

Yukon Geological Survey's outreach program: 2019 highlights

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Introduction

The Yukon Geological Survey (YGS) provides the geoscience information required for resource and land management for the benefit of all Yukoners. As this information can be highly complex and technical, public outreach and education is necessary in order to make this information accessible and meaningful.

In 2019, the YGS reached out to almost 2000 individuals from across Yukon. The majority of individuals were students, but we also met with members of the public and with First Nation citizens. While the author is the lead on most outreach activities, YGS staff also participate in public lectures, interpretive hikes and other outreach initiatives.

This paper provides a summary of outreach and education activities for 2019.

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Classroom visits and core library tours

Yukon schools follow the British Columbia curriculum, except for some Yukon-specific adaptations. Concepts of Earth science are introduced as early as grade three, or eight years of age. The YGS designs geoscience outreach and education in the classroom in a way that enhances the school curriculum by providing hands-on activities. Lessons are intended to last one class period (approximately 50-90 minutes; Fig. 1). Classroom activities will vary depending on the request by the teacher. Subjects may include any number of Earth science topics such as the rock cycle, rock and mineral identification, geologic time, geohazards, fossils or the uses of mineral resources in our everyday lives. Every attempt is made to feature rock samples from the local area. Knowledge of local rocks will help students identify them when exploring their backyard, outside of the classroom.



Figure 1. Grade 4/5 students of Golden Horn Elementary School in Whitehorse explore the various properties of identifying minerals.

Tours of the H.S. Bostock Core Library facility are always popular with Yukon students as it gives them access to tools, such as the lapidary slab saws (Fig. 2) and a petrographic microscope, used by both research and exploration geologists. While at the Core Library,

students may also use the Augmented Reality (AR) sandbox to learn about topography, or view some of the hundreds of rock and mineral specimens in the YGS' collection. In 2019, the author completed 11 classroom visits and 4 Core Library tours.



Figure 2. Grade 12 geology students from Vanier Catholic Secondary, learn how to use a rock saw.

Field trips

As with any science, the best way to engage Yukon students in geology is by bringing the classroom outdoors. Outdoor education has been proven to develop reflective and inquisitive thinking, while teaching students how to problem-solve in real-life situations. The proximity and accessibility to many geological sites in Whitehorse is ideal for taking students on field trips. These trips help students to develop a positive attitude towards science and a greater appreciation for nature.

In 2019, the YGS conducted 12 field trips. They focused on sites within the Whitehorse city limits such as the Whitehorse Copper Belt mineral occurrences and former mine sites; Miles Canyon basalt; Ibex Valley roadside geology; glacial landforms of the Chadburn Lake area; and gold panning in the Yukon River (Fig. 3). Panya Lipovsky, of the YGS, led a field trip for a class of secondary students from FH Collins (Whitehorse) to the Slims River in southwestern Yukon. Jeff Bond took grade 11 students from Robert Service School in Dawson City on a "White Channel gravel 101" tour of placer gold deposits on Bonanza Creek (Fig. 4).



Figure 3. (a) Grade 5 students from Golden Horn Elementary School collect mineralized samples of Whitehorse Copper Belt skarn. (b) Grade 12 students from Vanier Secondary School examine outcrop of the Whitehorse Trough along the Alaska Hwy west of Whitehorse. (c) A grade 2/3 class of Selkirk Elementary School explore glacial landforms in downtown Whitehorse. (d) Grade 12 students of Vanier Secondary School try their hand at gold panning on the Yukon River.



Figure 4. Jeff Bond of YGS and grade 11 students of Robert Service School in Dawson City at Lovett Hill on Bonanza Creek.

Events

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

Mining week

In Whitehorse, Mining and Geology Week takes place every year during the first week of May. The event celebrates the role that mining and geology plays in our society. The Yukon Chamber of Mines, in partnership with the Government of Yukon, hosts the event. The week includes an evening field trip for the public 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 and exploration is the largest private industry in Yukon, and this event provides an opportunity to educate Yukoners about what this industry contributes to the territory.

In 2019, a record number of people participated in YGS organized tours – a public evening field trip and student tours at Discovery Day Camp. Seventy people joined in on the field trip that explored the Whitehorse Copper Belt. This past year was an exceptional year as we were able to share Whitehorse's rich history in mining and geology with a visiting grade 10 class from Rossland Summit School in south-central British Columbia (Fig. 5).



Figure 5. This past year saw a record-number of participants at the evening field trip to the Whitehorse Copper Belt as part of Mining and Geology Week, 2019.

Student tours through the Mining & Geology Discovery Day Camp allow the YGS, participating mining and exploration companies, environmental firms, as well as other government organizations, to engage with Yukon students. Students take part in hands-on activities such as rock and mineral identification, mapping, gold panning, geode smashing and much more. In May 2019, more than 350 students from 11 Whitehorse schools, as well as ~100 members of the public visited Discovery Day Camp and learned about the sustainable and responsible mining and exploration industry in Yukon.

Yukon Mining Days

This past year, the YGS participated in Yukon Mining Days – a recently initiated event that brings awareness of mining and geology to communities of Yukon. It is a Yukon Women in Mining initiative, which brings government and industry partners together to give communities and youth the opportunity to learn more about Yukon's mining sector and its career, business and investment opportunities. In 2019, Yukon Mining Days took place in four communities: Watson Lake and Ross River in May, and Mayo and Carmacks in September. Each event provided education through interactive activities on topics of geology, mapping, exploration, infrastructure, technology and innovation. The YGS engaged with ~100 individuals at each event, which included students from the local schools as well as community members (Figs. 6 and 7).



Figure 6. Leyla Weston of YGS gives a lesson on topography using the AR sandbox to elementary students from J.V. Clark School, Mayo as part of Yukon Mining Days. Photo by Maitland Photography.



Figure 7. Amanda O'Connor of YGS teaches students from Tantalus Community School, Carmacks about the minerals that are found in products that we use in our everyday lives.

Keno Rocks

Since 2004, the YGS has organized an annual forum that brings together geologists from industry, government and academic institutions, as well as prospectors working in Yukon. The event is known as 'YGS rocks' and it is held in a different mining district each year. In 2019, approximately 40 participants gathered in Keno City (Fig. 8). A welcome BBQ and overview talks in the

historic Keno Mining Museum on the evening of August 21 were the precursor to two days of tours. The first day involved a whirlwind tour of Alexco Resource Corp.'s Keno Hill property; it included more than 10 stops at various open pits and vantage points around the Keno Hill district looking at silver and base metal-rich veins that have been mined for more than a hundred years. The second day was spent touring Thunder Gulch, Duncan Creek and Minto Creek placer operations and enjoying multigenerational stories about placer mining in a variety of surficial geology settings (Fig. 9).



Figure 9. Jeff Bond of YGS explains the modalities of glacier-related sedimentation and placer gold deposition at Duncan Creek.



Figure 8. Delegates of Keno Rocks pose at Keno City sign post.

Weekend on the Rocks

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. The YGS continues to facilitate 'Weekend on the Rocks', an event that was initiated by the late Charlie Roots, a former Geological Survey of Canada geologist with an incredible passion for geology and the outdoors.

Staff from the YGS, including Don Murphy (YGS Emeritus Geologist) provided a weekend of activities including two evening talks and three interpretive hikes. Visitors learned about the geology, tectonic history, as well as the processes of glaciation in the park. This weekend is always a popular event for Yukoners and tourists alike. Roughly 20 to 30 people braved the cool autumn weather to take part in the guided hikes and various activities (Fig. 10).



Figure 10. Tombstone Weekend on the Rocks: **(a)** Amanda O'Connor engages with tourists; **(b)** talk on the glacial history of Tombstone Park by Jeff Bond of YGS; and **(c)** geology hike up Goldensides.

Yukon Geoscience Forum

The Yukon Geoscience Forum and Trade Show continues to grow every year; in 2019, there were more than 700 delegates. The event is organized by the Yukon Chamber of Mines, and jointly funded by the Government of Yukon. It provides a great opportunity to engage students and inform them about the benefits of this important resource sector. The main outreach elements of the forum are Family Day and student tours, which both take place in the trade show area. The YGS continues to work with Mining Matters – a charitable organization based out of Toronto dedicated to bringing knowledge and awareness about Canada's geology and mineral resources to students, educators and the public. Together we provided a variety of hands-on activities to more than 150 people at Family Day, and 400 students over the two days of student tours (Fig. 11).

During the student tours, youth also had the opportunity to meet professionals working in the industry. The students were issued a 'Trade Show Passport' that included questions prepared by eight participating exhibitors/companies. Students engaged with the companies to answer the questions and in doing so, they learned about the modern technology applied to the discovery of mineral resources. Furthermore, they gained a better understanding of the global nature of the mining industry, discovered the wealth of career opportunities, and learned about the industry's social responsibilities to the environment and our communities (Fig. 12).

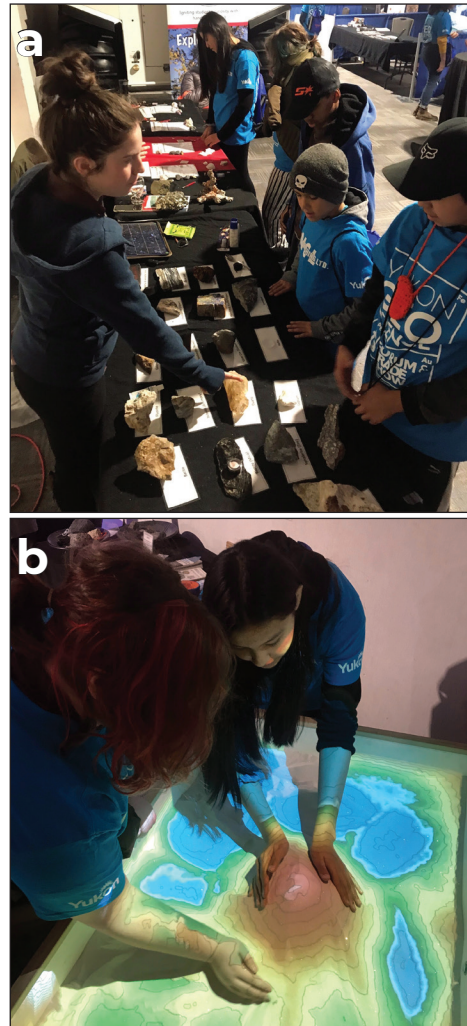


Figure 11. Students from the Ghùch Tlà Community School (Carcross) learn about (a) rocks and minerals, and (b) topography at the Yukon Geoscience Forum student tours.



Figure 12. A grade 7 student from Selkirk Elementary celebrates his win of an iPad for successfully completing his passport during the student tours.

Training

Parks and museum interpretive staff

Another component of outreach that the 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 the 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.

Public talks

Another effective way to communicate current research undertaken by the YGS, and geological phenomena happening around the territory is through public talks and presentations. Geological hazards such as earthquakes or landslides have a direct and measurable impact on the lives of Yukoners, and as such, it is important to keep the public informed and provide accurate scientific data on current events. Public talks are by request, and organizations such as the Yukon Science Institute have provided a great platform in the past through their public lecture series. Our staff of experienced geologists are always ready to share their knowledge and expertise on a broad range of geoscience topics. In 2019, YGS staff reached out to a wide sector of the public, both inside and outside of Yukon. Scott Casselman presented on Yukon’s mineral exploration highlights for 2018 to ~30 people at the Rotary Club of Whitehorse. In March, the author and Tiffani Fraser presented on the Denali fault project and geothermal research at a community open house in Burwash Landing. In late October, Warwick Bullen gave a talk to ~20 citizens of the First Nation of Na-Cho Nyäk Dun on the mineral potential of the Beaver River Watershed as part of the Beaver River Land Use Plan. Finally, Carolyn Relf spoke to approximately 70 students and faculty members at the University of Alberta on the YGS’ geothermal research in Yukon.

Media

The YGS has always maintained public outreach in the form of newspaper and radio media; however, local publishers (e.g., CBC radio, Yukon News, Whitehorse Star) typically initiate this. In 2016, the YGS delved into the world of social media through a Facebook page, which has transformed the way people learn about science and view our program activities. With billions of Facebook users around the world, there is no faster way to connect with people on a global scale. The YGS’ Facebook page currently has 1645 followers – a number that continues to grow. Most posts include geoscience events (e.g., Geoscience Forum, Keno Rocks, Mining Week, etc.), but also include updates on current research. The YGS’ most recent post about acquiring Yukon Consolidated Gold Corporation’s map scans from Libraries and Archives Canada (formerly known as the National Archives) reached 5.5 thousand people through shares and likes. This post sparked a CBC radio interview, as well as a potential podcast by Libraries and Archives (Fig. 13). Along with social media, Yukon North of Ordinary Magazine featured Panya Lipovksy in an article on the effects of permafrost thaw in Yukon.



Figure 13. Jeff Bond of YGS studies old maps from the Klondike.

First Nations engagement

The 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, the 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.

Since 2016, the YGS has been actively engaging and collaborating with several First Nations on our geothermal research in Yukon, namely, Ta'an Kwäch'än Council, Kwanlin Dün First Nation, Little Salmon Carmacks First Nation, Ross River Dena Council, Kluane First Nation and Teslin Tlingit Council. Our research, to date, has highlighted certain areas in southern Yukon as having promising potential for geothermal resources. However, our work is still in its infancy and there are many knowledge gaps. In southern parts of Canada, geothermal is being used for many direct-use applications such as heat pumps, agriculture, aquaculture, bathing, etc.; however, nowhere in Canada is there power generation from geothermal sources.

There is great interest from Yukon First Nations to become self-reliant and to move toward cleaner energy solutions, particularly those communities that rely on burning diesel fuel for heat and energy. However, the question remains – is geothermal development feasible in Yukon? In order to answer this question, the YGS looked to our neighbours in Alaska where Chena Hot Springs Resort, near Fairbanks, operates the lowest temperature geothermal power plant in the world (Fig. 14).

In early September 2019, the YGS facilitated a half-day workshop in Burwash Landing, followed by a visit and private tour of the geothermal plant at Chena Hot Springs in order to gain some insight into how to develop a small geothermal power plant, and observe direct-use applications that could possibly serve as a model for Yukon. There were 12 participants: 5 representatives from 4 Yukon First Nations governments (Kluane First



Figure 14. Aerial view of Chena Hot Springs Resort near Fairbanks, Alaska.

Nation, Teslin Tlingit Council, Carcross Tagish First Nation and Little Salmon Carmacks First Nation); 4 Yukon government representatives; and 3 leading Canadian experts in geothermal (from outside Yukon; Fig. 15).

The main goals of the Chena Hot Springs workshop and fieldtrip were to share information with community members about the YGS' current geothermal research program, and to advance our understanding of geothermal applications in a northern setting, i.e., having a small population, limited infrastructure, and a reliance on diesel fuel where isolated from the North American power grid. Despite having a low-temperature geothermal resource (temperature at the wellhead is ~80°C), the two power plants at Chena produce 0.4 MW of electricity, which is enough power to run the entire resort (Fig. 16). Prior to switching over to geothermal in 2006, the resort burned \$1000 USD of diesel per day.



Figure 15. Participants of the geothermal workshop and Chena field trip.



Figure 16. Two binary-system power plants generate 0.4 MW of electricity at the Chena geothermal plant.

In addition to power generation, the Chena geothermal resource has several direct-use applications. One of the main attractions at the resort is undoubtedly the hot pool, which uses ‘waste heat’ from the power plant. Wastewater from the power plant is piped into the pool giving it an average temperature of 41°C or 106°F (Fig. 17). Warm water is also pumped into a number of greenhouses and garden beds to produce fresh vegetables and herbs year-round (Fig. 18). Additionally, direct-use geothermal heats 46 buildings (>100,000 sq. ft.), including 80 hotel rooms, a main lodge, restaurant and bar. Besides heating, geothermal is used to chill the Aurora Ice Museum 365 days a year through some of the hottest summers, which can exceed temperatures of 30°C.



Figure 17. Tourists take a soak in the hot pool at Chena Hot Springs Resort.



Figure 18 Geraldine Pope of Kluane First Nation (back) and Rebecca Freeman from Little Salmon Carmacks First Nation (front) admire the fresh peppers and other vegetables in the many greenhouses at Chena.

Conclusion

Our society relies on natural resources to support all aspects of our 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.