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# Atlantic Universities Geoscience Conference 2016

## ABSTRACTS

*October 27-29, 2016*

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Abstracts from the Atlantic Universities Geoscience Conference (AUGC) are published annually in *Atlantic Geology*. Such publication provides a permanent record of the abstracts, and also focuses attention on the excellent quality of the oral presentations and posters at the conference and the interesting and varied geoscience topics that they cover.

THE EDITORS

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**Petrology and thermobarometric modeling  
of high-grade metamorphic rocks  
from the New Quebec orogen, Nunavik, Canada**

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The New Quebec orogen is a Paleoproterozoic mountain belt located in the eastern part of the Canadian Shield known as the Southeastern Churchill Province. It was formed through primarily transpressional collision between the Archean Core Zone and Superior craton which occurred between 1.82 and 1.80 Ga. The New Quebec orogen is made up of a collage of autochthonous rocks deposited adjacent to the Archean Superior craton (the Kaniapiskau Supergroup) and by allochthonous metavolcanic and metasedimentary assemblages accreted to the cratonic margin (the Rachel-LaPorte zone). The Core Zone is divided into the Gabriel terrane and the Leaf Bay terrane. The metamorphic grade is typically greenschist facies in the Kaniapiskau Supergroup, to upper greenschist and lower amphibolite facies in the Rachel-Laporte zone, increasing to upper amphibolite and granulite facies in the Gabriel and Leaf Bay terranes. This project will examine rocks of the Gabriel and Leaf Bay terranes using thin section petrography and thermobarometric modelling to better integrate metamorphic data with new geochronology and structural mapping done in the area. This study will use Theriak-Domino, a program for the calculation and plotting of equilibrium mineral assemblages in conjunction with petrographic interpretations. Preliminary work has allowed for the interpretation of pressure and temperature condition in two important rock units; a retrogressed granulite in the northern Leaf Bay terrane, and a garnet muscovite schist from the Gabriel terrane. The pseudosections and mineral assemblages of garnet, orthopyroxene, and amphibole suggest that the retrogressed granulite experienced peak metamorphic conditions of 600°C–800°C and 0.5–1.0 GPa. Pseudosections and mineral assemblages of garnet, biotite, muscovite and apatite suggest that the garnet schist experienced peak metamorphic conditions of at least 310°C and 0.3 GPa. Future work will focus on expanding the suite of samples examined and on integrating the results with known geochronology and structural data. [Poster]

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**Diagenetic effects and fluid flow along erosional  
boundaries in the Triassic Wolfville Formation  
at Rainy Cove, Nova Scotia, Canada**

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Rainy Cove is located along the south shore of the Minas Basin in the Pembroke area, Nova Scotia, Canada. Cliff outcrops along the beach preserve fluvial barforms and channel deposits of the Wolfville Formation, which is a member of the Fundy Group. The Triassic Wolfville sandstones lie unconformably over the steeply dipping metasedimentary rocks of the Carboniferous Horton Group. The Wolfville Formation at this location is a coarse-grained, subangular to angular red sandstone that is well cemented with a calcite cement. The fluvial sandstones plot in the 'litharenite' to 'feldspathic litharenite' fields on the Qt-F-L (Quartz-Feldspar-Lithics) classification after Folk (1968). The Wolfville Formation sandstones have undergone varied paragenetic processes including mechanical compaction, cementation, partial dissolution of unstable feldspars and cements, and creation of secondary porosity. In the Rainy Cove outcrop, erosional surfaces separate lithofacies packages within the formation. These consist of bounding surfaces due to change or resurgence of fluvial sedimentation, as well as an intra-Triassic unconformity where a cut and fill channel eroded previously deposited fluvial sediments. Heterogeneities in porosity and permeability along erosional boundaries could create preferential pathways, baffles, or barriers to fluid flow. Sixteen samples were collected during field work at Rainy Cove from an outcrop spanning approximately 200 m. Samples were taken above and below bounding surfaces and from the main units within the formation. Thin sections from the samples will be described in detail. Descriptions can then be correlated to measured sections and erosional bounding surfaces seen in the outcrop. Planned scintillometer and permeameter readings will be used to describe lithology and permeability variance between packages. There may also be an opportunity to perform cathodoluminescence analysis on the samples and investigate phases in cementation and diagenetic history. The objective of this project is to investigate diagenetic variance across the erosional boundaries and potential impacts on fluid flow.

***\*Winner of the Canadian Society of Petroleum Geologists  
Award for the best petroleum geology-related presentation***

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**Initial field and petrographic examination into the nature and relative timing of emplacement of an ultramafic-to-mafic sill in the Ashuanipi Complex of southwestern Labrador, Canada**

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The southwestern region of Labrador is part of the Ashuanipi Complex, a subprovince of the Archean Superior Province that has been metamorphosed to granulite facies conditions. Geological mapping and sampling of an approximately 400 × 70 m ultramafic-to-mafic sill that intrudes the migmatitic paragneiss, tonalite and diatexite of the Ashuanipi Complex was done to determine the igneous and metamorphic crystallization histories and to interpret the nature and the relative timing of emplacement of the intrusion. Field observations show evidence for deformation of the sill, and partial melting of the surrounding migmatite, which outlasted deformation. These ultramafic-to-mafic intrusions have a possibility of hosting economic mineral deposits associated with sulphide-bearing gossan zones. Twenty-eight polished thin sections of the sill and surrounding country rock were examined. Five of these are from gossan zones within this sill and from a second major mafic gabbroic sill for comparison. Petrographic work has so far shown relict igneous textures and cumulate layering along with local pervasive alteration and metamorphic overprint within the sill. The electron microprobe will be used to determine olivine, pyroxene, amphibole, and feldspar chemistry in both igneous and metamorphic assemblages for selected samples. The Scanning Electron Microscope will be used to assess sulphide textures found within gossan zones.

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**Geological setting of Au-Cu-Ni-Pb occurrences in the Second Gold Brook area, southwestern Cape Breton Highlands, Nova Scotia, Canada**

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Exploration and mining activity in the Gold Brook area of the southwestern Cape Breton Highlands dates back to the late 1800s, and focused on auriferous quartz veins in metasedimentary and metavolcanic rocks of what was then called the Precambrian George River Group. As a result of mapping in the 1980s, the metamorphic rocks were re-assigned to the Silurian Sarach Brook Metamorphic Suite. Subsequent work in the southern Cape Breton Highlands did not include the Second Gold Brook area, in spite of its apparent economic potential. Hence this study was

undertaken to provide enhanced understanding of the geology of the Second Gold Brook area, including mapping, sampling, petrographic interpretations and chemical analyses. Results so far show that the area is underlain by mafic metavolcanic rocks (amphibolite) interlayered with metasedimentary rocks and intruded on the east by granite of probable Devonian age. Petrographic features indicate that the metamorphic grade increases from south to north across the area. Chemical characteristics of the mafic metavolcanic rocks suggest they are tholeiitic and mixed MORB plus within-plate characteristics suggest that they may have formed in a back-arc setting. Chemical similarity suggests that they are related to the Silurian Sarach Brook and MacRae Brook formations elsewhere in the highlands. No indications of economic Au or other mineralization are evident in the chemical signatures of the metamorphic rocks, suggesting that such occurrences may be confined to the areas of historical mining activity.

*\*Winner of the Frank S. Shea Memorial Award for best economic geology presentation*

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**Quantification of water content in silicate melt inclusions via Raman Spectroscopy**

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In silicate magmas, key physiological properties such as liquidus and solidus temperatures, viscosity, and phase assemblages during crystallization will be heavily influenced by melt water content. Additionally, water released from magmas during their crystallization and cooling is an important mechanism for metal transport during the formation of metallic ore deposits. The purpose of this study is to develop a method to analyze the water content of silicate melt inclusions via laser Raman spectroscopy. Raman analysis is useful in that it provides high spatial resolution, is non-destructive to the sample, and can be performed on unexposed melt inclusions without advanced sample preparation or mounting techniques. Melt inclusions with known concentrations of water are being used to generate a calibration of the Raman spectrometer at Saint Mary's University. Preliminary method development has been successful and work in progress is resolving key interferences with water signals including secondary fluorescence generated from coloured melts. This method will be applied to the analysis of felsic melt inclusions in ancient volcanic rocks from a variety of ore deposit settings in British Columbia and New Brunswick in order to track the degassing and crystallization history of ore forming magmas, and hopefully predict the most productive (i.e., metal-fertile) magmatic events.

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**A geochemical and petrographic investigation of the distribution of cobalt within the Captain VHMS deposit, Bathurst Mining Camp, New Brunswick, Canada**

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The Captain deposit, located approximately 40 km southwest of Bathurst, is one of 46 volcanic-hosted massive sulphide deposits in the Bathurst Mining Camp. The Captain deposit was discovered by Captain Mines in 1956 and was the subject of Geological Survey of Canada Report 66-18. Most recently, Stratabound Exploration conducted an extensive 39-hole drilling program of approximately 11 km of combined length of core on the deposit. The deposit is hosted by a sequence of argillite and quartz-feldspar-phyrlic rhyodacite of the Middle Ordovician Nepisiguit Falls Formation. The Captain deposit has a strike length of 146 m, a down-plunge length of at least 400 m and a maximum width of approximately 50 m. Within this zone stringers, veins, semi-massive, and massive sulphides occur within an envelope of chlorite altered quartz-feldspar-phyrlic rhyodacite. The similarity in host rocks and alteration types in both structural footwall and hanging wall suggest that the deposit formed as a discordant stock work rather than a stratiform body. Likewise, Cu and Co mineralization with relatively low Zn and Pb content is consistent with high temperature paragenesis typical of the stock work deposits. In thin sections, cobalt sulphides exhibit vein-styled mineralization within pyrite and chalcopyrite crystals. The distribution of cobalt mineralization in the Captain deposit is inferred to be controlled by the remobilization of earlier sulphides by later fluids. This is evident in multiple recrystallization events observed in pyrite within the mineralized body. Cobalt-rich sulphides are able to be investigated in detail, utilizing Micro X-Ray Fluorescence and Instrumental Neutron Activation Analysis in conjunction with various micro-analytical techniques including, Reflected-Light Petrography. Preliminary litho-geochemical data show a relationship between the strongest cobalt enrichment and copper-poor zones. Further investigation of trace element geochemistry is warranted to completely understand the controls on cobalt mineralization within the deposit.

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**Predicting zones and potential sampling methods for elevated metal concentrations in urban soils, Halifax, Nova Scotia, Canada**

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Canada lacks a uniform method for sampling metals in soils, posing challenges for comparing studies and hindering the recognition of trends. Although problematic, the absence of a standard methodology is not unfounded. The extensive variability of soil properties throughout time and space makes it difficult to evaluate a study area. This is particularly the case in urban areas, where soils may have been disturbed and soil horizons are not well developed. Developing a standard methodology thus holds substantial significance, both in soil science and for society. Methods designed to be used ubiquitously not only allow studies to be comparable, but may add to the effectiveness of environmental and health risk assessments. This study focuses on developing a protocol for predicting and potentially mitigating elevated metals in city soils within Halifax, Nova Scotia. One aspect of the study aims to predict where high metal concentrations may arise in a city, by identifying past land use activities that are strongly associated with a particular metal(s). Prediction methods include the creation of a Geographic Information System (GIS) map, which illustrates potential zones of high metal concentration. Another aspect of the study involves developing a consistent sampling protocol for urban soils, using samples from within the city of Halifax. A total of 50 depth-based samples will be obtained from various locations. At each site there will be a collection of 0–5 cm and 0–15 cm sample depths, which will be evaluated through X-ray fluorescence (XRF) analysis. Of these samples, those that have metal concentrations close to or above provincial and federal guidelines will be sieved to particle sizes of 1 and 2 mm. Comparison of metal concentrations relative to particle size and sample depth will potentially add to the identification of patterns. Pending results of soil sample analysis, remediation efforts may be explored by evaluating dilution effects on soils with elevated metal content, using mass balance considerations. Conclusions drawn from analysis will aid in the refinement of useful sampling methodologies. The intent of this study is to build a foundation for determining the ‘best practice’ for assessing elevated metal concentrations in city soils.

*\*Winner of the Atlantic Geoscience Society Award for the best Environmental Science presentation*

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**Sulfur solubility of carbonatites, with implications for mass transfer in Earth's mantle**

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Carbonatites are rare, mantle-derived igneous rocks with >50 wt% carbon, compared to more typical SiO<sub>2</sub>-rich compositions. Whereas the solubility of sulfur for mafic silicate melts has been extensively studied, equivalent data for carbonate-rich compositions has not been obtained. This research looks to determine sulfur solubility in molten carbonate to assess the potential for such melts as a mass transfer agent for sulfur, along with precious metals, in the mantle. The goal is to determine the importance of carbonatite metasomatism to establish precious-metal-rich source regions for magmatic ore deposits. The concentration of sulfur at sulfide saturation in molten carbonate will be measured as function of several variables, including melt composition and pressure to assess the sulfur solubility mechanism. Experiments are done using piston cylinder apparatus at the Dalhousie Laboratory for High Pressure Geological Research. Run products are analyzed using the electron microprobe analyzer using wavelength dispersive spectroscopy. We use a synthetic carbonate melt modeled after experiments that produced in the phase equilibrium experiments with a mantle peridotite assemblage. This material is mixed with a similar mass of FeS, doped with 1 wt% each of Ni and Cu, then loaded, along with ~5 wt% H<sub>2</sub>O, into a graphite-lined Pt capsule. Capsules are placed into a pressure cell comprised of crushable MgO, with an outer graphite furnace and BaCO<sub>3</sub> sleeve. To date, one experiment has been done, at 1.0 GPa and 1100°C for 24 hours. Run-products consist of a crystalline pyrrhotite coexisting with quenched carbonate melt, represented by a fine-grained intergrowth of carbonate phases. Melt FeO concentrations are <1 wt%, and analyses reveal sulfur concentrations of ~700 ppm. This is in comparison to previous solubility measurements at similar conditions on silicate melt with ~10 wt% FeO containing ~1000 ppm sulfur or less. Results thus far suggest similar solubilities for carbonate versus silicate melts, although the FeO contents are significantly different. Additional experiments to test the effect of melt FeO content are in progress. Future experiments will be doped with Au, Ag, and platinum group elements in order to measure carbonatite-sulfide partitioning of precious metals. Further results from this study will provide a better understanding of sulfur solubility mechanisms, and the role of molten carbonate to dissolve and transport sulfur, as well as precious metals, which is currently unknown.

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**Apatite chemistry as a pathfinder for tungsten skarn deposits, Cantung District, Northwest Territories, Canada**

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The Cantung District is home to one of the largest tungsten skarn deposits, the largest outside of Asia. The tungsten ores recovered from Cantung are some of the highest grade (1–3% WO<sub>3</sub>), making it world class. The goal of the research is to determine if the chemistry of apatite in heavy mineral separates from surficial stream sediments and tills can be used to find hidden tungsten skarn deposits in the mineral apatite was identified by mapping polished 1 inch pucks containing coarse fractions on a Scanning Electron Microscope (SEM). The heavy mineral separates were gathered from upstream and downstream of the Cantung deposit along the Flat River valley, Northwest Territories. Minerals were identified, and representative compositional data was collected in both weight percentage and compound percentage. Based on the fourteen pucks analyzed forty-two apatite grains were located. Out of the forty-two grains three different types of apatite were located. This work was in preparation for the next step, which is to determine the trace element make-up of the apatite using laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS). Apatite from the hydrous skarn phase at Cantung is uniquely characterized by elevated As, W, LREE, and Sr. Analysis of apatite from heavy mineral separates will determine if apatite with these features was introduced into the sedimentary record surrounding the deposit. [Poster]

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**Geophysical detection of reducing springs: a new approach**

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Winter House Canyon is incised into the ultramafic Tablelands Ophiolite massif in western Newfoundland. The canyon contains springs characterized by high pH, large negative Eh values and the active precipitation of carbonate. The unusual electro-chemical and magnetic properties of these springs indicates that geophysical techniques may be able to determine the extent, geometry and location of the underground streams which feed the springs. The reducing waters emerging from the springs have Eh values of ~-700 mV. As the self-potential (SP) geophysical method involves measuring electrical potential differences, the Eh contrast between the springs and the surrounding area should produce SP anomalies related to the reducing fluids

percolating through the subsurface. The high alkalinity of the reducing springs is thought to be the result of active serpentinization of ultramafic rock. Since low temperature serpentinization results in the production of magnetite, there should be magnetic anomalies which correspond to areas of past and present serpentinization. Based on these considerations, a 100 m x 30 m area next to a known spring was surveyed by SP using new, low-noise electrodes built for this project, and a magnetic survey, using a fast, GPS enabled Overhauser magnetometer was carried out over an area of 1500 m x 200 m along Winter House Canyon, in an effort to locate and map the reducing groundwater. The geophysical data revealed that the known spring sites produce strong, coherent magnetic and SP responses, and a previously unknown spring was discovered based on its associated magnetic anomaly. Processing and analysis identified underlying structural elements of the ophiolite massif not visible on the exposed outcrop. Correlation of the surveys revealed sets of parallel, linear magnetic and SP anomalies. The strike of these anomalies indicates that reducing fluid is traveling within conduits which are perpendicular to the streambed and appear to predate incision of the canyon. This study presents a new exploration technique for locating new springs sites within Winter House Canyon and elsewhere in the Bay of Islands Ophiolite.

*\*Winner of the Canadian Society of Exploration Geophysics Award for best presentation of a geophysics-related paper*

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**Morphology and geochemistry of the enigmatic Ediacaran *Palaeopascichnus* in the Fermeuse Formation, Ferryland, Newfoundland, Canada**

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*Palaeopascichnus* is an exclusively late Ediacaran fossil comprised of a series of bedding parallel, crescentic, uniseriably-arranged lobes, which can be straight, sinuous, curved, branched, or meandering. It has been described from tuffs, cherts, carbonates, claystones, siltstones, sandstones, and dolomitic sandstones. It is known from Southern Australia, the United Kingdom, northern Norway, the Ukraine, southern China, and Newfoundland. *Palaeopascichnus* was originally described as a trace fossil, but more recently it has been considered to be a multi-chambered body fossil of a xenophyophoran protist, specifically, a benthic agglutinating foraminifera. This study aims to better constrain the morphology and biogeochemistry of *Palaeopascichnus*, as well as its biogeochemical signature. Polished blocks from

the Fermeuse Formation were cut perpendicular and parallel to bedding through the fossils. The blocks were then geochemically analysed using the SEM (EDAX) to produce elemental maps that could be directly related to the fossil material. The same fossiliferous blocks were then used to make petrographic thin sections to better appreciate the associated sedimentary fabrics. This study aims to determine whether there are any mineralogical or biogeochemical differences between the inferred chambers, and the host sediment. The results of this biogeochemical analysis are discussed in the context of the possible palaeobiology and affinity of this enigmatic Ediacaran. A sort of 'halo' surrounding the chambers, composed of for example the titanium bearing mineral rutile would suggest an agglutinating origin, however in our preliminary SEM modeling that does not appear to be the case, except perhaps in one sample.

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**Erosional isostasy modeling of the Northwest Passages, western Canadian Arctic Archipelago**

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Lithospheric flexure is an important control on dynamic topography and geomorphic processes. Isostatic response to surface unloading is critical in predictions for past, present and future environmental changes. The Northwest Passages consist of a series of deep channels (approximately 500 m in areas), some of which are bounded by fault-line scarps. Passages were deepened by fluvial and glacial incision through Cenozoic sediments. The Beaufort Formation was a Pliocene coastal plain deposit believed to stretch from the Northwest Territories to Ellesmere Island along the western Canadian Arctic Archipelago. The fluvial sediments and marine equivalents thicken toward the Canada Basin to as much as 3 km, despite having been deposited in a short time between 3.8 and 2.7 Ma. Paleoflow directions and the upper and lower contacts of the Beaufort Formation suggest that the coastal plain was contiguous, and while the large straits may have previously existed between the islands, they were filled during the Pliocene. How may have islands in the Canadian Arctic responded to the replacement of the eroded Cenozoic sediment with glaciers or seawater? Numerical modeling for lithospheric flexure is conducted using a new open source lithospheric flexure program. From initial loads gathered from bathymetric data in the channels, isostatic response was calculated using an iterative solution. 2-dimensional models were constructed for 3 transects using this method, varying effective elastic thickness values (30 km, 60 km, and 90 km). Each model considers excavation of sediment based on a paleo topographic gradient and infilling with seawater to modern sea level. Estimated isostatic uplift ranges between

50–150 m along the northern and southern flanks of Banks Island and Prince Patrick Island. Further models include 2-dimensional modeling considering erosion on islands, 2-dimensional models including affect of glaciation, and 3-dimensional models. Additionally, the second part of the thesis looks into deposition of the Beaufort Formation, specifically looking into possible rift flank uplift or sediment loading along the eastern Beaufort Sea margin to explain distribution of the Beaufort Formation.

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### McMurray reservoir assessment in the northern Athabasca Oil Sands deposits, Alberta, Canada

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The McMurray Formation was deposited 130 million years ago in the Early Cretaceous. During this time the Western Canadian Sedimentary Basin was dominated by three drainage systems: Spirit River, Edmonton Channel and McMurray Valley system. The McMurray Valley system is confined to the northeastern portion of Alberta by the highlands of the Canadian Shield and Grossmont High. Fluvial processes that deposited the McMurray Formation dominated the lowland regions. The McMurray Formation unconformably overlies the Devonian waterways formation and generally consists of sand, mud, and a variety of other minerals, water and bitumen. The bitumen of the McMurray Formation in Alberta is arguably one most of the important and economic hydrocarbon accumulation in the world. Therefore, extensive geological mapping is necessary to identify the resource potential in a specific region. Approximately 45 km northeast of Fort McMurray 3 townships were analyzed with the use of Petrel Studio to understand the resource potential. The examination of 445 well logs, 10 cores, provided sufficient data to establish resource potential and quality, as well as the presence of top gas. Concluding results have shown that: (1) there are three pay zones present within the study area. (2) there is a wide range in reservoir quality. A qualitative analysis was conducted to assess the reservoir quality based on thickness, volume of shale, resistivity and water saturation. (3) Gas saturated zones at the top of the McMurray formation is common within the study area and could potentially be structurally and stratigraphically trapped. Through this detailed geological analysis the resource potential was successfully analyzed to increase reservoir mapping in the Athabasca Oil Sands deposit.

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### Three-dimensional morphological characterization of the trace fossil *Parahaentzschelinia ardelia*, Atoka Formation, Oklahoma, USA

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The value of trace fossils lies in their use as indicators of paleoenvironment and depositional setting; however, there remains an issue in that some ichnotaxa have been poorly and inadequately defined from their sample material. One such example is *Parahaentzschelinia ardelia* from the Atoka Formation (Oklahoma), the focus of this research. Trace fossil material discovered in the Winterhouse Formation (Newfoundland), while similar to *P. ardelia*, contains additional morphological features revealed through three-dimensional reconstruction. This poses a taxonomic problem in that the type material is considered to be inadequately described. Revising ichnotaxonomic groups using modern methods and applications is one way of resolving this type of issue, in the hopes that taxonomic interpretations can be better implemented and regulated. A sample of the trace fossil *P. ardelia* was collected from an area south of Hartshorne, Oklahoma (N 34°76'47.59", W 95°57'91.71") relying on information reported during its original discovery in 1971. *P. ardelia* was obtained within a float rock from thinly bedded Pennsylvanian sandstones of the Atoka Formation, a 7620 m thick stratum dominated by greyblack shales with intermittent brown to light grey, thinly bedded quartz arenites. The sample exhibits both epirelief and full relief preservation, vertical upward branching burrows, and a highly weathered conical depression, similar to the trace fossil holotype. Burrow fill is primarily homogeneous mudstone with high colour contrast with the host rock. This topotype material was implemented with a three-dimensional approach to reconstructing and describing the fossil burrows using techniques developed at Memorial University of Newfoundland. Use of the serial grinding procedure with a Denford VMC 1300 3 axis CNC milling machine for the purpose of modeling three-dimensional features has not previously been performed for *Parahaentzschelinia*. The objective of this research is to fully characterize the type material from Oklahoma with the purpose of relieving all taxonomic issues. This will allow for a comparison in the morphology from the paratype material to other fossil material described as *Parahaentzschelinia*. The resultant morphology can be further compared with modern vertical burrows to better understand the ethology. Only once this work is complete will *Parahaentzschelinia* become a meaningful name and concept.

**\*Winner of the Science Atlantic Best Paper Award for best overall presentation**



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**Interpreting the geology of the Rocky Brook area,  
western Cape Breton Island, Nova Scotia, Canada**

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The Rocky Brook area is situated in a remote and rugged part of the Cape Breton Highlands, about 15 km southeast of the town of Chéticamp. This study is aimed at better understanding the characteristics of and relationships among the various rock units and mineral occurrences in the Rocky Brook area. The area was mapped during June 2016, and approximately 125 samples were collected for petrographic study and chemical analysis. The area is underlain mainly by the Cambrian(?) Jumping Brook Metamorphic Suite (JBMS) which consists of metasedimentary and metavolcanic rocks. It is bounded on the west and south by the Devonian Fisset Brook Formation, which in places unconformably overlies the JBMS and in other places is faulted against it, and on the east by a faulted contact with the Devonian Margaree Pluton. The JBMS in the study area is divided into two formations, the Faribault Brook Formation (FBF), consisting mainly of metabasalt and minor metagreywacke, interlayered with and overlain by the Barren Brook Formation (BBF), consisting of metagreywacke and quartz muscovite schist. Petrographic study and chemical data indicate that the protolith of metabasalt in the FBF is mid-ocean ridge basalt (MORB). An area of conglomerate is inferred to overlie the Barren Brook Formation. Petrographic study of clasts in this conglomerate has shown that it contains clasts of JBMS, varied granitoid rocks, and basalt of the Fisset Brook Formation, the latter in particular constraining its age to Devonian at the oldest and suggesting that it may be an intraformational conglomerate in the Fisset Brook Formation. The JBMS in the study area has been intruded by two different, but possibly related, porphyries: red quartz-feldspar porphyry and orange quartz-feldspar porphyry with intense stockwork quartz veining. Petrographic and chemical data will be used to investigate the tectonic setting of the porphyry bodies and their possible relationship to felsic rocks in the Fisset Brook Formation or to other felsic units in the region. Portable XRF analysis has provided a large chemical database to investigate the distribution of economic elements in the rocks.

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**Influence of mineralogical composition and texture  
on induced polarization (IP) effects in gold-bearing  
rocks from the Herbert-Brent gold showing,  
Yellowknife Greenstone Belt, Canada**

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On July 29th, 2016, two 400 m long IP/resistivity survey lines, with 5/10 m electrode spacing (multi gradient array), were completed over TerraX Minerals Inc. Hebert-Brent (HB) gold showing. The HB gold showing is located within the Barney Deformation Corridor of the Yellowknife Greenstone Belt (YGB), Northwest Territories. In June 2015, geological mapping discovered significant concentrations of gold in HB situated within an 11 m-wide highly sulphidized sericite-ankerite schist shear zone, hosted in a 10–15 m-wide, quartz-feldspar porphyry. Thirty-three samples were collected from the survey site across the main mineralized zone at 0.45 m increments using a rock saw. This study is designed to explore the viability of different interpretations for bodies (variably gold mineralized and non-mineralized sulphide-bearing zones) that are strongly anomalous in resistivity or chargeability. The resistivity and chargeability of each sample will be determined by using a two-electrode lab apparatus to measure IP effects both in the frequency domain (measuring resistivity as a function of frequency), and in the time domain (determining chargeability from the voltage decay that follows a step change in current across the sample). Detailed textural examination of polished samples using reflected light petrography aided by microXRF (EDS mapping) for point analysis is being used to identify the various mineral phases, and also identify if there are any significant non-sulphide IP sources. Polished thin sections are also being used in order to investigate the dependence of IP effects on sulfide type, concentration, texture, grain shape and size. Once these analyses are completed for each sample, the results will be used to help interpret the vertical IP section of estimated subsurface resistivity and chargeability. Results from these steps will be used to better define lithological and mineralized units in the subsurface and help define drill targets for gold exploration.

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**1D modelling approach to the investigation of  
Mesozoic source rocks in several offshore  
Newfoundland basins, Canada**

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During the break-up of Pangea, numerous rift basins formed along the conjugate margins of the Atlantic Ocean.

Sedimentary basin formation is complex in this region, posing challenges when evaluating the potential for oil and gas. Petroleum systems modelling (PSM) is a predictive tool that aids the understanding of basin development and the assessment of uncertainties. The objective of this study is to build upon the understanding of source rock distribution, potential, and maturation of offshore Newfoundland. The project focuses on the evaluation of the Late Jurassic Egret Member source rock, using one-dimensional modelling with PetroMod PSM software. Fourteen wells distributed across five basins are modelled: Carson, Horseshoe, Jeanne d'Arc, Outer Ridge Complex and Whale basins. Data is obtained from NRCan's BASIN database. Boundary conditions such as, paleo-water depth (PWD), surface-water interface temperature (SWIT), and heat flow are vital controls for the output of the model. Boundary conditions are manipulated and changed based on the interpretation of the dataset and previous work. Previous studies of this area tend to focus on one basin, whereas this study encompasses multiple. Preliminary results suggest that each basin has varying heat flow models, although these basins may have formed during the same rifting event. These fourteen 1D models provide a foundation for further development of 2D, 3D, and 4D models and adds to the geologic understanding of this region and possibly lead to further oil and gas development.

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**Early-Middle Jurassic coastal sabkha depositional environment variability in the Mohican I-100 Cores 7 and 8, Scotian Basin, Canada**

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Based on the interpretation of 15 thin sections taken at select intervals throughout Early—Middle Jurassic aged well Mohican I-100 cores 7 and 8 in the Scotian Basin, and the full core logs of both cores, a determination of depositional environment variation has been recorded and interpreted. This analysis is conducted in part to gain a better understanding of Early—Middle Jurassic carbonate and evaporitic strata emplaced along the modern central Atlantic margin during the formation of the proto-Atlantic ocean. As well, it provides an updated facies classification as conducted by earlier workers. These dolomitized sections will be further studied for source rock and/or reservoir potential, as well as larger-scale study of lithological intervals within the individual cores. The cores penetrate early—Middle Jurassic strata, and yield environments classified as a coastal, predominantly sabkha section which varies from semi-arid/coastal plain to inner shelf believed to be caused by base-level changes occurring on a regional scale theorized to be induced by the Pangea Breakup. This has been determined through an analysis of the microfacies

in thin section, and the larger facies transitions in the full cores against evidence of diagenesis, micro-organisms, and other relevant variations in section. Classifications of environments is based on earlier work with additional classifications created in study. [Poster]

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**An investigation of hybridization of Halifax Pluton, South Mountain Batholith, Nova Scotia, Canada**

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An investigation of magmatic growth history of the K-feldspar megacrysts in the Halifax Pluton, a Late Devonian age granite intruded into the Meguma strata bedrock, is ongoing. Specifically, the rocks being investigated outcrop along the coast by Prospect and Sambro Head, Nova Scotia. Several outcrops in these areas contain clusters of large mafic enclaves, which differ texturally from country-rock, metasedimentary xenoliths, and appear to be of a magmatic origin. The presence mafic enclaves suggest that a period, or periods, of magma mixing may have occurred. Magma mixing has been documented at Sambro Head, where a mafic intrusion has been injected into the still partially molten granitic host. Similar partial mixing zones have been described in other granitic intrusions of the same age in southwest Nova Scotia. Large K-feldspar phenocrysts (megacrysts) are present in both the granitic rocks and in some mafic enclaves by Prospect. Of note are enclaves which show megacrysts crosscutting their margins, suggesting that both the host granite and enclave were at least partially liquid during megacryst growth. This study will use field observations, petrography, whole-rock analysis and detailed electron microprobe analysis to study these mafic enclaves, surrounding host granitic rocks and in particular, the large megacrysts. Chemical zoning preserved in granitic feldspar megacrysts, where no obvious mafic enclaves occur, suggest that hybridization of this granitic pluton may have been more widespread than previously documented. [Poster]

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**A non-invasive, surficial approach to studying bedforms in the nearshore**

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Bedforms in nearshore environments are undulatory sedimentary structures formed by wave-forced fluid-sediment interactions at the seabed. Signature characteristics imprinted on the sediment fabric may be used to infer environmental conditions in the past by comparison to bedforms in the geologic record. Lunate megaripples and

cross-ripples are bedforms with complex geometries that have been observed in nearshore environments, however they are not well studied in the literature and the conditions required for their formation are unclear. Previous surveying methods have recorded observations using instruments installed in the seafloor, which can disturb the sediment and obstruct fluid flow. The purpose of this study is to refine methodology for observing lunate megaripples and cross-ripples non-invasively. The study site, Crystal Crescent Beach, in Sambro, Nova Scotia, was selected for its sandy bottom and clear water. A low cost, human-powered surface vehicle was utilized as the platform for mounting (1) a video imaging device to record bedform morphologies at varying depths, and (2) a sonar device to detect and document ocean floor topography. Sand samples were obtained for analyzing grain sizes characteristic of the bedforms. Weather, wind, and wave conditions were recorded before, during, and following fieldwork to document potential physical conditions associated with bed geometries. These observations can be used as a basis for further studies of bedform development in nearshore environments using instrumented surface vehicles. [Poster]

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**Rifted margin and sedimentary structure of the Porcupine Abyssal Plain, outboard of Goban Spur, southwest Ireland**

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Goban Spur is a relatively shallow submarine plateau located 250 km southwest of the Irish mainland. This sediment-starved bathymetric feature overlies ancient Hercynian continental crust. Various periods of uplift and erosion were documented following Leg 80 of the Deep Sea Drilling Project-International Phase of Ocean Drilling (DSDP-IPOD). Syn-rift sediments as old as Barremian age unconformably overlie the Hercynian basement, and are deposited in extensional listric faults dipping westward with throws of up to 4 km. Post-rift sediments overlie a regional unconformity of Aptian age. Goban Spur remained structurally high in the Aptian, receiving lesser sediment influx than juxtaposed basins. A recent seismic refraction survey has revealed a 120 km wide indeterminate region between the first magnetic anomaly related to seafloor spreading and thinned continental crust. High velocities and Poisson's ratio values are reported within the upper 1.5 km of basement 70 km seaward of the Pendragon escarpment. This region is interpreted to be a 70 km wide zone of serpentinized exhumed mantle. A bathymetric rise of 400 m is encountered to the west corresponding to a series of basement ridges. This 50 km wide region is persistent up to magnetic anomaly 34, which marks the beginning of seafloor spreading. New regional seismic reflection data

were acquired by the Petroleum Affairs Division (PAD), Energy and Natural Resources, Government of Ireland. These seismic lines will be reprocessed incorporating independent results. The intent is to produce an improved image of the transition from the rifted margin of the Goban Spur into the Porcupine Abyssal Plain, which is to be interpreted adhering to geological constraints from DSDP-IPOD Leg 80. [Poster]

*\*Winner of the Imperial Oil Award for the best poster presentation*

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**Circulation of deep groundwaters in the Canadian Shield and their relevance in ore deposit formation**

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There is a widely accepted concept at the Sudbury Igneous Complex, Ontario, of hydrothermal fluids derived from ancient saline groundwaters with unique compositional characteristics having been involved in the concentration of ore metals in sulfide deposits. The overall objective of this study is to determine whether there are different fluids in each area or if the same fluid flowed through both regions, and if so how did that fluid evolved compositionally. A comparison of fluid inclusion trace element compositional data from the Sudbury Igneous Complex and the nearby East Bull Lake intrusive suite, Ontario, was done in order to determine if the previously mentioned concept is true, or if all deep groundwaters in the Canadian Shield from that time period (1.85 Ga) are the same at a regional scale. Epidote-quartz pegmatite and quartz vein samples from the East Bull Lake yielded over 350 fluid inclusion analyses by optical microscopy, microthermometry, and laser ablation inductively-coupled plasma mass spectrometry (LA-ICPMS). The study involved two types of fluid inclusions: (i) two-phase liquid-vapour and (ii) three-phase liquid-vapour-halite inclusions. Parameters compared between East Bull Lake and Sudbury were the bulk fluid salinity (in NaCl eq wt%), and a large suite of major and trace elements as elemental concentrations and ratios. In particular, trace elements that occur in elevated concentrations in both fluids are Ba, Zn, Pb, Mg, Fe, Rb, and Sr suggesting, tentatively, that the saline fluids in both settings are related to a common source. Continued data interpretation is being carried out and stable isotope work is planned to further link the two different hydrothermal fluid systems.