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# 1992 ATLANTIC UNIVERSITIES GEOLOGICAL CONFERENCE

# ABSTRACTS

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Again this year, abstracts from the annual Atlantic Universities Geological Conference are published in "Atlantic Geology." This provides a permanent record of the abstracts, and also focuses attention on the excellent quality of and interesting and varied science in these presentations.

The Editors

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## Tectonostratigraphic development and economic geology of the Sops Head Complex, western Notre Dame Bay, Newfoundland

E. John Clarke
*Department of Earth Sciences, Memorial University of Newfoundland, St. John's, Newfoundland A1B 3X5, Canada*

The Sops Head Complex has been previously interpreted as a lower Silurian tectonic/olistrostromal mélange developed above a coarsening-upwards flysch sequence derived from the emergent Notre Dame Subzone. Detailed mapping coupled with geochemical and palaeontological studies indicate that the Sops Head Complex is actually an imbricate fold and thrust belt developed on the periphery of the Exploits Subzone. Flyschoid greywackes and conglomerates of the Sansom-Goldson type can be shown to be derived from the Exploits Subzone.

The Burnt Creek Fault has been previously thought to be part of the Red Indian Line, an Ordovician fault system marking the boundary of the Exploits and Notre Dame subzones. The Burnt Creek Fault can be demonstrated to be a Silurian, sinistral, strike-slip fault that dissects the imbricate sequence. Displacement along the Burnt Creek Fault is in the order of 4 km.

Facies relationships and palaeontology demonstrate the existence of rocks of Exploits Subzone affinity to the west side of the Burnt Creek Fault, thus rendering it obsolete as a terrane-bounding fault. Stratigraphic and facies relationships coupled with rare-earth element geochemistry suggest the tholeilitic terrane of the Robert's Arm Group may also represent part of the Exploits Subzone, requiring the Red Indian Line be moved further to the northwest.

Molybdenite-gold-arsenopyrite-stibnite mineralization within the Sops Head Complex is directly related to two small peraluminous granodiorite stocks of presumed Silurian age. Au-As-Sb mineralization is largely restricted to faults and fractures within sedimentary rocks but elevated concentrations also occur within the heavily altered stocks. Rare-earth element geochemistry of fresh, altered and altered/mineralized rocks suggests that mineralization was a result of late-stage, deuteric alteration of the granodiorite. The low-potassium, peraluminous, fluorine-deficient nature of the intrusions precludes the application of an anorogenic, Climax-type model of ore genesis.

## Geochemical and isotopic constraints on the Avalon Composite Terrane during the Early Silurian

Mary Pat Cude
*St. Francis Xavier University, Antigonish, Nova Scotia B2G 1C0, Canada*

The age and nature of the accretion of the Avalon Terrane to North America are pivotal to our understanding of the Appalachian Orogeny. The Lower Silurian to Middle Devonian Arisaig Group, Northumberland Strait, Nova Scotia, provides a continuous Avalonian stratigraphic record during accretionary and post-accretionary events. The Arisaig Group is composed of Lower Silurian, bimodal, basalt-rhyolite volcanic rocks overlain by a thick succession of marine, fossiliferous, siliciclastic rocks. Although the geochemistry of the volcanics indicates a local intracontinental setting, its regional tectonic significance is unclear. Recently, it has been proposed that the geochemical signature of turbidite sediments may help identify tectonic settings. The Lower Silurian Beechill Cove sedimentary rocks, the lowermost shallow marine sequence in the Arisaig Group, were selected for geochemical and isotopic analysis.

The geochemistry of the Beechill Cove Formation cannot simply be attributed to Avalonian basement, and therefore may have a significant chemical contribution from other adjacent land-masses in the Early Silurian. Major elements reveal elevated $K_2O/Na_2O$ and $Al_2O_3/CaO+Na_2O$ and low $FeO+MgO$, $TiO_2$ and $Al_2O_3/SiO_2$ relative to Avalonian crust. Trace elements record an increase in Rb/Sr ratios relative to the less differentiated Avalonian material, and samples normalized to chondrite give a distinctive pattern with elevated light rare earth elements over heavy rare earth elements and a pronounced Eu anomaly.

Silurian palaeographic reconstructions suggest many possible sources for the detritus, including the Caledonide Orogenic Belt of western Europe. If the isotopic analysis of Beechill Cove sediments helps constrain the chemical contribution of old continental crust, this has exciting implications for palaeographic reconstructions and the accretionary history of the Appalachian Orogeny.

## Terrain stability and thermal performance along the Norman Wells pipeline

Jan MacDonald
*Department of Geology, Acadia University, Wolfville, Nova Scotia B0P 1X0, Canada*

Many of Canada's oil reserves are located in the North, and further exploitation is likely in the future. Hence, it is important to develop safe and efficient ways to transport oil south across permafrost terrain. More than 50% of Canada's landmass is underlain by permafrost.

The Norman Wells pipeline is owned and operated by Interprovincial Pipeline Limited (IPL). The pipeline is a small diameter pipe (32.4 cm) which transports oil through

869 km of discontinuous permafrost, from Norman Wells, NWT, to Zama, northern Alberta. It is the first completely buried oil pipeline in discontinuous permafrost in northern Canada. The oil is chilled close to ground temperature at the ESSO pump station in Norman Wells, so that it will have less effect on the surrounding terrain. Permafrost terrain can be sensitive to construction and land use, therefore careful monitoring is necessary. A Permafrost and Terrain Research and Monitoring program was developed between IPL and the Government of Canada to monitor changes in the thermal and physical conditions of the terrain, and to identify improvements which could be applied to future northern pipelines. Government scientists and IPL established a series of monitoring sites along the route.

Sloping terrain is particularly sensitive to thaw action. Wood chips are used to insulate thaw-sensitive slopes. According to design, the active freeze/thaw layer should remain within the wood chips, and the base of the wood chips should remain frozen. With only a few exceptions the wood chips have performed well.

Pipe and ground temperatures have increased since pumping began in 1985, likely due to an increased flow rate, and from clearing of the right of way. This heating has caused subsidence and ponding in areas along the pipeline route. Weekly aerial monitoring and monthly ground monitoring are carried out to check erosion or disturbance near the pipe or surrounding terrain.

The terrain along the pipeline route is slowly stabilizing. Most initial soil disturbance has settled, pipe and ground temperatures are leveling out, and the right of way has successfully revegetated. The overall pipeline performance has been for the most part within design expectations.

## Structure of the Dunamagon Granite, Baie Verte Peninsula, Newfoundland

Laurel McDonald
*Department of Earth Sciences, Dalhousie University, Halifax, Nova Scotia B3H 3J5, Canada*

The Dunamagon Granite is a Silurian pluton situated 15 km east of the Baie Verte Line, northwest Newfoundland. The Baie Verte Line is a narrow structural zone that separates continental margin rocks of the Humber Zone and the accreted volcanic arc rocks of the Dunnage Zone. The Dunamagon Granite also separates rocks of the Humber and Dunnage zones (Ming's Bight Group and Pacquet Harbour Group, respectively). The juxtaposition of these groups raises some questions: What is the relationship of the Dunamagon Granite to the surrounding rocks? Is the Dunamagon Granite a stitching pluton or is it a thrust sheet?

Field work in the summer of 1992 involved mapping structures within the Dunamagon Granite and its contacts. Its southern contact, with the Pacquet Harbour Group, is intrusive but the northern contact, with the Ming's Bight Group, is structurally more complex. The granite is sheared near the contact, and is cut by the Big Brook Shear Zone. Evidence suggests that the contact of the Dunamagon Granite with the Ming's Bight Group is tectonic. Structures within the pluton include a shallowly dipping early foliation, a steeply dipping later foliation, and lineations that plunge obliquely down-dip. Cross-cutting features include deformed aplite dykes, mafic dykes with internal fabrics, several generations of quartz veins, and shear zones. The data indicate that the Dunamagon Granite has been thrust over the Ming's Bight Group.

## Late Paleozoic volcanic stratigraphy and structurally constrained dyke emplacement, Squally Point, western Cobequid Highlands, Nova Scotia

David J. Pass
*Saint Mary's University, Halifax, Nova Scotia B3H 3C3, Canada*

Fieldwork in the Squally Point area (tip of the Chignecto Peninsula) has revealed a complex volcanic stratigraphy composed of late Paleozoic intrusive and extrusive units. The presence of volcanic tuffs, basalt flows, and a pebble conglomerate confirm sub-aerial exposure. Observed hyaloclastites and pillow basalts indicate that some of the extrusions were submarine or sub-lacustrine. Porphyritic-spherulitic-flow banded rhyolites are present at the base of the stratigraphic column.

Substantial deformation of the rhyolite has resulted in a bimodal distribution of pervasive fractures. Several subhorizontal fault planes cut the Squally Point section. To the south at the mouth of the Eatonville estuary, a singular prominent fault plane was observed. Thrust splays flattening to the fault planes have eastward strikes and southward dips suggesting a northward component of thrusting.

Significant mafic dyke intrusions along the primary fractures in the rhyolite occurred in the (?) late Carboniferous. Some minor dykes (<1 m) have east-west strikes. Shear zones propagate along the margins of most of the dykes, but a few predate their intrusion.

The area has undergone extensive mineralization. Minor fractures are hematized and chloritized. The rhyolites and basalts have patchy areas of silicification and epidotization. The thrust planes have a unique mineralized zone associated with them that weathers a distinctive yellow in outcrop.

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