Minerals and Energy Branch

Mining Matters for Nova Scotia 2001

OPPORTUNITIES FOR ECONOMIC DEVELOPMENT

Report ME 2001-2

Ed. D. R. MacDonald

NOVA SCOTIA
Natural Resources

Honourable Ernest L. Fage
Minister

D. J. Graham
Deputy Minister

Halifax, Nova Scotia
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Program

Thursday, November 8, 2001

8:30 am - 7:00 pm - Registration (Commonwealth Foyer)

8:30 am - 9:00 am - Coffee and refreshments (in Commonwealth B)

9:00 am - 9:20 am - Fall business meeting of the Mining Society of Nova Scotia (MSNS) in Commonwealth B

10:00 am - 9:00 pm - Displays open (Commonwealth A)

9:30 am - 9:40 am - Welcoming remarks (Dan Graham, Deputy Minister of Natural Resources)
Note: All talks will be presented in Commonwealth B

Session 1 - The Many Facets of Resource Development (hosted by MSNS)
Session Chair: Kevin Beaton, President, MSNS

9:40 am - 10:00 am
George O'Reilly, DNR: Potential for rare metal deposits in southern Nova Scotia

10:00 am - 10:20 am
Steve King: Potential field interpretation and modelling: applications to onshore natural gas and salt exploration

10:20 am - 10:40 am
Don Jones, DNR: Coal in Nova Scotia: past and future

10:40 am - 11:00 am
Refreshment break

11:00 am - 11:30 am
Bakes Mitchell and Kirk MacLellan, Metals Economics Group: Global trends in non-ferrous exploration activity

11:30 am - 11:50 am
Darcy MacLeod, DalTech: The efficiency of flodrip wellhead separators

11:50 am - 12:10 pm
TBA

12:10 pm - 1:30 pm
Lunch break (no scheduled event)

Session 2 - Minerals and Economic Development in Nova Scotia
Session Chair: Mike Cherry, DNR

1:30 pm - 1:35 pm
Mike Cherry: Opening remarks

1:35 pm - 2:05 pm
Wayne Miyagashima, EnviroGold Technologies Ltd.: The Dufferin gold mine: past and present

2:05 pm - 2:35 pm
Gordon MacDonald, Petroleum Office of the Guysborough County RDA: The role of minerals in Guysborough's plan for future economic development

2:35 pm - 2:50 pm
Refreshment break (Commonwealth B)

2:50 pm - 3:20 pm
Jason Ross, Titanium Corporation Inc.: Exploration strategies for mineral sands deposits: Shubenacadie River case study

3:20 pm - 3:50 pm
John Keating, Black Bull Resources Inc.: The White Rock Mine project - from discovery to development

3:50 pm - 4:20 pm
Mike MacDonald, DNR: Future trends in the Nova Scotia mining industry

4:20 pm - 4:30 pm
Refreshment break

4:30 pm - 4:50 pm
Linda Ham and Paul Smith, DNR: Update on the Eastern Shore Compilation Project

4:50 pm - 5:10 pm
Dan Kontak, DNR: Geological insights into understanding industrial mineral resources in Nova Scotia: Yarmouth silica-clay and North Mountain zeolites

5:10 pm - 9:00 pm
Beer and Beef-on-a-bun Reception, hosted by the Hon. Ernest Fage, Minister of Natural Resources

Friday, November 9

8:30 am - 12:30 pm - Registration

8:30 am - 4:00 pm - Displays open (Commonwealth A)

8:30 am - 9:00 am - Coffee and refreshments

Session 3 - Current Geoscience Research in Nova Scotia
Session Chair: Mike Cherry

9:00 am - 9:20 am
Peter Giles, Natural Resources Canada, Rob Naylor, DNR, and Paul Tèniére, Acadia University: Geology of the Horton Group, northeastern Guysborough County and Isle Madam

9:20 am - 9:40 am
Susan Pullan, GSC, and Ralph Stea, DNR: Mapping shallow subsurface structure using seismic reflection techniques - examples from southern Cape Breton Island

9:40 am - 10:00 am
Brendan Murphy, St. Francis Xavier University: Late Paleozoic origin and evolution of the St. Marys Basin, mainland Nova Scotia

10:00 am - 10:20 am
Refreshment break

10:20 am - 10:40 am
Pierre Jutras, St. Mary's University: New tectonostratigraphic framework in the northernmost sector of the Maritimes Basin (Chaleur Bay area) - correlation perspectives

10:40 am - 11:00 am
Andrew Rencz, GSC: Multi-disciplinary study of mercury in Kejimkujik National Park, Nova Scotia

11:15 am - 12:00 pm
Keynote address, Tony Andrews, PDAC: Public image of the mining industry: some myths and realities

1:00 pm - 2:00 pm
Panel discussion on the future of geoscience in Nova Scotia and beyond

1:00 pm - 4:00 pm
Displays Open

4:00 pm
Conference closed

Public Image of the Mining Industry: Some Myths and Realities

T. Andrews[1]

For many years in Canada, the mining industry has yearned for a better level of understanding and appreciation from the general public, or, as it is so often phrased - *a better public image*. Among all of the challenging issues faced by our industry at any given time, this one has been placed, more persistently than any other, at or very near the top of our priorities, by both the rank and file and the leaders of the mining community.

The main underlying assumptions that have been driving this issue are that (a) the mining industry has a very poor public image, (b) the future survival and success of our industry depends on significantly improving our image with the general public, (c) it is within our means to accomplish this effectively and (d) the way to go about it is to educate and inform the general public through communication campaigns. It was assumed that increased awareness and appreciation by the general public would result in a higher level of credibility and support in political circles and thus a higher degree of success in dealing with all of our other issues.

Experience accumulated in Canada over the past 15 years indicates that the underlying assumptions with respect to the issue of public image and the approach on how to effectively address it, as articulated above, are fundamentally wrong. Evidence is presented which indicates that the level of support for our industry by the general public is not nearly as bad as we had suspected. More important, however, are the indications that the general public cannot be readily influenced and any effort to do so would be highly costly and very limited in any permanent results. These and other factors strongly suggest that strategies focused primarily on the general public will not be effective in altering the way in which the mining industry is perceived and, therefore, improving its public image.

The point of view is presented that the focus of our efforts should be on *special publics* as opposed to the *general public*, including government decision-makers at both the political and bureaucratic levels, local communities where we operate, school-aged children, and non-governmental organizations willing to support us. The general media are a force unto themselves, accountable to no one, and can easily spin our good news stories into bad ones. As such they are not an appropriate vehicle for this application. And to date our efforts to develop constructive relationships with environmental advocacy organizations have, with few exceptions, produced inconsistent and disappointing results.

The real key to changing how we are perceived is to let go of the idea that this is simply a public relations project - because it isn't. Our ultimate objective should be the improvement of *public trust* rather than simply *public image* and to accomplish this based on what we *do,* as opposed to simply what we *say*.

[1]Executive Director, Prospectors and Developers Association of Canada, 34 King St. E, 9th Floor, Toronto, Ontario, Canada M5C 2X8

Volcanic and Granitoid Rocks in the Western Part of the Sporting Mountain Area, Cape Breton Island[1]

S. M. Barr[2] and C. E. White

Because of limited outcrop, the distribution and nature of volcanic and granitoid rocks in the western part of the Sporting Mountain area were previously not well known. Earlier work in the Sporting Mountain area in the mid-1980s led to assignment of the volcanic rocks to the Pringle Mountain Group, while retaining the previously established name Sporting Mountain Pluton for the mainly granodioritic plutonic rocks that underlie most of the area. Based on petrological similarities, the Pringle Mountain Group and Sporting Mountain Pluton were assumed to be similar in age to the ca. 620 Ma volcanic and plutonic rocks of the East Bay and Coxheath Hills to the northeast.

Renewed interest in the Sporting Mountain area has developed because it partly lies on NTS map area 11F/11, part of the mandate of the South-central Cape Breton Island Targeted Geoscience Initiative aimed at developing the economic potential of the area. Hence, the results of previous mapping are being re-evaluated, and new mapping was done in the summer of 2001. Improved and new roads as a result of logging activity in the area provide better access and enhanced outcrop distribution. The new mapping shows that volcanic rocks are more extensive in the area than previously thought. They are closely associated with fine-grained granitic rocks in the southwestern tip of the Sporting Mountain Pluton, indicating that the area represents a subvolcanic part of the pluton. Varied dacitic, lithic and crystal tuff appears to grade upward into rhyolite, amygdaloidal andesite, and a sequence of maroon tuffaceous rocks, slate and arkose. A rhyolitic unit was sampled for U-Pb dating, and additional chemical analyses are being done to compare the volcanic rocks to those elsewhere in southeastern Cape Breton Island.

An outlying area of poorly exposed igneous units separate from the Sporting Mountain block is located southwest of Dundee. The area includes coarse-grained gabbro and diorite, overlain nonconformably by Macumber limestone (Windsor Group). The contact is well exposed in Hughies Brook, where the limestone contains numerous veinlets of chalcopyrite.

[1]Project funded in part by a research grant to S. M. Barr from the Natural Sciences and Engineering Research Council of Canada
[2]Department of Geology, Acadia University, Wolfville, Nova Scotia B0P 1X0

Stratigraphy and Structure of the Kingsville Salt Deposit, Windsor and Mabou Groups (NTS 11F/14), Inverness County, Cape Breton Island - Preliminary Observations[1]

R. C. Boehner

The Kingsville salt deposit is located near Kingsville, Inverness County, in the southwestern end of the River Denys valley, approximately 18 km north of Port Hawkesbury. Exploration work on the property by Domtar Inc. during the late 1960s to early 1970s outlined a large (>1 billion tonnes), geologically complex salt resource for solution mining. The full limits of the resource have not been defined by the ten exploration diamond-drill holes and one solution mining test well (KBW1) to depths of approximately 1200 m. Notable intersections of very high-grade salt were present in drillholes DK5, 6, 7, 9 and KBW1; however, a detailed stratigraphy or correlation of the Windsor Group was not described.

A very distinctive section of anhydrite with limestone and dolomite beds occurs at depths of 600-900 m (2000-3000 ft.) in drillholes DK10 and DK12. The sequence of green siltstone, carbonate then anhydrite in a normal upright minor cycle forms a major synform succession. Examination of the core from these drillholes confirms these are major synforms and probably are the upper Windsor Group C1 Limestone. The dips are steep (65-75º) and the true stratigraphic thickness is probably only approximately 75 m (250 ft.). Stratigraphically correlative units are represented in the adjacent drillholes (e.g. DK11 and DK8 with multiple fold repeats probable). DK11 has an overturned section of three carbonate/anhydrite/salt minor cycles, inferred to be the C1 Limestone. Synform/ antiform folds repeat part of the stratigraphic section three times with a synform at 872 m (2860 ft.) and an antiform at 1018 m (3340 ft.).

A similar succession with the C3 Limestone occurs in the transect that includes the KBW1 brine well. Here, DK3 has a major antiform sequence and lithology typical of the C3 Limestone at a depth of 550-800 m (1800-2620 ft.). The fold axis is inferred at a depth of approximately 686 m (2250 ft.) and two mirror image intersections of the C3 Limestone occur upright at 555-597 m (1820-1960 ft.) and overturned at 738-800 m (2420-2620 ft.). An upright section through the C3 occurs in DK9 at 646-665 m (2120-2180 ft.). Although the drill core is not available, a lithologically similar section occurs in KBW1 at 753-780 m (2470-2560 ft.) in an upright orientation. KBW1 and DK9 are only 38 m (125 ft.) apart; however, the 70º dips produce an intersection depth difference of 107 m (350 ft.). The dips are very steep 70-85º and thus the >1200 m drillholes may contain as little as a 300-500 m (or less if fold repeated) of stratigraphic section and consequently only a hundred metres (stratigraphic) of salt. The lithology of DK4 is very similar to the lower part of the Mabou Group with saline evaporite facies near the top of the Windsor and grey (minor red) lacustrine mudrocks (Hastings Formation). This hole has been sampled for palynological dating to confirm the relative ages.

In general, the Domtar drilling appears to represent the upper Windsor Group to lower Mabou Group, but may not reach the sections of Major Cycle 2 (B subzone) or Major Cycle 1 (A subzone of the Lower Windsor). These are generally the most saline of the Windsor cycles and thus may be prospective at deeper levels or elsewhere in the area. The depth to the bottom of the saline Windsor Group may be very deep, based upon extrapolation from the existing drilled stratigraphy and structure. It may be interrupted, however, by a major structural break and consequent section truncation (e.g. top of a possible basal anhydrite decollement/ thrust?). Stratigraphic and structural comparisons with McIntyre Lake and Port Richmond salt deposits as well as the Orangedale and Malagawatch salt and potash deposits will be investigated.

[1]Contribution to the federal-provincial Targeted Geoscience Initiative in south-central Cape Breton Island

Stratigraphy and Structure of the Orangedale Salt Deposit, Windsor Group, Central Cape Breton Island, Nova Scotia[1]

L. Cook[2] and P. S. Giles[2]

The Orangedale salt deposit is defined by three wells in the Orangedale area, 10 km northwest of Malagawatch, in central Cape Breton Island. The host strata are part of the regionally extensive Viséan Windsor Group.

Well Noranda-225-3 was drilled into a moderate- to steeply-dipping succession of interbedded siltstone, gypsum and minor limestone. At 75 m, the well intersected the Herbert River Limestone, the base of which marks the defined base of the upper Windsor Group. At 260 m, the well penetrated the first salt horizon. This salt interval contains thin interbeds of anhydrite with minor limestone as the well passes into the lower part of the middle Windsor Group. At 355 m, anhydrite with interbedded dolostone becomes the dominant lithology. At 430 m, the thicker dolostone units disappear, indicating the changeover to lower Windsor Group rocks and the second major zone of salt. The 'A' potash was encountered at 575 m and intersected again at approximately 650 m in overturned lower Windsor strata. The well did not encounter the middle Windsor Group 'B' potash, which was possibly removed by salt dissolution. Total depth of the well is 754 m.

Noranda-225-4 was drilled into 171 m of leached caprock consisting of lower middle Windsor Group gypsiferous siltstone and carbonate, before intersecting the first salt with interbedded siltstone of the upper parts of the lower Windsor Group at 160 m. At 268 m, the drill penetrated overturned lower Windsor salt and proceeded downhole but up-section into middle Windsor dolomite and anhydritic dolomite before intersecting 240 m of overturned middle Windsor salt. Hole O-225-3 did not encounter the 'A' or 'B' potash zones. Overall, the well records an overturned asymmetrical fold containing middle and lower Windsor Group rocks.

Well Noranda-225-5A contains 1078 m of middle Windsor Group strata. The hole first intersected overturned leached caprock of gypsum and siltstone. It penetrated five fold axes repeating the distinctive 'triplet marker' horizon six times, and the middle Windsor 'B' potash zone three times. The thickest intersected salt zone was encountered between 450 m and 800 m in a folded section of strata.

The Orangedale salt deposit displays a complex post-depositional tectonic history in which Windsor Group rocks are folded and overturned to form northeast-southwest recumbent folds. The area has relatively good economic potential for salt resources. However, the potash may be of lesser economic potential due to the structural complexity of the deposit.

[1]Contribution to the federal-provincial Targeted Geoscience Initiative in south-central Cape Breton Island

[2]Natural Resources Canada, Geological Survey of Canada Atlantic, P.O. Box 1006 Dartmouth, Nova Scotia B2Y 4A2

The Prospector Assistance Program

H. V. Donohoe and R. F. Mills

In the past ten years, prospectors have assumed an increasingly important role in mineral exploration. Through the Canada-Nova Scotia Economic Diversification Agreement, both governments have been helping prospectors in Nova Scotia with the Prospector Assistance Program (PAP). The PAP provides funding to train prospectors, explore their properties and market the mineral potential of their properties. The program is valued at $600,000 and began in 1997 with a four year time span. Its duration was extended into 2002 because not all funds were spent. The PAP has supported instruction for 289 people who enrolled in prospecting courses. Eighty-one prospectors have received financial assistance to work on their properties. Each prospecting assistance recipient may receive up to $5,000 from the program but must add an additional 30% in either in-kind work or direct expenses. On average, prospectors have increased their share from about 52% additional in 1998 to more than 78% in 2001. A small amount of money from the program leverages a considerable sum from the prospectors. Equally important as training and prospector assistance has been the marketing component of the PAP. By the end of the program in March 2002, 73 prospectors will have attended international trade shows in Canada to promote their properties. Each of these people has learned a considerable amount about the business side of prospecting. The program has been successful because prospectors have increased their skills for prospecting and for business development. Some prospectors have attracted the attention of major international exploration companies for tantalum (Sons of Gwalia Pty.) and gold (Anglo Gold Corporation). The province has benefiited because we now have twice as many active prospectors as when the PAP began in 1997. And most important of all, the PAP has motivated prospectors to become more active in their own work and in the affairs of the Nova Scotia Prospectors Association. All of us in the mineral industry benefit from nurturing the grass-roots of the mineral industry — prospectors.

A New Geological Map of the Cape Breton Highlands Based on Combined Geological and Remote Sensing Databases[1]

M. Ethier[2], S. M. Barr[2] and R. P. Raeside[2]

The Cape Breton Highlands of Nova Scotia consist of rocks with a wide range in age from more than 1200 Ma to less than 360 Ma and a wide range in composition. The distribution of these varied rocks and the nature of contacts between rock units as revealed by geological mapping are not everywhere clear due to limited exposure and difficulty of access in many areas. This study was undertaken to try to improve on the map interpretation by combining geological and remote sensing information. The geological information was gathered mainly by faculty and students of Acadia and Dalhousie universities during the 1980s. Remotely sensed databases used in the study included Radarsat S7, Landsat TM, gravity, magnetic (vertical gradient and total field), and radiometric data. In addition, a detailed digital elevation model (DEM) was constructed from 174 Nova Scotia 1:10 000-scale contour map sheets. These data were integrated into a Geographical Information System, and the resulting datasets used to evaluate the various geological interpretations of the highlands.

The resulting maps generally support the distribution of map units distinguished by geological mapping. Granitoid map units are particularly well distinguished using radiometric data, which were used to modify the shapes of most plutons compared to previous interpretations based solely on field data. The distinctive Grenvillian-age orthogneissic and plutonic units of the Blair River inlier are clearly distinguished from younger plutonic units of the Aspy terrane. The Black Brook Granitic Suite and associated units in the northeastern part of the Aspy terrane contrast with those in the remainder of the terrane, and with those of the Bras d'Or terrane. Vertical gradient data fused with the elevation model and with gravity data provided insight into the various metamorphic and structural domains in the highlands. These images indicate, for example, that the Eastern Highlands Shear Zone is truncated by a major north-trending structure that appears to merge to the north with the northeast-trending Aspy Fault. The combined data suggest that the Gillanders Mountain block east of Lake Ainslie may have been separated from the Cheticamp block by the development of a strike-slip basin represented by the Margaree Valley.

The generated images clearly distinguish the geological terranes that comprise the Cape Breton Highlands, and enable better definition of the positions of terrane boundaries in areas of limited outcrop, in particular in the central part of the highlands. However, the nature of the contacts and the significance of the differences among the terranes remain a matter of interpretation.

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[1]Funded by Acadia University and a research grant to S. M. Barr from the Natural Sciences and Engineering Research Council of Canada
[2]Department of Geology, Acadia University, Wolfville, NS B0P 1X0

3-Dimensional Basin Modelling in South-central Cape Breton Island[1]

M. Feetham, R. R. Stea and S. E. Pullan[2]

Work continued in south-central Cape Breton Island (NTS 11F/11, 11F/14) in 2001 as part of the Targeted Geoscience Initiative. The main goals of the surficial component of this project are to create 3-dimensional stratigraphic models of the basins, and investigate possible targets for industrial mineral resources in the Mesozoic and Cenozoic sediments infilling these lowlands.

Several methods are used to compile 3-D data. Drilled water wells (data from Nova Scotia Department of Environment database) were located for individual landowners by using a hand-held GPS unit. Depth of bedrock, as well as type of surficial material encountered is recorded in each well log. This information is an extremely useful and inexpensive tool in obtaining data for large areas. Approximately 364 water wells have been located out of a total 1500 for map sheets 11F/11 and 11F/14.

Other sources of data used in the compilation include field data from previous and current surficial mapping (R. R. Stea), bedrock geology (P. Giles, GSC), the Nova Scotia Department of Natural Resources drillhole database, and geotechnical drill logs from Department of Transportation and Department of the Environment.

In areas where information is limited, 100 m seismic test spreads are used to further delineate areas of deep surficial cover. In the fall of 2000, 79 spreads were run over the entire study area. An additional 59 spreads were run in June 2001. A 5 km detailed seismic line is planned across the deepest part of the River Denys Basin.

Drilling conducted in the winter of 2001 tested four lowland areas including three holes in the River Denys Basin (NTS 11F/14) and one in the River Inhabitants Basin (NTS 11F/14). Data will be released as an Open File Report as well as digitally on the Targeted Geoscience Initiative web page (under construction). Further drilling is planned in late 2001.

The data from these investigations will be presented in a GIS format using ARCVIEW®, and in HTML format as pages on the Nova Scotia Department of Natural Resources website. Digital 3-dimensional models and isopach base maps will be products of this study.

Work on this project will continue throughout 2002 and into the spring of 2003.

[1]Contribution to the federal-provincial Targeted Geoscience Initiative in south-central Cape Breton Island

[2]Geological Survey of Canada, Minerals and Continental Geoscience Branch, 601 Booth Street, Ottawa, ON K1A 0E8

Follow-up Mapping of the Glendale Graphite Deposit

P. W. Finck

Graphite is a black, very soft carbon mineral that occurs in flake, lump or amorphous form. The carbon content of a finished product should be as high as possible with amorphous graphite typically ranging from 70-85% C, flake graphite from 80-99% C and lump graphite from 90-99% C. Graphite is commonly used in refractory applications, crucibles, brake linings, carbon products, foundries, batteries, powdered metals and pencils.

A significant occurrence of graphite has been known to exist in the Glendale area of Cape Breton Island since the early 1900s. This deposit was revisited this summer in order to conduct detailed geological mapping, to familiarize staff with the deposit from a first hand perspective, and to serve as a base from which to compile previous work. The mapping was conducted at a scale of 1:2000.

Mapping confirmed in most cases the general results of previous work. The amorphous graphite deposit appears to follow a north-south orientation and is hosted by highly deformed black graphitic shale and black, graphitic metacarbonate. The results of the mapping are still in the process of being compiled. However, the deposit may be more structurally complex than previously thought, as features previously mapped as bedding may in fact be large scale mineral foliation developed by intense deformation.

In addition to graphite, an occurrence of highly coloured red marble was also located. The deposit has an apparent thickness of up to 100 m with an unknown depth. There appears to be potential for extension along strike of several hundreds of metres. Also associated with the red marble are jet black marbles cut by white calcite veins and black marbles with white calcite and hematite-stained calcite veins. All of these varieties exhibit intense plastic deformation and also occur as intensely brecciated and re-cemented metacarbonate. This potential dimension stone occurrence is being further investigated.

A map and report of the field work will be produced and released in early 2002.

Geology of the McIntyre Lake Salt Deposit[1]

P. S. Giles[2]

Seven deep wells drilled in the vicinity of McIntyre Lake (NTS 11F/11) in southwestern Cape Breton Island, define a major, structurally complex salt deposit. Since the early 1980s, this deposit has been known to consist of highly deformed strata ranging from the middle to upper Windsor Group and overlain by grey mudrocks of the lower Mabou Group. Since this deposit was defined, several large comparable deposits which are less complex structurally have been drilled in Cape Breton Island. Data from these deposits permit a stratigraphic re-assessment of the McIntyre Lake deposit and a reconsideration of structural interpretations.

Almost every well drilled at McIntyre Lake collared in basal gray mudrocks of the Hastings Formation (basal Mabou Group). Drillholes 5 and 2 penetrated a normal contact with uppermost Windsor Group strata, which are notably saline in character. Each of the upper Windsor Group carbonate marker horizons in these wells is part of a small scale cycle of sedimentation recorded by an ascending sequence of carbonate to anhydrite to halite to non-marine siltstone. Hole 5 bottomed in beds of the upper Windsor Group. Hole 2 extended to greater depths, and passed through a faulted contact between upper Windsor Group strata and highly deformed middle Windsor Group rocks. Hole 3 collared in upper Windsor Group beds at approximately the level of the D3 limestone marker. Hole 3 recorded several fold- and fault-repeated sections, mainly in beds of the upper Windsor Group, and in addition drilled a small interval of the middle Windsor Group. Hole 7 intersected Mabou Group grey mudrocks in its upper part, then passed into highly deformed salt of the lower or possibly middle Windsor Group. In the lower part of that deep well, one distinctive fossiliferous marine carbonate interval with associated anhydrite and salmon-coloured siltstone was drilled twice without change in facing, indicating fault repetition. The assignment of that carbonate marker is uncertain since it was observed only in one well where it could not be linked to any associated carbonate markers. Salts which overlie and underlie this carbonate marker contain minor associated potash, suggesting that the carbonate represents one of the numerous markers of the middle Windsor Group. Potash has not been documented in upper Windsor Group saline successions in Atlantic Canada.

Each well at McIntyre Lake can be interpreted in terms of its structural configuration, and the stratigraphic relationships for the most part can be compared with less deformed saline successions of the Windsor Group. Correlation between the seven wells is in many cases tenuous at best, attesting to the degree of structural complexity in this deposit, perhaps more severe than in any other salt deposit in southern and central Cape Breton Island. Nevertheless, the deposit is situated relatively close to the Strait of Canso and is currently of interest for possible development of underground storage caverns for hydrocarbons.

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[1]Contribution to the federal-provincial Targeted Geoscience Initiative in south-central Cape Breton Island

[2]Natural Resources Canada, Geological Survey of Canada Atlantic, P.O. Box 1006, Dartmouth, Nova Scotia B2Y 4A2

Stratigraphy and Structure of the Malagawatch Salt Deposit - Windsor Group, Central Cape Breton Island, Nova Scotia[1]

P. S. Giles[2]

Ten deep wells define a major salt deposit in the Malagawatch area of central Cape Breton Island. This deposit is notable for its documentation of the stratigraphic extent of bedded rock salt throughout almost the entire Windsor Group in cyclically repeated sedimentary rhythms of variable thickness. In addition, extensive coring of the deposit in combination with downhole mechanical logging provides an excellent base-line study of variations in the geophysical response of Windsor Group strata both laterally and vertically. These deep wells also reveal the importance of ground-water dissolution in governing the depth (from surface) to salt, and more importantly, document that the first downwards appearance of bedded halite in any such deep well has little significance in terms of marking local stratigraphic position.

The highest Windsor Group strata intersected in the Malagawatch drillholes are redbeds lying just above the C3 limestone of the upper Windsor Group. The lowest Windsor Group strata were cored in a separate series of more shallow holes, included in the accompanying cross-section, and represent basal Windsor beds of the thick "basal anhydrite" and laminated limestone of the Macumber Formation. Hole M10 drilled almost the entire thickness of the basal anhydrite, but stopped short of the Macumber Formation. Although tightly folded in both small and large scale structures, the Malagawatch wells collectively provide an excellent record of stratigraphic detail, unmatched in any other area of Cape Breton Island.

Potash salts are interbedded with halite at two principal stratigraphic levels, the higher within the middle part of the Windsor Group, and the lower within the thick salt succession which completes the first major cycle of sedimentation in the lower Windsor Group. These potash beds are regionally of economic interest, but at Malagawatch may have limited potential due to the deposit's structural complexity. Thick beds of relatively pure halite are also potential resources, and may provide horizons suitable for the development of underground storage caverns. Other economic aspects of the deposit include the presence of light liquid hydrocarbons in holes drilled to the level of the Macumber Formation at relatively shallow depths on the flanks of North Mountain.

[1]Contribution to the federal-provincial Targeted Geoscience Initiative in south-central Cape Breton Island
[2] Natural Resources Canada, Geological Survey of Canada Atlantic, P.O. Box 1006, Dartmouth, Nova Scotia B2Y 4A2
e-mail giles@agc.bio.ns.ca

Stratigraphy of the Estmere Salt Deposit, Central Cape Breton Island, Nova Scotia[1]

P. S. Giles[2]

The Estmere salt deposit is defined by a single deep well (Noranda 227-1) drilled in 1981 as part of a regional exploration program for salt and potash. This well was cored from a depth of 345 m to TD at 860 m. The first salt horizon was intersected at approximately 396 m in strata near the top of the middle Windsor Group. The well bottomed in the main salt of the lower Windsor Group. No potash salts were encountered.

The 227-1 well cored an apparently undisturbed succession of middle and lower Windsor Group strata. Mechanical logs, compared with the Malagawatch succession data located south and west of the Estmere deposit, show that the lower beds of the upper Windsor Group were also encountered in the upper part of the well. The succession can be correlated with the composite Windsor Group succession with considerable confidence from a level slightly above the B3 limestone (upper Windsor Group) to the total depth within the lower Windsor Group salt beds. Unlike other wells drilled in the central part of Cape Breton Island, the Estmere 227-1 well shows no evidence for fold or fault repetition within the Windsor Group.

The uppermost succession in the well, known only from mechanical logs and cuttings descriptions provided by the Noranda well description, remains problematic. Recorded descriptions indicate that mudrocks extend from surface to approximately 143 m. This thickness of uninterrupted mudrock is unknown within gently- to moderately-dipping Windsor Group beds, but is not atypical in general terms in the overlying Mabou Group. Without any available data concerning tectonic tilt of beds in the highest part of the well, it is not possible to identify the stratigraphic position of these mudrocks. Only if they were steeply dipping could they be reasonably assigned to the Windsor Group. In southwestern Cape Breton Island, many wells have penetrated Mabou Group strata faulted against underlying Windsor Group strata. This might also be the case in the Estmere salt deposit.

All salt deposits in southwestern and central Cape Breton Island show varying degrees of structural complexity. The apparent simplicity of structure in the Estmere deposit may be real. However, considering the scale of fold structures well documented at Malagawatch, where fold limbs reach more than 600 m in thickness, structural simplicity at the Estmere deposit could be quite misleading for any future development, and would require independent substantiation. Potash potential has not been established, although the well may not have penetrated to sufficient depth in the lower Windsor Group to test for the ‘A potash’. The ‘B potash’ in the middle Windsor Group was not recorded in cores through the target interval, and it is presumed to be absent in this deposit. Nevertheless, several thick and relatively pure salt intervals are prospective both for salt as a resource, and as horizons with potential for cavern development.

[1]Contribution to the federal-provincial Targeted Geoscience Initiative in south-central Cape Breton Island

[2]Natural Resources Canada, Geological Survey of Canada Atlantic, Dartmouth, Nova Scotia B2Y 4A2
e-mail giles@agc.bio.ns.ca

Stratigraphy and Structural Geology of the Cleveland Salt Deposit (Noranda 227-2 Well)

P. S. Giles[1]

The Cleveland salt deposit is defined by a single deep well drilled in a search for potash resources. Located in the east-central portion of NTS map area 11F/11, the well was cored from surface. The stratigraphic setting of the deep sub-surface revealed dramatic complexity, quite unexpected when compared with gently dipping strata at surface.

Highest strata in the well are assigned to the Pomquet Formation of the Mabou Group and comprise mainly fine-grained red siltstone and sandstone. At intermediate depths, the hole penetrated grey mudrocks with minor red mudrocks and rare limestone of the Hastings Formation (lower Mabou Group). All Mabou Group strata are essentially flat-lying, as they are in surface exposures near the well head. Beneath the Mabou Group, the well intersected significant thicknesses of salt-bearing Windsor Group. The uppermost Windsor strata represent the main lower Windsor Group salt, impure with interbedded siltstone and overturned. The well passed downwards and up-section into middle Windsor Group beds represented by intercalated anhydrite and fossiliferous marine carbonate rocks, still facing downwards in the hole, and then passed through a fold axis and drilled the same beds facing normally. At this depth, the hole passed through a fault and cored coral-bearing limestone of the Herbert River limestone (basal upper Windsor Group), also facing normally. Near the bottom of the hole, the Herbert River limestone was intersected for a second time, still facing normally, and interpreted as a fault-repeated section. The hole bottomed in uppermost beds of the middle Windsor Group a short distance below the base of the Herbert River limestone. The total thickness of Windsor Group strata intersected in this well represents only a small portion of the total Windsor Group known in other salt deposits in southern Cape Breton Island, such as Malagawatch and McIntyre Lake.

The relationship of the Mabou Group strata to the underlying Windsor Group is a fault, the nature of which is problematic. In southern Cape Breton Island, Mabou strata in some areas are juxtaposed on the basal limestone of the Windsor Group across an interpreted extensional detachment. The Mabou-Windsor contact in well 227-2 may represent this same detachment. However, the occurrence, beneath this fault surface, of middle Windsor Group above upper Windsor Group strata, all facing normally across a second faulted contact, suggests that reverse faults must be invoked in the deeper subsurface. The data provided do not allow a full assessment of the potential of the deposit to host significant salt and/or potash, and indeed do not provide any firm indication of depth to the true base of the Windsor Group. The degree of stratigraphic and structural complexity revealed by this well suggests a need for caution in constructing any cross-sections to depths below those penetrated by deep salt wells in south-central Cape Breton Island.

[1]Natural Resources Canada, Geological Survey of Canada Atlantic, P.O. Box 1006, Dartmouth, Nova Scotia B2Y 4A2
e-mail giles@agc.bio.ns.ca

Geology of the Horton Group, Northwestern Guysborough County and Isle Madame, Cape Breton Island[1]

P. S. Giles[2], R. D. Naylor and P. J. Ténière[3]

Horton Group rocks in northwestern Guysborough County are tightly folded, strongly cleaved and cut by major faults. Historically this has made lithostratigraphic subdivision of these rocks difficult. The rocks are also thermally mature, making recovery of useable palynmorphs for biostratigraphic analysis nearly impossible. Despite these challenges our mapping this summer has allowed us to make considerable progress in recognizing lithostratigraphic subdivisions within the Horton Group. The oldest Horton Group beds in the study area are assigned to an informal lower member of the Clam Harbour River Formation (CHR). Best exposed in the vicinity of England Lake in the core of a major anticlinal structure, this member is typified by pebbly sandstones, polymictic conglomerates, and interbedded maroon and grey-green siltstones. The upper member of the CHR lacks significant coarse-grained facies and is dominated by both grey-green and red siltstones, often banded at centimeter scale, with interbeds of fine-grained sandstone. The Tracadie Road Formation (TR) overlies and is transitional through limited interbedding with the CHR. Dark grey to black siltstones are characteristic of the Tracadie Road Formation. In its lower parts, the TR consists of grey, multistoried fluviatile sandstones interbedded with lessor black siltstones. Polymictic conglomerates occur as lags within the sandstone bodies, which reach tens of meters in thickness. In its upper parts, dark grey and black siltstones dominate the TR, although sandstones are intercalated, often containing plant remains and evidence for rooting. In the northwestern part of our map area the TR is characterized by highly calcareous black parallel-laminated and banded siltstones. The Caledonia Mills Formation (CM) conformably overlies the TR, and is characterized by thick fluviatile quartz-rich sandstones intercalated with red siltstones. Black and dark grey siltstones are not typical of the CM on 11F/11, but are intercalated with fine-grained red strata of the CM in areas to the west and southwest. Polymictic conglomerates derived almost solely from granitoid rocks of the Cape Porcupine complex occur in the lower parts of the CM north of Aulds Cove. The Caledonia Mills Formation is overlain unconformably by the Macumber Formation (basal Windsor Group). South of Cape Porcupine, we have mapped a succession of pebbly sandstones, red, green-grey and black siltstones, and minor polymictic conglomerate which overlies black siltstones of the TR near Mulgrave, and grey and red strata of the upper CHR to the south at Steep Creek. The varied relationship at the base of this capping succession suggests that it unconformably overlies older Horton Group strata. It is itself overlain by the Macumber Formation, and is concordant and possibly conformable with that rock unit.

Mapping of the Horton Group on Isle Madame is not yet completed. Sharpstone conglomerates, previously assigned to the Horton Group, are intercalated with marine limestones, and are here assigned to the Windsor Group. We have recognized a mappable interval dominated by black, parallel laminated and banded siltstones with associated grey-green siltstones and lesser fluviatile quartz-rich sandstones. This unit overlies a succession of fluviatile sandstones with coarse- well-rounded polymictic conglomerate interbeds, and interfingering intervals of dark grey banded siltstone. These rocks may collectively represent the two informal members of the Tracadie Road Formation in Guysborough County. Underlying strata are dominated by red muddy-matrix fine-grained conglomerates interbedded with red muddy sandstones. Strata overlying the black siltstone interval are typically conglomeratic with colours ranging from red to brown with sandy matrix. Overall, Horton Group strata on Isle Madame are coarser than those mapped in Guysborough County, and correlative relationships with the latter area are not yet secure.

[1]Contribution to the federal-provincial Targeted Geoscience Initiative in south-central Cape Breton Island

[2] Natural Resources Canada, Geological Survey of Canada Atlantic, P.O. Box 1006, Dartmouth, Nova Scotia B2Y 4A2
[3] Department of Geology, Acadia University, Wolfville, Nova Scotia B0P 1X0

Geochemical Metadata Compilation

T. A. Goodwin and B. E. Fisher

What are metadata? Quite simply, metadata consist of data about data. For example, stream sediment geochemical surveys are available for most parts of the province. Client requests for these data are normally in the form of a digital file that contains a UTM co-ordinate and analytical results for the stream samples. The digital files do not, however, contain information with respect to the size fraction used, dissolution techniques, or the type of instrumental finish employed. A metadata file contains this and additional complimentary information cross-referenced to specific geochemical survey results.

Why capture metadata? There are a number of reasons why metadata should be captured into a database for future reference. First and foremost, if metadata are not recorded, critical survey information will be lost with the passing of time. A metadata database will serve as a timeless archive of all survey parameters. These parameters are critical when comparing or merging various data sets that are not linked temporally or analytically. End users can best determine the applicability of each data set once metadata files are reviewed. Key fields of metadata information to be recorded include: NTS map sheet coverage, accuracy of X-Y co-ordinates, field collection techniques, laboratory name, preparation techniques, size fraction, digestion, instrumentation, and upper/lower detection limits, to name a few.

The Canadian Geoscience Knowledge Network (CGKN) is a collaborative effort between the 12 provincial and territorial geoscience agencies and the federal Geological Survey of Canada (GSC), which operates six offices across Canada. The plan is for the CGKN to be a single window, using the Internet, to access the geoscience holdings of all the surveys. Nova Scotia is a partner in the CGKN Geochemistry On-line project, which is an attempt to build a common geochemical data model. By using a common data model and consistent quality standards, databases can be managed by the contributing organization on their own database servers while providing a seamless Internet connection to other contributing partners.

Through CGKN the Department of Natural Resources was given limited funding to identify provincial geochemical data sets that require capture of metadata information. The department, through this outside financing, was able to hire one person on a part-time basis for several months whose main functions were to sleuth out and record pertinent metadata information on various regional geochemical data sets.

The effort of finding and recording pertinent metadata on a particular geochemical survey was labor intensive. The process required searching for and reviewing original field maps, original laboratory reports, published maps and reports from both levels of government and, of course, discussions with department staff who may have served as party chiefs or field crew members. This research resulted in the added benefit that inconsistences and errors in the data sets were identified. The overall process also involved additional human resources from the department, namely those involved in the design and structure of the new databases and the creation of programs that would populate the new data model.

To date, the department has entered metadata from three regional geochemical surveys namely: (1) a 1986-1987 regional stream sediment and stream water geochemical program from northern Nova Scotia, (2) a regional biogeochemical survey from southwestern Nova Scotia and (3) a series of till surveys over mainland Nova Scotia that commenced in 1977 and continued through to 1986. Data from one survey have been entered into the new geochemical data model which is currently being tested at the GSC. CGKN is currently looking at building tools that will reduce the amount of programing required to populate the database model.

Future work will include capture of pertinent metadata for all geochemical data sets available from DNR and the identification of any inconsistences or errors that may reside within the data sets. The availability of human and financial resources will ultimately dictate the number of geochemical data sets to be incorporated into the metadata database.

Mercury in Till, Kejimkujik National Park, Nova Scotia - An Update

T. A. Goodwin, P. K. Smith and B. M. Culgin[1]

The source(s) of the mercury (Hg) recently identified in biota tested in and around Kejimkujik National Park is currently unknown and is the focus of a broad, multi-disciplinary research effort involving biologists, chemists, meteorologist and geologists. One component of the geological/geochemical research involves: (1) the collection and analysis of C horizon till samples for Hg and multi-element geochemistry, (2) bedrock (and surficial) mapping, (3) collection and analysis of bedrock samples for Hg, multi-element geochemistry, sulphide type/content and magnetic susceptibility and (4) detailed ground magnetics.

Approximately 45 till sites were sampled during the summer of 2001. Most of these samples were collected immediately south of the park boundary. Sample sites were selected to adequately represent the various geological and surficial units identified on existing maps and from observations and interpretations based on field work completed during the summer of 2000. In addition to the till samples, nine rock samples were also collected from various stratigraphic units of the Halifax and Goldenville formations.

C horizon till samples were collected approximately every 100 m to 200 m along three transects that crossed the inferred Halifax/Goldenville contact. These samples were collected along logging roads and bush trails from depths ranging between 70 cm and 120 cm. Rock samples were also collected during the till sampling program where outcrops were observed. Detailed ground magnetics (12.5 m stations) were also completed along the same transects.

Strict quality control protocols are being followed for the collection, preparation and analysis of the till and rock samples. For example each site was photographed in the field and detailed notes were recorded. For samples submitted for geochemical analysis, sample batches were routinely accompanied by a certified reference standard, a field duplicate and a preparation split. Geochemical results are pending.

Bedrock mapping indicates the Halifax/Goldenville contact in the study area is farther north than indicated on published bedrock geology maps. Preliminary interpretation of the detailed ground magnetic profiles indicates the contact may be as much as 500 m to 1000 m north of the contact as presented on published maps. This is significant because Hg from till samples collected during the 2000 field season exhibit a spatial correlation with geologic contacts (particularly the Halifax/Goldenville) and increased Hg in till. The placement of the geologic contact farther to the north is also consistent with transported clasts observed in the various till matrices.

[1]Department of Earth Sciences, Dalhousie University, Halifax, Nova Scotia, B3H 4J1

Surficial Geology and Geochemistry of the Main Line and the Halifax Lateral Natural Gas Pipelines, Nova Scotia

T. A. Goodwin and R. R. Stea

A 230 km long trench averaging 3 m in depth was excavated from Goldboro, Guysborough County, to the New Brunswick border during the summer of 1999 prior to the installation and burying of Nova Scotia's first natural gas pipeline (Main Line). The gas, destined for markets in eastern Canada and the northeastern United States, originates from Nova Scotia's offshore gas fields. A second trench referred to as the Halifax Lateral is approximately 125 km in length and runs from Pictou County to Dartmouth. The Halifax Lateral was excavated and backfilled during the summer of 2000 and brings natural gas to businesses and homes in the Halifax-Dartmouth metropolitan area.

Once all safety requirements with respect to working around open trenches were met, Maritimes and Northeast Pipelines granted permission to the Nova Scotia Department of Natural Resources to map the surficial geology of the trenches and to sample material removed from the trenches.

The surficial geology of the Main Line and the Halifax Lateral was mapped in 1999 and 2000, respectively. The surficial geology was broadly classified with respect to type and associated landform features. Locally, one mappable till unit predominated, although more than one till unit was noted at a number of locations. Where observed, a distinct peat layer separating two till units was mapped and sampled for subsequent age determination.

Samples for geochemical analysis were collected approximately every 500 m along the entire length of both trenches. During the sampling of the Main Line in 1999, 10 kg till samples were routinely collected at each sample site. However, during sampling of the Halifax Lateral in 2000 a 5 kg sample and a separate 500 g sample were routinely collected at each sample site. Strict quality control protocols were adhered to during the collection of the samples in the field and during the laboratory preparation and analysis.

All samples have been analyzed for Au, Hg and multi-element geochemistry (<63 microns fraction). These data are currently being assessed and prepared for publication as an Open File Report. Future processing of the bulk till samples is budget-dependent and may include preparation of heavy mineral concentrates, mineralogical descriptions and clast counts.

All sample material is currently being stored at the department's Core Library in Stellarton.

Gabbroic Intrusions in the Meteghan - Yarmouth Area of the Meguma Terrane, Southern Nova Scotia[1]

R. C. Gould [2], C. E. White and S. M. Barr[2]

A number of gabbroic plutons and dykes outcrop in the Meteghan -Yarmouth area of the Meguma terrane of southern Nova Scotia. They occur in both metasandstone and slate units of the Cambrian to Early Ordovician Goldenville and Halifax formations and metavolcanic and metasedimentary rocks of the Late Ordovician to Silurian White Rock Formation. Recent 1:10 000-scale bedrock mapping related to the Southwest Nova Mapping Project has better defined the contact relationships, shape, orientation, size and areal extent of these intrusions. Their age is not well constrained but based on petrographic and chemical similarities to gabbroic and basaltic units in the White Rock Formation, they are interpreted tentatively to be Silurian. A suite of samples has been collected from the intrusions to better describe their petrographic and chemical characteristics and determine the age and tectonic setting.

The Nickerson Point gabbro outcrops along the coast northwest of Yarmouth and consists predominantly of medium-grained equigranular gabbro with well-developed fine-grained chilled margins against adjacent metasandstone of the Goldenville Formation. Near the contacts, the gabbro contains xenoliths of metasandstone and locally displays weak layering (<2 cm wide) defined by alternating plagioclase-rich and plagioclase-poor bands. Locally, the gabbro is cut by amphibole-bearing pegmatitic dykes and pods and “granitic” aplite. On the southwestern margin the gabbro is intensely altered and displays a shallow, well-developed southwest-dipping foliation.

Two gabbroic intrusions occur in the Mavillette area. They are more texturally varied than the Nickerson Point gabbro, and locally contain large poikilitic plagioclase and acicular amphibole crystals, as well as pegmatoid gabbro patches. Texture is generally ophitic to intergranular, dominated by plagioclase and clinopyroxene, largely altered to amphibole. In addition, these bodies contain significant amounts of pyrite and pyrrhotite. New exposures in the area show that the Mavillette gabbro bodies intruded quartzite and metavolcanic rocks of the White Rock Formation. Previously reported chemical data from one of the bodies indicates an evolved, Fe-rich tholeiitic composition. The Mavillette gabbro intrusions have been extensively quarried for breakwater construction.

The Wentworth Lake gabbro forms a narrow, northeast-trending elongate body exposed on islands in the lake. It is texturally similar to the Nickerson Point gabbro, although to the southeast it becomes increasingly deformed and mylonitic in character. Locally the gabbro contains significant amounts of chalcopyrite. Contacts with the Goldenville and Halifax formations are not exposed. A sample from the Wentworth Lake gabbro has been collected for U-Pb dating.

Based on textural similarities, some gabbroic dykes/sills in the Halifax Formation are interpreted to be related to the gabbroic intrusions and have also been sampled for petrological study.

If the gabbroic intrusions are related to mafic volcanism in the White Rock Formation, then igneous activity related to latest Ordovician-Early Silurian extension within the Meguma terrane is more voluminous and widespread than previously recognized.

[1] Project partially funded by a Research Grant to S. M. Barr from the Natural Sciences and Engineering Research Council of Canada
[2] Department of Geology, Acadia University, Wolfville, Nova Scotia B0P 1X0

Volcanic Rocks in the White Rock Formation in the Torbrook Area, Nova Scotia: Petrology and Tectonic Setting[1]

D. M. Hagan[2] and S. M. Barr[2]

Previous mapping and stratigraphic study have shown that volcanic rocks are a significant component of the White Rock Formation in the Torbrook area in the southwestern part of the Meguma terrane of Nova Scotia. The volcanic rocks include both mafic and felsic units, and a U-Pb (zircon) age of 442±4 Ma has been reported for felsic volcanic rocks at the base of the section. However, no detailed study of the petrology of the volcanic rocks has been done. The purpose of this project is to map and sample the volcanic rocks, describe their petrochemical features, and compare them to volcanic units of similar age in the Yarmouth area that are also assigned to the White Rock Formation. The petrological features of the volcanic rocks will be used also to interpret the tectonic setting in which they formed. The chemical compositions of the mafic volcanic rocks will be compared to the compositions of mafic sills and dykes that are abundant in the underlying Halifax Formation in the Torbrook area, as well as in the Wolfville area, in order to determine whether or not the mafic intrusive rocks are likely to be co-genetic with the Silurian volcanic rocks, or with younger volcanic episodes such as that in the late Silurian New Canaan Formation.

Previous work in the Torbrook area has suggested that the volcanic units occur on both limbs of the Torbrook syncline, and can be traced over a strike length of about 35 km. The relationship with the underlying Halifax Formation appears conformable; however, based on the presence of fossils no younger than Tremodocian in the Halifax Formation, and the ca. 442 Ma age (latest Ordovician to early Silurian) from the felsic volcanic rocks at the base of the White Rock Formation, the contact is more likely to be a disconformity representing an age gap of as much as 40 million years. The volcanic rocks occur interbedded with slate and are overlain by quartzite units characteristic of the White Rock Formation. Pillow basalts have been reported in Fales River, overlying the felsic volcanic rocks. The felsic volcanic rocks are mainly welded tuffs, with well preserved igneous textures in spite of a strong regional and local contact metamorphic overprint.

Also included in this study is an investigation of reports of felsic keratophyre in the upper part of the White Rock Formation in the Wolfville area. Preliminary results indicate that a felsic igneous unit is present at least locally, but it is not yet clear if it is an extrusive unit or a sill.

[1]Project funded by a Research Grant to S. M. Barr from the Natural Sciences and Engineering Research Council of Canada and B.Sc. honours thesis research funds of the Department of Geology, Acadia University
[2]Department of Geology, Acadia University, Wolfville, Nova Scotia B0P 1X0

Eastern Shore Compilation Project

L. J. Ham and P. K. Smith

A wealth of information exists in the Nova Scotia Department of Natural Resources (NSDNR) databases, private research files, and internal company reports on the numerous gold districts located along the Eastern Shore of Nova Scotia. The first documented gold discovery was in 1858. By 1861, several gold-bearing areas were officially declared gold districts and gold had been discovered in a large number of mining districts throughout the Eastern Shore. Geological maps were produced early in the 19th century by E. R. Faribault, and W. Malcolm wrote a classic memoir on the gold districts in 1929. Since then, work has been done by mineral exploration companies, prospectors, universities and others.

The Eastern Shore Compilation Project was initiated to: (1) compile pre-existing geoscientific information on the gold districts and surrounding areas of the Eastern Shore, (2) incorporate relevant information on a digital base map with attached databases, and (3) write site-specific deposit reports, including historical and current reviews of deposit geology and the generation of interpretive models. Some of this work (whole-rock geochemistry) is being completed co-operatively with the Geological Survey of Canada (GSC). Work thus far has involved the easternmost portion of the study area (Guysborough to Country Harbour) and current work is centred around Musquodoboit Harbour. This work includes numerous gold districts, including Country Harbour, Wine Harbour, Forest Hills, Mooseland, Tangier and Montague.

Work to date has involved primarily digitizing the early work of Fletcher and Faribault (1886) and correcting and referencing the work on the digital base maps. Geological information from many other sources (maps and reports) were also digitized and overlain on this information. Initial work, done in AutoCad® 14 with Fieldlog® 3.4 (for the database component), was then consolidated in ArcView® 3.1 with other NSDNR information, primarily the mineral occurrence and drillhole databases with corrected drillhole locations. Individual gold districts recently digitized by the GIS section of the Minerals and Energy Branch, composite cross-sections, representative mine plan maps, and geophysics are incorporated on the base maps. Database information includes microprobe and whole rock geochemistry, petrography, gold and other selected metal analyses and isotopic data. Graphics plan maps based on NSDNR data files are ‘hotlinked’ to other digital files, including photographs. In addition, Malcolm’s 1929 memoir has been converted to digital form, complete with the original photographic images, and will be released by the GSC on CD-Rom.

The project area is underlain by metasedimentary rocks of the Goldenville and Halifax formations, with the Goldenville rocks forming anticlines and the Halifax rocks lying in the troughs of synclines. The structure of these formations, particularly in the gold district areas, is very complex. Some of the more important geological features of the districts include domed anticlines and numerous faults, which generally trend northwest and occur both locally and as cross-country faults. Local faults, found in all gold districts, are believed to be related mainly to the late-stage doming of anticlines. The Wine Harbour gold district is highlighted in the talk and posters, where gold was first discovered in interbedded veins in 1860, mined from 1862-1939, and 42,346.5 troy ounces were produced.

References

Fletcher, H. and Faribault, E. R. 1886: Province of Nova Scotia, Guysborough County, Map to Illustrate Geological Survey of Canada; Part A, Annual Report, v. 11; maps 25, 26, 27, 29 and 30; scale 1:63 360.

Malcolm, W. 1929: The gold fields of Nova Scotia; Geological Survey of Canada, Memoir 156 (reprinted in 1976 as Geological Survey of Canada, Memoir 385).

Geophysical Investigation of Salt Tectonics and Structure in the Eastern Magdalen Basin

N. Hayward[1], A. Grant[1], S. A. Dehler[1] and P. Durling[2]

The effects of regional tectonics on formation of the eastern Magdalen Basin are investigated in a geophysical study of salt structures and related magnetic anomalies. Resting on the crystalline basement of the Acadian Orogeny, the basin contains up to 10 km of Carboniferous rocks. These were intensely deformed by regional faulting and salt tectonism immediately following Viséan Windsor Group deposition, and prior to deposition of up to 8 km of Late Devonian sedimentary rocks. Rhomboidal zones of very low amplitude magnetic anomalies, associated with gravity anomaly highs, are enclosed by clusters of NNE- and ENE-trending, short wavelength magnetic lineations. These are shown on seismic profiles to be related to zones of diapir collapse and deformation near the margins of the salt structures. Magnetic models indicate both shallow (<300 m) and deeper (<1 km) fault or contact type magnetic sources for the lineations. Shallow sources are interpreted to result from mineralization associated with alteration in salt-impregnated, iron-rich sedimentary rocks, brecciated during salt activity. Deeper sources are related to faulting and may be linked to the deeper structure. The deepest regionally mappable seismic horizon at 2-5 s TWTT (~ 5-11 km), is associated with an unconformity at the base of the Windsor Group, sampled by the Cap Rouge well. Salt structure trend and location exhibit influence by faults and associated topographic highs in the base event.

The orientations of structural data in the eastern Magdalen basin are consistent with regional deformation associated with middle Carboniferous dextral strike-slip motion on the east-trending Cobequid - Chedabucto fault system. In the eastern Magdalen Basin this produced NW compression and ENE dextral motion from Viséan to at least Westphalian D. This resulted in thrusting of the base event to the SE of the Magdalen Islands and NE of Cape Breton Island, and dextral motion on faults which bound the southern edges of rhomboidal structures.

[1]Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, PO Box 1006, Dartmouth, Nova Scotia, B2Y 4A2; 902-426 5070, hayward@agc.bio.ns.ca
[2]Corridor Resources Inc. 5475 Spring Garden Road, Suite 301, Halifax, Nova Scotia, B3J 3T2

Geology of the Dufferin Gold Mine

R. J. Horne, M. Jodrey[1], P. K. Smith and K. Woodman[2]

Recent underground development and mining in the Dufferin gold mine has provided an opportunity to study the geology, in particular the vein system, of this deposit. The deposit occurs in the hinge zone of the Crown Reserve Anticline, a minor fold on the south limb of the Salmon River Anticline. The deposit represents the faulted extension of the old Dufferin mine, which operated during late 1800s and early 1900s. The Crown Reserve Anticline is a tight chevron fold in the Goldenville Formation, and in the mine area consists of thickly bedded metasandstone with minor slate. The deposit consists of several stacked saddle-reef veins, which occur with regular spacing within slate intervals. Locally, deep diamond-drilling has identified thirteen individual or groups of saddles to a depth of 400 m and shallow drilling indicates a 700 m strike extension for at least the upper two saddles. Development thus far is restricted to the upper two saddles. Cross faults locally offset the vein system by several metres.

Saddle reef and associated bedding-concordant (leg reefs) veins dominate the vein system. Both vein types result from flexural folding late in the folding history, with bedding-concordant veins related to high shear strain within slate intervals and saddles reflecting related hinge zone dilatency. Evidence of flexural shear is ubiquitous, defined by local leg reefs, rotation of cleavage, and common movement horizons, consisting of slip planes, thin clay layers and breccia zones. Movement horizons occur within nearly all slate layers, usually at the upper contact. Movement-related striations have a steep rake, consistent with flexural slip.

The upper saddle zone includes three saddle veins, with development restricted to the top vein, which is approximately 1-1.5 m thick. The second saddle vein is approximately 4 m thick at the hinge, with a similar horizontal thickness at the inner arc. Both the upper and second saddle veins are strongly asymmetric, with thick, massive quartz leg reefs extending down the north limb and a short, attenuated south limb. The saddle veins consist mainly of massive white quartz, with common crystal-lined voids. Minor laminated quartz and common en echelon shear veins occur at the margins of the saddles. Leg reefs extend from the upper saddle veins, and occur in several slate intervals stratigraphically above the upper saddle. These veins include laminated veins and en echelon shear veins. Laminated veins are typically 5-8 cm thick, consisting of dark banded quartz. Movement striae on internal laminae (planes) support a shear origin. Shear veins consist of an en echelon vein array confined to a bedding horizon, where individual veins strike parallel to bedding and their intersection with bedding is parallel to the fold hinge. These veins are strongly sigmoidal (pegged in sandstone and rotated within the slate intervals) and record significant reverse, dip-slip bedding-parallel shear. In some instances these veins are rotated into cleavage and extended (boudinaged) parallel to cleavage.

Arseonpyrite is abundant as coarse crystals and aggregates within the wall rock and throughout all veins. Pyrite is common on fractures and decorating quartz crystals. Galena is locally common and appears to show a positive correlation with visible gold. Chlorite is abundant in some en echelon and discordant veins.

[1]Department of Geology, Acadia University, Wolfville, Nova Scotia B0P 1X0
[2]D. R. Duncan and Associates, P.O. Box 3249, Windsor, Nova Scotia B0N 2T0

Geology Map of the Meguma Group, Wittenburg Mountain, Centre Musquodoboit Area

R. J. Horne and M. S. King[1]

The Meguma Group in the Centre Musquodoboit area of Wittenburg Mountain consists entirely of the Halifax Formation, which has been subdivided into the lower Cunard Member and overlying Glen Brook Member. The Cunard Member consists of dark slate and lesser, but significant, metasiltstone beds. The Cunard Member is typically sulphide rich, with coarse pyrite and pyrrhotite occurring within slate and metasiltstone intervals. This unit corresponds to areas of elevated aeromagnetic response along the margins of the Wittenburg Mountain slate belt. The Glen Brook Member consists of mainly green to grey, thinly bedded metasiltstone and slate. Metasiltstone beds are commonly cross-bedded, whereas slate beds are planar bedded. An interval of dark shale, locally with abundant centimetre-scale concretions, occurs in the lower part of the member, defining a useful marker horizon. Decimetre- to metre-thick metasandstone beds locally occur, particularly near the base of the member. The Glen Brook Member contains only small amounts of sulphide and underlies areas of relatively low aeromagnetic response.

The Wittenburg Mountain slate belt consists of a kilometre-scale synclinorium, herein referred to as the Wittenburg synclinorium. The overall synclinal form of the slate belt is supported by repetition of the lower Cunard Member on both margins. Three folds occur within the Glen Brook Member, including the South Branch Stewiacke Anticline in the centre of the synclinorium, which is flanked by two unnamed synclines. Bedding-cleavage relations and sedimentary structures indicate all folds are upward facing, and folds are steeply inclined and plunge moderately to the northeast and southwest. The lack of folds on the steep limbs of the synclinorium (Cunard Member) suggests that the folds within the Glen Brook Member formed after regional folding of the slate belt, and probably reflect shortening within the hinge of synclinorium. A cross-section constructed through the area is constrained by stratigraphy, including the concretion-bearing unit in the Glen Brook, and aeromagnetic data, and indicates that the folds are tight and that the Cunard Member is near surface in the hinge of the South Branch Stewiacke Anticline.

The Wittenburg Mountain slate belt defines an elevated, fault-bounded horst, bounded in the north by the Meadowvale Fault and in the south by the Musquodoboit Valley Fault. A wide zone of deformation occurs in the Halifax Formation adjacent to the Musquodoboit Valley Fault. This deformation is defined by a regional-scale, fault-related fold marginal to the fault, the geometry of which indicates north-side-up, dip-slip movement on the Musquodoboit Valley Fault. Bedding-cleavage relationships are constant across the fold, supporting a post-regional folding, fault-related origin for folding.

A copper occurrence consisting of malachite, chalcopyrite and bornite, occurs in the concretion-bearing dark slate unit of the Glen Brook Member on a logging road off the Branch Road, north of Elmsvale. The mineralized slate is restricted to a metre-wide altered zone (sericite) which appears to be controlled by cleavage.

[1]Consulting Geophysists, 72 Johnstone Avenue, Dartmouth, Nova Scotia B2Y 2KS
e-mail one.king@ns.sympatico.ca

New Tectonostratigraphic Framework in the Northwesternmost Sector of the Maritimes Basin (Chaleur Bay Area): Correlation Perspectives

P. Jutras[1]

Carboniferous geology in the Gaspé Peninsula of Québec was recently revised. Local Carboniferous stratigraphy is now subdivided into five formations, only one of which was recognized prior to 1999. The whole Carboniferous succession in Gaspé was mapped as the Bonaventure Formation by Logan (1846), and was later subdivided as the Bonaventure and Cannes-de-Roches formations by Alcock (1935). A red clastic unit, older than the Bonaventure Formation, was recently identified and is referred to as the Paspébiac Formation. Recognized remnants of this unit are limited to two small grabens or half-grabens located in the southern Gaspé Peninsula. The uppermost limestone detritus beds of the Paspébiac Formation underwent cementation and subsequent karstic weathering prior to being massively calcretized by saturated groundwaters for several metres in thickness. Similar, thick and massive groundwater calcretes affect the basal grey beds of the La Coulée Formation, which was recently identified in the eastern Gaspé Peninsula, and are demonstrably coeval with sedimentation of this unit. Thick and massive groundwater calcretes are rare in the geological record and are genetically associated with the proximity of evaporitic basins. An unconformable contact with the Bonaventure Formation is observed above the groundwater calcretes that affect the sommital karst-related regolith of the Paspébiac Formation, as well as above the groundwater calcretes that affect the clastic sediments of the La Coulée Formation. On account of this, these groundwater calcretes are considered penecontemporaneous, which suggests that the Paspébiac Formation is older than the La Coulée Formation. The Lower and Middle members of the abandoned Cannes-de-Roches Formation are now considered equivalent to the Bonaventure Formation and are also underlain by calcretized clastics of the La Coulée Formation. The grey clastics with plant remains that characterize the Upper Member of the Cannes-de-Roches Formation are also observed above the Bonaventure Formation within its former limits, which correspond to a separate subbasin (the Ristigouche Basin) with higher accommodation than that of the former Cannes-de-Roches succession (the Cannes-de-Roches Basin). These grey clastics bear a spore assemblage corresponding to that of basal Mabou Group beds (early Namurian) and are now referred to as the Pointe Sawyer Formation. They are conformably overlain by mature reddish-brown sandstones referred to as the Chemin-des-Pêcheurs Formation. Transpressive deformation affected the entire Carboniferous succession, probably during Pennsylvanian to Early Permian times, and juxtaposed the Ristigouche and Cannes-de-Roches basins. A La Coulée-type groundwater calcrete was recently identified unconformably beneath the Bathurst Formation of northern New Brunswick, which adds to other lines of evidence suggesting that the latter unit is equivalent to the Bonaventure Formation. Redbeds of the Shin, Hopewell Cape and Maringouin formations of southern New Brunswick are also similar to the Bonaventure Formation and seemingly occupy the same stratigraphic position, directly underneath early Namurian beds. In the Cumberland Basin, these redbeds conformably overlie middle Windsor Group limestone and bear a spore assemblage corresponding to that of the Upper Windsor. A La Coulée-type groundwater calcrete overlies a paleomarine wave-cut platform in the southern Gaspé Peninsula, suggesting that this circum-evaporite unit is also within the Windsor Group time-frame and that the La Coulée-Bonaventure unconformity is possibly an intra-Windsor event. The graben- or half-graben-bound Paspébiac Formation, 'stratigraphically' below the wave-cut platform, is most likely a Horton Group or Hillsborough Formation equivalent.

[1]Geology Department, Saint Mary's University, Halifax, Nova Scotia, Canada B3H 3C3
email jutras_pierre@yahoo.ca

The Black Bull Resources White Rock Mine Project - From Discovery to Development

J. Keating[1]

Black Bull Resources Inc. is a mineral development company trading on the Canadian Venture Exchange (CDNX) under the symbol BBS. Exploration work in recent years has identified a large resource of high purity quartz, kaolin and mica at the company's White Rock Property in Yarmouth County, Nova Scotia. Community consultation, baseline environmental studies, product development and other activities have been completed or are on-going with plans to commence production in 2002.

The White Rock property consists of 105 claims covering some 1650 hectares of Crown land. The property is approximately 45 km by paved highway from the deep-water port at Shelburne, and has a power grid within 10 km at the now closed Kemptville tin mine. Primary quartz and kaolin were first discovered in the early 1980s by Shell Canada Ltd. while exploring for greisen-hosted tin deposits. In 1997, CAG Enterprises Ltd. staked the area and confirmed the presence of large intervals of quartz and kaolinized granite.

Black Bull subsequently acquired the property and completed geophysical, trenching and drilling programs between 1999 and 2000. To date, 15 million tonnes of quartz (+98% SiO_2) and 4.7 million tonnes of kaolin have been outlined by drilling over a 1200 m strike length. The quartz breccia and kaolin-quartz-mica breccia zones occur within the Tobeatic Shear Zone as it transects leucogranitic rocks of the South Mountain Batholith. Mineralized zones vary from 100 to 200 m in width, exceed 100 metres in depth, and are open at depth and along strike. Approximately 5 km of favorable geology remain to be tested along strike. Preliminary analytical results indicate quartz breccia zones are of high purity and contain relatively low major oxide levels (Fe_2O_3, Al_2O_3, and CaO). Kaolinized breccia zones have higher yields than Cornish clay deposits, and all other factors (brightness, particle size, grit percentage, abrasion) meet standard filler clay specifications.

Quartz is used in glass, nonferrous smelting, foundries, cement, abrasives and other specialty products such as decorative landscaping and engineered stone tiles or countertops. Kaolin is a clay mineral used primarily in the paper industry as a filler and coating product. Mica would be a value-added product derived from the processing of kaolin. Mica is a platy mineral used in products requiring chemical- and heat-resistant qualities or structural stability such as joint compounds, paint and plastics. Black Bull is also investigating the development of value-added kaolin products for use in paper, ceramics and paints through a project co-funded with the federal government's Industrial Research Assistance Program.

MGI Limited began collecting baseline environmental data for Black Bull in 2000. Municipal, regional, provincial, and federal governments have been consulted on the development along with local environmental and other public interest groups. Representatives of surrounding native communities have also carried out a Mi'Kmaq Knowledge Study with historical and environmental components.

Next steps include the completion of kaolin product development work, securing of permits, and targeted exploration to further outline the quality and size of other mineralized zones on the property. Quartz production is anticipated to begin early in 2002, dependent on receiving the necessary permits. Construction of a kaolin processing facility will commence after completion of kaolin product development and securing financing.

[1]President and CEO of Black Bull Resources Inc., #303-Sun Tower, 100 West Pender Street, Vancouver, British Columbia V6B 1R8

Potential Field Interpretation and Modelling: Applications to Onshore Natural Gas and Salt Exploration[1]

M. S. King[2]

Recent developments in the East Coast oil and gas industry, including the construction of natural gas infrastructure, have lead to a marked increase in onshore exploration over many of the Carboniferous basins throughout Nova Scotia. Exploration mainly utilizes 2- and 3-D seismic acquisition; however, more effort has recently been directed toward the use of potential field (e.g. gravity and magnetic) data. In particular, the use of 2- and 2.5-D potential field models to aid in the layout and design of seismic surveys by mapping depth to economic basement and delineating gross sub-surface structure and stratigraphy.

The amount of detail in any potential field model is dependant on the sample spacing. The Carboniferous basins of Nova Scotia are covered by many generations of potential field data, including aeromagnetic and ground gravity surveys acquired from the 1950s to the present. The survey specifications are variable; however, they can provide accurate regional scale information for preliminary modelling of subsurface structure and stratigraphy. In many cases, however, it can be shown that prudent data acquisition provides a very cost effective method to image the sub-surface structure and stratigraphy of these basins in conjunction with more conventional petroleum exploration techniques.

A successful multi-stage modelling program was recently completed on behalf of Northstar Energy Corporation as part of a natural gas exploration program in the Kennetcook and Cumberland basins. Three generations of models were created: the first from the pre-existing regional data set, the second included a small number of additional gravity stations, and the third from detailed ground gravity and magnetic data collected in concert with more than 150 km of seismic data. The detailed ground survey information aided magnetic interpretation in particular by defining large-scale basement block faulting that significantly affects the present geometry of the Kennetcook Basin.

In the case of salt body delineation for either storage purposes or natural gas bearing structures, potential field modelling can prove particularly useful for two reasons. Firstly, the large density contrast to the surrounding strata tends to generate a strong gravity response. Secondly, many Carboniferous basins are underlain by magnetic strata (e. g. Halifax Formation); therefore, variation in the measured magnetic signal tends to define basement structure and stratigraphy. Empirical observations of work completed to date indicate that salt tectonism is also directly related to structural features originating in basement units. Magnetic data and modelling has successfully delineated these structures in both the Kennetcook and Cumberland basins.

[1]Data presented with permission of Northstar Energy Corporation, Calgary, Alberta
[2]Consulting Geophysicist, 72 Johnstone Ave., Dartmouth, Nova Scotia B2Y 2K5 e-mail one.king@ns.sympatico.ca

The Mira - Bras d'Or Terrane Boundary in Cape Breton Island, Nova Scotia: Potential Field and Petrophysical Investigations Applied to Tectonic Analysis in the Northern Appalachian Orogen[1]

M. S. King[2] and S. M. Barr[2]

The regional geology of Cape Breton Island is interpreted to consist of pre-Carboniferous terranes, correlative with those in other areas in the northern Appalachian orogen. The Mira terrane in southern Cape Breton Island is part of the Avalon terrane, based on features such as volcanic and plutonic events characteristic of those in the Avalon terrane elsewhere, and a Cambrian-Ordovician cover sequence. The Bras d'Or terrane in central Cape Breton Island differs from the Mira terrane in its complex metamorphic and tectonic history, and it is thought to represent a component of the Gander terrane. The interpreted boundary between the Mira and Bras d'Or terranes is situated in south-central Cape Breton Island and appears to be structurally complex, influenced by several tectonic events. However, its exact position is difficult to identify as most of the interpreted location lies beneath Bras d'Or Lake and/or Carboniferous sedimentary cover.

This project aims to constrain the spatial position and orientation of the Mira - Bras d'Or terrane boundary using potential field (i.e. magnetic and gravity) data supported by petrophysical (i.e. magnetic susceptibility and specific gravity) information. To date, several digital data sets comprising regional and detailed-scale airborne magnetic surveys and ground gravity surveys have been acquired and processed to generate detailed total field and enhanced potential field maps. In addition, magnetic susceptibility and specific gravity data have been collected on approximately 1200 samples.

This information will be used to generate a quantitative set of data associated with each of the two terranes. These criteria can then be used to evaluate the placement of the interpreted contact and to compare with other areas in the northern Appalachian orogen where similar geophysical and petrophysical data exist. In addition, the data will be used to generate 2-D models of the interpreted contact to evaluate its sub-surface position and orientation.

[1]Project funded by a Research Grant to S.M. Barr from the Natural Sciences and Engineering Research Council of Canada, and by the Nova Scotia Department of Natural Resources through the Targeted Geoscience Initiative
[2]Department of Geology, Acadia University, Wolfville, Nova Scotia B0P 1X0

Geological Insights into Understanding Industrial Mineral Resources in Nova Scotia: Yarmouth Silica-Clay and North Mountain Zeolites

D. J. Kontak

Industrial mineral production in Nova Scotia has been an important part of the provincial economy for over 150 years with, for example, extraction of coal, gypsum, limestone, aggregates, salt and barite, among the many varied products. Recent exploration and development indicates that two mining operations may soon join the list of important industrial mineral commodities produced within the province. These deposit environments have until recently been under-explored and not characterized in terms of their genesis. The aim of the present work is to: (1) examine these environments in the context of their formation, (2) characterize all aspects of the resource that may be relevant to development and beneficiation, and (3) determine features that are essential to understanding the extent of the resource and delineating additional resources.

Yarmouth Silica-Clay Deposit (formerly Flintstone Rock)

The deposit, under assessment by Black Bull Resources Inc., occurs at the contact of the Meguma Group metasedimentary rocks and the peraluminous 370 Ma South Mountain Batholith (SMB) and is located near many local markets that utilize a high-quality clay product. The mineralized zone was first realized during tin exploration in the late 1970s and early 1980s and staked in the mid 1990s for its clay potential. The deposit occurs as high-grade silica (ca. >98-99% SiO_2) and high-quality kaolinite (80-85% brightness) within a brittle-ductile fault zone of ≤1.5 km width, although the main mineralized zone is ≤200-300 m width. A drill indicated resource of 16 Mt silica and 4.6 Mt kaolin represents only a portion of the 6 km strike length of the mineralized zone. The mineralized zone consists of a margin of sheared granite, a border zone of quartz-kaolinite breccia, and a core of quartz breccia. Paragenetically, early silicification and feldspar-destructive clay alteration is succeeded by repeated brecciation and quartz infill. Preliminary fluid inclusion and stable isotope work indicates the fluids have minimum entrapment temperatures of 141° to 218ºC, salinities of ≤0.8 wt. % eq. NaCl, and represent a mixture of magmatic and meteoric reservoirs. Comparison with previous data for nearby mineralization at Little Tobeatic Lake suggests that the mineralized zone is laterally extensive (i.e. tens of kilometres) and represents part of an extensive silica/clay/base metal/ and precious metal environment. The structurally controlled mineralization probably occurred during rapid uplift of the SMB shortly after emplacement with incursion of meteoric water along a vertically extensive fault structure.

North Mountain Basalt Zeolite Deposit

The 201 Ma North Mountain Basalt (NMB) is well known for its abundance of zeolites. However, it is only recently that commercial development of these minerals has been realized by the C_2C Zeolite Corporation, presently in advanced stages of development of the Mountain View deposit. Zeolite mineralization occurs within the middle unit of the thick NMB, which comprises multiple thin (≤8-12 m) flows. Internally these thin flows are subdivided into distinct zones defined on the basis of vesicle distribution. Most important, the vesiculated zones are predictable and can be mapped for hundreds of metres along strike, which is relevant to resource development. Internally, the highest-grade zeolite zones occur within the middle to upper parts of flows and include zeolites occluding primary porosity (≤30-49%) and also replacing primary feldspar and glass. The process of zeolite formation involved initial degassing of a gaseous basaltic magma during eruption to form the vesicle-rich zones. Subsequently, heated fluids, currently of unknown origin, are inferred to have leached alkalies during reaction with matrix glass and formed the zeolites. Thus, the zeolites represent a hydrothermal event rather than burial metamorphism.

Glacial Stratigraphy and Till Geochemical Dispersion Controls Associated with the Brazil Lake Pegmatites, Southwest Nova Scotia

A. L. Locke[1], C. Stanley[1] and I. Spooner[1]

Southwest Nova Scotia is covered by a thick sequence of glacial till that represents an impediment to mineral exploration in that area. However, this till blanket also represents an opportunity, in that with knowledge of the glacial flow history and the results from soil and till analyses, exploration geochemical surveys can be properly interpreted and possibly lead to the discovery of underlying mineralization. As a result, glacial till exposures along the Atlantic coast have been examined to gain insight into the till stratigraphy of this area. An orientation survey was also initiated over and down-ice from the Brazil lake pegmatite, a Li-Cs-Be-Ta bearing dyke near Kemptville, Nova Scotia.

Glacial material is being analyzed geochemically and pebble count and size fraction data are being collected. Comparison of these results will be made with the glacial till and outwash occurring to the west along beach exposures at Cape Cove and Salmon River. Clast orientation, pebble count and size fraction distribution data are being combined with existing data to determine the history of glacial movement and to understand the stratigraphy of the glacial drift in this region.

Results are expected to provide insight into the glacial flow history of southwestern Nova Scotia, and facilitate mineral exploration in that area by identifying appropriate sampling, analytical and interpretation strategies to employ in till geochemistry surveys.

[1]Department of Geology, Acadia University, Wolfville, Nova Scotia B0P 1X0

Future Trends in Nova Scotia's Mining Industry

M. A. MacDonald

Mining is a cornerstone of the Nova Scotia economy, directly employing approximately 2000 people with several times this number indirectly employed in support industries. Commodities currently produced for both domestic and export markets include gypsum, salt, coal, gold, aggregate, limestone, dolomite, peat, barite, silica sand, slate and granite. Secondary processing of several of these commodities produces a wide range of products including bricks, various salt products, gypsum board, patio stones, pipe and other cement products, asphalt, traction sand and various other silica products, to name a few. The diverse geological setting of the province provides a rich endowment of industrial and metallic minerals and energy resources that continue to provide development opportunities.

Development of new mines ensures continued mineral production. Tusket Mining Ltd. and their partner Knauf began limited mining activities at the 300 million tonne Murchyville Gypsum Mine in 1999. Newfoundland Goldbar Resources Inc. commenced underground mining activities at its Dufferin Gold Mine on the Eastern Shore. Georgia Pacific Canada Corp. is currently developing a surface gypsum mine at Melford, Inverness County, to replace its nearby Sugar Camp Mine.

Advanced exploration and development projects will provide new mines for the future. C_2C Zeolite Corporation has received all the necessary permits for its zeolite mine near Greenwood and plans to commence production in 2001. Black Bull Resources Inc. is conducting feasibility work at its quartz-kaolin-muscovite deposit near Yarmouth.

Exploration activities may delineate new mineral deposits for future development. Titanium Corporation Inc. continues to evaluate the economic potential of titanium-bearing heavy-mineral sand deposits in the Shubenacadie River. Waseco Resources Inc. recently announced plans to explore for tantalum and other rare metals in the Brazil Lake area near Yarmouth.

Investment in new mining and processing technologies ensures that current operations remain competitive and represents a long-term commitment to Nova Scotia=s mining industry. Fundy Gypsum Company recently spent $20 million on a state-of-the-art crushing facility at its Miller Creek mine near Windsor. Pioneer Coal Limited has developed a high-wall miner to increase production at its surface coal mines in central Nova Scotia.

Other developments will impact the future of Nova Scotia=s mineral industry. Development of Nova Scotia's offshore oil and gas deposits will provide a domestic market for mineral products, most notably including mud-grade barite for drilling. Natural gas may provide the catalyst for heavy-industry developments that could consume a variety of mineral fillers. Natural gas may also be used as an energy source for processing mineral commodities including calcining kaolin and gypsum. Recent announcements by the US government regarding multi-billion dollar upgrades to road, rail and air infrastructure will provide a market for Nova Scotia aggregate materials. On-going research into clean coal-burning technology could provide environmentally friendly ways to generate electricity using Nova Scotia coal deposits.

Nova Scotia has an enormous transportation advantage over many other jurisdictions. Our many deep-water ice-free ports allow for cost-effective shipping of bulk mineral commodities. Clearly, the future for mineral development in Nova Scotia can be bright. One of the major hurdles facing mineral development is access to land. Finding the balance between competing land values while sustaining the political will to support mineral development is a significant challenge to the industry.

The Efficiency of Flodrip Wellhead Separators

D. MacLeod[1]

This project evaluates the overall efficiency of the Flodrip wellhead separator package. Tests were performed to determine under what conditions the Flodrip separator would operate optimally. The project focused predominantly on the design and limitations of the Flodrip separator, clarifying its applicability for gas installation in PanCanadian applications.

To perform the testing a monitored gas loop was created. By tapping the casing of a deep gas well, flow rates were monitored and a known amount of ethylene glycol was added to the gas stream. Gas and glycol were mixed upstream of the Flodrip separator using a choke. In theory, the Flodrip unit would separate the glycol from the gas and a dry gas stream would exit. Injected and recovered glycol levels were recorded. From these measurements, the efficiency of the “liquid knockout” from the Flodrip apparatus was calculated.

Data analysis on the Flodrip separator package resulted in the following conclusions:

1. Average separation efficiency of the Flodrip separator was 75.2% at (i) an average flow rate of 18.53 E3M3/D, (ii) an average pressure of 193.9 psia, and (iii) an average flow velocity of 2.61 ft/sec.
2. In general, as pressure increases, separation efficiency increases, and as flow rate increases, separation efficiency decreases.
3. As gas velocity increases, the separation efficiency decreases at an approximate rate of 10% per ft/sec.
4. For a minimum efficiency of 80%, a velocity of under 2 ft/sec should be maintained.
5. The two most important factors in the application of a Flodrip unit are the flow pressure and the flowing volume of gas. If one of these factors can be adjusted, as is not always the case, then the Flodrip’s efficiency can be controlled.
6. Flodrip’s capacity curves are slightly overrated. At lower flow pressures the Flodrip did not perform up to specifications with respect to capacity or velocity.
7. The Flodrip only operated at ~50% efficiency when the velocities were over 4 ft/sec.

[1]Department of Mining Engineering, Dalhousie University, Halifax, Nova Scotia

George River Group Metacarbonates – Advances in Resource Assessment[1]

D. J. MacNeil[2] and M. P. Cullen[3]

Metacarbonates of the George River Group in southern Inverness County (at Upper Glencoe, Kewstoke, Glendale, Cameron Mountain, Marble Mountain, Kennedy's Big Brook, Churchview) have been recognized for over a century as a significant industrial mineral resource. At various times, particularly since the mid-1970s, their potential for cement, metallurgical, chemical, filler-extender, building stone, aggregate, aglime, and pollution abatement material has been explored. Core drilled at Upper Glencoe in the mid-1970s and late 1980s by the Nova Scotia Department of Mines and Energy provides the best geological information on what is perhaps the best preserved carbonate-dominated succession of the George River Group, with its complexly deformed metacarbonates and associated siliciclastics, intrusives and rocks of possible volcanic origin.

Geological interpretation based on the Upper Glencoe drill core indicated that continuity of large-scale units within the carbonate is adequate to define large bulk-tonnage resources such as cement and metallurgical limestone. However, defining specific carbonate units which would satisfy specialized markets with tight physical and chemical specifications (e.g. fillers, decorative building stone) requires development of a finer correlation framework. Previous experience has shown that accomplishing this is fraught with difficulty, as might be expected in dealing with poly-deformed metacarbonate.

As a contribution to the Targeted Geoscience Initiative, a suite of core from the Glencoe limestone deposit was selected for examination with a view to assessment of litho-stratigraphic and structural relationships. Core from several adjacent panels was laid out and examined by several geologists (R. Boehner, L. Baechler, M. Cullen, G. Demont, D. MacNeil, R. Ryan, and P. Webster) with a variety of expertise and experience in these carbonates.

This collegial approach resulted in identification of potential marker horizons in thin quartzites, possible volcaniclastics, dolomites, and a conglomeratic unit. It is suggested that large-scale overturned folds occur, and isoclinal minor folds were identified. Ductile shear zones were recognized in the carbonates. Most significantly, the work resulted in recognition that detailed lithologic logging can identify markers, and individual carbonate units can be correlated laterally up to 125 m and it is suggested that this can be substantially extended.

[1]Contribution to the federal-provincial Targeted Geoscience Initiative in south-central Cape Breton Island
[2]Nova Scotia Department of Natural Resources, 300 Mountain Road, Sydney, NS B1V 1L8
[3]Mercator Geological Services Limited, 57 Portland St., Dartmouth, NS. B2Y 1H1

Management and Compilation of Digital Data for the Targeted Geoscience Initiative in South-central Cape Breton Island[1]

J. MacNeil and B. Fisher

Upon commencing work on the Targeted Geoscience Initiative (TGI) project, reviews of the project scope and sources of digital information relevant to the project were performed. Over ninety data sets were initially identified for potential inclusion in the project. These included maps that were currently in hard copy, databases, images, and other digital data sets. In conjunction with this activity, discussions were held to determine efficient data storage methods. Due to the amount and variety of data types, this organization is important to facilitate data handling, quality control, and distribution.

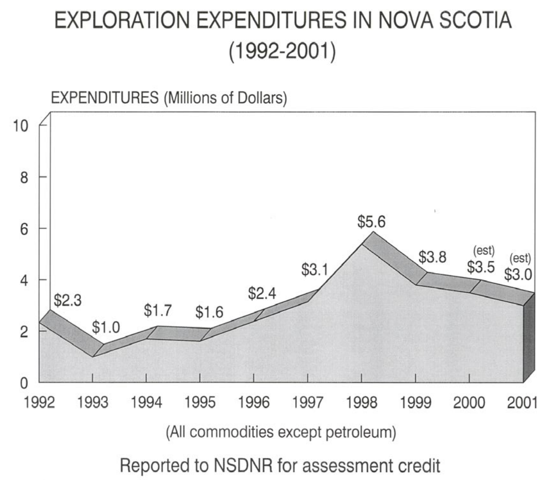
As the project progresses, additional data needs have been identified and refined. Different methods of data capture and processing are being investigated to determine the most effective combination of data format and ‘usability’. Methods include: scanning (image of data); scanning and raw georeferencing (allows use as a backdrop in GIS); scanning and correction (rubber-sheeting or orthorectification - more accurate backdrop/heads-up digitizing); digitizing and coding (allows electronic access to data in compilation and full GIS analytical capabilities); and conversion of data from one digital format to another.

The TGI:digital data project will bring together data and research, both past and present, in an accessible and readily usable manner. A web site is being developed which will contain the reports and digital products produced by everyone working on the project. All of the digital data sets will be incorporated into the Minerals and Energy Branch (MEB) Geographic Information System (GIS) and included as layers within one or more ArcView® projects that are being developed. Most of these digital products will also be made available by downloading from both the TGI and MEB web sites. A CD will eventually be released that will contain the entire web site, all the digital products and the ArcView® projects. Most of these products will also be included in the MEB Public Access GIS and on the Internet Map Server that the Branch is currently developing.

[1]Contribution to the federal-provincial Targeted Geoscience Initiative in south-central Cape Breton Island

Highlights of Mineral Exploration in Nova Scotia, 2001

P. D. McCulloch



The level of mineral exploration in Nova Scotia during the first nine months of 2001 has continued at approximately the same level of activity as in 1999 and 2000. In general, exploration expenditures have continued to decline over the past three years, however, with field expenditures expected to be in the range of $2.5-3 million for 2001, compared with $3-3.5 million for 2000, and $3.8 million for 1999. Exploration focused primarily on industrial minerals and gold, with very little activity for base metals. In this regard, interest in the exploration and development of industrial mineral commodities has strengthened in recent years, whereas activities related to the exploration and development of gold and base metals continues to decline due primarily to low commodity prices for metals and the difficulty in raising venture capital to fund exploration programs. Highlights of exploration activities during the first nine months of 2001 are outlined below.

Exploration and development of industrial minerals continued in 2001, including kaolin, silica sand, limestone, and zeolites. Black Bull Resources Incorporated, under an option agreement with CAG Enterprises Limited, continued a detailed exploration program for kaolin and silica in an altered quartz-kaolinite breccia zone along the Tobeatic Shear Zone in the Flintstone Rock area, Yarmouth County. The company completed additional trenching and bulk sample testing on the property during the year and completed a preliminary evaluation of mica reserves associated with the kaolin and quartz. Black Bull has also initiated a product research program to investigate the development of value-added kaolin products for the paper and ceramics industry.

C_2C Zeolite Corporation continued a detailed evaluation of the zeolite potential of amygdaloidal basalts along North Mountain in western Nova Scotia. The company completed diamond-drilling on its Pelton Mountain Road property in Kings County and are continuing development work on the company=s Tower View (Stronach Mountain) property. C2C has been issued a mining lease on the Tower View property and has received conditional environmental approval for an open pit mining operation. Nar Resources Limited, under an option agreement with Titanium Corporation of Canada Limited, continued to evaluate the titanium potential of heavy mineral sands in the Shubenacadie River near Maitland, Hants County. The company completed additional drilling during the year and to date has delineated mineral sand reserves of 330.9 million tonnes grading 1.936% Ti-bearing heavy minerals.

Shaw Resources recently completed an overburden drilling program in the McPhees Corner-Admiral Rock area as part of an ongoing program to evaluate the potential for silica sand resources. The company currently operates a silica sand processing plant near Shubenacadie. Robert MacDonald and George MacKay continued a detailed evaluation of the former Novex Mining Pine Brook barite deposit at Lochside, Richmond County. Additional diamond-drilling was completed on the property early in the year.

Newfoundland Goldbar Resources Incorporated completed surface diamond-drilling during the year to evaluate the strike extension of gold-bearing saddle reef structures on the company's Dufferin Mine gold property at Port Dufferin. EnviroGold Technologies Incorporated, operators of the Dufferin Mine, began producing gold in May 2001 at a preliminary production rate of 200 tonnes/day. True Metallic Explorations Incorporated continued a detailed evaluation of the paleoplacer potential for gold associated with clastic sedimentary rocks of the Lower Carboniferous Horton Group near Castle Frederick, Hants County. The company recently completed an evaluation of preliminary drilling results carried out in the fall of 2000 and expect to complete additional drilling on the property in the near future.

Maritimes Groundwater Initiative: Groundwater Resources Assessment in the Carboniferous Basin

Y. Michaud[1], M. Stapinsky[1], C. Deblonde[1], R. H. Morin[2], V. Boisvert[3], C. Carrier[4], T. Thériault[5], D. Conohan[6], B. Hulsman[6], E. Bourque[1], M. Parent[1], S. Paradis[1], S. Castonguay[1], G. Chi[1], K. Butler[6] and E. Boisvert[1]

Groundwater is an important source of water supply for over 60% of the population in New Brunswick, 50% in Nova Scotia, 29% in Newfoundland, and the entire population of Prince Edward Island. The bulk of groundwater supplies comes from aquifers within sedimentary rocks of the Carboniferous Basin and its surficial sediment cover. The Maritime Groundwater Initiative (MGWI) is a multi-disciplinary and multi-agency research project that aims to improve the understanding of groundwater flow dynamics within the major aquifers in the Carboniferous Basin, located in eastern New Brunswick, Prince Edward Island and northwestern Nova Scotia. The main objectives of the project are to provide baseline information for a regional groundwater resource assessment in the Maritimes, which will allow efficient groundwater management and protection during the land-use planning process. Phase I of the MGWI (2000-2003) consists in building a hydrogeological conceptual model of the Carboniferous Basin based upon existing information and detailed mapping in the study area. Extensive field work was carried out in the study area including: a regional water-level survey, pumping and packer tests, soil and rock sampling, groundwater sampling, installation of shallow monitoring wells, and borehole geophysical logging. A preliminary assessment of groundwater resources in the Carboniferous Basin is underway based upon field work results. More specifically, a piezometric map showing the direction of regional groundwater flow was made along with a series of assessments regarding the hydraulic properties for distinct rock units and the groundwater quality.

Acknowledgments: This project is funded through the Geological Survey of Canada Project Approval System (PAS). Major contributors to the project are: Nova Scotia Department of Environment and Labour (Mr. Briggins); New Brunswick Department of Environmental and Labour (Mr. Pupek and Mr. Brinsmead); Prince Edward Island Department of Fisheries, Aquaculture and Environmental (Mr. Somers and Mr. Mutch); the University of New Brunswick; Laval University; and INRS-Géoressources.

[1] Geological Survey of Canada, CGC-Québec, 880 Chemin Ste-Foy, P.O.Box 7500, Ste-Foy, Québec City, Québec G1V 4C7 (corresponding author)
[2] USGS, Denver, Colorado
[3] INRS-Géoressources, Québec City, Québec
[4] Laval University, Department of Geography , Québec City, Québec
[5] Laval University, Department of Geology and Engineering Geology, Québec City, Québec
[6] University of New Brunswick, Department of Geology, Fredericton, New Brunswick

Investigation of the Goddard Prospect, Mill Village, Nova Scotia

R. F. Mills

Recent underground exploration of the Gold Eagle workings at Mill Village have revealed very good grades of ore on initial inspection. This has renewed interest in investigation of the Goddard Prospect, which was the original site of discovery at Mill Village.

The Goddard Prospect was first investigated in 1897. At this time, W. H. Prest (1910) undertook a trenching program, which was subsequently continued by G. W. Goddard, in order to find the source of quartz float boulders from a 16 inch lead. Boulders from the prospect were reported to carry grades from 6 to 8 ounces per ton. Exploration at Mill Village would subsequently generate two producing mines (the Gold Eagle and the Thompson mines) and several further underground prospects (the Fairbanks Shaft, Twin Shafts and Winter Shaft) of sub-economic grade ore in the 1930s. The 16 inch vein reported to be the source of the Goddard Prospect was never found, however.

Faribault (1912) attributed this lack of exploration success to the fact that the Goddard Prospect lay under a relatively thick layer of drift (approximately 20 feet). Furthermore, while the general geometry of the local anticlinal structure had been determined to be that of a gentle dome, the location of the hinge had never been found. Finally, Prest's understanding of surficial geology is today recognized as being advanced, considering the state of knowledge regarding glacial geology of the day. Prest engaged an exploration strategy to "generally follow" boulder trains and dispersed material north. Prest understood that ice flow directions could be modified over landforms locally, but field methodology, at that time, had not been developed that could be used to recognize the modification of localized ice flow directions around autochthonous geomorphology. These impediments to understanding the original position of the source veins along the anticline were major encumbrances to further development in the vicinity of the Goddard Prospect.

Modern sources of structural information relavant to the structural question, such as enhanced (second vertical derivative) aeromagnetic digital data (King, 1997) and vertical gradient data can assist in the placement of the domal structure and position of the anticline hinge. Till fabric data taken from one of the original Prest pits indicate a northeast pattern of glacial dispersal at the Goddard Prospect.

References

Faribault, E. R. 1912: Summary Report, Geological Survey for 1912 (p. 377-378) Mill Village Gold District, Queens County, Nova Scotia; Nova Scotia Department of Natural Resources, Assessment Report 21/A 02D, 21-N-09 (02), 4 p.

King, M. S. 1997: Meguma Teranne enhanced (second vertical derivative) aeromagnetic digital data; NTS map sheet 21/A02, Liverpool, Queens and Lunenburg Counties, Nova Scotia; Nova Scotia Department of Natural Resources, Minerals and Energy Branch Open File Map 97-023, scale 1:50 000.

Prest, W. H. 1910: Recollections of Mill Village Gold District, Queens County, Nova Scotia, July 1910; Nova Scotia Department of Natural Resources, Assessment Report 21/A 02D, 21-N-09 (01), 4 p.

Dufferin Gold Mine - Past and Present

W. Miyagishima[1]

The exploration and production history of the Dufferin Gold Mine for the period of 1868 to 1999 will be reviewed to describe the resource that exists at Dufferin. Current gold mining operations at Dufferin being conducted by EnviroGold Technologies Inc. will be described along with a discussion of future challenges and goals. The presentation will begin with an overview of EnviroGold Technologies Inc. and conclude with a slide show of current operations.

[1]P. Eng., President & CEO - EnviroGold Technologies Inc., 351 Prominence Heights SW, Calgary, AB, T3H 2Z6

Metamorphism and Structure of the White Rock Formation in the Yarmouth Area, Nova Scotia[1]

D. P. Moynihan[2], C. E. White and R. A. Jamieson[2]

The White Rock Formation (WRF) in the Yarmouth area of the Meguma terrane in southwestern Nova Scotia consists predominantly of mafic metavolcanic rocks with less abundant metasedimentary rocks, and minor intermediate and felsic metavolcanic rocks. The WRF is in contact with slate of the Cambrian to Lower Ordovician Halifax Formation. Together with the comagmatic Brenton Pluton, the WRF is interpreted to have formed in a latest Ordovician to Early Silurian extensional tectonic regime (MacDonald *et al.,* 2001).

Because of the presence of Halifax Formation on the flanks of the WRF, it was traditionally interpreted to define a large synclinal structure. However, recent mapping in the area has shown no obvious repetition of stratigraphic units and consistent younging directions to the southeast, calling into question the presence of a synclinal structure. The formation has tentatively been re-interpreted as comprising a southeast-dipping succession consisting of seven map units.

During the Acadian Orogeny, rocks in the Meguma terrane of western Nova Scotia were deformed into regional-scale, northeast-trending upright folds with an axial planar cleavage. Moderate-pressure mineral assemblages are found in the WRF of the Yarmouth area. This contrasts with low-pressure assemblages developed in the Halifax Formation southeast of the study area. Alleghenian strike-parallel shear zones associated with retrogression and structural overprinting now mark the northwestern and southeastern boundaries of the WRF with the older Halifax Formation (Culshaw and Liesa, 1997).

The present study is designed to assess the distribution and P-T conditions of metamorphism in the WRF and to determine the relative and absolute timing of metamorphism and deformation. Field mapping, metamorphic, microstructural and geochronological studies will form the basis of a M.Sc. thesis by the senior author and will help to constrain regional tectonic interpretations.

Preliminary results indicate that staurolite-bearing schists are present along the southeastern margin of the WRF and within the southern part of the Cranberry Point Shear Zone on its northwestern margin. Those in the NW are heavily retrogressed and only locally present in an area dominated by garnet-chloritoid assemblages in pelitic lithologies. Because the rocks of the adjacent Halifax Formation display only low-grade metamorphic mineral assemblages, the presence of these amphibolite-facies rocks within or adjacent to bounding shear zones suggests that these shear zones may represent significant crustal structures that have accommodated large amounts of post-peak-metamorphic displacement.

References

Culshaw, N. G. and Liesa, M. 1997: Canadian Journal of Earth Sciences, v. 34, p. 833-847.

McDonald, L. A., Barr, S. M., White, C. E. and Ketchum, J. W. 2001: Canadian Journal of .Earth Sciences (in press).

[1]Project partially funded by a NSERC research grant to R. A. Jamieson
[2]Department of Earth Sciences, Dalhousie University, Halifax, NS B3H 3J5

Late Paleozoic Origin and Evolution of the St. Marys Basin, Mainland Nova Scotia, Canada

J. B. Murphy[1]

The late Paleozoic evolution of the St. Marys Basin, mainland Nova Scotia, preserves evidence of protracted dextral shear along an intra-continental fault zone during collisional orogenesis and the assembly of Pangea. The St. Marys Basin is an episutural basin that formed within the E-W Minas Fault Zone (MFZ) along the boundary between the Avalon and Meguma terranes and consists almost entirely of latest Devonian-Tournaisean continental clastic rocks that are 3000-4000 m in thickness.

The origin and evolution of the basin is attributed to either discrete or progressive dextral strike-slip tectonics along the MFZ between the Late Devonian and Late Carboniferous. Evidence for the Late Devonian origin of the basin is recorded along its southern flank by the fabrics of the deformed ca. 370 Ma granites, the overall sedimentary facies distribution and some syn-depositional features within the clastic rocks. The most intense deformation within the basin is concentrated in a relatively narrow ENE-trending zone, in which predominantly fine-grained clastic rocks are deformed into periclinal folds and related reverse faults. The orientation of this zone relative to the MFZ is consistent with dextral shear. At least some of this deformation occurred after deposition of the overlying Viséan Windsor Group. The style of deformation along the present northern margin of the basin (the Chedabucto Fault) is also consistent with regional dextral shear.

The St. Marys Basin is an example of basin development and evolution adjacent to an intra-continental fault zone associated with oblique convergence during orogenesis. Its evolution provides constraints on the potential relationship between the termination of the mid-Paleozoic Acadian orogeny, subsequent basin development and the ongoing interactions between the Avalon and Meguma terranes, and between Laurentia and Gondwana during the assembly of Pangea. More generally, although the relationship between fabric development and motion along intra-continental strike-slip faults in continental zones is difficult to interpret, the sedimentology and structural geology in basins developed along these fault zones may preserve less ambiguous records of the main tectonic events.

[1]Department of Geology, St. Francis Xavier University, Antigonish, Nova Scotia, Canada B2G 2W5
email: bmurphy@stfx.ca

Aggregate Program 2001

G. Prime and A. Sherry

The aggregate program is an ongoing effort to document the aggregate resource throughout Nova Scotia. The current focus of attention is a regional study examining the Annapolis Valley and surrounding areas. Implemented in 1995, the project is an evaluation of the granular and bedrock aggregate potential in Hants, Kings, Annapolis, Digby and Yarmouth Counties. The primary methods for conducting this research are the gathering and utilization of reference geological data, air photo interpretation, field investigation, a sampling program and laboratory analysis. These techniques have permitted a comprehensive examination of known deposits, and provided an opportunity to identify new resource potential.

The focus of the 2001 field season is parts of Yarmouth and Digby Counties on National Topographic Series map sheets 21A/4, 21A/5, 21B/1, 21B/8, 20O/16, 20O/9, 20P/12 and 20P/13. At the time of writing it is anticipated that these areas will be completed by late October. A small number of sites or deposits requiring work in the other counties will be examined later in the year or early spring. This will conclude the field phase of this research. Below is a summary of observations made during the 2001 field season.

The majority of granular aggregate deposits examined between Weymouth and Yarmouth are glaciomarine raised beach deposits occurring along the coast. The materials usually consist of well sorted gravel with a minor component of sand. They vary in thickness from a veneer to several metres deep. Iron and manganese mineralization are common. The lithological composition of the gravel usually consists of a large component of metamorphic sedimentary rocks. Rocks such as schist, slate and argillite produce low durability aggregate clasts which are platy and subject to weathering. Much of the Halifax Formation slate contains sulphide mineralization, which can cause unsightly iron stains in exposed aggregate products. The metagreywacke and quartzite components of the gravel produce durable aggregate particles. Although most of these deposits probably wouldn't pass highways materials specifications, they are successfully used in the communities for many applications, such as driveways and back fill.

Other types of glacial deposits used for aggregate in the area include ice contact deposits, tills and boulder fields. The ice contact deposits consist of eskers, kame deltas and kame mounds, which occur scattered throughout the area. These materials commonly contain a higher component of sand which is needed in the construction industry. Most of the easily accessed deposits in proximity to the markets have been seriously depleted. Tills from moraine ridges and drumlins have been extensively used for fill purposes in many areas. Boulder fields have provided rip rap and armourstone for the numerous breakwaters in the region, as well as shoreline stabilization. The tabular or rectangular shape of the metamorphic sedimentary rock types in some of the coarse gravel deposits and tills makes excellent materials for fence walls, retaining walls and foundations. The craftsmanship of these structures is among the finest in the province.

Crushed stone from quarried bedrock is becoming a popular alternative for construction aggregate. This is largely a consequence of the product quality and consistency that can be achieved in some of the rock types in the region. Quarries are also capable of producing a wide variety of products ranging from sand to armourstone. Rock types in the area that have been quarried or have good potential are the fine- to medium-grained igneous rocks, including granitic rocks, mafic intrusives and volcanic rocks. Metamorphic sandstones such as quartzite and metagreywacke may locally have potential as well.

Mapping the Shallow Subsurface Structure Using Seismic Reflection Techniques - Examples from Southern Cape Breton[1]

S. E. Pullan[2] and R. R. Stea

Shallow seismic reflection methods provide a means of delineating the structure and stratigraphy of unconsolidated sediments. These methods are being used in the TGI geological mapping project on South-central Cape Breton Island to determine regional depth to bedrock, which might indicate areas of thick Cenozoic cover with the potential for buried Cretaceous sediments. The regional study consists of a seismic testing program designed to provide an estimate of bedrock depth and an evaluation of the seismic data quality that can be acquired in the area. To date, data have been acquired at 139 test sites located primarily in the River Inhabitants and River Denys valleys. The sites were located to augment sparse borehole data and to determine if Cretaceous fault-basins were buried under the Quaternary glacial cover. Several isolated areas of thick (>50 m) overburden have been identified, though as yet the seismic data show no indication of the existence of large hidden faulted basins such as those recently discovered in central Nova Scotia. Initial drilling results have identified thick Quaternary sequences, including multiple till sheets, glaciolacustrine clays exceeding 50 m in some areas, and buried organic horizons. Additional drilling is planned for this fall as well as follow-up seismic profiling across the River Denys Basin adjacent to the fault on the south side of the Creignish Hills. The only known outlier of Cretaceous strata at Diogenes Brook occurs along this fault.

[1]Contribution to the federal-provincial Targeted Geoscience Initiative in south-central Cape Breton Island
[2]Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8

Dalhousie University: Department of Earth Sciences

P. H. Reynolds[1]

Earth Sciences at Dalhousie is well equipped for research in a range of disciplines: petrology and geochemistry, sedimentary geology, micropaleontology, tectonics, structural geology, and thermochronology (argon, fission track, thermal and optical luminescence, and in 2002, cosmogenic isotope dating). The department includes 11 full-time faculty members and 6 university technicians, with 17 Ph.D., 10 M.Sc. and 13 B.Sc. final year honours students registered in 2001-2002. Most graduate students hold scholarships or fellowships paid from University and/or research funds.

New This Year

A JEOL 8200 electron microprobe was installed in the department in September, 2001 to serve the Dalhousie Regional Electron Microprobe Laboratory (a joint venture of Dalhousie, Saint Mary's, Acadia and St. Francis Xavier Universities). This is a state-of-the-art digital imaging instrument with five wavelength spectrometers and one energy dispersive spectrometer.

Prof. John Gosse, appointed in July 2001 to a Tier II Canada Research Chair, is building a cosmogenic nuclide extraction laboratory in the department. The abundance in rocks of isotopes produced by cosmic ray interactions is a measure of the length of time these rocks have been exposed to cosmic radiation. Hence, this is a method whereby the age and erosion history of landforms can be determined.

Student Research in Nova Scotia: Theses Completed in 2001

M.Sc.
Gauley, Billie-Jo Lithostratigraphy and Sediment Failure on the Central Scotian Slope
Page, Krista D. An Examination of Mercury (Hg) Contamination in Kejimkujik National Park: The Role of Geological Sources

B.Sc. Honours
Bogutyn, Patrick A. White Micas in the Lake Lewis Leucogranite, Nova Scotia
Campbell, Andrew W. Bedform Sedimentology and Morphometrics of the Shoreface - Attached Sand Ridges on Sable Island Bank, Scotian Shelf.
Dondale, Aaron T. Thickness and Facies Variation of the Carboniferous Sydney Mines Formation in the Morien Syncline, Cape Breton Island
Hoehne, Johanna Seismic Velocities and Reflection Sequences of Wisconsinan Glacial Deposits in Emerald Basin (Scotian Shelf)
McCuish, Krista L. Schlieren in the South Mountain Batholith and Port Mouton Pluton Meguma Zone, Nova Scotia
Rabin, Mark A. The Zeroing Properties of Quartz with Respect to Different Depositional Environments
Sabean, Jennifer A. Monitoring Oil Spill Bioremediation Using Marsh Foraminifera as Indicators
Surrette, Megan J. Analysis of Aquifer Tests in Two Fractured Rock Wells, Halifax Area, Nova Scotia
Warren, Stephen N. ^{40}Ar/^{39}Ar Laser-Probe Study of the K-Feldspars from the New Ross Area of the South Mountain Batholith, Nova Scotia

Graduate Thesis Research Underway
S. Carruzzo (Ph.D.): Ore deposits in the New Ross area
A. M. Ryan (Ph.D.): Radio-elements (radon, uranium) in Nova Scotia
R. Tobin (Ph.D.): Use of foraminifera as pollution indicators

[1]Chair, phone: 902-494-2358; mail us at Halifax, NS, B3H 3J5 or check us out at http://is.dal.ca./~es/es-home.htm

Exploration Strategies for Mineral Sand Deposits: The Nova Scotia Mineral Sands Deposit – A Case Study

J. D. Ross[1]

Exploration for mineral sand deposits poses many unique challenges in comparison to hard rock exploration campaigns. Once potential mineral sand deposits are identified a new set of challenges present themselves in terms of attempting to ascertain the potential of any given deposit with respect to mining logistics, process metallurgy and product marketing. Unlike conventional hard rock, base metal projects, the appraisal of mineral sand deposits places a far more significant onus upon process metallurgy rather than simply evaluating a deposit in terms of tonnage and grade. Any given mineral sands deposit may in fact be of enormous size and appear to have a rich mineral suite. If, however, the deposit does not at the onset lend itself to a proven and practical metallurgical processing flow sheet the chances of any degree of successful development is highly unlikely.

Titanium Corporation Inc. commenced its exploration for mineral sand deposits in Nova Scotia marine settings in the fall of 1997. Subsequent to the early exploration efforts the company focused its activities in the vicinity of the Cobequid Bay and Shubenacadie River basin. The results of this program led to the delineation of a deposit comprising 330 941 945 tonnes of mineralized sand, which contains what is believed to be economic concentrations of ilmenite, leucoxene, rutile and zirconium.

The deposit itself may be viewed as unconventional due to the fact that it is in an active marine setting. This, however, provides more advantages than disadvantages. Significantly, the nature of the deposit could potentially facilitate flexibility in terms of dredging, as a dredge on this deposit would have the ability to move freely to and from high-grade areas within the deposit without costly ground preparations. Secondly, there is no required overburden removal, contrary to other existing mineral sand mining operations. Finally, the nature of the deposit dictates that common problems in other mineral sand deposits such as the prevalence of "iron pan" and clay horizons "slimes", which make for difficult mining, are not likely to be encountered at this project.

It is important to stress that although initial deposit delineation, metallurgical testing and engineering studies have been favorable, much work still remains in order to advance this project to final feasibility.

[1]Vice President, Exploration, Titanium Corporation Inc., 1096 Queen Street, Suite 280, Halifax, NS B3H 2R9

The Horton Group of the Maritimes Basin: Geology, Hydrocarbon Source Rocks and Reservoir Potential in Atlantic Canada

R. J. Ryan

The term Horton Group has been applied as a “catch-all” name for all of the basin fill rocks below the marine Windsor Group strata and overlying the crystalline basement rocks beneath the Maritimes Basin. Adding to the confusion are innumerable formation and group names applied in different sub-basins to the same rock units. By comparing the similarities in the Horton Group stratigraphy throughout the Maritimes Basin it is possible to establish units that can be correlated.

The Middle to Late Devonian redbed and volcanic rocks in the Maritimes Basin should be excluded from the Horton Group (Tournaisian) as these strata represent a unique rift-related sequence. Although these older rocks are important in understanding the initial basin evolution, they have minimal hydrocarbon potential. The Horton Group, therefore, refers to only the early Carboniferous clastic sequence underlying the Windsor Group (Viséan). The rocks of the Horton Group are more locally derived than the younger Carboniferous units and, therefore, reflect the adjacent source areas and consequently are heterogeneous in nature. Although the source areas can be local, the basin tectonics that control the large scale allocycles (megasequences) within the Maritimes Basin are regional in extent and result in broadly distributed packages of rocks with similar depositional settings.

In a broad sense, the Horton Group can be divided into three basic divisions: a lower coarse-grained unit, a middle lacustrine grey shale and carbonate unit, and an upper red sandstone and/or conglomerate unit which interfingers basinward with siltstones. The lower coarse-grained unit is compositionally dependent on the local source area and is commonly conglomeratic near the basin margins. The sandstone and less abundant mudrocks are commonly grey and contain significant amounts of plant debris. These are interpreted as alluvial fan, braided-fluvial and floodplain deposits. The middle grey fine-grained unit also contains abundant plant debris as well as fresh water fish scales, suggesting a lacustrine environment; however, the recent recognition of the presence of marine fossils (trilobites and crinoids) and glauconite grains at a few horizons suggest some marine influence. Oil shales are often developed within this unit and organic carbon is abundant. Near the top of this unit coarser-grained rocks often interfinger and overlie the finer-grained shale, siltstone and carbonates. These are interpreted as lacustrine deltas, beach sands, and incising meandering and low sinuosity river deposits. The upper unit of the Horton Group is often made up of thick arkosic sand sequences, especially where granitoids flank the basin margin. The unit may also have basin margin conglomerates developed. The unit is interpreted as representing renewed uplift in the basin source areas following relative tectonic quiescence during deposition of the lacustrine middle unit. In general terms, almost every sub-basin within the Maritimes Basin exhibits a similar tripartite sequence within the Horton Group strata.

The fine-grained rocks of the lower and middle Horton Group are excellent source rocks, especially for gas, whereas the overlying sandstones of the middle unit and the coarse clastics of the upper units exhibit porosities and permeabilities indicating significant hydrocarbon reservoir potential. Thermal maturation studies indicate that most of the Horton Group strata at surface are often within the oil window and that the kerogen is capable of producing significant amounts of gas. Thermochronological studies indicate that the basin reached maximum burial 290 Ma and subsequently up to 4 km of cover was quickly eroded; therefore, gas generated at the time of maximum burial could only be preserved in a well-sealed reservoir. The thick evaporites of the overlying Windsor Group form an effective seal for reservoirs in the Horton Group strata and, therefore, areas with evaporites overlying the Horton Group are prospective exploration targets.

Comparison of Hg Contents of Surface Exposures in the Kejimkujik Park Area with Similar Meguma Group Lithologies Collected from Depth in Drill Core[1]

A. L. Sangster[2] and P. K. Smith

Surface samples of Meguma Group lithologies (Goldenville & Halifax formations) and the Kejimkujik granite were collected from the area of Kejimkujik National Park and their Hg content compared with samples of Meguma Group lithologies collected from drill core from several locations in Nova Scotia.

Total Hg analyses were carried out by commercial laboratories and at the Geological Survey of Canada in Ottawa. In preparation for analysis, the rock samples were cleaned in fresh water and oxidized surfaces were removed.

Samples from surface exposures in the park area contain very low Hg levels. Contents of Hg were lowest in rocks of the Goldenville Formation and Kejimkujik monzogranite, varying from <0.5 ppb to 4.0 ppb (n=47) and <0.5 to 5.8 ppb (n=31). Halifax slate samples are marginally higher at <0.5 to 16.4 ppb (n=100).

Samples of Goldenville and Halifax formation lithologies contain substantially higher but not major concentrations of Hg. Samples of Goldenville Formation core from holes at Eastville, Wire Lake and Molega Lake contained Hg levels from <0.5 to 13.4 ppb (n=35). The Halifax Formation in drill core from Clarksville, Eastville, and Lake Charlotte contain the highest Hg contents from <0.5 to 242 ppb (n=56). Some of the highest Hg levels are related to traces of sphalerite [(Zn,Fe)S] mineralization at Eastville.

The data may indicate that there is an incipient devolution of Hg from the bedrock surface during the earliest phases of weathering. The effect is most pronounced in the sulphidic black slates which are more porous, have a well developed cleavage, and have a built in acid-generation capacity with the presence of up to 5% pyrite and/or pyrrhotite. The data are not well enough constrained vis a vis mass balance considerations but certainly the current effects have formed since the erosional event of the last glaciation ~10,000 years ago.

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[1]This project is a joint Geological Survey of Canada-Nova Scotia Department of natural Resources component of the Toxic Substances Research Initiative (TSRI) administered by Health Canada

[2]Geological Survey of Canada, 601 Booth Street, Ottawa K1A 0E8

The Ceramic Potential of Clay Deposits in Southwest Cape Breton[1]

R. R. Stea, P. W. Finck, M. Feetham, S. E. Pullan[2] and W. Ostrom[3]

There are abundant surface clay deposits in the lowlands of southwest Cape Breton with potential for use as low temperature ceramic products. Large glacial lakes formed in the region at the end of the last glaciation when glaciers dammed up rivers flowing into the Gulf of St. Lawrence. Lowland basins adjacent to the Creignish Hills were filled with fine-grained , turbid sediment from eroding till deposits washed in by slope runoff and glacier melt in the highlands. The clay deposits found in these basins are unusually fine-grained and massive. They lack graded beds, with coarse silt and sand strata that often characterize glacial lake sediments (varves) and have a low percentage of drop-stones (drop-stones are larger rocks that have been carried into the lake via floating ice or icebergs and later dropped by melting). The implication is that active glaciers were not directly calving into these bodies of water, but dammed the basin outlets at lower elevations. The age of the youngest of these ice-dammed lakes has been bracketed by an organic paleosol underlying lake clay at several localities dated around 11,200-10,800 ^{14}C years. (GSC-6518) and regional basal lake sediment accumulation ages of around 10,000 yr BP. The last of these ephemeral ice-dammed lakes formed when a glacier in the Gulf of St. Lawrence re-advanced during the Younger Dryas period (11-10 ka), a brief but intense cold period at the end of the last glaciation.

From mapping and sampling we have determined that these clay deposits are widespread, quite fine-grained and homogenous. Utilization of clay as a resource material for ceramics and structural clay depends on a range of properties unique for each industry. A common denominator for all industrial clay uses are a large-volume source of moderately uniform clay with a low shrinkage/swelling percentage, consistent firing color, relatively low firing temperature, and good strength after firing. The initial firing tests show that clays are of the earthenware type, and meet the requirements of many low temperature ceramic products. They have excellent plasticity and good strength after firing. It appears from the initial testing that the Cape Breton deposits are very similar to Lantz clay, which is exceptional clay for structural (brick-tile) and pottery use. More testing will be required to fully evaluate these clays, and a joint program to evaluate Cape Breton clays is being initiated with the Nova Scotia College of Art and Design.

[1]Contribution to the federal-provincial Targeted Geoscience Initiative in south-central Cape Breton Island
[2]Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8
[3]Nova Scotia College of Art and Design (Ceramics Department), Halifax, Nova Scotia

Stratigraphy and Structure in the Lochaber-Mulgrave Area, Nova Scotia[1]

P. J. Ténière[2], D. C. MacIsaac[2], S. M. Barr[2] and C. E. White

During the summer of 2001, extensive mapping was done in the Lochaber-Mulgrave area of northern mainland Nova Scotia as part of an on-going study of stratigraphy and structure in this complex area, bounded by the Glenroy Fault on the north, the Strait of Canso on the east, the Roman Valley Fault on the south, and pre-Carboniferous rocks of the Antigonish Highlands on the west. Sedimentary rocks in the area are now assigned to the Early Devonian Knoydart Formation, Early Carboniferous Horton and Windsor groups, and Late Carboniferous Mabou Group. The Knoydart Formation lies between the Lochaber Lake and South River Lake faults and consists of red-brown to purple micaceous siltstone and shale with thin interbedded green siltstone and shale, and rare polymictic conglomerate. The Horton Group underlies most of the map area, and has been divided into three units (from oldest to youngest): (1) Clam Harbour River Formation, (2) Tracadie Road Formation, and (3) Caledonia Mills Formation. The Clam Harbour River Formation contains minor polymictic conglomerate, light green-grey to maroon siltstone and sandstone with dolomitic lenses, and is interpreted to have been deposited in a predominantly lacustrine environment. The overlying delta-lacustrine Tracadie Road Formation consists of dark grey to black laminated siltstone interbedded with minor quartz arenite and pebble conglomerate. Rare lepidodendron-type plant fossils of Tournaisian age are found in the light grey, fine-grained sandstone and dark grey shale beds. The overlying Caledonia Mills Formation consists of red to light grey, massive to well laminated siltstone and sandstone and is interpreted to have been deposited in an arid fluvial environment. These units are lithologically similar to those assigned to the Horton Group in the St. Marys Basin. The sedimentary provenance may be confirmed through $^{40}Ar/^{39}Ar$ dating of detrital muscovite grains in the Horton Group sedimentary units. In much of the area, the sequence of units appears to be gradationally conformable, however a fault or unconformity occurs between the Knoydart Formation and overlying Caledonia Mills Formation. The Macumber Formation (Windsor Group) overlies the Horton Group along the Glenroy Fault and the Strait of Canso and consists of dark-grey to black laminated limestone with rare fossils. Uncleaved light grey and maroon siltstone and sandstone of the Mabou Group overlies the cleaved Horton Group units in the eastern part of the study area.

In comparison to the Horton Group in other areas, the rocks in the Lochaber-Mulgrave area are highly deformed. In addition, most of the area has undergone low-grade regional metamorphism and cleavage is well developed as a result of accompanying deformation. The western part of the region has open to tight, upright to overturned, northeast- and northwest-trending folds with well-developed axial planar cleavage. The eastern part has tight to close, upright, north-south-trending folds with moderately developed axial planar cleavage. Folded axial plane traces and scattered cleavage orientations indicate the region has undergone polyphase deformation. The structural complexity in the Lochaber-Mulgrave area may be related to interaction between the Avalon and Meguma terranes during their juxtaposition along the Cobequid-Chedabucto fault system.

[1]Funded by a Natural Sciences and Engineering Research Council of Canada Research Grant to Sandra M. Barr and by the Nova Scotia Department of Natural Resources (through the Targeted Geoscience Initiative)
[2]Department of Geology, Acadia University, Wolfville, Nova Scotia B0P 1X0

Tectonic Setting of Silurian Igneous Activity in Nova Scotia and New Brunswick[1]

C. E. White and S. M. Barr[2]

Several models for the evolution of the northern Appalachian orogen have suggested that Silurian volcanic and sedimentary units in southern New Brunswick, southern Nova Scotia, and the Antigonish and Cape Breton Highlands of northern Nova Scotia represent a Silurian overstep sequence. Although recent precise U-Pb dating of zircon has confirmed that these units are of similar early Silurian age (ca. 440 Ma-430 Ma), mapping and petrological studies show that they have different petrochemical characteristics and formed in varied tectonic settings, and hence do not constitute an overstep sequence.

The Kingston terrane of southern New Brunswick consists of mainly felsic tuffaceous rocks intruded by comagmatic high-level granitic rocks. Both have yielded U-Pb (zircon) ages of ca. 438-435 Ma. Their chemical compositions indicate calc-alkalic affinity and emplacement in a continental margin volcanic arc. These rocks are similar in age, petrologic features, and inferred tectonic setting to volcanic and granitic rocks of the central Aspy terrane in Cape Breton Island, and direct correlation between these now widely separated units is proposed. They are interpreted to represent a Silurian ocean-closure event between separate Late Proterozoic-Early Paleozoic peri-Gondwanan terranes.

Although U-Pb dating has shown that volcanic rocks in the White Rock Formation of the Meguma terrane in southern Nova Scotia are of similar Silurian age, they are a bimodal alkalic basalt-rhyolite suite formed in a within-plate continental extensional setting, and differ chemically from the arc-related Kingston-Aspy volcanic-granitic suites. They may have formed as part of the process of separation of the Meguma terrane from Gondwana.

Silurian volcanic and fossiliferous sedimentary sequences in the Arisaig Group of the Antigonish Highlands are located in the Avalon terrane. Although published descriptions of their petrochemical features suggest that they formed in a continental extensional setting like that of the White Rock Formation, some chemical characteristics are distinct from those of the White Rock Formation, and the two units are lithologically distinct.

Hence, we suggest that it is not valid to use these widespread Silurian units to infer that the various outboard terranes of the northern Appalachian orogen were amalgamated by the Silurian.

[1]Funded in part by a Research Grant to S. M. Barr from the Natural Sciences and Engineering Research Council of Canada
[2]Department of Geology, Acadia University, Wolfville, Nova Scotia B0P 1X0

Preliminary Bedrock Geology of the Yarmouth (20O/16) and Western Half of the Tusket (20P/13) Map Areas, Southwestern Nova Scotia

C. E. White, R. J. Horne, R. C. Gould[1], P. J. Ténière[1] and M. J. Jodrey[1]

Geological bedrock mapping (1:10 000 scale) related to the Southwest Nova Mapping Project continued through the summer of 2001 on the Yarmouth and western part of the Tusket map (NTS 20O/16, 20P/13), in southwestern Nova Scotia.

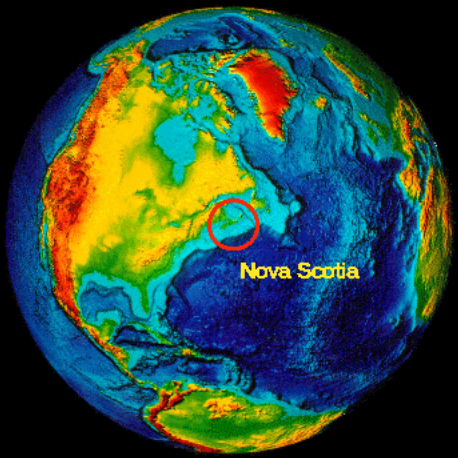
As on the previous map areas to the north, the oldest units are the Cambrian to Early Ordovician Goldenville and Halifax formations of the Meguma Group. The Goldenville Formation occurs in the northwestern and central parts of the map area and consists predominantly of metasandstone with lesser amounts of metasiltstone and slate. A distinctive feature of the Goldenville Formation in the northeast is a thick (<1.0 km) unit of mainly metasiltstone that contains abundant trace fossils and small magnetite grains. The Halifax Formation is subdivided into two stratigraphic units, the Bloomfield member and overlying Cunard member. In the Cheboque Point area, the Bloomfield member consists of a thin (<20 m) unit of well-laminated metasiltstone. In the Cranberry Point area the Bloomfield member consists of a 200 m thick, locally well-crenulated phyllite. Contacts with the underlying Goldenville Formation are sharp and conformable. Conformably overlying the Bloomfield member are black to rust-brown slate with abundant pyrite and pyrrhotite of the Cunard member. Rocks of the Halifax Formation also occur in the eastern part of the map area but due to the high grade of metamorphism have not been assigned to a member.

The White Rock Formation (WRF) is well exposed in coastal sections in the Yarmouth area and is composed mainly of mafic metavolcanic rocks with less abundant metasedimentary rocks, and minor intermediate and felsic metavolcanic rocks. The granitic Brenton Pluton forms a fault-bounded lens-shaped body in the WRF along the southeastern contact with the Halifax Formation. Based on exposures along the coastal sections, the WRF can be subdivided into seven units. Together with the comagmatic Brenton Pluton the WRF is interpreted to have formed in a latest Ordovician to Early Silurian extensional tectonic regime.

The units in the Meguma Group have been folded into regional, northeast- and north-trending F_1 folds, with an axial planar cleavage during the Devonian Acadian Orogeny. Intersection lineation data typically indicate a moderately southwest- to northeast-plunging axis. Previous mapping suggested that the WRF occupied a major synclinal structure;however, a lack of stratigraphic repetition and the consistent southeast younging directions does not support this interpretation. In addition, several Alleghanian shear zones have been delineated in the area the most significant are along the contacts with the White Rock and Halifax formations. Deformation was accompanied by greenschist- to amphibolite-facies metamorphism that resulted in the eastward increase in metamorphic grade from biotite zone in the west to garnet-silliminate assemblages in the east. In addition, recent studies further defined a straurolite zone within the WRF bounding shear zones.

The Middle to Late Devonian Barrington Passage Pluton intruded the garnet-silliminate schist of the Halifax Formation in the eastern part of the map area and consists dominantly of medium-grained, locally foliated tonalite. The Late Carboniferous Wedgeport Pluton intruded metasandstone of the Goldenville Formation and plutonic rocks of similar age maybe responsible for contact metamorphic rocks observed to the north of this pluton.

[1]Department of Geology, Acadia University, Wolfville, Nova Scotia B0P 1X0



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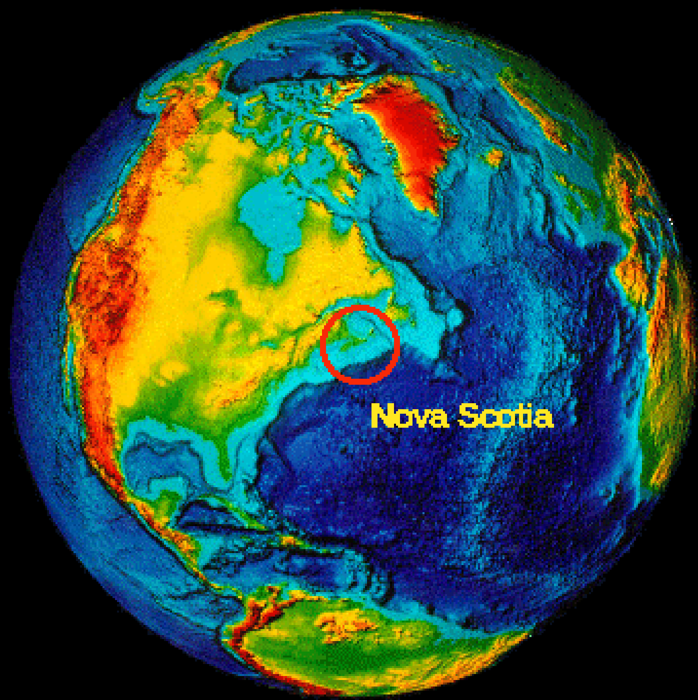

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macduff@is.dal.ca