

# The Geological Record

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**Comments or questions? Please contact:**

Doug MacDonald  
Editor, *The Geological Record*  
NS Department of Energy and Mines  
Geoscience and Mines Branch  
Geological Survey Division  
P.O. Box 698, Halifax, NS B3J 2T9  
Phone 902-424-2510  
[Douglas.R.MacDonald@novascotia.ca](mailto:Douglas.R.MacDonald@novascotia.ca)

## New Coastal Monitoring Program

The coastal environment is a dynamic system with a multitude of processes governing its evolution. Understanding the current states of coastlines in Nova Scotia, and the stresses being placed upon them, will lead to a broader understanding of how to develop, protect, and live within the coastal regions of the province. A multi-year coastal monitoring program, which will utilize drone technology, will begin this spring and summer. The drones will allow us to measure erosion rates, storm surge vulnerability, and beach stability, as well as monitor the impacts of sea-level rise on the different coastal regions of Nova Scotia.

The Department of Energy and Mines has purchased two drones for use by the Geological Survey Division during the 2019 field season. One drone is equipped to produce 3D point clouds (see the image below), whereas the other is equipped for thermal imaging. These drones will allow for survey-grade point clouds, similar to lidar, to be generated for monitoring the morphology of the coast. The thermal cameras will be used in several research applications from detecting groundwater discharge within coastal bluffs to possible classification of rock types based on thermal properties.

In 2019 we hope to visit over 80 monitoring sites throughout the province. The first goal for the project is to build baseline data for Nova Scotia's coastal regions, so that changes within these environments may be accurately measured in the future.

*Peter Horne*



Point cloud image from the first drone survey near Antigonish (250 points per m<sup>2</sup>).

## Danielle Nicholson is the New Technician in the Registry of Mineral and Petroleum Titles

Danielle Nicholson has been part of the registry team since she came to us from the private sector more than 10 years ago. Originally hired to provide support during staffing changes and then to support preparation for the new NovaROC registry system, Danielle has been adept at providing excellent support to clients and staff. Her industry background has provided insight into many stakeholder concerns, and the ability to answer complex regulatory questions in a way that all clients can understand and appreciate.

Danielle has been a key part of the ongoing improvements to NovaROC (see article below), Nova Scotia's online mineral rights management system. She works with clients and staff to identify and correctly describe a problem, and then works with the software developer to devise a solution or improvement, which is followed by thorough testing. She also worked on the teams developing the new *Mineral Resources Act* and *Regulations*.

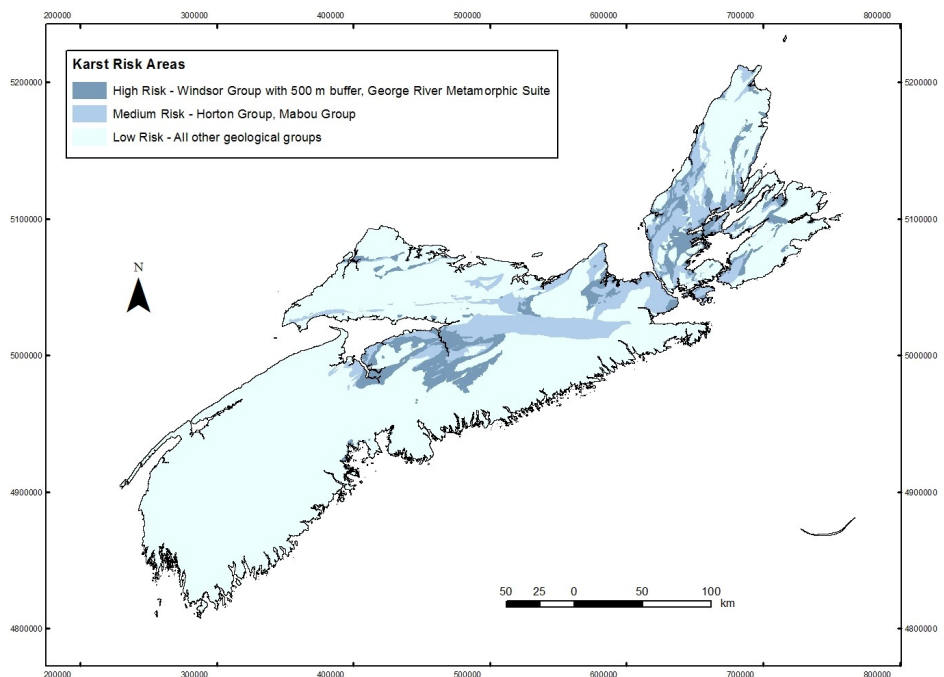
Danielle has a B.Sc. (geology) from St. Mary's University and is an avid curler, serving on the Dartmouth Curling Club Board of Directors. If you visit the Registry of Mineral and Petroleum Titles in Halifax, be sure to introduce yourself.

John MacNeil

## New Karst Risk Map Released

A new provincial karst risk map was released in February 2019. Karst refers to the distinctive terrain that develops over soluble bedrock, such as gypsum and limestone, and includes features such as sinkholes, caves, and springs. Sinkhole development in karst terrain can cause extensive damage to buildings, roads, and other infrastructure. In Nova Scotia, most natural sinkholes associated with karst are formed in areas where gypsum occurs, although other rock types in the province are also known to develop sinkholes. Preparation of the new karst risk map involved the compilation of existing geology maps and karst occurrence data, review of lidar data, and field verification of sinkhole occurrences. The resulting karst database contains over 1,000 records of known sinkhole locations. The map, associated open file report, and information on managing karst risks can be accessed from the department's sinkhole webpage: <https://novascotia.ca/natr/meb/hazard-assessment/sinkholes.asp>.

John Drage



Karst risk in Nova Scotia.

## NovaROC: Most Frequently Asked Questions

**Q** I hate my long password. How do I change it? **A** Under "Client Account," choose "Change Password."

**Q** Do I have to be a registered prospector to acquire an exploration licence? **A** No, these are independent of each other.

**Q** How do I add an agent? **A** Under "Client Account", choose "Agent Management".

**Q** How do I obtain contact information for other clients? **A** If the client was previously a rights holder, use the "Search" tab. Enter the client's name in the "Holder Name" field.

**Q** How do I search on a map? **A** Click on the binoculars to toggle to advanced search; in the "Fields" box, double click on the option "Right Number;" on the keypad, click on the equal sign (=), then in the text box, type the five-digit licence number in single quotation marks (example: '50397').

**Q** Where can I find the name of the licensee? **A** If you have the licence number, which can be found on the map, go to the "Search" page, and enter the licence number in the "Right Number" field.

**Q** How do I determine who the land owner is? **A** This information is not available through the NovaROC system. Contact Nova Scotia Land Registry.

Danielle Nicholson



## Mineral Resources Development Fund Enhanced for 2019-2020

On April 9, 2019, the Nova Scotia Department of Energy and Mines launched the Mineral Resources Development Fund (MRDF) for the 2019-2020 fiscal year. We are pleased to announce that the fund has an approved budget of \$1.5 million for this fiscal year, an \$800,000 increase over last year. This will allow the department to support significantly more projects compared to prior years. The funds will be shared across seven funding streams that support various sectors of the province's mining industry. Although the funding streams will remain the same for 2019-2020, the department has worked hard to help improve the program's Terms and Conditions, and address some of the feedback we received from stakeholders, such as streamlining the application process for the 'Prospecting and Exploration' and 'Shared Funding' streams. Also, to help support post-secondary students in the geoscience and engineering fields, the total award for Prospecting and Exploration and Shared Funding grants may be increased by up to \$5000 if the applicant hires a student to assist with the exploration program.

As part of the lead-up to the launch of the MRDF, the department hosted an educational workshop on April 3, 2019. The workshop was open to prospectors, researchers, companies, and other stakeholders who wished to attend. A wide variety of topics, ranging from how to complete an application form to reporting requirements for grant recipients, was presented to the group in an effort to help potential applicants navigate the application process. The deadline to submit applications was May 6, 2019, but there may be a call for Post-secondary Research Grants in the fall of 2019. For more information about the Mineral Resources Development Fund, including Terms and Condition, forms, and previous grant recipients, please visit <https://novascotia.ca/natr/meb/mrdp.asp>.

Jonathan Bonaparte

## Water Well Owners Urged to Test for Manganese

Health Canada has set a new drinking water guideline for manganese (Mn) of 0.120 mg/L. Consumption of Mn over a prolonged period can adversely affect brain development in children, and memory, attention and movement in adults. The aesthetic objective for manganese in drinking water has also been lowered from 0.05 mg/L to 0.02 mg/L. More than 40% of Nova Scotia households get their drinking water from private wells, and it is estimated that about 30% of these private well owners may have Mn concentrations above the new health-based guideline (0.120 mg/L). In May, the Geological Survey Division released an updated map showing the distribution of Mn in bedrock aquifers in Nova Scotia in comparison to the new guideline [https://novascotia.ca/natr/meb/download/mg/ofm/htm/ofm\\_2019-002.asp](https://novascotia.ca/natr/meb/download/mg/ofm/htm/ofm_2019-002.asp).

Private well owners should test their well water for chemical contaminants, such as manganese, every two years. If manganese exceeds the acceptable level in drinking water, it should be treated before consumption. More information about private well testing is available at <https://novascotia.ca/well-water-testing> and more information about manganese in well water and appropriate treatment is available at [https://novascotia.ca/nse/water/docs/Drop\\_on\\_Water\\_English.pdf](https://novascotia.ca/nse/water/docs/Drop_on_Water_English.pdf).

Gavin Kennedy

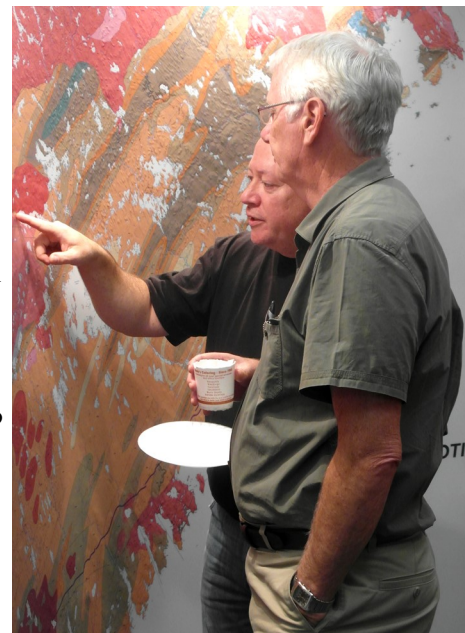
## Mining Association of Nova Scotia Honours Retired Geological Survey Geologist George O'Reilly

The Mining Association of Nova Scotia (MANS) established the President's Award to provide recognition to an individual, respected by their peers, who has provided outstanding personal, financial, or strategic support to the industry. Past recipients include well known industry figures like John "Nova" Chisholm, Pat Mills, John Wightman and Gord Dickie.

George O'Reilly worked as a mineral deposits geologist with the Geoscience and Mines Branch for 37 years. He began his work with the former Department of Mines in 1976 as a field geologist studying granites in southeastern Cape Breton Island. The following years took George from one end of the province to another, examining mineral deposits of all kinds. This experience led to his work on the department's Mineral Occurrence Database: more than 3000 occurrences, most of which he visited in person. He retired in 2013. George has always been a strong supporter of the mining industry, and that support has continued in retirement. He currently sits on the Mineral Resources Development Fund's Council, and serves on the board of the Minerals Research Association of Nova Scotia.

It is worth noting that George is the first recipient of the President's Award who did not work in the mining industry. Presenting the award to George acknowledges the vital partnership between the mining industry and the provincial government. It benefits industry and government – and most importantly, Nova Scotians – when we work collaboratively to grow the industry and create jobs. George's years of public service provide a great example of this partnership at its best.

Sean Kirby, MANS, and Ron Mills



Geologists George O'Reilly (foreground) and Chris White examine Chris's new geological map of southwest Nova Scotia, October 2013.

## Mining Association of Nova Scotia Hosts Two Educational Conferences

Thanks to funding from the Mineral Resources Development Fund (see article on p. 3), the Mining Association of Nova Scotia held two one-day conferences this past year, focused on consultation and social licence, and mine safety.

### Consultation and Social Licence

In November 2018, the Mining Association of Nova Scotia (MANS) hosted a conference to address consultation and social licence as applied to mining. The purpose of the conference was to bring together speakers who could address why social licence matters, how to do it better, and to present different perspectives on what it means for the industry. The keynote speaker addressed the mining industry's duty to consult, and stressed the importance of aboriginal consultation and involvement. Speakers from government, industry, and several with no connection to mining, shared strategies and advice on how to work with, and build support within, host communities.

### Safety

While Nova Scotia's mining industry has reduced its injury rate by 90% in the past two decades, we believe in continuous improvement in safety. The most important thing to come out of a mine is the miner. The safety conference was hosted in February 2019, and featured speakers who discussed continuous improvement in safety through best practices, advances in new technology and safety systems, and building a safety culture. The keynote speaker discussed the role of artificial intelligence in improving safety and productivity.

The conferences were free to attend thanks to the generous support of the Government of Nova Scotia through the Mineral Resources Development Fund, and several corporate sponsors (Anaconda Mining, Dexter Construction, GHD and Toromont Cat). MANS gratefully acknowledges the Mineral Resources Development Fund. Information about the fund is available at <https://novascotia.ca/natr/meb/mrdp.asp>.

Sean Kirby, MANS

## Study Shows High Potential for Corrosive Groundwater in Most of Nova Scotia's Private Wells

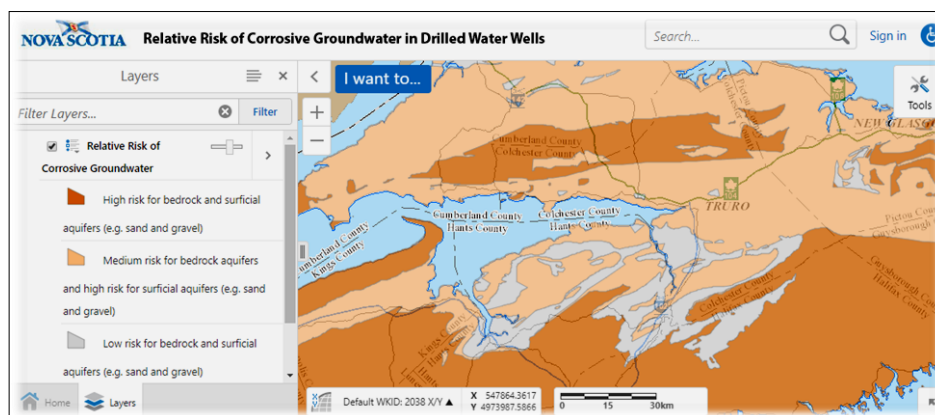
In April 2019 the Geological Survey Division released a report ([https://novascotia.ca/natr/meb/data/pubs/19ofr02/ofr\\_me\\_2019-002.pdf](https://novascotia.ca/natr/meb/data/pubs/19ofr02/ofr_me_2019-002.pdf)) and web map application (<https://fletcher.novascotia.ca/DNRViewer/index.html?viewer=Drilled+Corrosive+Groundwater+NS.Relative+Corrosivity+of+Groundwater+in+Drilled+Water+Wells>) showing the potential corrosivity of groundwater associated with seven major aquifer types across Nova Scotia. Corrosive groundwater can leach lead and other metals from plumbing materials. Although public drinking water systems in Nova Scotia are regulated for lead exposure, private well-water supplies account for over 40% of Nova Scotia's domestic water supplies and are not regulated for water quality.

Lead exposure in private wells, associated with corrosive groundwater, is therefore a significant public health concern. Although the content of lead in plumbing materials has been restricted for over 30 years, issues with respect to lead exposure from drinking water supplies persist, mainly due to the presence of lead in older plumbing materials. Lead in drinking water is associated with a range of adverse health effects, including impaired neurological development and behaviour in children, and increased blood pressure or kidney problems in adults. Health Canada lowered the maximum acceptable concentration for lead in drinking water to 0.005 mg/L earlier this year. For more information about the guideline change and the health effects of lead in drinking water, visit <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/what-about-lead.html>.

The assessment of the potential corrosivity of groundwater in Nova Scotia used available groundwater chemistry data, and the chloride-to-sulphate mass ratio and Langelier Saturation indices to identify areas where there may be a greater likelihood of lead in private well-water supplies. Crystalline bedrock aquifers and most of the province's surficial aquifers, which together supply about 56% of the province's private wells, have the highest potential for corrosive groundwater. Aquifers with a higher potential for corrosive groundwater were also associated with a higher likelihood of lead concentrations in well water exceeding acceptable levels due to leaching of lead from plumbing materials.

A relative risk map of the potential corrosivity of groundwater was produced to communicate risk to private well owners and to highlight the importance of routine water quality testing of private wells. Recommendations on water sampling for lead and other contaminants can be found on Nova Scotia Environment's website: [https://novascotia.ca/nse/water/sample\\_chemical.asp](https://novascotia.ca/nse/water/sample_chemical.asp).

Gavin Kennedy



A section of the web map application showing relative risk of corrosive groundwater.



# From the Mineral Inventory Files

## The Jordan Falls Be-Mo Pegmatite

A quartz dyke containing beryl and molybdenite occurs about 700 m east of the Lake John Road in Shelburne County, about 5 km north of Highway 103 (Fig. 1). From the bridge over Lead Mine Brook, follow the brook northeast for about 700 m and you will encounter some water-filled trenches adjacent to a 90 m long trench. The trench exposes a quartz dyke intruding biotite-garnet-andalusite metasiltstone and metawacke of the Cambro-Ordovician Halifax Group. There is also a smaller mineralized pegmatite dyke exposed in an outcrop along the south bank of Lead Mine Brook, about 100 m west of Lake John Road.

The Jordan Falls dyke was first discovered in 1890, but until the mid-1950s interest was only directed at its molybdenite content by way of trenching and blasting. In 1957 attention shifted to the Be potential when A. E. Cameron of the provincial Department of Mines analyzed several samples that returned in the order of 5.5-9.5% BeO. Over the following three years the trench was extended to 90 m length and surveyed with a beryllometer, which indicated an overall grade of 0.18% BeO. In 1961 Talisman Mines Limited acquired the property and carried out a program of mapping, geophysics, and drilling of 11 holes totalling 569 m. This work defined the main dyke as being 90 m long and extending to 130 m depth, but it appeared to be pinching out. The company also encountered numerous parallel, but thin, beryl-bearing quartz veins. In 1992 M. C. Corey of the provincial Department of Natural Resources drilled four diamond-drill holes on the property to evaluate the rare-element potential of pegmatites in southwest Nova Scotia. All four holes intersected beryl- and molybdenite-bearing quartz dykes and veins, but their distribution was sporadic. Two of the holes also intersected a 4 m wide, texturally variable and muscovite-rich leucogranite dyke that carries disseminated pyrite, chalcopyrite, and molybdenite. The leucogranite, as well as all the quartz intrusions, have a well developed, bleached alteration halo that contains significant black tourmaline.

The main quartz dyke consists predominantly of a mix of massive white

and translucent quartz. The translucent portions display an obvious layering that, in thin section, has been proven to be minute shear bands. Muscovite-rich greisen "selvages" with abundant tourmaline occur as patches along portions of the dyke-wallrock contact (Fig. 1). Beryl in the dyke usually occurs as white opaque to translucent pale green, anhedral to subhedral crystals generally <3 cm long. There are also reported to be some beryl-rich masses consisting of a mix of fine-grained, anhedral, translucent beryl and a feathery white variety of albite called cleavelandite. Molybdenite occurs as small subhedral flakes in the massive quartz, but most commonly as disseminations in the greisen selvages.

By strict definition the Jordan Falls dyke is not a pegmatite and, as some examiners have noted, may be more fittingly termed a quartz-greisen. Its dyke-like form and mineral assemblage, however, are more typical of rare-element pegmatites, and the fact

that the southwest region of the province has numerous rare-element pegmatite intrusions has led most to call it a pegmatite. For many years the Jordan Falls dyke was considered to be something of an orphan because it didn't appear to have a nearby parent granite pluton. The pattern of magnetic anomalies present over the Jordan Falls area revealed in federal government airborne magnetic surveys, however, shows an obvious disruption of the magnetic patterns around an area of low response that underlies the Jordan Falls property (Fig. 1). This strongly suggests the presence of an unknown or subcropping granite pluton and has thus been recognized as such on C. E. White's recent geological map of southwest Nova Scotia. If this is the case, then it highlights the Jordan Falls property as being a target area with potential for more rare-element intrusions than are currently known.

G. A. O'Reilly

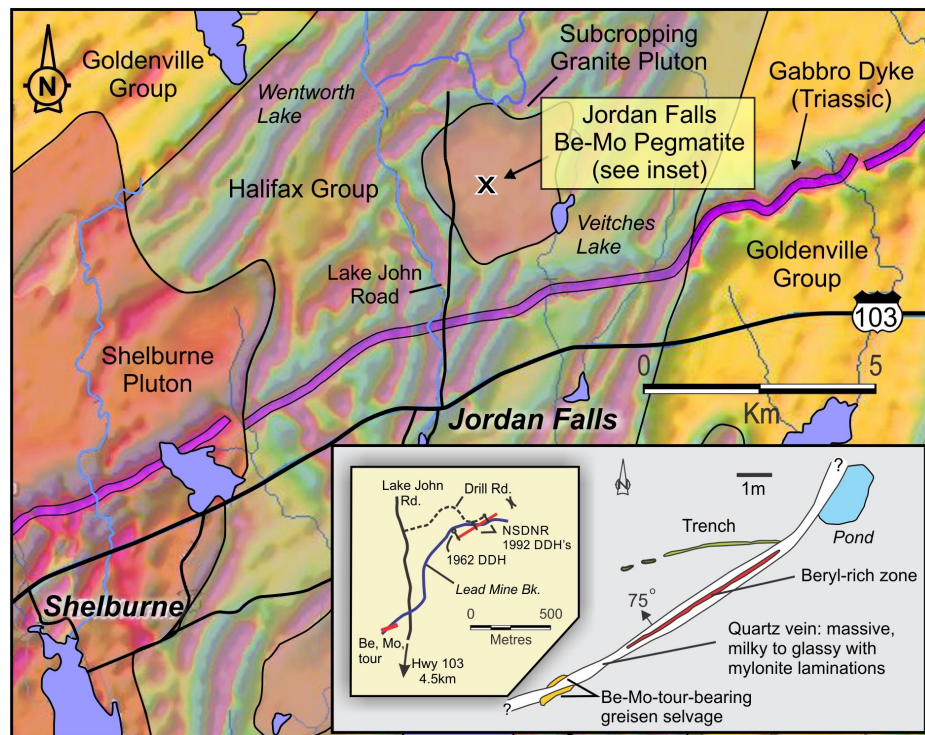


Figure 1. Geology map of the Jordan Falls area draped over a federal government second-derivative aeromagnetic map of the same area. The location of the Jordan Falls Be-Mo pegmatite is shown relative to an underlying, subcropping, granite intrusion that is suggested by disruption of the aeromagnetic anomaly patterns.

## Chris White and Co-authors Win Best Paper Award for 2018

The Canadian Journal of Earth Sciences (CJES) is one of the world's most respected journals for scientific research. The journal recently recognized an April 2018 contribution to CJES by the Geological Survey Division's Chris White as its best paper of 2018. The paper is titled *U-Pb (zircon) ages and provenance of the White Rock Formation of the Rockville Notch Group, Meguma terrane, Nova Scotia Canada: evidence for the "Sardinian gap" and West African origin*. Chris collaborated on the research with co-authors Sandra Barr of Acadia University, and Ulf Linnemann of the Senckenberg Natural History Collections of Dresden, Germany.

Work on the research project began in 2015 and covered an area comprising southwestern Nova Scotia and parts of the Annapolis Valley. The research identified an unconformity between rocks of the Halifax Group and those of the overlying Rockville Notch Group, which had previously been thought to be continuous. Instead, a gap of roughly 30 to 40 million years exists between the two groups of layered rocks. This "Sardinian gap" has been documented in Europe, but not previously in North America.

Doug MacDonald



The best paper award was presented by the Canadian Journal of Earth Sciences to (left to right) Drs. Chris White, Sandra Barr, and Ulf Linnemann at the May 2019 Geological Association of Canada-Mineralogical Association of Canada conference in Quebec City.

## Nova Scotia Department of Energy and Mines Debuts at PDAC 2019

In March 2019, the Geoscience and Mines Branch attended the Prospectors and Developers Association of Canada (PDAC) convention in Toronto for the first time as part of the Department of Energy and Mines. Nine members of the Department of Energy and Mines attended the convention, including Deputy Minister Simon D'Entremont, as well as a group of 10 prospectors supported by Marketing Grants under the Mineral Resources Development Fund, and Derek Peters from the KMKNO Mi'kmaq Rights Initiative.

PDAC 2019 was a big success for Nova Scotia, which drew significant attention due in large part to the ongoing success of Atlantic Gold's Moose River gold mine. Recent exploration successes by other companies, including Northern Shield Resources and Transition Metals, helped draw additional interest in the mineral resources of Nova Scotia. Among the changes to the Nova Scotia presence at PDAC this year was the purchase of a series of individual kiosks to be used by the prospectors, providing them with a new, professional-looking space where they could exhibit their properties, samples, and other information to interested explorationists and investors.

This year marked the 25<sup>th</sup> Annual Nova Scotia Mining Breakfast, which

was a huge success, with record attendance, and featured an enthusiastic and informative keynote talk from Mr. Ian Bliss, the CEO of Northern Shield Resources, about the company's Shot Rock epithermal gold project in the Antigonish Highlands. As the premier global mining and exploration event of the year, this strong, successful presence from the department and local industry interests will continue to drive the promotion, growth, and development of Nova Scotia's mineral resources.

In a strategic effort to strengthen the global mining profile of the Atlantic Canada metal mining sector at PDAC 2019, a new forum, *Canada's Atlantic Edge*, was organized and hosted by the Atlantic Canada Mining Alliance. Mining associations and provincial government staff from NS, NB, and NL, with support from Atlantic Canada Opportunities Agency (ACOA), organized the event with a full agenda of presentations from exploration and mining companies from all three provinces. The event was full to capacity, with an audience that included fund managers, financial institution representatives, and major equity firms. Planning is currently under way to expand the event to include additional global mining investment forums.

Diane Webber and Geoff Baldwin



Photograph of some of the new prospector kiosks introduced this year by the Nova Scotia Department of Energy and Mines at the Prospectors and Developers Association of Canada convention, March 2019.



## South Shore Field Trip for Students and Pros

Every year the Department of Earth and Environmental Science at Acadia University organizes a field trip in late April to the South Shore of Nova Scotia for students who have completed courses in igneous petrology, tectonics, and metamorphic geology. The trip is designed to show students some of the spectacular geology in this part of the Meguma terrane, and provide an opportunity to put their learning into action. This year, in addition to Acadia students, several geologists from Atlantic Gold Corporation participated in the trip.

After refueling at one of the many Tim Hortons in Bridgewater, the group, led by Chris White (NS Geological Survey) and Sandra Barr (Acadia University), observed examples of metasedimentary rocks of the Goldenville and Halifax groups southeast of the Chebogue Point shear zone (Dublin Shore to Yarmouth), at both low and high metamorphic grades, as well as some of the region's granitoid plutons and a Mesozoic gabbroic dyke that intrudes them. After staying overnight in Yarmouth, the second day was spent looking at rocks northwest of the Chebogue Point shear zone, including the Goldenville and Halifax groups and metavolcanic and metasedimentary rocks of the Silurian White Rock Formation (Rockville Notch Group).

The field stops were slightly modified on the second day to accompany the interests of the Atlantic Gold Corporation participants. We visited the Wedgeport area to see the slate and metasandstone of the Moses Lake Formation, but high tides prevented seeing any of these rocks. Fortunately, however, a new sand and gravel pit in the Arcadia area bottomed-out in rocks associated with the Chebogue Point shear zone, exposing highly deformed pyrite- and pyrrhotite-rich quartz veins, quartzite, slate, and gabbro.

The trip was not blessed with sunny weather, as rain and fog prevailed throughout the two days. This uncomfortable weather situation was somewhat offset by funding provided by Atlantic Gold Corporation that reduced student costs for this trip. The sponsorship was greatly appreciated by all participants.

Chris White



Field trip participants standing at the contact between pale brown felsic tuff of the White Rock Formation (Rockville Notch Group) on the right, and dark slate of the Bear River Formation (Halifax Group) to the left, on the beach at Cape St. Mary.

## Special Note

### E-mail Notification

If you would like to receive an e-mail notice (with hot links) when new maps, digital products and publications are released, or when a new issue of *The Geological Record* is released, please send your e-mail address to [DNR.Library.List@novascotia.ca](mailto:DNR.Library.List@novascotia.ca).

## Dates to Remember

### August 16-18, 2019

Nova Scotia Gem and Mineral Show and Sale, Lion's Arena, 2163 Western Ave., Parrsboro, NS. For more information please visit <https://fundygeological.novascotia.ca/gemshow>.

### October 17-19, 2019

Nova Scotia Gold Show, Alt Hotel, Halifax Stanfield International Airport. Please note that advanced registration is required. For more information, please visit [tmans.ca/goldshow](http://tmans.ca/goldshow).

### October 24-27, 2019

Atlantic Universities Geoscience Conference, St. Francis Xavier University, Antigonish, NS. For more information please visit <https://ees.acadia.ca/event-reader/augc2019.html>.

### October 27-29, 2019

Exploration, Mining, and Petroleum New Brunswick Conference, Delta Hotel, Fredericton, NB. For more information please visit [http://www2.gnb.ca/content/gnb/en/departments/erd/energy/content/conference/Conf\\_home.html](http://www2.gnb.ca/content/gnb/en/departments/erd/energy/content/conference/Conf_home.html).

### November 6-9, 2019

Mineral Resources Review 2019, Delta Hotels St. John's Conference Centre, 120 New Gower Street, St. John's, NL. For more information please visit <http://www.nr.gov.nl.ca/nr/mines/mineral.html>.