The Geological Record

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In This Issue

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NOVA SCOTIA

Minister Announces Nova Scotia Mineral Incentive Program Grants

In June, Natural Resources Minister the Hon. Margaret Miller visited the DNR Core Library in Stellarton to announce $184,540 in grant funding for the Nova Scotia Mineral Incentive Program. Details of the grants awarded are listed below.

Prospector grants

Henry Schenkels, two grants valued at $4,540 (total), Guysborough County;
John Shurko, two grants valued at $20,000 (total), Yarmouth, Inverness and Victoria counties, Cape Breton Regional Municipality (CBRM);
Perry Bezanson, $15,000, Halifax Regional Municipality;
Charles Banks, $13,000, Hants County;
Perry MacKinnon, $12,000, Colchester County;
John Wightman, $10,000, Lunenburg County;
Joel Godbout, $4,500, Halifax Regional Municipality.

Shared-funding grants

The Goldfields Group, $45,000, Yarmouth County;
Genius Properties Ltd., $45,000, Victoria County and CBRM.

Research grant

Jacob Hanley, Saint Mary's University, $15,000, Colchester and Pictou counties.

There will be more Mineral Incentive Program grants announced later this year. Information about the Nova Scotia Mineral Incentive Program is available on the Geoscience and Mines Branch web site: https://novascotia.ca/natr/meb/nsmip/nsmipl.asp.

Nova Scotia Department of Natural Resources

Minister of Natural Resources the Hon. Margaret Miller (L) examines drill core with prospector John Shurko (R) in Stellarton, June 19 (photo by Communications Nova Scotia).

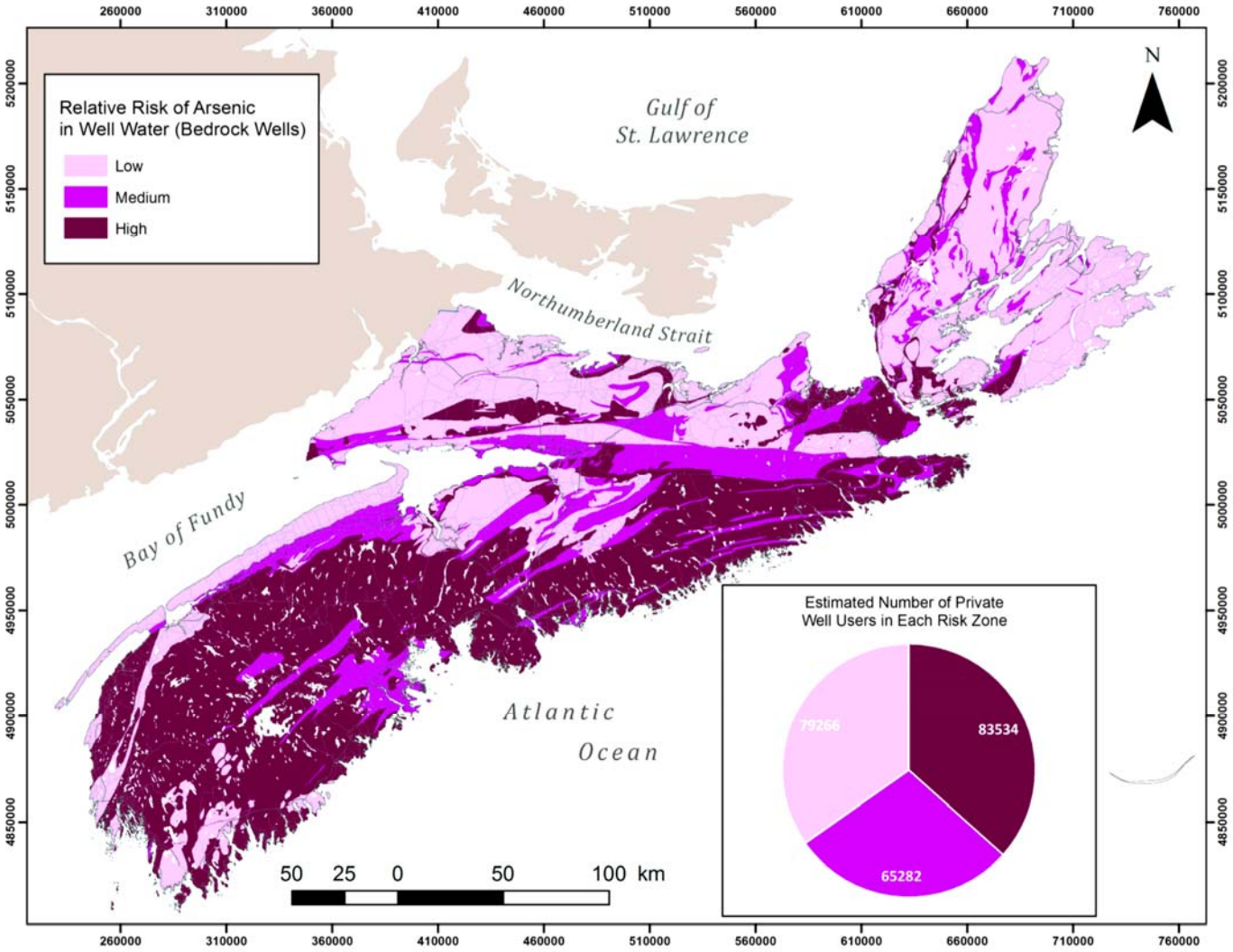
New Map Shows Risk of Arsenic in Nova Scotia Well Water

Variable amounts of arsenic occur naturally in Nova Scotia groundwater and arsenic exposure from well water is associated with adverse health effects, including increased incidence of skin and internal cancers. In 2016, DNR released Open File Report ME 2016-006 (http://novascotia.ca/natr/meb/data/pubs/16ofr06/ofr_me_2016-006.pdf), which reviewed the past 40 years of government activities related to arsenic in well water. In June 2017, the department released Open File Report ME 2017-003 *An Arsenic in Well Water Risk Map for Nova Scotia based on Observed Patterns of Well Water Concentrations of Arsenic in Bedrock Aquifers* (http://novascotia.ca/natr/meb/data/pubs/17ofr03/ofr_me_2017-003.pdf) to communicate risk to private well owners.

Bedrock geology is the most important provincial-scale control on the distribution of arsenic in well water. The rate of arsenic in well water samples exceeding the Health Canada maximum acceptable concentration of 10 µg/L was tabulated for the province's five major groundwater regions and over 60 bedrock units. Based on observed exceedance rates, a revised arsenic in well water map was produced dividing the province into low, medium and high risk zones. Over 80,000 households relying on private wells (~37% of all private well users) are located in the highest risk zone, and the overall rate of private well water exceeding safe drinking water limits in Nova Scotia may be as high as 20% (~90,000 persons).

Arsenic can usually be removed from well water with conventional household treatment systems, so effective communication of risk is essential to encourage well owners to regularly test their water and implement appropriate water treatment. Recommendations for well owners for the testing and treatment of arsenic can be found here: https://www.novascotia.ca/nse/water/docs/droponwaterFAQ_Arsenic.pdf.

Gavin Kennedy



Map showing the risk of arsenic in well water for bedrock wells in Nova Scotia.

Searching for Elusive Ediacaran Fossils on Scatarie Island

Preserved in the cleaved mudstone, sandstone, and tuffaceous rocks of the Mistaken Point Ecological Reserve of eastern Newfoundland is the oldest diverse assemblage of complex multicellular organisms yet described anywhere in the world. This Ediacaran biota lived from about 580 to 542 million years ago, in rocks that we now include in Avalonia. Rocks of the same age form the Main-à-Dieu Group of the Mira terrane in Cape Breton Island and are well exposed in sea cliffs of Scatarie Island in the Savage Cove Formation.

As part of a long-term collaborative study of Late Ediacaran to Ordovician stratigraphy, Drs. Soren Jensen and Teodoro Palacios (Universidad de Extremadura, Badajoz, Spain) returned to Nova Scotia to continue their research into trace fossils and microfossils (acritarchs) with Drs. Chris White (DNR) and Sandra Barr (Acadia University). Our focus on this late June expedition was to examine the Ediacaran section exposed on Scatarie Island with hopes of observing these ancient organisms for the first time in Nova Scotia.

Weather conditions were not favourable, with strong (20+ knot) southwesterly winds and 3 m high swells, but they were no match for our experienced Zodiac captain, Dr. Bruce Hatcher (Cape Breton University), who got us safely to and from the island (albeit with some physical discomfort). Although primary sedimentary structures are abundant in the Savage Cove Formation, no body fossils were conclusively observed, perhaps because the rocks are more volcanogenic and were deposited in a more active depositional environment compared to those at Mistaken Point; however, on this short trip only coastal sections of the formation were examined and hence the presence of Ediacaran fossils cannot be ruled out. Furthermore, samples were collected from the Ediacaran section that might be suitable for microfossil study (e.g. cyanobacteria) and the overlying Cambrian succession yielded several previously unrecognized grazing and burrowing trace fossils, as well as rocks suitable for acritarch study.

These samples will be used to better constrain the age and depositional environment of these rocks, as well as to aid in regional geological correlations with Newfoundland and southern New Brunswick.

Chris White

Spectacularly exposed, thinly bedded volcaniclastic rocks of the Savage Cove Formation, Main-à-Dieu Group, on the north shore of Scatarie Island. Photo by Soren Jensen.

Cu-Porphyry Drill Core Moved to Stellarton Core Library

As part of her thesis on intrusion-related mineralization in Cape Breton Island (funded by the Targeted Geoscience Initiative—Phase 5; see article on p. 8), Alicia Moning, together with her supervisor Dr. Sandra Barr (Acadia University), discovered that the Gillis Mountain Pluton and its country rock had been drilled in 2008 by Globex Mining Enterprises Inc. Although the information for these four holes was captured in the NSDNR drillhole database, the actual core was not part of the inventory at the Core Library in Stellarton. After contacting Perry MacKinnon, who was employed by Globex at that time, we discovered that the core still existed and was stored in Ingonish Ferry. In addition, Perry informed us that in 2008 Globex drilled near Faribault Brook and that core was also stored there.

Realizing that the core was stored outside we anticipated that the quality of the core may have deteriorated, but a visit to Ingonish Ferry in early July revealed that the core was still in relatively good shape. We were able to sample the entire Gillis Mountain core for Alicia's thesis, restack it, and replace the few rotted boxes with fresh ones.

Subsequently Mick O'Neill was contacted about salvaging this entire drill core stash. On July 12, after searching the assessment reports on the Faribault Brook drill core, Mick and his summer student Mary Besaw, together with Chris White and his summer student Gabriel Sombini dos Santos, arrived in Ingonish Ferry to assess the state of the remaining drill core. By mid-afternoon most of the relevant core (about 300 boxes) had been stacked on six pallets ready for pick up. A flatbed truck collected the core later in July.

The importance of acquiring 'abandoned' drill core cannot be overestimated. In the case of Gillis Mountain, for example, the core displays its Devonian porphyry-style Cu mineralization and related alteration in both granite and host rocks. Without the core, this unique deposit would be difficult, if not impossible, to assess because most of the bedrock in the area is buried under glacial sediments.

Chris White

NRCan Announces $52 Million Clean Growth Fund

Mine operators in Nova Scotia interested in reducing their impacts on air, land and water resources, while enhancing competitiveness and creating jobs, can now tap into funds available from the federal government. In June 2017, Natural Resources Canada (NRCan) announced a new 'Clean Growth in Natural Resource Sectors Program,' or 'Clean Growth Fund' for short. It will allocate $51.7 million for research and development projects and demonstration projects for emerging technology in the mining sector across Canada. Similar amounts are going to the energy and forestry sectors.

The Nova Scotia Department of Natural Resources (DNR) attended the launch of the fund in June and responded to a questionnaire that will kick start a bilateral discussion on potential areas of collaboration between NRCan, DNR, local industry and academia. If you have a project that might be eligible, please contact the author at DNR (details below).

Areas of potential research specific to Nova Scotia include reducing impacts on aquatic ecosystems by advancing techniques for wetland restoration at disturbed mine sites; improving energy efficiency through electrification and automation of mining operations; minimizing landscape disturbances by developing novel ways to rehabilitate mine sites; improved waste management by using emerging technologies to extract high-value products from historical mine wastes; and reducing greenhouse gas emissions by using geothermal energy and exploring ways to capture and store carbon dioxide.

NRCan plans to make a call for letters of intent in September 2017. They will make a call for project proposals in November 2017 and begin to allocate funds in February 2018.

Patrick Whiteway
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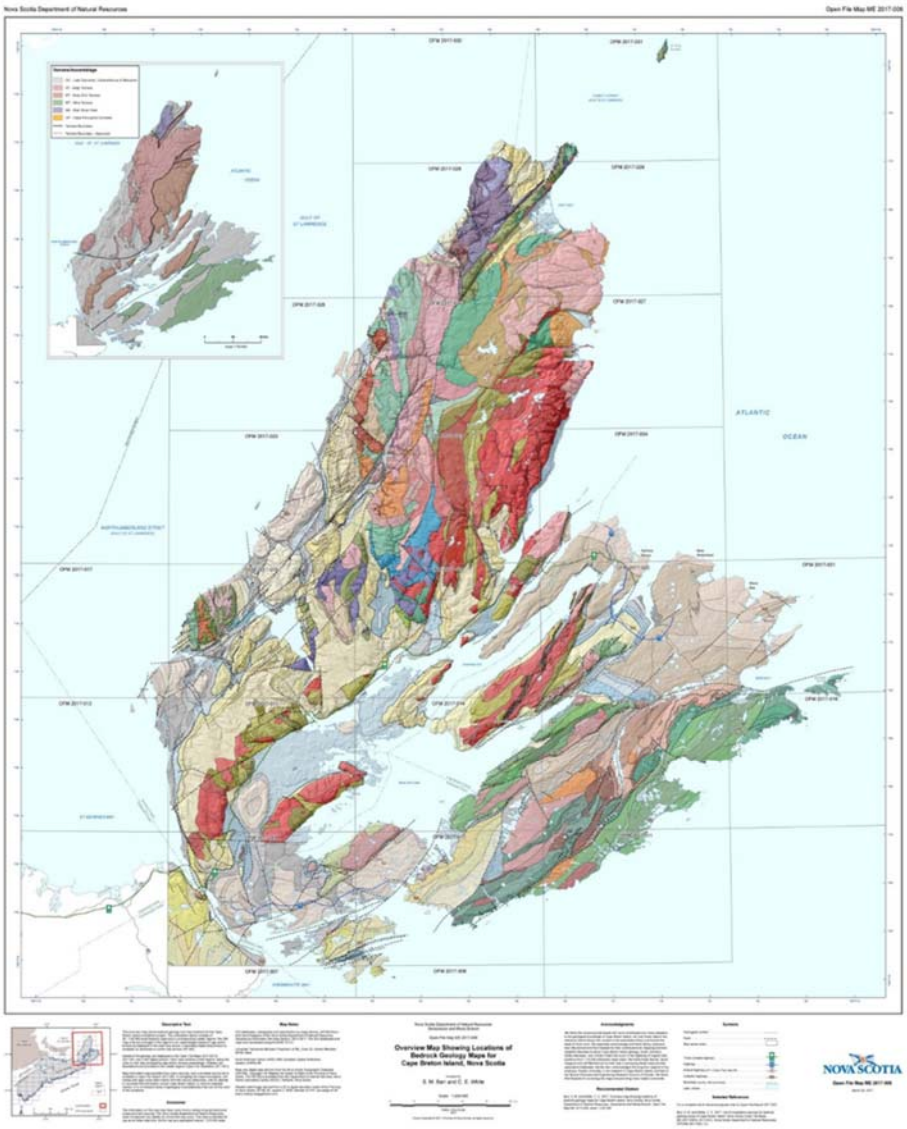
Compilation of Cape Breton Island Bedrock Geology Released

In June the Geoscience and Mines Branch released 26 bedrock geology maps of Cape Breton Island (https://novascotia.ca/natr/meb/data/pubs/rn/rn2017-06.pdf). Dr. Chris White (DNR) and Dr. Sandra Barr (Acadia University) worked with branch GIS staff to compile and integrate previous field work and detailed bedrock geological mapping on the island from the last 25 years. This release consists of one 1:220 000 scale overview map (OFM ME 2017-006) and twenty-five 1:50 000 scale bedrock maps (OFM ME 2017-007 to OFM ME 2017-031). The legend has also been published as an Open File Illustration (OFI ME 2017-001). Open File Report ME 2017-002 provides a list of compilation sources. The digital product (DP ME 433), which will be released soon, consists of 52,032 outcrops, 24,723 associated structures, and 1,857 geological polygons representing 352 geological units. It also includes 1,121 mineral occurrences, 6,368 drillholes and 49 named coals seams. An image of OFM ME 2017-006 is shown below (https://novascotia.ca /natr/meb/download/mg/ofm/htm/ofm_2017-006.asp**)**.

Jeff Poole



From the Mineral Inventory Files

The Bezanson Lake Mineral Target

Discovery of the greisen-hosted East Kemptville Sn-Zn-Cu-Ag deposit in southwest Nova Scotia (*Nova Scotia Minerals Update*, v. 29, no. 4) was an example of a collaborative effort involving several exploration techniques. Till geochemistry, airborne radiometric geophysical surveys, geological mapping and prospecting all played a role in discovery of this world-class tin deposit and the Southwest Nova Scotia Tin Domain (*The Geological Record*, v. 3, no. 3). The area is underlain by highly evolved granitic intrusions termed "specialized granites," which are coincident with pronounced anomalies in airborne gamma-ray radiometric surveys for equivalent uranium (eU) and also the equivalent uranium/equivalent thorium ratio (eU/eTh). Lastly, the blanket of glacial till over the area contains a very pronounced geochemical Sn anomaly, as well as common highly mineralized and hydrothermally altered boulders of greisen and metasomatized granite.

The Bezanson Lake area, north of Chester, is another contact zone of the Devono-Carboniferous, peraluminous South Mountain Batholith (SMB), which has a similar coincidence of mineralization indicators (Fig. 1). The Nova Scotia Department of Mines and Energy carried out a multidisciplinary study there in 1988 as part of the SMB mapping project. This work was published in 1989 (Open File Report 89-027) and highlights the coincidence of favourable geology (i.e. specialized granites), strong eU/eTh anomalies, and the presence of numerous glacial till, boulder and bedrock samples mineralized with a granophile element suite consisting of Sn, W, F, Li, As, Cu, Zn and Ag. Figure 1 presents a summary of these data. The SMB locally consists of four granitic units that intrude the Cambro-Ordovician Meguma Supergroup metasedimentay rocks. The Sherwood monzogranite and the Spectacle Lake leucomonzogranite are coarse-grained, megacrystic, biotite-bearing units that are the earliest (i.e. oldest) and least chemically evolved phases of the SMB in this region. Intruding these units are the New Ross and Panuke Lake leucomonzogranites, which are medium- to fine-grained, muscovite-dominant, late-stage granitic phases. The Panuke Lake phase typically occurs as protuberances and embayments within the New Ross, suggesting that it is a highly evolved, lateral gradation of the New Ross unit. The Panuke Lake phase, in particular, displays the strongest indications of metasomatism, hydrothermal alteration and mineralization.

Mostly locally derived glacial tills blanket the Bezanson Lake area. Till samples collected and analyzed as part of the SMB mapping project showed a strong clustering of anomalies in areas underlain by the Panuke Lake unit, in particular the area south of Houghton Lake. In these tills, significant levels of Sn, W, As, Cu, Pb and Zn were obtained, similar in magnitude to those reported from till surveys in the East Kemptville area. Lithogeochemical sampling at Bezanson Lake returned numerous mineralized boulders and outcrops with up to 0.4% Sn, 0.2% W, 0.33% Cu, 0.42% Zn, F commonly between 0.5-1.0%, and Li up to 852 ppm.

The eU/eTh data derived from 1978 federal government gamma-ray radiometric surveys show a close correlation of the specialized Panuke Lake granite, frequency of mineralized boulders and till geochemical anomalies with areas of elevated eU/eTh. This association of indicators is identical to that found at East Kemptville, and suggests that Bezanson Lake also has a very high potential for granophile element deposits. Unlike East Kemptville, however, which has undergone significant exploration, the Bezanson Lake area has received only cursory exploration. Evidence suggests it deserves a lot more.

G. A. O'Reilly

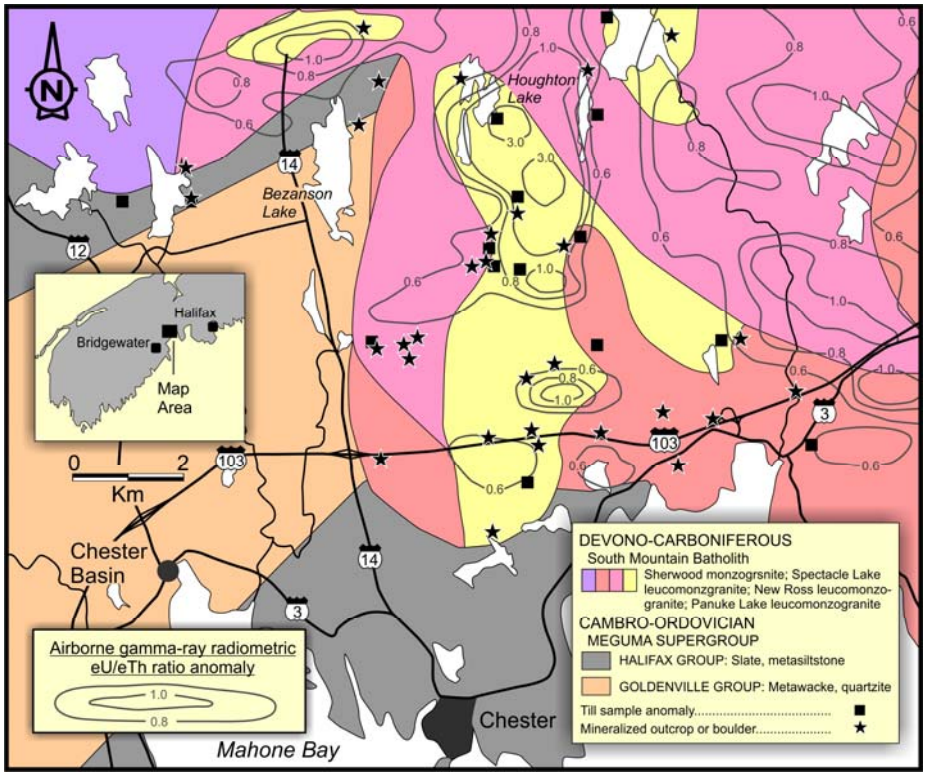


***Figure 1**. Geology of the Bezanson Lake area showing the results of till and litho-geochemical sampling, and airborne gamma-ray radiometric eU/eTh ratio anomalies.*

Beaver Dam Update

Atlantic Gold Corporation's Beaver Dam gold mine project in Halifax County is undergoing cooperative federal and provincial environmental assessments. The processes involve several steps and allow for comments from interested stakeholders.

The 3-4 year Beaver Dam mining project will include an open pit operation with some 2 million tonnes of crushed ore per year being trucked 31 km to the mill at Touquoy (Moose River Gold Mines), producing 87,000 oz. of gold annually. The mine will contribute significantly to Nova Scotia's mineral industry, creating and maintaining about 250 jobs and contributing an estimated $38 million annually to the province's economy.

In June 2017, Atlantic Gold submitted a revised Environmental Impact Statement (federal process), which also serves as an Environmental Assessment Registration Document for the provincial process. These documents were open for review by government, the Mi'kmaq and the general public for 30 days (to July 28, 2017).

Comments and information requests made to the Canadian Environmental Assessment Agency (CEAA) during that period will be provided to Atlantic Gold for a response. Once CEAA is satisfied, the agency will prepare a draft Environmental Assessment Report for public comment before finalizing the report for consideration by the Minister of Environment and Climate Change.

Comments and information requests made to Nova Scotia Environment (NSE) will be provided to the proponent for response and will be made public. Once NSE is satisfied, the Minister of Environment will also issue a decision.

All provincial documentation can be found at: http://bit.ly/2u46Tbz. All federal documentation can be found at: http://bit.ly/2hmX2rk.

Patrick Whiteway

Donkin Mine Approaches Production Phase

Kameron Coal Management Limited expects to start Phase II of the Donkin underground coal mine development in Cape Breton County in August 2017. This phase, called the production phase, will include operation of a coal processing plant or wash plant (pictured below) that will upgrade the run-of-mine coal by removing impurities. The impurities, called waste rock, will be transported to a waste rock disposal area that has been designed and constructed to collect and treat all runoff water before it is released to the environment. Due to the iron sulphide (pyrite) content of the waste rock, that water has the potential to be acidic. Water treatment will include the addition of caustic, aeration and sedimentation. The Department of Natural Resources (DNR) worked co-operatively with Nova Scotia Environment to review the company's plan to reclaim both the wash plant and the waste rock piles at the end of the life of the mine. That plan includes an HDPE liner (engineered geotextile) below the waste rock piles, a leachate collection and treatment system, a second HDPE liner over the piles, and a covering of 60 cm of soil before revegetation, making the cover impermeable to precipitation. A financial security, in the amount of the estimated cost of this reclamation work, must be supplied to DNR before the wash plant and waste rock disposal area become operational. Together with the financial security that the company has already provided to DNR for the exploration (Phase I) stage of the project, the reclamation plan for the entire site will be fully secured and the province will have no financial liability associated with reclamation of the site. Seventy-three workers are employed at the Donkin mine, and as of June 7, 2017, about 40 000 tonnes of coal had been produced. The development plan anticipates total annual production approaching 3.6 million tonnes of metallurgical grade and thermal grade coal.

Patrick Whiteway

Photograph of the Kameron Coal Management Ltd. Donkin mine site, showing the coal processing plant. The production phase of the mine's development will begin in August 2017.

New Personnel in the Geoscience and Mines Branch

In May and June the Geoscience and Mines Branch (GMB) was able to fill three vacant positions, some of which had been unoccupied for many months.

Amy Tizzard was the successful candidate for the Regional Geologist position, which was transferred to GMB from DNR's Regional Services Branch. Amy has a B.Sc. (Honours) in geology from Acadia University, an M.Sc. from the University of Victoria, and an Advanced Diploma in Geographic Information Systems (GIS) from the NSCC College of Geographic Sciences. She has ten years experience working as a geoscientist for both government and industry, in locations around the world. Amy began working from the Stellarton office in May.

Courtney MacMullen was the successful candidate for the vacant Geologist/GIS Specialist position. Courtney has a B.Sc. from St. Mary's University and an Advanced Diploma in GIS from the College of Geographic Sciences. She spent several years working as a project geologist for exploration companies in Canada, but spent the last two years working as a GIS Analyst in Halifax. Courtney began work from the department's main office in Halifax in June.

Eugene MacDonald was the successful candidate for the job of Geoscience Editor/Indexer, filling in for the maternity leave of GIS Specialist Sonya Cowper. Eugene has too many degrees to list here, but a Ph.D. in earth sciences (Dalhousie University) and an MLIS (Master of Library & Information Studies; Dalhousie) represent some of his core capabilities. Eugene started work, also in Halifax, in June.

The education, skills and experience of these new staff members will be a great asset to the department, and specifically to the geoscience programs carried out by the Geoscience and Mines Branch. Welcome to all!

Brian Fisher

Reflections on the Loss of a Jeep

It is with deep sorrow that I announce the sudden passing of my beloved DNR Jeep, on Monday, July 3, 2017, as the result of a fatal transmission failure.

"The Jeep," as it was affectionately known, was a third generation (Sahara-Wrangler Unlimited model), compact, mid-size vehicle. My first experience was in the tick-infested jungles of Yarmouth and Shelburne counties in southwestern Nova Scotia where it performed above the call of duty. For the most part it was a great vehicle. It carried me wherever I needed to be, protecting my students, co-workers, visiting scientists, and rock samples. It was the best off-road vehicle that I have ever driven and was the envy of all in the DNR fleet. The Jeep and I received many positive comments from the public, along the lines of: "Finally DNR has a proper off-road vehicle!"

Besides the main caretaker and driver (Chris White), the Jeep is also survived by its sibling, "The Other Jeep," driven by Trevor MacHattie. I extend my thanks to the staff of Midway Motors Jeep Dealership in Middle River for their help and support in the Jeep's last days.

Sadly, I still find myself waving to oncoming Jeeps.

Chris White

Targeted Geoscience Initiative - Phase 5: Cape Breton Island

The Targeted Geoscience Initiative (TGI) is a collaborative Geological Survey of Canada (GSC) program that provides industry with the next generation of geoscience knowledge and innovative techniques, which will result in more effective targeting of buried mineral deposits. Projects associated with the Cape Breton Island (CBI) part of TGI will focus on timing constraints for various igneous suites and detailed structural studies on major shear zones.

Our summer field camp in Middle River, central CBI, is a base for several of the TGI-5 projects. As a result, Drs. Chris White and Sandra Barr, along with NSDNR summer student Gabriel Sombini dos Santos, have taken the time to introduce the TGI-5 geologists and students to the geology of Cape Breton Island. One student project (M.Sc., Acadia) started early in June and is investigating factors controlling intrusion-related mineralization. For instance, why are some Devonian plutons in Avalonia mineralized whereas similar ones in Ganderia are not? This project is being done by Alicia Moning and supervised by Dr. Sandra Barr (see article on p. 3).

Another project under TGI-5 is a Ph.D. study undertaken by Nicolas Piette-Lauzière (UBC) with student Zoik Brault (UQAM) and supervised by Dr. Kyle Larson. This project will investigate strain gradients across shear zones in CBI using quartz C-axis orientations. Much of this work will focus on the Eastern Highland shear zone. The field-based aspect of the thesis started in the first week of July and entails collection of oriented rock samples across numerous shear zone transects.

Results for samples collected last year for $^{40}Ar/^{39}Ar$ (Dr. Dawn Kellett - GSC) and U-Pb dating (Dr. Deanne van Rooyen - Cape Breton University) have shown that rocks in Cape Breton Island have experienced more extensive Silurian-Devonian metamorphic, deformational, and igneous events than expected. These data place timing constraints on event(s), which are critical for the student projects.

Chris White

Sign post at the intersection of the Highlands and Park Spur logging roads. Left to right: Gabriel Sombini dos Santos (DNR), Zoik Brault (UQAM), Nicolas Piette-Lauzière (UBC), and Dr. Deanne van Rooyen (CBU).

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 2016-17
Report ME 2017-001 was released on the branch web site in August, and is available free of charge online: http://novascotia.ca/natr/meb/pdf/17re01.asp.

Dates to Remember

August 18-20, 2017
Nova Scotia Gem and Mineral Show and Sale, Parrsboro, NS. For more information please visit the web site: https://fundygeological.novascotia.ca/gemshow.

October 26-28, 2017
Atlantic Universities Geoscience Conference, Memorial University of Newfoundland, St. John's, NL. For more information please visit the web site: http://ees.acadiau.ca/event-reader/augc2017.html.

November 1-4, 2017
Mineral Resources Review 2017, Delta St. John's Hotel and Conference Centre, St. John's, NL. For more information please visit the web site: http://nr.gov.nl.ca/nr/mines/mineral.html.

November 5-7, 2017
2017 Exploration, Mining and Petroleum New Brunswick conference, Fredericton Convention Centre, Fredericton, NB. For more information please visit the web site: http://www2.gnb.ca/content/gnb/en/departments/erd/energy/content/conference/Conf_home.html.