

Digitizing British Columbia's Geological Heritage

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Introduction

The province of British Columbia (BC) has a rich mining history with many communities built around exploration, mining and prospecting activities. Today, mining and mineral exploration continue to play a key role in the provincial economy, providing jobs and resources such as coal, metals and minerals. These resources are essential for many modern technologies as well as for generating and storing renewable power. Despite this, many British Columbians remain disconnected from the integral part mining plays in their day-to-day lives. Many organizations and events exist within BC to bridge this gap between citizens and the mining industry. The Below BC Geological Association, or Below BC, is a nonprofit Earth science outreach organization, whose goal is to connect BC citizens with the local geology as well as to provide education about a variety of topics, including the history of mining. This summer, Below BC has collaborated with Geoscience BC, mining and mineral exploration companies, professional geologists, prospectors, rockhounds, and municipal and provincial government agencies to launch its latest endeavour, the BC Geological Heritage Project.

Currently in its early stages, the project consists of an online, interactive museum and database of geological samples—rocks, core, fossils and minerals—from all areas of BC (Figure 1). The goal is to centralize and increase accessibility to geological data, while preserving the samples and heritage pieces. The digital museum, or Rock Library, will be complemented by virtual geotours, or field trips, providing 360° views and insight into the geology at key locations across BC. The digital museum and virtual geotours will integrate high-quality interactive images with scientific studies, chemical data, maps, multimedia and social history to form a user-friendly resource for geologists and non-geologists alike. The BC Geological Heritage Project will increase accessibility to rock collections and geological data from BC, making research simpler and eliminating

the necessity to travel, thus contributing to the reduction in carbon emissions. In addition, the process of digitally recording samples and locations preserves and archives BC's geological history, protecting it from loss, destruction or re-development.

The digital museum and database will be accessible to a wide range of audiences for research, education, outreach and general inquiry. The creators and participants of the project hope that it will serve as a valuable and unique resource to professional geologists in their projects and studies, while engaging other audiences to give the Earth sciences context, delivering facts in an understandable manner and ultimately improving the overall Earth science literacy of British Columbians.



Figure 1. Over 700 rock, mineral and fossil specimens from British Columbia were digitally documented this summer by the Below BC Geological Association to increase accessibility to, and preserve and promote, BC's geology and geological heritage. This specimen of molybdenum and pyrite in a quartz vein comes from the Davidson deposit, at Hudson Bay Mountain, near Smithers, British Columbia (specimen courtesy of D. Ethier).

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Earth Science Literacy

One of the primary goals of the BC Geological Heritage Project is to engage a variety of audiences—professional geologists in industry and academia, university students, educators, kindergarten to grade 12 students, communities and policy makers—to improve the overall Earth science literacy of BC residents. In 2010, the United States National Science Foundation created the Earth Science Literacy Principles, a guide comprising nine ‘Big Ideas’, to help geologists and educators effectively communicate Earth science (Earth Science Literacy Initiative, 2019). The guide defines an Earth science literate person as an individual who

“...understands the fundamental concepts of Earth’s many systems, knows how to find and assess scientifically credible information about Earth, communicates about Earth science in a meaningful way, and is able to make informed and responsible decisions regarding Earth and its resources.”

‘Big Idea’ 7 from the Earth Science Literacy Principles focuses on humankind’s dependence on Earth’s natural resources and is most relevant to the framework of the BC Geological Heritage Project. Improving the Earth science literacy of British Columbians using this project and similar initiatives can improve attitudes toward exploration and mining, provide insight and greater appreciation for the past and present roles of mining within the province, promote stewardship and sustainable practices, and allow BC to continue to be a global leader in the mining and mineral-exploration industry. In addition, engaging new audiences could encourage youth to pursue education in the field of Earth sciences, potentially halting the declining enrollment numbers in Earth Science programs in Canadian universities (Johnston et al., 2018).

The Digital Rock Museum and Database

The digital museum, the first of its kind, uses high-resolution interactive images that provide a full 360° perspective of a geological sample (Figure 2). The clarity of the high-quality images is remarkable; the photos are aesthetic and precise, revealing mineral cleavage, mineral habit, texture, mineralization and alteration in detail (Figure 3). Individual specimens will have their own detailed rock descriptions, complete with age and location. Available complementary data and resources will also be added (e.g., thin-section images, scientific studies, chemical data, maps, press releases, figures and diagrams, as well as videos).

Rock suites curated from private collections, museums, mining and exploration companies, local exploration groups, and government organizations have been documented and will be added to the Below BC server. Already, over 100 rock, mineral and fossil specimens from the Association for Mineral Exploration, the Pacific Museum of Earth of The

University of British Columbia, the BC Ministry of Energy, Mines and Petroleum Resources, and the Smithers Exploration Group are available; already, these have been used by academics, geological researchers, schools and the public.

Virtual Geotours

Virtual field trips created for the BC Geological Heritage Project will highlight important geological locations throughout the province by providing the audience with a 360° perspective. This technique documents and digitally preserves landscapes, outcrops, viewpoints, exploration sites and museum displays in case they are destroyed or re-developed. The virtual field trips share these locations with a wider audience, which otherwise would be unable to visit the various sites.

To produce the virtual field trips, an ultra-wide-angle THETA camera from Ricoh Company Ltd. and robotic camera mount by GigaPan Systems are used to capture, respectively, outward 360° images and detailed panoramic images. The outward 360° image can be taken instantaneously and allows the observer to be virtually placed at the scene. The panoramic images from the GigaPan comprise hundreds of images, taken fully zoomed into the subject, which are then stitched together. The final product is a highly detailed panoramic image that allows small details, such as a boulder in the distance, to be preserved (Figure 4). As was the case for the samples in the digital library, additional material and data can be integrated with the virtual field trips to provide the reader more information (e.g., scientific studies, chemical data, maps, satellite imagery, press releases, figures and diagrams, as well as videos).

Digitizing and Preserving Geological Specimens

The project organizers required the collaboration of individuals, companies, museums and government agencies to photograph and digitize the geological samples, which will be preserved and shared on the digital museum platform and database. These collaborations will allow Below BC to access a variety of rock suites, which represent the diverse geology of BC. In the summer of 2019, Below BC organized two trips, phase 1 through southern BC and phase 2 through northwestern BC, to collect material not only for the digital museum and database but also for the virtual field trips (Table 1). Over the span of two months, the organization was able to collect historical data, virtual geotours and panoramas, while also digitizing over 700 rock, mineral and fossil specimens.

Conclusion and Future Work

Geologists possess a fundamental understanding of the Earth and its systems; they have the responsibility and privilege of sharing that knowledge with people of all back-



Figure 2. Multiple photographs of a single specimen are taken from different angles and stitched together to produce an interactive, high-quality, rotating 360° image that can be accessed in the Digital Rock Library created by the Below BC Geological Association. This specimen of quartz-calcite crystals comes from the Bluebell Mine in Riondel, BC (specimen courtesy of P. Ransom at the Kimberly Underground Mining Railway).



Figure 3. A series of macroscopic images are taken at different locations (focal depth) on the sample and are focus stacked to produce high-resolution images. **(Left)** Massive sphalerite vein. **(Right)** High-grade vein material from the Granisle mine, Babine Lake, British Columbia (specimens courtesy of the Smithers Exploration Group).

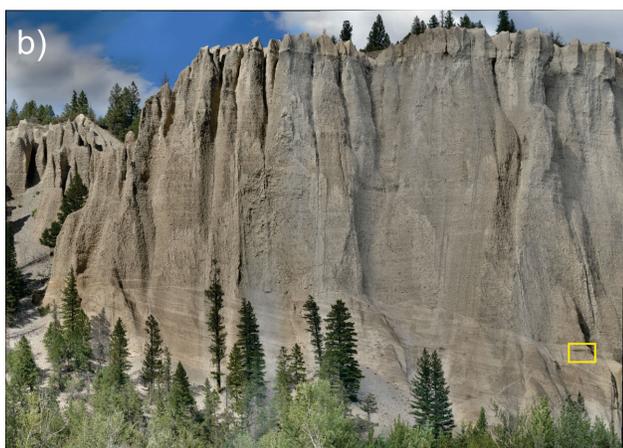


Figure 4. Examples of **a)** cameraman with the robotic panohead by GigaPan Systems taking pictures of the Hoodoos near Fairmont Hot Springs, British Columbia; **b)** photograph taken from a distance of 1 km (location of (c) indicated by box with yellow outline); **c)** details of individual rocks in the layers picked up by the camera; resolution can be increased, but even at this medium resolution, data can be captured about sorting, roundness and distribution of the pebbles that are otherwise lost in the first 'distal' image.

grounds and education levels to improve Earth science literacy, which is especially essential in a location such as BC where geology is ubiquitous. The BC Geological Heritage Project gives geologists, communities, governments, and mining and exploration companies the opportunity to collaborate on a unique initiative, through which geological samples and sites are digitally archived, preserved and promoted through the digital museum and database, and vir-

Table 1. Sites visited on phase 1 and phase 2 trips across southern and northwestern BC, respectively.

| Location | Rotating 360° sample images |
|---|-----------------------------|
| Hedley Museum | 14 |
| Princeton Museum | 13 |
| Oliver Museum | 16 |
| Greenwood Museum | 13 |
| Rosland Museum | 34 |
| (Kaslo) Kootenay Star Mining Museum | 14 |
| Kimberley Heritage Museum | 11 |
| Sandon Museum | 10 |
| East Kootenay Chamber of Mines | 22 |
| Kimberley Underground Mining Railway | 22 |
| Ministry of Energy, Mines and Petroleum Resources (Cranbrook) | 21 |
| D. Pighin (private collector) | 6 |
| Revelstoke Museum | 7 |
| Silvery Slokan mine (New Denver) | 14 |
| Cranbrook History Centre | 11 |
| Nelson Chamber of Mines | 22 |
| Margaux Resources Ltd. | 31 |
| Crystal Lake Mining | 63 |
| Stewart Museum | 27 |
| Decade Resources (private collector) | 15 |
| Drifter Ventures Ltd. (private collector) | 18 |
| D. Ethier (private collector) | 19 |
| Lakes District Museum | 20 |
| Quesnel and District Museum | 23 |
| Museum of Cariboo Chilcotin | 19 |
| Barkerville Historic Town | 5 |
| Smithers Exploration Group | 275 |

tual tours. The project allows past and present geological information to be centralized, making the information more widely accessible. This project allows fusion of an old and evolving industry integral to this province's history with modern technology. In the future, Below BC plans to continue building its database of specimens with additional trips to Vancouver Island and northeastern BC. Below BC will continue to work with the Smithers Exploration Group to catalogue their collection and improve the quality of both groups' websites.

Acknowledgments

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