The Geological Record

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NOVA SCOTIA

Surveys Show an Active Season of Erosion

Below is a map showing the change from April to September, 2019, for Heather Beach on the Northumberland Strait, Cumberland County. Since the beach was first surveyed in April it has lost up to 2.3 m to erosion. Between the drone survey in July and another flown after Hurricane Dorian there was a change of up to 2 m in some locations along Heather Beach. The photograph shows the kind of till cliff in the area, and its vulnerability to erosion. So far we have surveyed more than 40 sites throughout Nova Scotia, and are actively adding more sites. The project's objective is to survey more than 60 sites by the end of the year.

Peter Horne

From the Mineral Inventory Files Articles Compiled by Summer Student

For nearly 25 years, our recently retired colleague George O'Reilly has been contributing a popular series of articles to the Geoscience and Mines Branch newsletter. The articles supply historical and current information, photographs, and maps of interesting mineral properties in Nova Scotia. The series, titled *From the Mineral Inventory Files*, now consists of 70 articles published from 1995 to the present in the *Nova Scotia Minerals Update* and the *Geological Record*.

This year, summer student Braeden Gray extracted and compiled these articles as individual PDF documents. Braeden also georeferenced the outline of the map figures in each article (see illustration below), and integrated them into an online web map application to allow clients to interactively access the articles.

This is a significant body of work covering the entire province. The link to the application and a full listing of the articles can be found at https://novascotia.ca/natr/meb/pdf/FTMIF.asp.

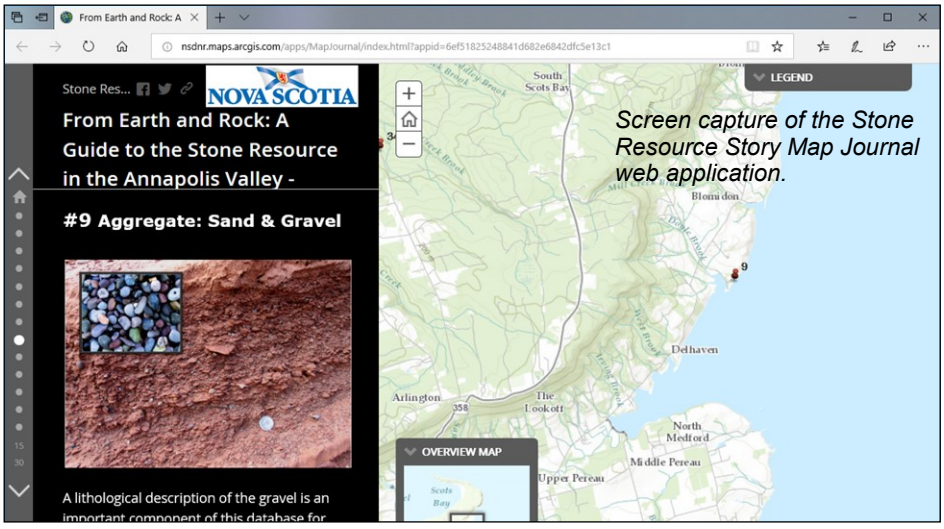
Jeff Poole

Stone Resources in the Annapolis Valley: a Preview Web Map Application

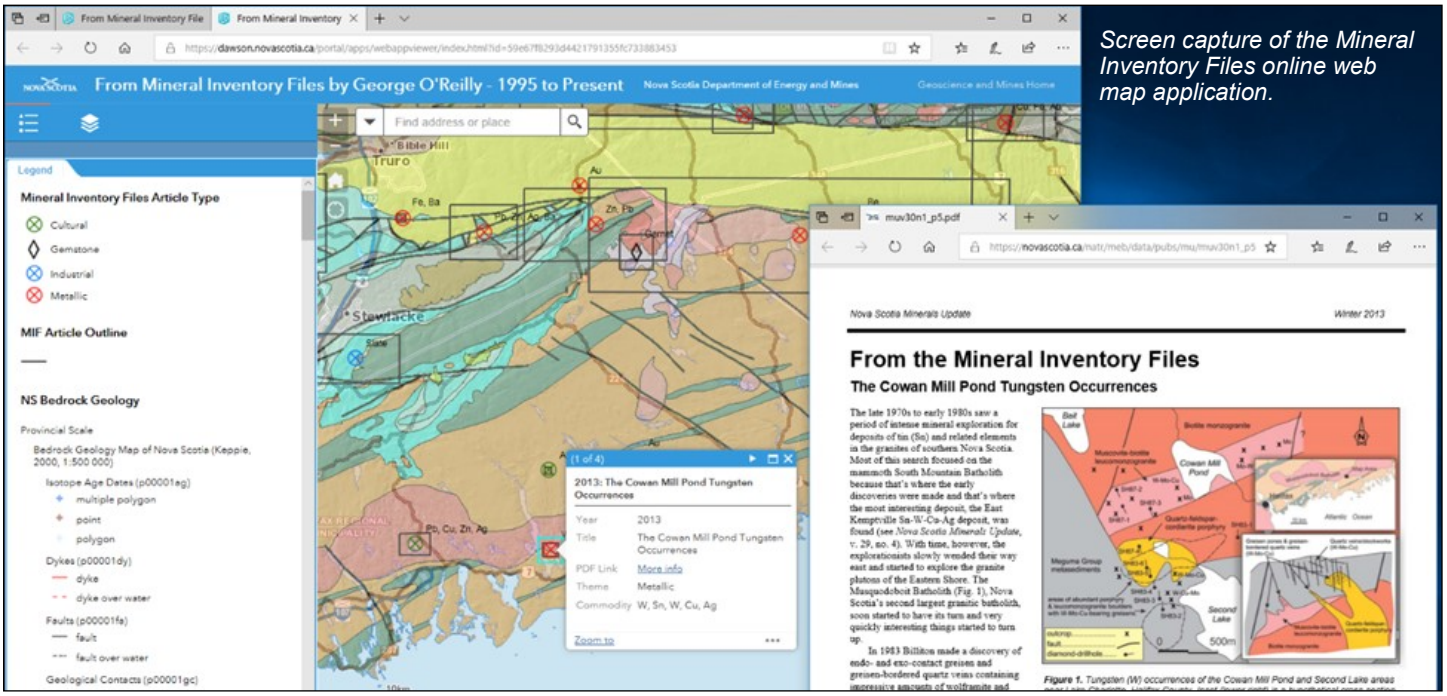
Stone products such as aggregate, dimension stone, clay, armourstone, and engineered soils are the most widely used materials in Nova Scotia today. The Geoscience and Mines Branch has focused on locating, evaluating, and documenting stone potential throughout the province. Geologist Garth Prime retired last year, but one of his last projects was a field study in the Annapolis Valley-Acadian Shore region, to examine the stone resource in Hants, Kings, Annapolis, Digby, and Yarmouth counties.

A GIS database displaying the findings of this research is being prepared for release as a digital product and map service. Sonya Cowper, the branch's map server specialist, has put together a web application Story Map Journal as a preview, with 38 sites that highlight some of the concepts and findings using maps, photographs, and short text descriptions. The web link to this application is https://novascotia.ca/natr/meb/geoscience-online/StoneResource_about.asp.

Jeff Poole



Screen capture of the Stone Resource Story Map Journal web application.



Screen capture of the Mineral Inventory Files online web map application.

Spanish Geologists Return to the Maritimes in Search of Fossils

As part of a continuing collaborative study of Late Ediacaran to Ordovician stratigraphy, Drs. Soren Jensen and Teodoro Palacios (Universidad de Extremadura, Badajoz, Spain) returned to the Maritimes in 2019 to continue their research on trace- and micro-fossils (acritarchs) with Drs. Chris White (NSDEM) and Sandra Barr (Acadia University). This summer they brought along another Spanish geologist, Dr. Jose Javier Álvaro (Universidad Complutense, Madrid, Spain), who specializes in Cambrian syn-rift unconformities and Middle Cambrian limestone sequences in Morocco.

The focus on this expedition in late July and early August was to re-examine the Late Ediacaran to Cambrian sedimentary type sections exposed in southern New Brunswick (e.g. Summerset Street, Ratcliff Brook, Hanford Stream, Glen Falls/Mystery Lake, and Beaver Harbour areas) and southeastern Cape Breton Island (MacCodrum Brook, Bengal Road, New Boston, and Framboise River areas). Susan Johnson, a geologist from the New Brunswick Department of Energy and Resource Development, joined us for the New Brunswick leg (see article on p. 4), and Dr. Deanne van Rooyen from the University of Cape Breton joined us for a day "out on the Mira." In addition to studying the trace fossils and collecting samples for microfossils, another purpose of this trip was to collect samples of volcanic ash beds for high-precision U-Pb zircon dating. It is hoped that these new ages will place absolute time constraints on the biostratigraphical control that has been established on these units, and will aid in correlations with similar units in Newfoundland and perhaps Morocco.

Weather conditions for the midsummer field expeditions were hot and dry. Water levels were at an all-time low, exposing outcrops not previously observed. Conditions were also perfect for sampling. The only obstacles slowing down this intrepid group were hundreds of metres of deadfall, overgrown with thorn bushes, coupled with bottomless string bogs and swarms of blood-thirsty flies. In spite of all this, the Spaniards are planning on returning in the near future to continue their research.

Chris White

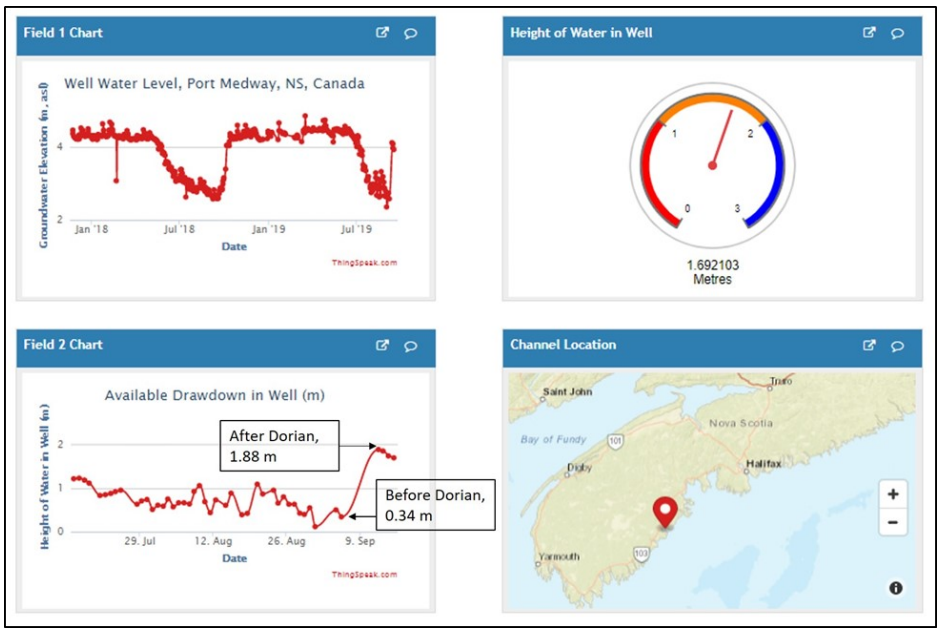
The research team discusses the significance of the red limestone at their feet, part of the Middle Cambrian Canoe Brook Formation near Marion Bridge, and its likely equivalent units in the High Atlas region of Morocco. Left to right: Teodoro Palacios, Sandra Barr, Javier Álvaro, Soren Jensen, and Deanne van Rooyen.

Hurricane Dorian Causes Well Water Levels to Rise

Hurricane Dorian brought significant rainfall and wind to many areas of Nova Scotia on September 7, 2019. Rainfall amounts varied across the province, with the highest being recorded in the southwest. Environment Canada's climate stations at Shelburne and Liverpool recorded precipitation amounts of 133 mm and 128 mm, respectively, on September 7. Well water levels in the southwest part of the province, which were at their summertime lows when the hurricane hit, saw significant jumps after the hurricane due to aquifer recharge.

The Nova Scotia real-time shallow aquifer monitoring network (https://tinyurl.com/NS-Realtime-Well-Water-Network) includes three dug wells in this part of the province, and each saw water level increases of approximately 90 cm or more after Dorian. The water level rise at these wells were 89 cm at Clyde River, 92 cm at Lockeport, and 154 cm at Port Medway. Results from the Port Medway well below (https://thingspeak.com/channels/368729) indicate that prior to Dorian this well was practically dry, with only 34 cm of available water. After Dorian, the well had 188 cm of available water, making it a viable water supply once again after the dry summer.

John Drage



Data from a dug well in Port Medway showing 1.54 m rise in water level after Dorian.

Personnel Changes in the Mineral Management Division

In March 2019, Mining Engineer Patrick Whiteway retired as Manager of the Mineral Development and Policy Section, Mineral Management Division. Patrick earned a degree in geology from Acadia University and an engineering degree from the Technical University of Nova Scotia. Patrick was section manager for seven years and contributed often to this newsletter.

In June 2019, Scott Hearn joined the Geoscience and Mines Branch as the new Manager of Mineral Development and Policy. Scott earned degrees from the College of Geographic Sciences (2000), Saint Mary's University (2005), and a Bachelor of Mineral Resource Engineering from Dalhousie University (2008). Scott has worked in the mining industry in Saskatchewan at the Esterhazy Mine and in Newfoundland and Labrador at base metal mining operations. In addition, he worked for the Government of New Brunswick in their Mines Branch as a Mine Engineer. In his spare time he enjoys cooking and going camping with his family.

On July 15, 2019, Mining Engineer Dan Khan began a full-time, two-year secondment at Nova Scotia Lands Inc. At Nova Scotia Lands, Dan will be involved in work on some of the province's historical abandoned mines, including the Montague Mines and Goldenville sites. Dan's secondment will link the efforts of the Department of Energy and Mines to the work being carried out by Nova Scotia Lands Inc. on environmental remediation of Crown lands in the province.

George MacPherson

Dan Khan takes a photo on a field trip to Cape Breton Island, 2013.

Potential NS-NB Collaboration a Result of the Mineral Resources Development Fund

One component of the Nova Scotia Mineral Resources Development Fund (MRDF) was established to support geoscientific research related to the province's mining industry. Drs. Graham Layne (Memorial University of Newfoundland) and Sandra Barr (Acadia University) were successful applicants in receiving a second grant to continue their work on the metallogeny of the Avalonian Mira terrane in southeastern Cape Breton Island this summer.

The lithogeochemical sampling and analysis accomplished during the first year of study (2018-2019) provided a valuable starting point for further assessing and subdividing rock types in the Mira terrane, especially rocks in the ca. 620 Ma and ca. 575-560 Ma belts. Three locations discovered during the initial field campaign were anomalous for Au and pathfinder metals, as well as displaying alteration typically associated with epithermal- or porphyry-style mineralization, similar to sites in the Avalon zone of Newfoundland (e.g. Big Easy prospect). The results of this work were presented at the Atlantic Geoscience Society (AGS) meeting in early February in Fredericton, NB, and at the annual meeting of the Newfoundland Section of the Geological Association of Canada in St. John's, NL, in late February.

As a result of Graham's presentation at AGS, Susan Johnson, a geologist with the New Brunswick Department of Energy and Resource Development, who is currently mapping equivalent Avalonian units in southern New Brunswick, was invited to participate in this summer field work in Cape Breton Island. With the blessings of her management team, Sue joined us in late June. In addition to visiting various sites in the Mira terrane we visited mineral occurrences in the Faribault Brook and Dauphine Brook formations in the Chéticamp area.

The discussions that occurred on the outcrops of Cape Breton Island showed that collaboration between governments and universities is critical to expanding our geoscience knowledge across provincial boundaries. This builds on the "Canada's Atlantic Edge" theme at the 2019 Prospectors and Developers Association of Canada (PDAC) convention in Toronto, which is a strategic effort to strengthen the global mining profile of Atlantic Canada. This summer's trip showed that increased cross-border collaboration between universities and provincial governments can provide exploration companies with sound geoscience information to highlight areas of favourable resource potential and to increase the probability of a successful exploration venture.

Chris White

(L to R) Susan Johnson, Graham Layne, and Sandra Barr standing in front of the Mountain Top adit, Chéticamp area.

From the Mineral Inventory Files

Kaiser Celestite: Fireworks and Colour TV Screens

It's a reasonable argument that at one time the largest tonnage strontium (Sr) deposit in the world was found at Lake Enon in southeast Cape Breton Island (Fig. 1). The deposit of celestite (strontium sulphate) and lesser strontianite (strontium carbonate) was discovered by Avard Hudgins and Lura Corporation in 1962. Lura developed the deposit over the subsequent years, and the Kaiser Celestite Mining Company purchased it from them in 1969, operating the Kaiser Celestite Mine from 1970 to 1976. Kaiser also built and operated a chemical plant at Point Edward, 60 km away near Sydney, to convert the ore to the market products $SrCO_3$, $Sr(NO_3)_2$, and Na_2SO_4.

In the 1970s, strontium was mainly used for the coating on picture tubes of colour TVs, for Sr salts that make fireworks and flares glow brilliant red, and for the manufacture of military ordnance. In 1976, competition from higher grade Sr deposits in Mexico and changes in the Sr market resulted in closure of the mine. During its mine life, 272,000 short tons of celestite ore grading 50-55% $SrSO_4$ were produced from three sites separated by about 2 km (Fig.1): the Enon site at the southeast end of Lake Enon; the MacRae site 2 km to the northeast; and to a lesser extent, the Almac site opposite the intersection of the Loch Lomond and Salmon River roads. Mining was predominantly an open-pit operation, but some underground mining was carried out from a 135 m long decline at the Enon workings. A resource of 1.9 million tons of ore remains in the deposit.

The Kaiser Celestite deposits, or Lake Enon deposits as they are also known, occur as beds and lenses of celestite up to 3 m thick in limestone beds within the lower units of the Carboniferous Windsor Group. These deposits have been termed manto deposits, manto being Spanish for blankets or cloaks, which reflects the bedded form of the mineralized rock. In strict terms, manto deposits are formed where the host beds are replaced by mineralizing fluids. Most of the Kaiser Celestite deposits, however, did not originate in that way. Although the deposits clearly occur as lenses or beds within the limestone units, they are believed to have formed by direct precipitation of strontium sulphate from the ancient Windsor sea, along with the $CaCO_3$ that formed the limestone beds. As such, they are not true replacement deposits. Minor amounts of celestite also occur as euhedral and subhedral crystals in veins and vug fillings throughout the host Windsor Group. In addition, minor occurrences of galena, pyrite, chalcopyrite, sphalerite, manganite, realgar, orpiment, and native sulphur have all been reported in the Windsor Group carbonates by previous workers.

As is obvious, a considerable resource of Sr remains on this property. Perhaps someday, when Sr markets improve, or if new applications develop that require Sr, then the province has a deposit of the metal waiting for another opportunity to shine, brilliant red of course.

G. A. O'Reilly

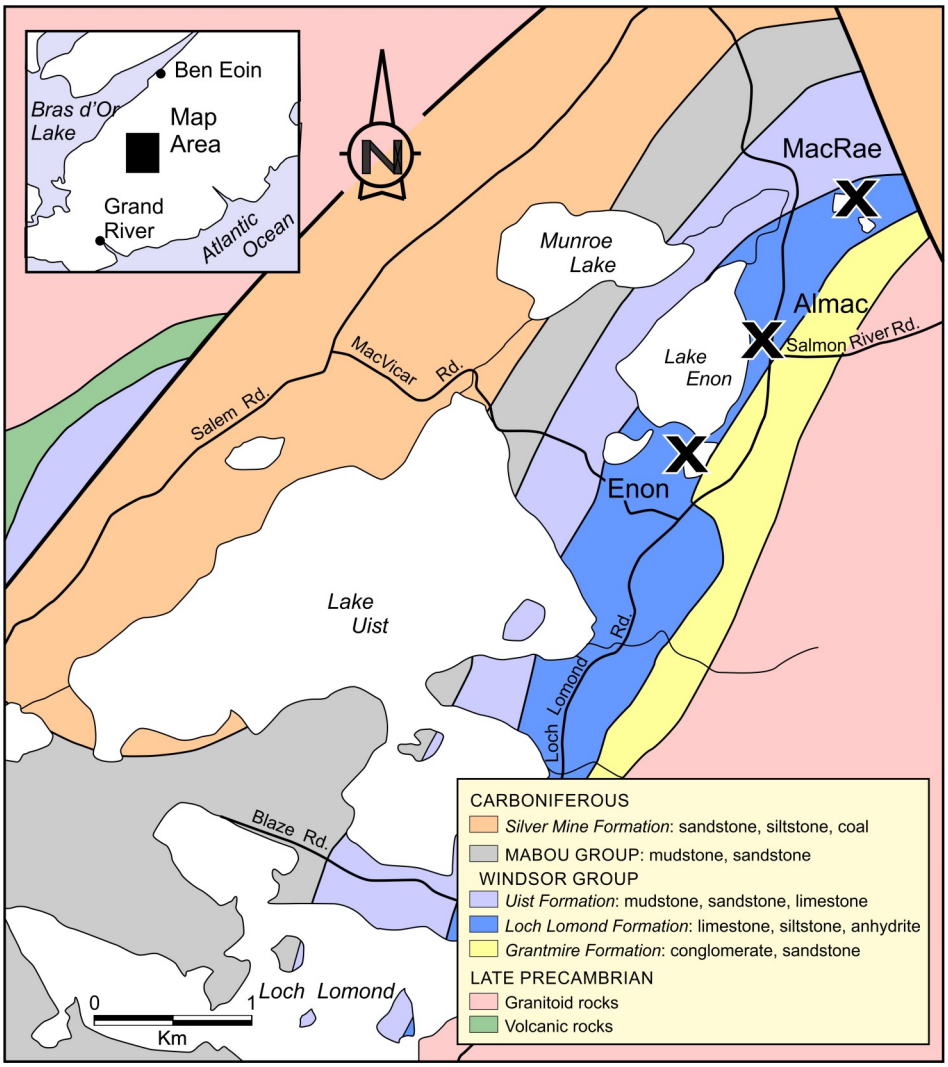


Figure 1. Geology of the Lake Enon area in southeast Cape Breton Island, Nova Scotia, showing the location of the three producing sites of the former Kaiser Celestite Mine.

Decision on the Cliffs of Fundy Aspiring Geopark Expected in April 2020

After four years of preparation and community involvement, the Cliffs of Fundy Aspiring Geopark has learned that just one step remains on the path to becoming Nova Scotia's first UNESCO Global Geopark. At the Asia-Pacific Geoparks Conference in Lombok, Indonesia, the Global Geoparks Council voted to send Cliffs of Fundy forward to UNESCO for their ultimate endorsement. That decision will be announced at the UNESCO General Council meeting in April 2020.

The Cliffs of Fundy Geopark Society is the not-for-profit governing body of the aspiring geopark and is anchored by the Municipalities of Colchester and Cumberland, with representation from the Confederacy of Mainland Mi'kmaq and several provincial agencies. The geopark initiative was born of the Nova Scotia Geological Survey's geoheritage program, which is designed to identify and compile information on geoheritage sites across the province. Members of the Geological Survey have provided geological and cartographic expertise and guidance throughout the past four years.

Around the world, Global Geoparks now number 147 in 41 different countries, with 14 aspiring geoparks being evaluated this year by the Global Geoparks Network. Should the Cliffs of Fundy and Discovery Aspiring Geopark, in the Bonavista Peninsula of Newfoundland, be successful, the number of Canadian geoparks will grow to five.

John Calder

Dr. John Waldron (left) describes the geology of the Minas (Cobequid) Fault to Global Geoparks evaluators at Cape Chignecto Provincial Park on July 27, 2019. From left, Dr. Waldron, Dr. Asier Hilario (Basque Coast, Spain), Dr. Nickolas Zouros (President, Global Geoparks Network, Greece), Don Fletcher (Municipality of Cumberland and Chair, Cliffs of Fundy Geopark Society Board), Dr. Eleanor Haine-Bennett (Canadian Commission for UNESCO), Stephanie Moreau (Tourism Development, Municipality of Cumberland), Louise Leslie (Cliffs of Fundy Education Committee, Royal Rhodes) and Marlee Leslie (Project Co-ordinator, Cliffs of Fundy Aspiring Geopark).

Special Notes

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.

Geoscience and Mines Branch Report of Activities 2018-2019
Report ME 2019-002 was released in September and is available on the branch web site: https://novascotia.ca/natr/meb/pdf/19re02.asp.

Dates to Remember

October 17-18, 2019
Nova Scotia Gold Show, Alt Hotel, Halifax Stanfield International Airport. Please note that advanced registration is required. For more information, please visit http://tmans.ca/goldshow.

October 24-27, 2019
Atlantic Universities Geoscience Conference, St. Francis Xavier University, Antigonish, NS. For more information please visit https://augc2019.squarespace.com/.

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.

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.