Yukon Geological Survey's Outreach Program: 2021 highlights

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Introduction

Geoscience, which is the study of Earth systems, is complex and highly dynamic. It examines the interactions between the lithosphere, hydrosphere, biosphere and atmosphere – all of which are critical to sustaining our planet (AGI, 2012). The Yukon Geological Survey's mandate is to provide objective geological information to Yukon government, Yukon First Nations and the general public. This information underpins geoscience-related policy and investment decisions in the territory, and adds value to Yukon's geoscience knowledge base. With a staff of more than 15 geoscientists, the Yukon Geological Survey (YGS) conducts a wide variety activities from traditional bedrock and surficial mapping, to focused studies such as community hazards mapping (e.g., monitoring landslides and thawing permafrost), and mineral assessments, among others. As a government organization, it is our duty to not only engage with First Nations and other governments, but to also educate all citizens of the Yukon about the importance of geoscience in order to help society find and manage our natural resources for the present and future (Geoscientists Canada, 2018).

YGS recognizes the importance of having a geoscientist on staff who is dedicated to outreach and education. Communicating geoscience effectively, and educating Yukoners on how Earth systems work will help them to make informed judgements that affect our territory, as well as our planet (AGI, 2011). Despite the ongoing pandemic, YGS remained very active in public outreach and education; this paper provides a summary of activities for 2021.

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Earth science education in Yukon schools

Yukon schools follow the British Columbia curriculum with some Yukon-specific adaptations. Concepts of Earth science are introduced in grade three; however, the author has recognized from experience that some concepts of Earth's processes can be introduced as early as kindergarten. In Whitehorse, which is known as Canada's 'Wilderness City', teaching about geologic processes can take place right in our backyards. Today's students are the ones that will face future challenges of climate change and will need to make decisions about how we use our natural resources. We have an opportunity to connect our Yukon students to their environment and teach them about how Earth science affects their daily lives.

In order to support Yukon teachers, YGS designs geoscience education in the classroom in a way that enhances the school curriculum. Lessons are meant to be engaging and predominantly consist of hands-on activities as opposed to lecture-style (Fig. 1). Activities will vary depending on the request by the teacher and may include any number of Earth science topics such as the rock cycle, rock and mineral identification, geologic time, geohazards, glacial landforms, or the uses of mineral resources in our everyday lives (Fig. 2). Every attempt is made to feature rock samples from the local area.

Figure 1. *Grade 5 students of Whitehorse Elementary School test their knowledge of the Rock Cycle to identify various samples of Yukon rocks.*

Figure 2. *Grade 10 and 11 students from Porter Creek Secondary's WILD program match everyday products with the mineral or rock specimen that is used to make them.*

As with any science, the best way to engage Yukon students in geology is by bringing the classroom outdoors. Field trips allow students to experience the local environment first-hand and observe geological processes in the real world. Most trips in 2021 focused on sites within the city limits of Whitehorse: Whitehorse Copper Belt mineral occurrences and former mine sites; Miles Canyon basalt; Ibex Valley roadside geology; and glacial landforms of the Chadburn Lake area. These trips help students to develop a positive attitude towards science and a greater appreciation for nature. Where time allowed, field trips were preceded by classroom visits to teach basic concepts that could be highlighted in the field. Knowledge of the local geology will help students not only connect with their environment, but also give them the confidence to participate in community discussions related our changing climate and sustainable development.

Although most geoscience education takes place during the school year, the author is also actively involved in leading guided field trips in the summer for the Wildlife Preserve Day Camp (Fig. 3), as well as interpretive walks for the public at Miles Canyon organized by the Yukon Conservation Society.

Figure 3. *Children from the Yukon Wildlife Preserve summer day camp visit the sites of the Whitehorse Copper Belt.*

In 2021, the author, with support from other YGS staff, reached out to more than 500 Yukoners, including students and members of the public, through classroom visits and field trips (Fig. 4). Included in those were visits to the community schools in Faro (Del Van Gorder School) and Dawson (Robert Service School).

Annual events

Every year, YGS participates in, and/or facilitates several public geological events that highlight aspects of Earth science and Yukon geology. Due to the ongoing COVID-19 pandemic, many of these events were redesigned to a virtual format, or in some cases, were cancelled altogether (e.g., Yukon Mining Days, "YGS Rocks" August annual forum, and Yukon Geoscience Forum student tours).

Yukon-Stikine Regional Science Fair

For the past several years, the author has participated in many aspects of the Yukon-Stikine Regional Science Fair: as a member of the organizing committee; as a judge to both the Whitehorse school fairs and the regional fair; and as an organizer of science activities for participants on the day of the regional event (Fig. 5). In April 2021, the Yukon Regional Science Fair Society, together with the Science Fair Foundation of British Columbia (BC), put on a virtual fair due to the continuing pandemic. Hundreds of students from across the Yukon and northern BC showcased their projects over a two-day period. Students from grades 4 to 12 submitted a digital photo of their posters and a description of their projects ahead of time and then presented to a small panel of judges via Zoom on the days of the event.

Figure 4. ***(a)*** *Grade 2/3 students from Selkirk Elementary School learn about glacial landforms in Riverdale.* ***(b)*** *Students from Golden Horn School visit the former Little Chief Mine site of the Whitehorse Copper Belt.* ***(c)*** *Jeff Bond of YGS explains the formation of the sand dunes at Bennett Lake to grade 10 students of the Wood Street FACES program.* ***(d)*** *Grade 11 students from Wood Street ES program measure movement along the Takhini thaw slump as evidenced by the split trees.*

Figure 5. *Staff of YGS put on various geological demonstrations and activities at the Yukon-Stikine Regional Science Fair.*

Figure 6. *Potential future geologists enjoy prospecting at the Whitehorse Copper Belt during an evening field trip celebrating Yukon Mining and Geology Week.*

The virtual platform, albeit not without some technical challenges, was a great success in that it attracted more participants from communities in Yukon, as well as the town of Atlin, since it did not require travel to Whitehorse.

Mining week

For the second year in a row, Mining and Geology Week was a virtual event. As part of this annual celebration, the Yukon Geological Survey, in partnership with the Yukon Chamber of Mines and Yukon Women in Mining, strives to raise awareness of the role that mining and geology plays in our society. Mining and Geology Week took place between May 31 and June 4 this year, commemorating the 125 anniversary of the discovery of gold in the Klondike. The main events included an evening public field trip with 12 participants (Fig. 6), and an industry luncheon with guest speakers.

The 'Discovery Day Camp' at the S.S. Klondike, which typically attracts over 300 students to the one-day event, was cancelled due to the pandemic. In its place, a virtual activity was designed that would engage not only Yukon students, but also their friends and families—essentially all Yukoners. It consisted of a 'scavenger hunt' with maps and locations of 61 geologic and mining-relevant sites; 18 sites were in Whitehorse and the remaining 53 sites were spread over 14 Yukon communities. The sites were diverse and included activities such as finding a rock in your community containing a specific mineral, visiting a mining history display at a museum, viewing ancient shorelines on the side of a mountain, or simply finding an appealing rock and writing a story about it. Prizes were donated by local businesses and awarded to participants who visited the most sites during the contest (Fig. 7). The virtual scavenger hunt was launched very late in the 2021 school year resulting in a low number of entries; however the organizers anticipate launching the "Yukon Rocks & Walks Scavenger Hunt" again in early May, 2022 in order to attract more participants.

Figure 7. *Amber and Inara Church win "Geologists of the Year" for the best Yukon rock sample and field photos during the "Yukon Rocks & Walks Scavenger Hunt". From L-R: Nicolette Dickson (YukonWIM), Anne Turner (YukonWIM), Inara Church, Amber Church and Leyla Weston (YGS).*

Weekend on the Rocks

Tombstone Territorial Park, known as Ddhäl Ch'èl Cha Nän meaning "ragged mountain land" is situated on the Traditional Territory of the Tr'öndëk Hwëch'in First Nation. The park is a very popular destination for tourists and Yukoners alike and offers a variety of programming throughout the summer. Every weekend during the month of August, the Tombstone Interpretive Centre showcases a different aspect of the park's natural history. For the past several years, YGS has facilitated 'Weekend on the Rocks', a free public event that highlights the glacial history and geology of the park. This year, a special dedication was made to the late Charlie Roots, a former Geological Survey of Canada geologist who spent the better part of his career with the Yukon Geological Survey – working and raising a family in the Yukon. Charlie had an incredible passion for geology and the outdoors and loved educating the public on the fascinating world of geology. Charlie, along with members of 'Friends of Dempster Country' founded 'Weekend on the Rocks'. This August, a bench was installed in Charlie's memory to honor his efforts and dedication to increasing our understanding and appreciation for the land in the park and along the Dempster Highway (Fig. 8).

Staff from YGS, including Don Murphy (YGS Emeritus Geologist) provided a weekend of activities including two evening talks and two 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 and is well attended. Almost 40 people braved the cool autumn weather to take part in the guided hikes and various activities (Fig. 9).

Figure 8. *Commemorative bench installed for the late Charlie Roots – one of the founders of 'Weekend on the Rocks'. Seated are his family, from left to right: Galena Roots, Logan Roots and Mary Ann Roots.*

Figure 9. *Weekend on the Rocks:* ***(a)*** *Hikers brave the rain, sleet and snow during an interpretive hike with YGS Quaternary geologist, Jeff Bond.* ***(b)*** *Participants take in the various activities in the Tombstone Interpretive Centre.* ***(c)*** *YGS geologist Leyla Weston and Emeritus geologist Don Murphy lead an interpretive hike along Lil Creek in Tombstone Territorial Park.*

Training and inreach

The author and other YGS staff are often called upon throughout the year for their expertise on various geological topics and sites in the Yukon. This can be in the form of outreach for private, non-profit organizations (e.g., Yukon Conservation Society) or inreach for other Yukon government branches (e.g., Historic Sites and the Yukon Beringia Interpretive Centre). The author has been involved in providing non-technical geological descriptions for Historic Sites Branch for interpretive panels that have been designed for sites along Tintina Trench, Mt. Haldane near Mayo, and Montana Mountain. Every spring, the author trains summer staff of the Yukon Conservation Society (YCS) on the geological history of Miles Canyon in preparation for their summertime free guided hikes: "Created in the Canyon". Additionally, she led guided hikes through the canyon for the public (Fig. 10). The author also contributed to a joint publication by the Canadian Parks and Wilderness Society (CPAWS) and YCS on the natural and cultural history of McIntyre Creek (CPAWS and YCS, 2021).

Figure 10. *YGS geologist, Leyla Weston leads a public themed hike "Geology in the Canyon" for Yukon Conservation Society.*

First Nations engagement

Yukon Geological Survey engages 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 endeavors to increase communication and seek input from First Nations (FN) early on in the planning stages of projects. Routine engagement includes spring and fall update letters to all affected FNs with respect to our program activities, as well as meetings with Lands and Resources staff of the FN governments. Due to the pandemic, in-person meetings have not been possible; however, meeting virtually via Zoom has proven to be quite successful, as it has provided much more opportunity to meet without the challenges and expenses of travel to and from the communities.

This year, YGS hired a youth from a Yukon First Nation for one week during the summer. Landis Smith of Carcross Tagish First Nation (CTFN) worked with YGS project geologist Patrick Sack in early June learning about some of the local geology on his Traditional Territory (Fig. 11). Although Landis did not meet the requirements to work as a geological field assistant, this experience gave him an exposure to bedrock mapping and field geology, and was highly valuable to both the YGS and CTFN.

> "Landis was a very nice addition to our crew. He shared some of his bush experience and wildlife knowledge with us. He learned from us and we learned from him – a very positive experience." Patrick Sack, YGS Project Geologist.

YGS also continues to actively engage and collaborate with several First Nations with respect to ongoing geothermal research in southern Yukon. In 2020, YGS acquired $2 million of funding (spread over three years) from Natural Resources Canada (NRCan) to explore for geothermal resources associated with crustal-scale fault systems. 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. Three First Nation communities that are situated along major fault systems were targeted for this research:

Figure 11. *Field assistants Landis Smith of CTFN (left) and Sam Bonar (right) working on Mt. Stevens, southern Yukon; Bennett Lake in the background.*

Kluane First Nation in Burwash Landing (Denali fault); Teslin Tlingit Council (Teslin fault); and Liard First Nation in Watson Lake (Tintina fault). All three First Nations have supported the survey's work and have been keen to engage in discussions about geothermal energy potential. Liard First Nation and YGS signed a project Memorandum of Understanding in January and have been co-managing the study near Watson Lake. Details of the geothermal research activities carried out to date are summarized by Relf (2022).

Special projects

Geological history of Whitehorse illustrations

For over a decade, the author has been leading field trips to various geological sites in the Whitehorse area for both students and the public. One of the most popular field trips is to the mineral showings and deposits of the former Whitehorse Copper Belt, which included an 1800-tonne-per-day mill at the Little Chief Copper Mine, which operated between 1967 and 1982 and was located only minutes from downtown Whitehorse. Despite having a mine in their backyard, many residents of Whitehorse are unaware that it even existed, nor do they know the significant role the discovery of copper played in the establishment of the City of Whitehorse. When people initially visit the local-area geology and learn about the processes that led to the formation of the copper-skarn deposits, they are always fascinated. Furthermore, when Yukoners are able to identify rocks and recognize different geologic features on the landscape, it creates a new connection to their environment. However, explaining the concepts of geologic time and the geologic history of a local area can often be very challenging to the layperson. To convey a proper understanding of the subject matter, it needs to be engaging, interesting and accessible (Dolphin, 2021). One method used to communicate complex subjects in an easily comprehensible way is through scientific illustration – it allows us to 'see the unseeable' – a critical element in the study of geology (Franklin Institute, 2021).

Scientific illustration requires a skilled artist who is also familiar with the subject matter. In February 2021, YGS contracted Esther Bordet to create a series of illustrations depicting those geologic time periods that capture the formation of the rocks in the Whitehorse area and the timing of the Whitehorse Copper Belt mineralization. Esther is not only an artist, but also a geologist who worked with the Yukon Geological Survey for four years mapping and working in the area south and east of Whitehorse, becoming an expert on the local-area geology.

From the inception of the project, it was very important for the author to work with the illustrator to create visuals that would depict the typical landscape and environment of the geologic time periods in question (*e.g.*, Triassic, Jurassic and Cretaceous); the process known as paleogeographic reconstruction. It was essential to have illustrations that would make the geological concepts more accessible to the non-geologist and give the viewer an opportunity to 'step back in time'. The illustrations not only capture the geological processes, but also the flora and fauna of the time (Fig. 12). A series of four illustrations (Triassic, Jurassic, Cretaceous and Late Miocene-Quaternary) will be completed by March 2022 and are anticipated to be used as interpretive panels in strategic locations around Whitehorse in the future.

Summary

Understanding geoscience is becoming increasingly vital for all citizens as it relates to climate change, finding and extracting natural resources safely, and having access to clean air and water. Furthermore, having geoscience knowledge is critical to making informed decisions with respect to land use planning and development. The Yukon Geological Survey views geoscience outreach and education as essential in providing all Yukoners and Yukon First Nations accurate geological information that will help our communities move toward greater sustainability.

Figure 12. *Paleogeographic reconstruction of the Jurassic landscape (including fauna) that will be used for the 'Geologic History of Whitehorse' illustrations.*

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