ATLANTIC GEOSCIENCE SOCIETY BIENNIAL SYMPOSIUM

ABSTRACTS

The biennial symposium of the Atlantic Geoscience Society was held on the 23rd and 24th of January, 1981 in Fredericton.

Invited speakers on the topic of "Mineral and Energy Resources of the Atlantic Provinces" were D.F. Strong (G.A.C. National Lecture Tour Speaker), G. Leavitt of Mobil Oil, and M.J. Russell of Strathclyde University (A.G.S. Lecture Tour Speaker).

Abstracts of these papers and the other eighteen which were contributed are presented in the following pages.

MARITIME SEDIMENTS AND ATLANTIC GEOLOGY
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Stratiform and vein-type lead-zinc ores at Gays River metallogenic implications

Samuel Akande - Department of Geology, Dalhousie University

The Gays River lead-zinc deposit is hosted in a carbonate reef complex of lower Carboniferous (Windsor) age. Lead-zinc ores are distributed in stratiform bodies and discordant vein systems within the dolomitic reef.

The stratiform lead-zinc ores are concordant open-space fillings distributed in highly porous, structurally-controlled erosional channels between knobs and ridges of the Goldenville quartzite basement. Sphalerite, galena, and gangue minerals e.g. barite, fluorite, chalcopyrite, pyrite and marcasite occupy interparticle, sheltered, moldic, fenestral, vuggy and fracture porosites of the microdolomitic host rock.

Detailed mapping underground has recognized discordant vein systems which are localized within a pattern of E-W, NNE and N-S fractures. Maximum concentrations of sulphide minerals occur in these veins and they represent the highest grade areas in the mine. Sphalerite and galena in the vein systems occur as massive replacement bodies with knife edge contact with a dedolomitized hanging wall and a fenestral wackestone footwall. Localized brecciation and dedolomitization of the host rock microdolomite are spatially related to faulting adjacent to the veins.

Lesser concentrations of sphalerite and galena are found in stomatactoids, geopetal structures and stylolites. The concentration of massive sulphide and gangue minerals in general appear to be directly proportional to the primary porosity and proximity to areas of faulting and fracturing.

The general view on the genesis of the deposit has been that the stratiform mineralization represents an early diagenetic cement. Contact relationships between the stratiform and vein ores, however, suggest that the discordant veins could have served as feeders, for the epigenetic mineralization at least in part.

The geochemical characterization of the different ore types and their host-rocks with respect to stable isotope and fluid inclusion determinations are being studied to evaluate critically the multiple genetic hypothesis.

The close cooperation of Messrs. William Palmer, John Horton and Chris Kavannagh of Canada Wide Mines Limited in this continuing study is gratefully acknowledged. The author alone however takes responsibility for the statements expressed in this paper.

Mineralization indicators in granitoid plutons of Cape Breton Island, Nova Scotia

S.M. Barr, J.R.D. Setter and R.M. Campbell
Department of Geology, Acadia University

Various types of economic mineral deposits commonly occur in genetic association with granitoid rocks, and hence the abundant granitoid plutons of Cape Breton Island are appropriate targets for exploration. In fact, several of these plutons are already known to be

associated with Cu, Mo, Zn, W, and/or other metal occurrences. A study of granitoid plutons in Cape Breton Island was begun in 1978 in cooperation with the Nova Scotia Department of Mines and Energy, to assess the economic potential of plutonic rocks in Cape Breton Island and also to identify aspects of petrology and background geochemistry which may be guides to mineralization. The project includes mapping and sampling followed by petrographic and geochemical studies.

Studies of 16 plutons are completed or in progress. The results show that these plutons generally have I-type characteristics and hence are more favourable for Cu-Mo-W mineralization than Sn or U. Elemental indicators of Sn-specialized or uraniferous granites such as Rb, F, Li, Sn, and U and ratios K/Na, K/Rb, and Li/Zn which have proved successful in other areas also suggest little potential for Sn or U mineralization associated with these plutons. A comparison of five of the plutons in Cape Breton Island known to have Cu-Mo±W mineralization with the apparently unmineralized plutons shows differences in geochemistry, especially higher mean background values, wider ranges, and larger standard deviations in As, Ba, Cu, Mo, Pb, Zn, S, and possibly W in the mineralized plutons. Hence this study suggests that some plutons in Cape Breton Island are poor targets for mineral exploration. However, many other plutons have yet to be assessed.

A metallogenic study of the Antigonish Area, Nova Scotia with special reference to copper occurrence of the Ohio-Sylvan Glen Belt

P.D. Bourque - Department of Geology, St. Francis Xavier University

Significant mineralization in the Antigonish Area is, to date, found only in the Carboniferous sediments of the basinal areas within the region. The Antigonish Highlands, made up of volcanic and sedimentary rocks of the Browns Mountain Group has shown so far little indication of any substantial mineralization other than Cambro-Ordovician ironstones.

Several mineral groups, defining metallogenic areas are delineated. Each group comprises several mineral occurrences in similar lithological environments. With the exception of Cambro-Ordovician and Silurian ironstones, a minor Cambro-Ordovician contact metamorphic copper-zinc showing and a sedimentary copper deposit in Devonian rocks, all significant mineral groups are confined to Carboniferous lithologies.

Other mineral groups include galena occupying pores in Upper Windsor carbonate mounds; red-bed copper occurrences in fluvial sediments of the Canso Group and "Kupferschiefer" type mineralization along the Horton-Windsor contact.

Ore textures within the copper belt of the Horton-Windsor contact suggest that pyrite formed contemporaneously with the sediments, possibly through the production of H_2S by bacterial action. Ore textures further indicate that the pyrite was subsequently replaced by chalcopyrite, which was in turn replaced by increasingly copper-rich sulphides. One of the genetic models considered involves compaction and dewatering of oxidized Horton sediments and expulsion of copper bearing water; copper sulphides are precipitated upon contact with pyrite in a reducing environment.

This study was sponsored by the NSDME.

Salmon River lead mine - Current Research

Oliver J.H. Bonham - Department of Geology, Dalhousie University

The Salmon River Lead Mine on Cape Breton Island, operated by Yava Mines Ltd., is a sandstone-hosted lead deposit situated in fluviatile clastics of Pennsylvanian age. The sediments consist of cyclical fining-upwards sequences of fluviatile conglomerates, sandstones and shales. The section also contains abundant coal debris. The dominant and only economic sulphide present is galena, which occurs as bands and disseminations within the sandstone. Sphalerite, pyrite and marcasite occur locally.

Research will be directed towards the following aspects:

1. The controls to the distribution of mineralization within the sedimentary units and in relation to the basement topography.
2. Investigation of the petrography and geochemistry of the host rocks and mineralization, with a view to ascertaining the age and conditions of mineralization, and possible sources for the mineral components.

This study commenced in the summer of 1980. A review of the research proposals will be made and some preliminary observations will be presented.

Uranium favorability interpreted from Uranium Reconnaissance Program data, ground radiometry and gravity (New Brunswick)

**J.J. Chandra - Geological Surveys Branch and D.E. Gemmell*
Mineral Development Branch, New Brunswick Department of Natural Resources

Twenty-nine anomalies selected from the U.R.P. survey (1976), were investigated on the ground by hand-held and truck-mounted gamma-ray sensors. Of these anomalies, nine have been found to be real. The remaining twenty pseudo anomalies are due to $>2\pi$ sensor-source geometric effects, extensive bedrock exposure and/or lack of vegetative cover resulting from clear-cutting and forest fire.

Data from these ground investigations have shown that airborne measurements of 3-4 ppm eU in drift-covered areas correspond to an overburden uranium content of 5-7 ppm eU and a concentration of the order of 13-18 ppm eU in the underlying bedrock. In the same manner, the airborne-ground radioelement correspondences were determined for the elements K and Th. This upgrading of the airborne data has allowed the calculation of Uranium Favorability Indices (U.F.I.'s) from the equation (Saunders, 1978):

$$U.F.I. = \frac{MeTh \cdot MeK}{MeU}$$

Three U.F.I.'s were calculated; U.F.I.-1 using airborne data only; U.F.I.-2 equating airborne data to ground regional values and U.F.I.-3 equating airborne data to bedrock radioelement content. In addition, a Radioactive Heat Product map (R.H.P.) was produced utilizing the regional airborne and regional ground radiometric values.

The nine valid airborne anomalies of the U.R.P. survey fall within well defined uranium favorability zones outlined by this study. Interestingly, these several areas of potential uranium enrichment outlined in the four maps show a strong relationship to regional and residual gravity anomalies.

Recent interpretations of the Geology of the Springhill Coalfield

John H. Calder - Nova Scotia Department of Mines and Energy

The Springhill coalfield comprises Westphalian B sediments of the lower fine facies of the Cumberland Group, and is situated within the Cumberland basin of deposition. Recent diamond-drilling conducted by the coal section of the Nova Scotia Department of Mines and Energy has cast new light on many aspects of the geology at Springhill. The coalfield is deformed by a diapir of Windsor Group evaporites to the north-east, resulting in a step graben configuration across a south-easterly plunging anticline.

A stratigraphic model has been proposed for the Springhill coalfield. It is envisaged that a braided stream plain transitional from the underlying coarse facies sloped northward into the basin. The coal seams in Springhill transgress southerly, onlapping the braid plain, while a fluvial member lies stratigraphically above these seams. Two previously unrecognized coal seams of mineable thickness have been outlined in conjunction with this model by diamond-drilling during 1980. This has allowed correlation of seams on both limbs of the anticline. In excess of 6,500,000 tons of high volatile bituminous coal has been delineated in the upper of the two seams, and proposals have been received for development of an underground mine. The insight recently gained will allow a better understanding of the coal geology in the remainder of the Cumberland Basin.

Coal Resources of Nova Scotia

K.S. Gillis - Nova Scotia Department of Mines and Energy

Coal is, within the provincial context, the most important, proven, indigenous source of energy in Nova Scotia. Total resources are estimated at over 3 billion tons and the amount of recoverable coal reserves is estimated at over 1 billion tons which is adequate to support planned levels of production for over a century. Of the total coal reserves, 234 million tons of recoverable coal are considered to be of metallurgical grade while the remainder is of thermal grade. Thermal coal would primarily be used to replace oil in electrical generation and industrial heating while metallurgical coal would be used for steelmaking and for export.

The bulk of coal resources outlined is found in the Sydney coalfield particularly in the submarine area. The rank of the coal is high volatite "A" bituminous but there are variations within this rank. The remaining resources are found in various coal basins throughout the province as recent exploration programs have identified individual seams that have a potential for immediate mine development. The seams have variable characteristics as regards their quality, quantity and area of mineable resources.

Development and use of coal reserves are critical components of Nova Scotia's energy plans. Proper use of these reserves will provide an opportunity for industrial growth and will result in direct and substantial benefit to Nova Scotians in the form of new jobs and extra income.

SN, W, MO, and U mineralization in the Appalachian-Hercynian Fold Belt: A regional metallogenic comparison

A.K. Chatterjee - Nova Scotia Department of Mines and Energy

Important Sn, W, Mo, and U mineralization in the Meguma Zone is spatially and probably genetically related to the emplacement of the granitoid rocks of Devono-Carboniferous age. The mineralization is enclosed either in the granitoid rocks (intrabatholithic) or in the metamorphic rocks of the aureoles (peribatholithic). Similar geological situations are also found in the Hercynian province of western Europe. For regional comparisons examples are selected from the Iberian Meseta (Alto-Altenterjo, Fe, Morille and Galicia), the Armorican Massif (Mortagne), the Massif Central (Margnac, Peny, Hyverneresse and Montredon-Labessonnie) and the Bohemian Massif (Pechtelsgrun, Freiberg, Cinovec, Pribram and Jachymov).

The intrabatholithic mineralization varies in form from a linear type with vein infillings or sheet-like bodies to a columnar type in the greisenized granite. The enclosing granites generally have a leucocratic mineral composition and a special association of accessory minerals, among which cassiterite, helvite, uraninite, topaz, tourmaline, garnet, dark micas of siderophyllite-protolithionite composition and fluorite are most important. Geochemically the granites are characterized by higher SiO_2 and K_2O contents, lower contents of TiO_2, Fe_2O_3, MgO, and CaO, and a strong increase in Rb, Sn, U, Li, Be and F when compared with normal granites. Often the columnar type of mineralization is represented by the presence of vascular rocks (episyenites) of various compositions. The enclosing granites are also characterized by late-magmatic autometasomatic and post-magmatic metasomatism leading to muscovitization, albitization and greisenization.

The peribatholithic mineralization occurs as impregnations, as replacement veins and as net-vein stringers in shear zones in the pelitic rocks within the metamorphic aureole of the specialized/fertile granites. Characteristically, the Sn-W-Mo mineralization occurs in oxide-silicate-sulphide association (e.g. cassiterite-wolframite-hematite-malayite sulphides of Cu, Zn and Ag), whereas the uranium mineralization is essentially in the form of silicate-phosphate-sulphide-association (e.g. coffinite-autunite-saleeite-phosphuranylite - pyrite - chalcocite). Geochemically the enclosing pelitic rocks are characterized by increased levels of Cu, Zn, Sn, U, Li, and F when compared with the average Paleozoic shale.

Based on geological, mineralogical, geochemical and regional metallogenesis, it is concluded that the granitoid rocks in the Appalachian - Hercynian tectonic province have acted as metallotects, and many features may be used in the search for both surface and hidden deposits of endogenous type.

Geology of the Austin Brook Iron Formation

J.L. Davies - New Brunswick Department of Natural Resources

Re-examination of the Austin Brook Iron Formation (known since 1898) in 1950-52 led to the discovery of the Brunswick No. 6 (Zn-Pb-Cu-Ag) massive sulphide deposit, the first of many sulphide deposits subsequently discovered in the Bathurst-Newcastle district, New Brunswick.

The Austin Brook Iron Formation, similar in many respects to "Algoman" type iron formation, is sandwiched between two eruptive cycles of regionally metamorphosed, predominantly rhyolitic pyroclastic rocks of the Tetagouche Group. Secondary structures and textures indicate perhaps three main deformation phases (D_1, D_2, D_3). The dominant structure in the Austin Brook area is an F_1 isoclinal anticline.

The rhyolite pyroclastic rocks are intensely altered as indicated by low Na + K and high K/Na ratios. It is thought that these features are the result of hydrothermal alteration shortly after extrusion.

The Austin Brook Iron Formation comprises (1) an oxide facies, consisting of laminated magnetite-hematite, and quartz-siderite-calcite intercalated with (2) a chlorite (silicate) facies, consisting of laminated chlorite-quartz magnetite-biotite-stilpnomelane-carbonate schist and poorly laminated chloritic clastic sediment (oxide and chlorite facies originally up to 12.2 m thick), and (3) a basal sulphide facies comprising massive pyrite (up to 4.3 m thick) with variable amounts of sphalerite and galena, and chalcopyrite, and pyritic sericite-quartz (chlorite) schist (up to 24 m thick). Similar facies relations occur in the Brunswick No. 6 area, though the sulphide facies is much thicker.

The Austin Brook Iron Formation represents a siliceous iron-rich sedimentary rock deposited in a marine evnironment during a quiet period separating eruptions of rhyolitic pyroclastic rocks. The oxide facies is a chemical precipitate of either (1) mixed hydrous ferrous-ferric oxides and silica under flucating Eh (slightly reducing to slightly oxidizing) or (2) dominantly hydrous ferric oxides under positive Eh (oxidizing conditions) and present Fe^{+2}/Fe^{+3} ratios are products of digenesis and hydrothermal metamorphism. Enrichment of Mn and lack of evidence of original ferrous silicates support (2) above. The source of the silica was probably that released by hydrothermal alteration of glass, pumice, ash and feldspars of associated rhyolitic pyroclastic rocks. Anomalous amounts of An, Pb and other elements are attributed to absorption in hydrous Fe and Mn oxides. A strong positive correlation exists between Zn and Mn in the oxide facies.

A chlorite facies represents layers of turbidite that sporadically entered the basin, which is otherwise free of clastic sediments during the period of quiet chemical sedimentation.

Massive pyrite and the underlying pyritic schist are thought to be the result of sulphate reducing bacteria and perhaps hydrothermal replacement of oxide facies iron formation after burial under conditions favouring high Pb_2S.

Lithogeochemical indicators of uranium and tin mineralization in the South Mountain Batholith, Nova Scotia

A.K. Chatterjee - Nova Scotia Department of Mines and Energy
G.K. Muecke - Department of Geology, Dalhousie University

The South Mountain Batholith (SMB) of Nova Scotia is a post-tectonic peraluminous granodiorite-granite complex which intrudes Cambro-Ordovician to Lower Devonian metasediments and volcanics. Stratigraphic relations and radiometric dating constrain the time interval between complete crystallization of the batholith (372-361 Ma) and surface exposure through erosion to a few million years.

The main mass of the batholith consists of biotite granodiorite into which are intruded a number of smaller, discrete bodies of biotite-muscovite monzogranite (including porphyries) and dykes and irregular bodies of aplite and pegmatite. Major and trace element and isotopic studies suggest that all these bodies form part of a cogenetic suite. Although fractional crystallization played a major part during the early differentiation process, it cannot adequately explain the evolution of the late stage rocks. The generation of a fluorine-rich fluid phase is thought to have played a major role in determining geochemical trends during the terminal phases of crystallization of the batholith. A para-intrusive suite, consisting of biotite leucogranite, argillized and sericitized granites, albitized granites and albitites as well as various types of greisen, appears to be the product of the interaction of the fluid with residual magma and/or crystalline rocks. The principal Sn-W, Sn-Be, Sn-W-U, W-Mo-U, and U-P-F mineralization in the SMB is spatially and genetically associated with the monzogranite-leucocratic monzogranite bodies, and in particular with para-intrusive rocks found within these complexes. The rapid unroofing of the batholith following its emplacement produced dilatancy and shear fractures which acted as channelways to mineralizing fluids and resulted in mineralized zones in (ex. Gaspereau Lake) or near (ex. Millet Brook) the most differentiated portions of the batholith.

Mean concentrations show an increase in U and decrease in Th abundance from the least differentiated granodiorites to the highly differentiated leucocratic monzogranites. The decrease in Th/U ratio with differentiation (3.0 → 0.5) is accompanied by progressive enrichment in F, Be, Li, Rb, Cs, Ta, Sn and depletion in Sr, Ba, REEs, Sc, Zr, Hf. In the para-intrusive suite elemental correlations often break down and particular elements, for example U versus Th, can show extreme enrichments or depletions. The negative correlation between Th and U as well as Th depletion is not shared by all the plutons. The Davis Lake and Plymouth plutons show a positive correlation and elevated Th abundances in the para-intrusive suites; both bodies are associated with substantial Sn-W mineralization.

Airborn gamma-ray spectrometric maps indicate the presence of a number of other high radioactivity, high thorium bodies in the SMB which have not yet been studied, but should be of interest in mineral exploration. Other lithogeochemical indicators of mineralization include elevated alkali element (Li, Eb, Cs) and fluorine abundances and rare earth enrichment in fluorites.

Diagenetic alteration of 'red bed' clastics and potential uranium and petroleum resources, Carboniferous Basin, Atlantic Canada

H.E. Dunsmore - Economic Geology Division, Geological Survey of Canada

The Carboniferous sedimentary rocks of Atlantic Canada continue to be a source of coal, base metals and evaporitic minerals, but to date have yielded only minor amounts of oil and gas, and no economic concentrations of uranium. However, geological evidence suggests the search for these vital energy resources should be continued.

'Red bed' clastic rocks are not inert containers of petroleum, but undergo diagenetic alteration when in contact with pooled or migrating hydrocarbons. The most conspicuous features are changes in colour, from reddish brown to grey or greenish-grey, and in degree of cementation, from a poorly cemented to a well cemented, more resistant sandstone. These altered zones also commonly contain petroleum-derived bitumens, fracture-filling white calcite and pyrite, and local concentrations of uranium. They are found in close proximity to fault zones throughout the Carboniferous basin.

The best exposures of these 'fossil' hydrocarbon reservoirs or seepage zones are found on the Magdalen Islands in the Gulf of St. Lawrence. Large lenses or pods of altered sandstone flank the evaporite piercement structures which created the Islands, indicating that petroleum has at one time been present in structural traps on the flanks of these structures.

Applying this concept to the search for uranium in carboniferous strata, the greatest potential for sandstone-hosted uranium deposits appears to be along the fault-bounded margins of the Moncton sub-basin, New Brunswick, and the Deer Lake basin, Newfoundland. Hydrocarbons expelled from highly bituminous, lacustrine oil'shales' may have migrated along zones of structural and stratigraphic permeability in nearby alluvial fan deposits. The chemically reducing environment created by the passage of these hydrocarbons would precipitate uranium from uranium-bearing groundwaters and preserve uranium deposits from subsequent leaching.

Oil and gas in Canada: past, present and future

D.C. Umpleby and G.L. Williams - Atlantic Geoscience Centre, Geological Survey of Canada, Bedford Institute of Oceanography

Although Canada produces 1.6 million barrels of crude oil per day, domestic demands exceed production by almost 20%. This state of affairs could deteriorate in the next few years so that Canada could run out of known conventional supplies by the early 1990s. The Natural gas reserves are in much better condition, with domestic consumption being about 65% of annual production and reserves now stand at 60 Tcf. The recent National Energy Program proposes accelerated substitution of natural gas for oil, thereby reducing our imports and extending the life of our reserves.

Late Paleozoic Plutonism and related Mineralization in New Brunswick

L.R. Fyffe and A.A. Ruitenberg - Geological Surveys Branch
New Brunswick Department of Natural Resources

The Late Paleozoic Plutons of New Brunswick have been classified on the basis of mineralogical and compositional distinctions, the character of metamorphic aureole, textures, internal structure and intrusive relationships of spatially related intrusions. The resulting plutonic types, in approximate sequence of decreasing age, are: A) Mafic plutons, including diorites, gabbros and ultramafic rocks; B) Medium-grained, subporphyritic to porphyritic, biotite ± hornblende granite to granodiorite; 409±20 m.y., 403±20 m.y., 370±30 m.y.; C) Syntectonic tonalite and granodiorite; D) Medium-grained, muscovite-biotite granite; 424±24 m.y.; E) Medium-grained biotite granite with minor muscovite-bearing phases; F) Megacrystic biotite±hornblende granite 378±7 m.y.; G) Medium-grained biotite + hornblende granite; 406±7 m.y., 383±6 m.y.; H) Coarse-grained biotite granite with minor porphyritic and granophyric phases; 351±8 m.y., 345±8 m.y., 337±15 m.y. The plutons appear to form a continuous sequence of intrusions from early Devonian to Carboniferous time. The bimodal character of the suite is attributable to mantle-derived basic magma and felsic magma produced by crustal anatexis.

The occurrence of miarolitic cavities, intrusive breccia, and associated volcanics variously attest to the high level of emplacement of Types B, G, and H; whereas the occurrence of sillimanite-bearing contact aureoles and garnetiferous pegmatite with Types C, D, E, and F indicates a deeper level of emplacement for these plutons.

The various plutonic types are associated with characteristic mineral deposits: disseminated Fe, Ni, Cu sulphides with Type A; Cu, Mo-bearing fracture zones, Cu, Mo-bearing skarns, and Zn, Pb, Cu sulphide veins with Type B; Pb, Mo, F-bearing fracture zones with Type F; Mo as rosettes and disseminations with Type G; W, Sn, Mo, F-bearing quartz-greisen veins and Sb, U-bearing veins with Type H.

Value of occurrence of detrital particles of coal in tracing the provenance of sedimentary rocks

Peter A. Hacquebard - Atlantic Geoscience Centre, Geological Survey of Canada
Bedford Institute of Oceanography

This paper gives two examples of tracing the provenance of sedimentary rocks from properties of contained detrital particles of coal. The diagnostic coal properties include maceral composition, coal rank as determined by vitrinite reflectance, age determination by means of fossil plant spores and trace element content as determined spectroscopically.

Through these properties, the possible source area of coaly fragments present in sediments occuring below the seafloor at two localities in the Atlantic Ocean have been determined, namely, in Jurassic sediments from Orphan Knoll and in Quarternary deposits from the Sohm Abyssal Plain, 760

km east of Bermuda. The likely provenance of these sediments are, respectively, the coal bearing measures of South Wales in the United Kingdom and the Sydney coalfield of Nova Scotia.

The results permit speculations as to the pre-drift position of Orphan Knoll and also indicate the great distance over which turbidity currents can transport unconsolidated sediments. At the location in the Sohm Abyssal Plain this distance was at least 1300 km.

Uranium deposits, episyenites and peralkaline rocks: the carbonate connection

D.F. Strong - Department of Geology
Memorial University of Newfoundland

Vein-type uranium deposits are typically in peraluminous granitoid rocks associated with alteration zones characterized by mobility of a number of elements, but especially by a loss of silica and addition of carbonate. These alteration zones, termed episyenite, are also often accompanied by lamprophyres, leading to suggestions by some geologists that the carbonate was mantle-derived along the lamprophyres. Fluid inclusion studies show a positive correlation between uranium and CO_2 content, corresponding to experimental predictions of uranium transport by carbonate complexes in hydrothermal solutions.

Peralkaline granites exhibit high concentrations of an incongruous range of trace elements such as Zr, Zn, F, Nb, Ni, enrichment of heavy rare earth elements (HREE), and the peralkalinity itself, which correspond with carbonate enrichment and sodium metasomatism under apparently magmatic conditions. Isotopic $^{87}Sr/^{86}Sr$ ratios suggest that these sodium carbonate fluids were also mantle-derived.

The peralkaline St. Lawrence granite of southeastern Newfoundland displays a distinctive contact alteration zone associated with uranium mineralization. It is characterized by a complete replacement of K-feldspar and quartz of the fresh granite by albite and calcite towards the sharp contact with shales, according to a chemical reaction which can be written as:

67 QUARTZ + 11 ORTHOCLASE → 42 ALBITE + 35 CALCITE

This desilicification is accompanied by increase of P, Mg, Mn, Cu, Ni, Sr, F, REE (particularly HREE), Ga, and especially Zn and Pb, with decrease in Rb, Ba, Cr, Fe and Rb/Sr. A lack of hydration reflects the probability that the alteration fluids were essentially anhydrous, dominated by CO_2 and F, associated with late-stage emissions from the cooling granite.

Although not developed in the two-mica granite which characterizes the typical host-rocks of vein-type uranium deposits, the St. Lawrence zone of desilicification can be termed an episyenite formed by sodium carbonate alteration. This carbonate, presumably mantle-derived CO_2, thus provides a link in the continuum from peralkaline granite crystallization through desilicification to uranium transport and deposition.

Some geological features which affect the minability of coal of the Sydney Coalfield, Nova Scotia

S.V. Forgeron - Cape Breton Development Corporation

The mining of energy in the form of coal requires that men physically enter, and work within the solid geological environment of the earth's crust. In this respect coal differs from the acquisition of other energy sources. In the underground mine he is compelled to extract a marketable coal product in a safe and efficient manner while working under the physical restraints imposed by that particular geological environment. The degree of his success will be determined by the magnitude of geological factors present, the extent to which they are understood and by how well the mine is designed them.

This paper describes two such geological features (soft underclays and paleo sandstone river channels) which affect the mining of coal in the Sydney Coalfield of Nova Scotia. This is accomplished by first of all demonstrating their affect on mining; secondly, by venturing an opinion in regard to their cause and finally by illustrating the methods used in trying to forecast their future occurrence.

The mineral aggregate resource inventory program of New Brunswick

Jacques J. Thibault - Mineral Resources Branch
New Brunswick Department of Natural Resources

The management of non-renewable resources requires acceptance of land use planning to avoid sterilization of mineral resources. Adequate inventories of naturally occurring mineral resources are thus necessary, particularly for mineral aggregates which are a high volume - low unit price commodity.

Since 1974, the Mineral Resources Branch of the New Brunswick Department of Natural Resources has been actively pursuing a program of mineral aggregate resource inventory which aims at providing detailed information to users and decision makers concerned with aggregate related problems.

The primary objectives are as follows:

1) to collect data permitting a complete quantitative and qualitative analysis of granular aggregate deposits, and

2) to classify these deposits in such a way as to allow planners to make priority decisions on zoning, protection, and availability of granular aggregate resources.

Granular aggregate resources maps are constructed by combining field data, filed geotechnical data obtained from government or private engineering agencies, and air photo interpretation. These data are used to determine the nature, thickness and vertical and horizontal relationships of different geologic units which are frequently discontinuous and very thin. Each of these geologic units exhibits a characteristic deposit-type which aids in defining the potential a specific zone has for aggregate production.

Genesis of Late Tournaisian lead + zinc + copper + baryte deposits in Ireland and Nova Scotia

M.J. Russell - Department of Applied Geology
University of Strathclyde, Glasgow, U.K.

Cryptocrystalline baryte passes down dip (basinwards) into fine-grained pyritic zinc + lead + baryte ores at Silvermines, Ireland and Walton, Nova Scotia. At Silvermines the ores are demonstrably exhalative sedimentary, occur near the base of fault related depressions and are associated with submarine debris flows. Upward vertical zonation, Mn→Mn+Zn→Mn+Zn+Fe + Pb → Mn + Zn + Fe + Pb + minor Cu, reflects an increase in temperature of hydrothermal fluids with time up to at least 265°C. Chalcopyrite is also paragenetically late at Walton and Tynagh, a contrast with deposits of volcanic association.

Walton and the Irish deposits, Silvermines, Tynagh, Keel, Ballinalack and Navan, share a common basement, the Appalachian-Caledonian orogenic pile and, remarkably are coeval although separated by a predrift 20° of Earth circumference. Their features are accounted for by deriving the ore solutions from subsurface convective circulation of modified highly saline Early Carboniferous seawater. The circulation was initiated during rifting and driven by the high geothermal gradient (Appalachian-Caledonian granites froze between 420-360 Ma). As a result of continued extensional strain and cooling of the rock column the brittle to ductile transition zone is depressed and the circulating fluids penetrate to greater depths with time. Of the ore metals the downward-penetrating convecting fluids first leach and transport zinc and lead, but where the temperature of the fluids increase sufficiently with time, are later able to leach and transport copper. The minimum distance (≈18 km) separating ore deposits of this type is a function of the size of the convective systems.

The Lazy Head tungsten-copper-zinc prospect, Guysborough County, Nova Scotia

William G. Shaw - Department of Geology, Dalhousie University

Numerous tungsten occurrences in the Meguma Block of eastern mainland Nova Scotia are being systematically studied.

At Lazy Head, Guysborough County, (near Canso), tungsten, copper and zinc mineralization occurs within a 1.5 metre thick, conformable, lenticular altered zone within a slightly overturned sequence of Meguma Group metasediments in the proximity (250 m) of an intrusive granitoid body.

The altered zone which can be followed at least 80 metres along strike and has been intersected by drilling 50 metres down dip consists of a fine-grained garnet-(spessartite 80%, almandine, gossular 20%) chlorite-quartz-carbonate skarn.

Scheelite and chalcopyrite occur as sparse disseminations in the skarn, whereas concentrations of the above minerals plus sphalerite occur within about 20, lens shaped,

quartz-microcline - apatite veins (2 to 3 cm wide) that cut the zone discordantly over 40 metres of strike length on the surface.

The distribution of scheelite and the mineralogy of the skarn suggest that metasomatic-hydrothermal processes, possibly associated with granitoid intrusion are responsible for the mineralization of a reactive (calcareous, manganiferous ?) horizon within the Meguma Group at Lazy Head.

This contrasts with the concordant scheelite-quartz-carbonate arsenopyrite vein type deposits found elsewhere in Southeast Nova Scotia such as at Moose River.

Detailed mapping, structural, mineralogical and geochemical studies provide a data base with which the roles of the Meguma Group sedimentary sequence and the processes that have affected them are evaluated to ascertain the genesis of the tungsten concentrations.

The cooperation of the Nova Scotia Department of Mines and Energy in this study is gratefully acknowledged.

The Hibernia Structure

Gene M. Leavitt - Exploration Superintendent, Mobil Oil Canada, Ltd.

The Chevron *et al.* Hibernia P-15 well discovered hydrocarbons in 1979 on the Hibernia structure. Since that time the Mobil *et al.* Hibernia 0-35 and B-08 wells have been drilled. Results from the three wells indicate the presence of a major oil accumulation. Hibernia is located on the Newfoundland Grand Banks 315 kilometres east - southeast of St. John's. The Hibernia structure is described within the context of regional and local geological setting, local stratigraphy and potentially productive hydrocarbon zones. Seismic data are shown and discussed to demonstrate the structural and stratigraphic aspects of the feature as presently interpreted.

Megashear tectonics and Appalachian magmatism

D.F. Strong - Department of Geology, Memorial University of Newfoundland

Megashear tectonics may be described as the variety of deformational processes resulting from oblique plate interaction, dominated by ductile shear zones but including zones of extension and compression, eg. as characterized by the interaction of the Pacific and American plate along the San Andreas fault zone. A megashear environment has been postulated by a number of workers for late Paleozoic orogenesis of the north Atlantic regions, and the author has applied the concept to interpretation of the origin of granitoid rocks in the Northern Appalachians. These rocks range from peralkaline through metaluminous to peraluminous with mainly crustal isotopic ratios, reflecting the differing tectonic environments described above.

Granitoid rocks of the southern Appalachians are more typically calc-alkaline with mantle isotopic ratios, suggesting more "normal" subduction - controlled petrogenetic processes. However, these too can be related to the

megashear environment, occurring at the termination of the Hercynian megashear where the collisional regime would best be accommodated by subduction. Local zones of such compression might also be reflected in calc-alkaline volcanism such as that around St. John, New Brunswick.