

# Yukon Geological Survey's Outreach Program: Bringing earth science to all Yukoners

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## **Introduction**

With a staff of more than 20, Yukon Geological Survey (YGS) generates a significant amount of geoscience information annually in the form of bedrock and surficial maps, targeted geoscience studies and publications, permafrost research, community hazards maps, and more. This information can be highly complex and technical, posing a challenge when communicating this science to a non-technical audience. YGS recognizes that educating the public and providing them with some basic knowledge of Earth science is essential to meeting the environmental and resource challenges that we are facing today.

Since the inception of YGS, more than 25 years ago, outreach geology, in terms of education and awareness, has always been included in the organization's program activities. In 2011, a permanent Outreach Geologist position was created to meet the growing needs of the program, as well as provide a dedicated point-person to fulfill First Nation's engagement with respect to YGS' program activities. While the author is the lead on most outreach activities, YGS staff also participate in public lectures, interpretive hikes and other outreach activities.

This paper provides a broad overview of the types of outreach and education activities in which YGS engages.

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## Classroom Visits and Core Library Tours

Yukon schools follow the British Columbia curriculum (including some Yukon-specific adaptations), which was recently redesigned. Concepts of Earth science are introduced as early as grade three, or eight years of age. YGS designs geoscience outreach and education in the classroom in a way that enhances the school curriculum by providing hands-on activities (Fig. 1). These activities will vary from the introduction to the rock cycle with rock and mineral identification, to the processes and stages of mining whereby students finish off their activity with a delicious cookie! Rock specimens that are brought into the classroom are carefully selected to always include local samples that the students are likely to come across during their outdoor adventures. Classroom visits to Yukon schools are by request and direct invitation from a teacher, and typically last one class period (approximately 50–90 minutes). Over the years, the number of teacher contacts has grown as the teachers see the value in having experts in specific fields of science visit the classroom.



**Figure 1.** Leyla Weston of Yukon Geological Survey demonstrates specific rock properties with grade 4/5 students, Golden Horn Elementary School, Whitehorse.

In recent years, teachers from Whitehorse area schools have been bringing their classes for tours of the H.S. Bostock Core Library. Included in the core library tour are a number of activities: (1) a topography lesson with the Augmented Reality (AR) Sandbox; (2) rock properties and identification; (3) introduction to core logging; (4) training on the use of lapidary slab saws (Fig. 2); and (5) an introduction to optical mineralogy and the petrographic microscope. The H.S. Bostock Core Library also houses a collection of more than 200 Yukon rock and mineral specimens that students can view. Taking the students out of the classroom and giving them access to real-life tools used by both research and exploration geologists has been highly valuable in engaging Yukon students. In 2018, the author completed 10 core library tours and 7 classroom visits.



**Figure 2.** Ms. Jane Londero, grade 12 geology teacher at Vanier Catholic Secondary, teaches her student how to use a rock saw.

## Field Trips

There is no better way to teach a natural science, such as geology, than by getting outside the classroom and into the field. Whitehorse is uniquely situated adjacent to the Whitehorse Copper Belt, which includes a linear belt of more than 30 copper-skarn deposits and mineral occurrences. The old mine site, which has been reclaimed, offers a vast area where students can collect samples containing minerals such as bornite, chalcopyrite, yellow serpentine, magnetite, garnet and much more (Fig. 3). Furthermore, there are several road-accessible sites just a few kilometres from Whitehorse, where students can make field observations at outcrop exposures, which encourages critical thinking and long-term retention. Field trips help students to develop a positive attitude towards science and a greater appreciation for nature.



**Figure 3.** Grade 12 geology students from Vanier Catholic Secondary collect samples of mineralized rock from the Whitehorse Copper Belt.

YGS conducts, on average, 15–20 field trips to the Whitehorse Copper Belt annually. Field trips can be easily catered to participants of all ages. The area offers more than just interesting geology, but also a rich history that few local residents know anything about, namely that Whitehorse had an operating mine in their backyard. Exploring the Whitehorse Copper Belt not only exposes students and the public to the fascinating world of geology, but it also gives them a deeper connection to their community (Fig. 4). In 2018, the author led 15 tours through the Copper Belt, three through Miles Canyon, and one field trip that examined exposures of outcrop along the Alaska Highway in the Ibex Valley.



**Figure 4.** More than 25 participants attended the Whitehorse Copper Belt evening field trip as part of Mining & Geology Week 2018.

## Events

Every year, YGS participates and/or facilitates several geological events for Yukon students and the public that showcase all aspects of earth science.

### Mining week

Mining and Geology Week takes place every year during the first week of May. The Yukon Chamber of Mines, in partnership with the Government of Yukon hosts the event, which celebrates the role that mining and geology plays in our society. The week includes an evening field trip for the public (see Fig. 4) and

culminates with a one day, outdoor event—Mining & Geology Discovery Day Camp at the S.S. Klondike National Historic Site in downtown Whitehorse. Mining is the largest private industry in Yukon, and this event provides an opportunity to educate all Yukoners about what the industry brings to the territory. Participating companies, which include mining and exploration companies, environmental firms, as well as other government organizations, are set up in wall tents with geology and mining displays and activities (Fig. 5). YGS' main role during Mining & Geology Discovery Day Camp is to organize student tours; these include hands-on activities such as rock and mineral identification, mapping, and demonstrations that simulate a volcanic eruption. The event, with its central location, attracts more and more people every year. In May 2018, more than 400 students and Yukoners visited and learned about the sustainable and responsible mining and exploration industry in Yukon.

### Junior Rural Experiential Model (REM)



**Figure 5.** Students from a Whitehorse Elementary School enjoy gold panning at McBride Museum's exhibitor tent at Mining & Discovery Day Camp 2018. Photo courtesy of Yukon Chamber of Mines.

The Rural Experiential Model or REM offers hands-on learning experiences to rural students of Yukon. Junior REM brings together more than 120 grade 7 and 8 students from the communities of Watson Lake, Teslin, Carcross, Haines Junction, Carmacks, Pelly Crossing, Dawson City, Mayo, Old Crow, Faro and Ross River. REM is a two-day event that is held in a different community every year; this year students gathered in Tets'elūgé' (Watson Lake). The Junior REM is a unique experiential approach that integrates traditional ways of knowing and thinking with modern-day teaching and learning. It is designed to connect students with their heritage, culture and traditions while strengthening their emotional, mental and physical well-being. This event also enables students from Yukon communities to come together and connect with their peers (Fig. 6). Students participate in six daytime sessions and register for two sessions from each of the following three main themes: Yukon Culture Sessions (e.g., beading, trapping, traditional foods, etc.); Personal Wellness Sessions (e.g., climbing, introduction to First Aid, mental wellness, etc.); and Technology/Applied Skills/Fine Arts Sessions (e.g., carpentry, mini-med school, crime lab, etc.). YGS provided a 'Rock On' session in 2018 that included both an indoor and outdoor component. Hands-on activities helped students understand how Earth's processes have shaped the land beneath their feet and created all the natural resources that they rely on in their everyday lives.

### Weekend on the Rocks



**Figure 6.** Students enjoy evening games at Junior REM in Watson Lake.

The Tombstone Interpretive Centre, situated in Tombstone Territorial Park, offers a variety of programming throughout the summer that exposes visitors to the dynamic and rich ecosystem of the Park. YGS facilitates ‘Weekend on the Rocks’, one of several theme weekends, which takes place every year during the month of August. Weekend on the Rocks was formalized in 2012 and was an initiative that began with the late Charlie Roots, a former YGS geologist with an incredible passion for geology and the outdoors, but more importantly, he was highly dedicated to geoscience outreach and sharing his knowledge with people of all ages (Fig. 7). Charlie’s initiative has proven successful and Weekend on the Rocks has seen an

increase in the number of participants every year. YGS provides a weekend of activities including two evening talks and three interpretive hikes. Visitors learn about the geology, tectonic history, as well as the processes of glaciation—all that has shaped the rugged topography that we see today. This year saw a record number of participants. The evening talks were standing-room only with upwards of 60 people and despite the cool rainy weather, an average of 25 individuals participated in the interpretive hikes (Fig. 8). Special thanks goes to YGS Emeritus Geologist Don Murphy for taking time out of a busy retirement in order to give a talk and lead three guided hikes.



**Figure 7.** The late Charlie Roots discusses the geology of Tombstone Park, Weekend on the Rocks, 2013.



**Figure 8.** Emeritus YGS geologist Don Murphy guides an interpretive geology hike at Weekend on the Rocks, 2018.

## Yukon Geoscience Forum

This year's Yukon Geoscience Forum and Trade Show drew 700 delegates, nearly double the numbers from five years ago. This event, organized by the Yukon Chamber of Mines and jointly funded by the Government of Yukon, provides the greatest opportunity to engage students early and inform them about the benefits of the resource industry. The main outreach elements of the forum are Family Day and student tours, which both take place in the trade show area. The trade show is free and open to the public for 4 days during the forum and includes 75 exhibitors from all sectors of the industry. During Family Day, the public can learn about the mining and exploration activities that are occurring around the territory, or try their hand at gold panning with staff from the MacBride Museum. YGS is also committed to Family Day and exhibits the augmented reality (AR) sandbox, and provides hands-on geology activities with their partners at Mining Matters—a charitable organization based out of Toronto that is dedicated to bringing knowledge and awareness about Canada's geology and mineral resources to students, educators and the public (Fig. 9). This year, Family Day attracted more than 200 people of all ages.



**Figure 9.** Jason Davison of Mining Matters, teaches mineral properties to children of Whitehorse at Family Day, Yukon Geoscience Forum & Tradeshow. Photo courtesy of Yukon Chamber of Mines.

Along with Family Day, YGS facilitates student tours in the trade show area over the last two days of the forum. Students spend the first part of their tour at the AR sandbox (Fig. 10) and Mining Matters' activities table. Here, they learn about topography and 3-D spatial thinking, as well as the specific uses of minerals in our everyday lives. For the second part of the tour, students are issued a 'Trade Show Passport' or booklet that includes questions that are prepared by eight participating exhibitors/companies. Students engage with the companies to answer the questions and in doing so, they learn about the modern technology applied to the discovery of mineral resources. Furthermore, they gain a better understanding of the global nature of the mining industry, discover the wealth of career opportunities, and learn about the industry's social responsibilities to the environment and our communities. More than 320 students from 14 schools participated in the student tours: 11 Whitehorse schools and the Del Van Gorder School (Faro), the Ghùch Tlâ Community School (Carcross), and the St. Elias Elementary School (Haines Junction).



**Figure 10.** Whitehorse students learn about topography and 3-D spatial thinking with YGS' augmented reality (AR) sandbox. Photo courtesy of Cathie Archbould.

## Training

### Teacher Workshop

For the past three years, YGS and Mining Matters have offered a teacher workshop following Yukon Geoscience Forum. The workshop is hosted at the YGS Core Library, where participants can tour the lapidary facilities and see some of the survey's sample collections. Teachers from Whitehorse schools participate in a 2-hour workshop that is designed to give educators tools to develop their students' knowledge of Earth science, Canada's minerals industry and the diverse job opportunities available. Upon completion of the workshop, attendees have access to a 'teacher resource kit' that contains dozens of lesson plans, information bulletins, learning activities, rock and mineral samples, equipment, career information and additional resources (Fig. 11). YGS enhances the kit by providing access to hundreds of Yukon rock and mineral samples.



**Figure 11.** Allison Cunningham of Golden Horn Elementary, and Sharon Nehring-Willson of Jack Hulland Elementary try their hands at geotechnical engineering at a teacher workshop hosted by YGS and Mining Matters.

## Parks and Museum Interpretive Staff

Another component of outreach that YGS offers is training to parks and museum interpretive staff by providing expertise in both bedrock and surficial geology of Yukon. Every spring, YGS surficial geologists participate in annual training for Beringia Centre interpretive staff. This includes presentations on current research pertaining to the Pleistocene geology of Yukon. Yukon Conservation Society also calls upon YGS to train their summer staff on the geological history of Miles Canyon in preparation for their summer programming of free guided hikes and “Kids’ Ed-Ventures” in the canyon.

Kluane National Park in southwestern Yukon receives hundreds of visitors annually due to its spectacular mountains, wildlife and glacier systems. This year, three YGS staff (Panya Lipovsky, Rosie Cobbett and Leyla Weston) spent a day in Kluane National Park with 12 interpretive staff discussing the geologic history of the area; special emphasis was made on the tectonic evolution and structural geology of the Park, and the recent diversion of the Slims River (Fig. 12). Since the May 2016 piracy of the Slims River by the Alsek River, there has been an increased interest on the future impacts to the local ecosystem and Kluane Lake by First Nations and other residents of the area.



**Figure 12.** Panya Lipovsky of YGS explains the glacial history of the Kluane area to interpretive staff of Kluane National Park. View is to the southeast looking upstream on Vulcan Creek, southwestern Yukon.

## Public Talks

During the winter months, when Yukon Geological Survey staff aren't busy with interpreting data, compiling their maps and writing papers, they may be giving public lectures and talks. YGS is actively involved with the Yukon Science Institute public lecture series, which is an excellent platform to inform the public on the most current scientific research in the territory. Yukon is geologically highly complex and richly dynamic as was shown by the reversal of the Slims River in May 2016, and the May 1, 2017 earthquake that jolted Whitehorse residents from their sleep. Geological events such as these have a direct and measurable impact on lives of Yukoners, whether it be damage to private property through an earthquake or loss of habitat for fish stocks due to a drop in lake level. As such, it is important to keep the public informed and provide accurate scientific data on current events. Last winter, two YGS staff gave public lectures as part of the Yukon Science Institute talk series. Panya Lipovsky spoke about the rapid landscape changes that are being observed in the St. Elias Mountains since the last glaciation, and Maurice Colpron presented on the basic concepts of plate tectonics, the geology of the Northern Cordilleran mountain range, and the factors leading to seismic hazards in northwestern North America.

Along with outreach, YGS staff are always available for 'in-reach' services, or providing their geoscience expertise to other Government of Yukon branches. Last winter, Leyla Weston of YGS was invited to speak in Dawson City at a Community Open House facilitated by Community Services (Fig. 13). The City of Dawson recently partnered with Yukon government to replace old sewer and water mains which required a large-scale communications effort. When the original infrastructure was installed decades ago, the trenches were back-filled with rock that contained naturally occurring asbestos. In her talk, Weston focused on the local geology of Dawson City, where one might expect to find naturally occurring asbestos, and the health risks associated with exposure to asbestiform minerals. Weston assured residents of Dawson that the concentration of asbestiform minerals in the rock is known to be very low (<1%), furthermore, if the rock or contaminated soil is not disturbed, it poses no health risk.



**Figure 13.** Leyla Weston of YGS describes to residents of Dawson City the diagnostic characteristics of serpentine and how to identify asbestiform minerals.

## First Nations Engagement

Yukon Geological Survey is committed to engaging with Yukon First Nations with respect to our program activities. In order to build trusting and meaningful relationships with Yukon's First Nation governments, YGS is striving to increase communication and seek input from First Nations (FN) early on in the planning stages of projects. Routine engagement includes spring notification letters to all affected FNs with respect to our program activities, meetings with Lands and Resources staff of the FN governments, and fall follow-up letters detailing summer work. Additionally, when YGS hosts industry events in a community, e.g., Carmacks Rocks, an afternoon of geoscience education and outreach is always provided (Fig. 14).

This year, YGS is taking on a new initiative to be more proactive at informing FN citizens at the community level. YGS proposes to undertake a series of community-based workshops in order to raise the awareness of the importance of geoscience research, as well as enhance YGS' visibility and the support that we can offer to communities. For the next year, YGS will focus on eight FN communities—four that are most likely to be impacted by mineral exploration and development



**Figure 14.** Scott Casselman of YGS demonstrates copper plating to children of Carmacks at a community open house as part of Carmacks Rocks.

over the next 5 to 10 years, and four communities that are most prospective for geothermal development. To date, YGS has met with representatives from four out of the eight FN governments; YGS plans to complete two community workshops before fiscal year-end or March 2019.

## Publications

Yukon Geological Survey produces dozens of publications annually in the form of maps, internal reports and external scientific journals—all of which are highly technical. In recent years, it has become apparent that there is a need to provide simplified and relevant geoscience brochures that are designed for public consumption. YGS has started an Educational Series of brochures that is intended to target those areas of Earth science that are least understood or perhaps even misunderstood by Yukoners. One topic

in particular involves the many uses of geological maps, in other words, they are not simply treasure maps to hidden mineral deposits. In May of 2018, YGS published “Geology Matters” (<http://data.geology.gov.yk.ca/Reference/DownloadProduct/53085>), a brochure that explains the benefits of having geoscience knowledge and more importantly, why we should care about geology (Fig. 15a). Another educational series brochure that was recently published titled “Geothermal Energy Yukon” (<http://data.geology.gov.yk.ca/Reference/DownloadProduct/53086>) defines the basic concepts of geothermal energy and presents those areas in Yukon that are believed to have geothermal potential (Fig. 15b). YGS is planning a third brochure in the new year that will describe permafrost in Yukon and potential hazards related to thawing permafrost.

**a**



### The Yukon Geological Survey

As a government organization, all the work that we do is available to the public. Our work is free knowledge that can be used for many different purposes.

The following include some of the activities conducted by the Yukon Geological Survey:

- bedrock and surficial mapping
- targeted geoscience studies and publications
- permafrost research
- community hazards mapping
- geoscience education and awareness
- mineral assessments



### How do we make a geological map?

Making a geological map involves parties of two individuals traversing by foot over the land. Fieldwork is of very low impact and involves no mechanical work other than the use of a helicopter to access remote areas.

Geologists look for exposed bedrock and make observations about rock types and outcrop structures such as folds and faults. Observations are documented by taking notes and photos. Geologists may also use a rock hammer to collect small, fist-sized rock samples for further analysis in the lab. All data that are gathered during summer fieldwork are then analyzed in the fall and winter months and used to compile the geologic map.

The final map is a two-dimensional representation of the various rock types, the associated structures, as well as the overlying sediments that form the landscape all around us.




### Understanding geology and Earth's systems is critical to maintaining a healthy, sustainable way of life for future generations.

For more information about the Yukon Geological Survey, or if you have questions about this document, please contact:

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Geology Matters



# Geology Matters

## The World of Geology - Why Should We Care?

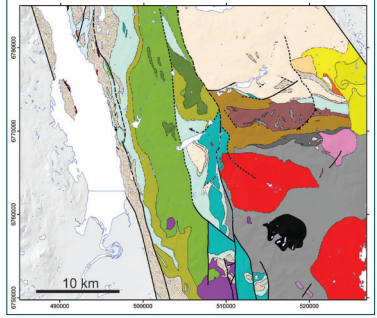
### What is geology?

Geology is the science that deals with the origin, history and structure of the Earth, and the processes that shape it. It looks at physical features such as rocks, mountains and oceans. It studies how processes such as volcanoes, earthquakes and floods have shaped these features over time.

Geological mapping is the main approach used in understanding how the processes act on the Earth's surface. These rocks, sediments and structures form the landscape all around us.

Geological maps illustrate the distribution of various rock types and the sediments that overlie them. The maps also depict structures that are visible at the Earth's surface. These rocks, sediments and structures form the landscape all around us.

Different colours represent various rock types (or units). Faults (breaks) and folds (bends) are geological structures that occur in rocks and sediments. Slow but powerful forces that work over millions of years (plate tectonics) cause these geological structures to form.




Example of a geological map.


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**b**



## Geothermal Energy Yukon




### WHAT IS GEOTHERMAL ENERGY?

Earth's interior contains heat energy (i.e., geothermal energy) that can potentially be harnessed for direct heating or electricity generation. The Earth's crust is naturally heated through the radiogenic decay of elements and the ascent of magma from the mantle. Although heat naturally radiates from depth to surface, local geological conditions in certain areas can lead to anomalously high heat flow and hence, geothermal resources that are within reach. In such regions, wells can be drilled into geothermal reservoirs where hot water and steam trapped in cracks and porous rock can be brought to the surface, allowing us to harness the energy.

Geothermal energy can be used for electricity generation where fluid temperatures are medium to high (generally >150°C); under some conditions, electricity generation is possible with a temperature as low as 80°C. Medium to low-temperature geothermal resources can be used for direct space heating of residences, commercial buildings and greenhouses. At low but constant temperature, shallow geothermal resources can also be tapped by geo-exchange (or heat pumps) to facilitate energy recovery.

Geothermal energy is a clean and renewable source of energy that, if managed properly, is able to provide an energy supply that does not fluctuate with changes in external factors such as wind speed or stream flow.





Geothermal power plant, Nesjavellir, Iceland.

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YGS Educational Series

**Figure 15.** Yukon Geological Survey builds on their Educational Series of publications in order to inform Yukoners on (a) the importance of geoscience knowledge and (b) present the geothermal energy potential in Yukon.

## Conclusion

As humans, we rely on natural resources in our everyday lives from recreation, to agriculture, manufacturing and building. Having geoscience knowledge is critical to maintaining a healthy, sustainable way of life for future generations. The Yukon Geological Survey is committed to continuing its outreach and providing all Yukoners and Yukon First Nations accurate geological information that will help our communities move toward greater sustainability.

