary sediments of the Labrador Shelf

*Marten Douma
Department of Geology, Dalhousie University, Halifax, N.S. B3H 3J5*

The clay-size fraction of rock cuttings from three Labrador Shelf exploration wells was examined by semi-quantitative x-ray diffraction to determine the relative abundances of smectite, illite, chlorite, and kaolinite. Distribution of these minerals in sedimentary rocks is the cumulative result of many factors. Important among these are source rock composition and weathering history, depositional environment, rate of

burial, temperature and pressure during burial, and age.

Early results show that, with increasing depth, smectite, illite, and chlorite diminish in abundance, at Tyrk P-100. A corresponding increase in kaolinite is seen. At Roberval K-92 and Hopedale K-33 smectite abundance remains relatively constant in Tertiary sediments, with increases, beginning in Cretaceous rocks of the Markland For-

mation, continuing down-hole.

The smectite increase comes at the expense of kaolinite at Hopedale, and of chlorite at Roberval, with little effect on illite content at either location. Furthermore, the increases in smectite abundance at Hopedale and Roberval correspond to temperatures (31 and 46 degrees C, respectively) and depths (1140 and 1800 metres, respectively) which are unlikely to be sufficient to have caused a diagenetic transformation of smectite.

A geohistory diagram of Roberval shows

that the high smectite abundance corresponds to a period of slow subsidence. Recovery of gas condensate at Hopedale indicates that the Markland Formation may be suitable source rock. However, the absence of a diagenetic transformation of smectite to illite, which would correspond to the top of the oil window, indicates that organic-rich sediments in wells that have undergone a similar burial history have not been subjected to enough cooking to produce liquid hydrocarbons.

Quaternary biostratigraphic database

*Iris Hardy, Regional Reconnaissance Subdivision,
Atlantic Geoscience Centre, Dartmouth, N.S.*

During the last year, an integrated data system originally implemented by Program Support and staff of the Eastern Petroleum Geology Subdivisions at AGC has been proven to be versatile enough to both manage and manipulate the Quaternary biostratigraphic data derived from the vast subsampling and coring program on the Labrador and Southwestern Baffin Island Shelves. This system presently includes data checking programs, automated report writing and distribution plots. The uniqueness of the system design has continued with the stan-

dardization of data tabulation by all users and the maintenance of a species dictionary that will retrieve the latest updated synonym. At present cumulative number and percent plots of specified foraminiferal species has permitted a chronostratigraphic zonation correlatable to acoustic facies in these same areas of study. Two cruises, 82054, from the Labrador Shelf, and 82034, from the Southeastern Baffin Island Shelf, are presently available in an Open File Report format at the Atlantic Geoscience Centre.

Soil geology and forest productivity in New Brunswick

*A.A. Ruitenberg, S.R. McCutcheon and H. van Groenewoud**
Mineral Resources Division, Department of Natural Resources, Sussex, N.B. E0E 1P0
**Maritime Forest Research Centre, Fredericton, N.B. E3B 5P7*

In order to improve forest productivity in New Brunswick, it has become necessary to divide the province's forest land into areas or sites for which productivity for certain species or combinations of species can be predicted. Recent interdisciplinary forest-ecological and soil-geological research has demonstrated that lithologic-mineralogic compositions of tills in New Brunswick show well-defined correlations with forest productivity. Statistical height growth and locally volume growth analyses were done on Black Spruce to measure productivity in different sites.

In the Veneer area of northern New Brunswick, high productivities were found for Black Spruce on soils developed on well-drained basal till predominantly derived

from sedimentary rocks of the Matapedia and Grog Brook Groups. Much lower productivity was determined in soils developed on basal tills composed predominantly of sedimentary rocks of the Temiscouata Formation.

In the Mount Pleasant area of southern New Brunswick, soils formed on well-drained basal tills composed predominantly of porphyritic microgranite of the Piskahegan Group and sedimentary rocks of the Flume Ridge Formation showed productivities in the same order of magnitude as those in Grog Brook tills in northern New Brunswick. Productivities of soils formed on tills predominantly composed of Seely's Porphyry and Little Mount Pleasant Tuff of the Piskahegan Group were much lower.

Regional significance of five new Rb-Sr dates from the Cape Breton Highlands

*R. A. Jamieson, Department of Geology,
Dalhousie University, Halifax, N.S. B3H 3J5*

Five new Rb-Sr isochrons have been obtained from a range of igneous and metamorphic rocks in the southern and central Cape Breton Highlands. The oldest unit dated is the Baddeck Lakes diorite-tonalite complex (752 \pm 26 Ma), a variably deformed pluton that cuts previously deformed metasedimentary rocks. A variety of Devonian to Carboniferous rocks has been identified, including the North River monzogranite (401 \pm 13 Ma), the Muskrat Brook - Sarah Brook mylonite zone (394 \pm 28 Ma), the MacMillan Mountain volcanic (384 \pm 10 Ma), and the Margaree granite (350 \pm 4 Ma). The extent of Acadian and later tectonic activity is greater than expected, but agrees well with the geology of southwestern Newfoundland. The significance of Middle to Late Cambrian granites in the Highlands remains uncertain, and the age of the low grade metavolcanic and metasedimentary rocks of western Cape Breton has not been constrained by this study. The dominance of late Precambrian and Devonian-Carboniferous tectonic activity agrees well with observations elsewhere in the Avalon Zone.