British Columbia Geological Survey

BRITISH COLUMBIA

Ministry of Mining and Critical Minerals

Information Circular 2025-02

The Survey

Because many modern societal issues centre on the Earth sciences, the need for objective, reliable, evidence-based geoscience provided by the British Columbia Geological Survey has become increasingly important. Credible unbiased geoscience is of particular value for exploration and mining of critical minerals, building relationships with Indigenous Peoples, and informing all people living in the province.

Founded in 1895, the Survey is the oldest scientific agency in the province. Drawing on continuously advancing concepts and technologies, the Survey conducts research to establish the geological evolution and mineral resources of the province and creates knowledge to guide decisions that balance the economy, the environment, and community interests.

Survey maps, reports, and databases are freely available online, connecting the minerals industry, Indigenous groups, public safety agencies, environmental scientists, other research organizations, and government to the province's geology and mineral resources.

Survey research dedicated to the search for, and co-production of, critical minerals helps British Columbia attract investment. This research, along with geology favourable for diverse mineral deposits and strong environment, social, and governance (ESG) performance, supports the province in remaining a preferred global exploration jurisdiction.

High-quality, modern, and accessible geoscience supports Indigenous Peoples self-determination and helps all people living in British Columbia better appreciate the science behind balancing Earth resource exploration and mining, environmental concerns, and economic realities.

Mapping is the most fundamental form of geoscience research

British Columbia Geological Survey geoscientists undertake field mapping and laboratory projects to document, assess, and better understand the geology and mineral resources of the province.

Bedrock geology, surficial geology, geochemistry, and geophysical maps are used to

- estimate mineral and aggregate potential
- document geochemical patterns in rocks, soils, sediments, and waters
- unravel the geological evolution of the province to guide mineral exploration
- evaluate risks posed by natural hazards
- determine groundwater sources and flow paths
- estimate geotechnical properties for construction and engineering projects

Survey structure

Survey geologists conduct research, curate historical data, provide easy online access to information, monitor industry activity, aid mineral exploration, attract global investment, and train the next generation of geoscientists.

The Survey is structured into three working groups.

- Cordilleran Geoscience Section
- Resource Information Section
- Mineral Development Office

Cordilleran Geoscience Section

Land-use decisions and co-management of natural resources require high-quality information. Geoscience delivered by the Cordilleran Section is foundational to understanding the mineral wealth of the province and the economic opportunities it provides.

The Section

- generates new geoscience with field-based bedrock and surficial geology mapping programs, regional geochemical surveys, and targeted mineral deposit studies
- curates the provincial archive of field samples, enabling the Survey and its partners to re-examine legacy specimens as analytical techniques evolve
- maintains laboratory facilities to process and examine field samples

Cordilleran Geoscience Section geologists conduct field-based projects

- Bedrock mapping with complementary geochemical, geochronologic, and isotopic studies document the geology and geologic history of a region and establish the age, origin, and controls of ore deposition.
- Thematic studies that consider how the tectonic evolution of the province controls the distribution of mineral resources.
- Surficial and glacial geology studies to help explore for hidden deposits buried beneath thick Quaternary sediments.
- Studies of deposits with mineral systems having the potential to host critical minerals.
- Studies that develop methods, models, and predictive tools to enhance mineral exploration effectiveness.

Resource Information Section

The British Columbia Geological Survey is the steward of all provincial public geoscience and mineral resource data. Through the Resource Information Section, the Survey preserves, archives, and provides free online access to information gathered for more than 130 years.

MapPlace, the Survey database-driven geospatial web service, provides open geoscience data and custom map-making tools to help decision makers from diverse disciplines reduce the costs of accessing and analyzing information.

The Survey is modernizing its information systems to improve the operation of databases, applications, and geospatial web services. The Geoscience Spatial Data Infrastructure (gSDI) project will modernize and integrate currently disparate geoscience and mineral resource databases into a single unified system ready for applied analytics using machine learning.

Mineral Development Office

The Mineral Development Office (MDO) is the Vancouver base of the British Columbia Geological Survey. Regional Geologists are part of the MDO and are stationed at exploration centres across the province where they provide geoscience expertise and monitor local industry activities. Public geoscience is one of the principal enablers of grassroots mineral exploration, the backbone of mining. The MDO provides technical information and investment intelligence to global business, government, and Indigenous groups.

The Mineral Development Office serves mineral resource decision making by

- linking the more than 1000 exploration and mining companies headquartered in Vancouver to provincial mineral and coal information
- conducting an annual expenditure and drilling survey to analyze short- and long-term industry trends
- producing the annual Provincial Overview of Mining and Exploration volume, a summary of mining and exploration projects, activities, production and expenditures
- responding to requests from government and Indigenous groups for mineral resource data needed for land-use planning and to support decision makers
- providing mineral resource, project, and technical data to government groups.

The Mineral Development Office promotes British Columbia as a preferred jurisdiction for mineral exploration by providing information to international trade offices and meeting with global industry representatives seeking technical discussions about potential projects.

Critical minerals

As society places more value on the transition to low-carbon energy, demand for the critical minerals needed for energy generation, storage, and transmission will increase.

Together with strong environment, social, and governance (ESG) performance and the geological potential of the province, the search for critical minerals presents a generational opportunity to support a thriving economy, attract investment, and build meaningful partnerships with Indigenous Peoples.

The Critical Minerals Atlas, released in 2024, was the initial step in evaluating the critical minerals endowment of the province and in building awareness of critical minerals opportunities for the exploration and mining industry. The Survey continues field and laboratory projects to assess critical mineral opportunities.

The Survey launched new multi-year projects to address knowledge gaps and gain insights into the mineral systems that contain critical minerals, the origin, age, and geographic distribution of mineralized rocks, and the spatial distribution of critical minerals within ore bodies.

One stream of projects examines the mineral systems that host significant deposits and mines, past and present. These projects are assessing if critical minerals might be added to production as co- or by-products in the short term. A second stream focusses on the longer term to identify new deposits and to encourage investment for under-explored mineral systems that may produce critical minerals in the future. These projects include foundational mapping, geochronology, geochemistry, and geophysics and developing new exploration techniques.

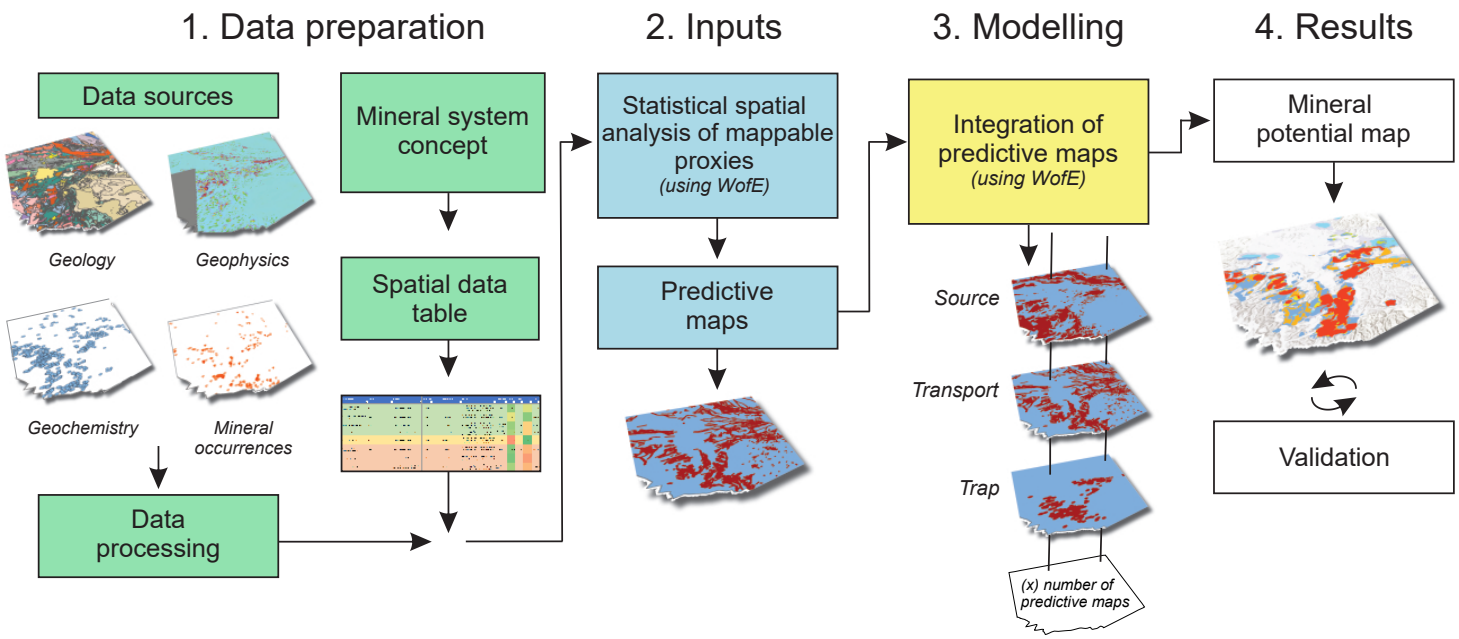
Supporting access to critical mineral information, the Survey is modernizing its database infrastructure.

Mineral potential modelling and land-use planning

The British Columbia Geological Survey is revitalizing its mineral potential mapping. The modelling will be used to evaluate the provincial endowment of critical minerals, particularly in underexplored areas. In addition, robust mineral potential information is a key component to guide land-use and investment decisions by government, Indigenous groups, and industry.

Coupled with advances in computing technology, the new modelling takes advantage of information gained since the 1990s. The current work adopts a mineral systems approach and considers the components that control generating deposits. Amenable to machine learning as new data become available, the modelling uses multiple geological features as proxies for complete mineral systems to create maps that portray the relative ranking of mineral potential. These maps indicate areas that are more likely and less likely to host mineralization, information needed by decision makers considering possible future exploration interests and economic opportunities.

British Columbia is Canada's largest producer of copper and only producer of molybdenum. The current modelling focusses on the mineral systems containing these commodities but also includes those that contain nickel, cobalt, rare earth elements (REE), niobium, tantalum, platinum group elements (PGE), and zinc.



Exploration and mining

Mining contributes greatly to the economy of British Columbia, and exploration is the backbone of mining. More than 1000 exploration and mining companies are headquartered in Vancouver. In addition, the exploration and mining industry is particularly important for northern communities and some Indigenous groups, employing more than 40,000 people.

Between 2019 and 2023, the total value of mining production was $63.4 billion and the exploration expenditure was $2.8 billion. For 2024, the forecast value of mine production is $16.5 billion, and the exploration expenditure is estimated at $552 million.

As the steward of mineral and coal resource information in the province, the Survey has an important role in stimulating activity, attracting investment, and providing continuous research based on a corporate memory that extends back more than 130 years.

The Survey reduces exploration risk by: providing the geological framework to identify areas with high mineral potential; increasing exploration efficiency by gathering regional information used for property-scale evaluation; and archiving exploration results so that projects can be advanced without duplicating previous work.

Regional Geologists

Based in Smithers, Prince George, Kamloops, Vancouver, and Cranbrook (vacant) the Regional Geologists monitor exploration and mining activities in their jurisdictions. The Regional Geologists also provide information on exploration trends and possible investment opportunities, respond to mineral lands assessment requests, and conduct public outreach.

Laboratory, sample archive, geochemistry, geochronology

Survey staff work with field samples at our in-house laboratory and our upgraded sample archive facility. The archive is a valuable resource that enables re-examining historical specimens without the expense of collecting new samples in the field.

The Survey maintains geochemical datasets that include about 5 million determinations from more than 86,000 samples, and has a geochronologic dataset with almost 8,300 age determinations.

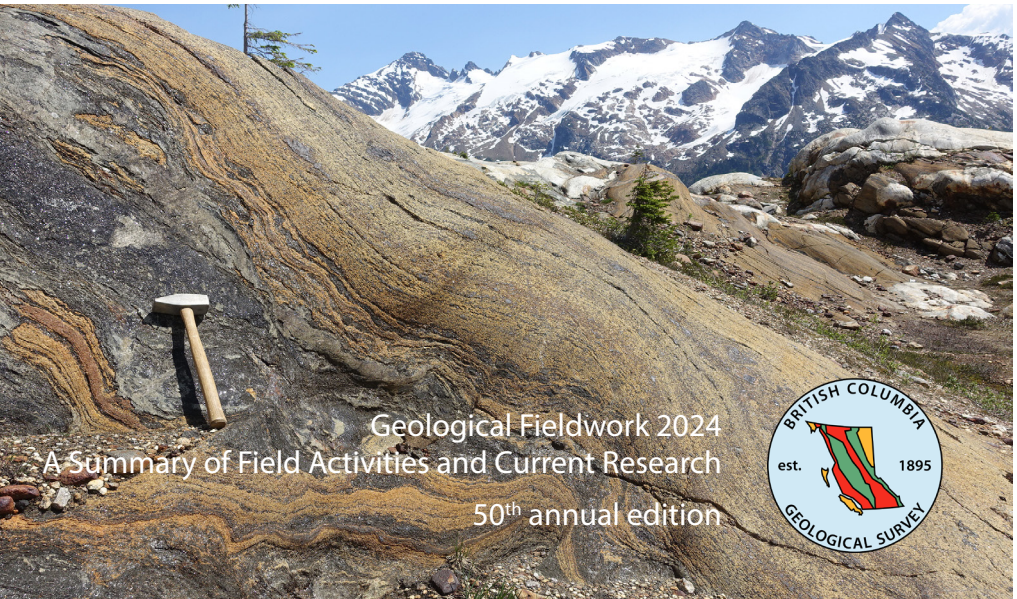
Current critical mineral-related programs include

- developing a modernized magmatic framework for critical mineral-bearing intrusive systems across the province using high-precision age and isotopic tracer data to establish the age, emplacement setting, and geographic distribution of both fertile and barren intrusions
- evaluating geochemistry and indicator minerals in modern surface water drainages to develop exploration tools for fingerprinting upstream carbonatite-hosted niobium, rare earth element, and other critical mineral deposits
- re-analyzing archived samples using modern whole-rock, trace element, and isotopic methods to classify and understand the geological settings important for mineralization
- measuring the physical properties (density, magnetic susceptibility, porosity) of archived samples to improve geophysical interpretations and enhance fertility assessments remotely

Publications

The British Columbia Geological Survey publishes Papers, Geoscience Maps, Open Files, GeoFiles, Information Circulars, and Digital Geoscience Data. All publications are available online, free of charge.

Published each January, the Geologic Fieldwork volume includes papers highlighting current field activities and research. The 2025 volume is the 50th edition. The Provincial Overview of Exploration and Mining in British Columbia, also published each January, summarizes industry activities of the previous year.



Partnerships

To lever funding, optimize resources, enhance data sharing, and reduce research duplication, the Survey actively seeks collaborations. The Survey partners with federal, provincial, and territorial governments, universities, other national and international geoscience organizations, and the mineral exploration and mining industry.

Skills training

The Survey invests in the next generation of geoscientists by hiring and training student assistants, mentoring student research, and supporting graduate students via numerous university partnerships.

Meetings

The British Columbia Geological Survey distributes maps and reports at regional, national, and international meetings. Survey staff regularly give presentations highlighting new developments in Cordilleran geology.

Engagement

Through its engagement program, the Survey is connecting Indigenous Peoples, local communities, government, the minerals industry, and the public to the geology and mineral resources of the province. This work enhances land-use planning and resource co-management, addresses diverse interests about resource development, and helps foster relationships. The Survey strives to be an ally and trusted broker of information and expertise about geological resources to rights holders across British Columbia.

Engagement with Indigenous Peoples is of particular focus

The exploration and mining sector is a significant employer of Indigenous people in British Columbia, and there is growing interest from Indigenous communities and leadership to better understand the mineral endowment of their traditional territories.

- Through the engagement program, the Survey links with Indigenous Nations to raise awareness of research projects on their lands, identify opportunities and challenges, and explore partnerships.
- The Survey provides Indigenous Nations with geoscience knowledge and tools to guide resource management and land-use decisions.
- As an unbiased public geoscience agency, the Survey builds trusted relationships with Indigenous Peoples in all facets of mineral exploration and mining.
- By walking together and learning from each other, we share traditional knowledge and Western science to build a common understanding of the natural history and geological resources in the province.

2024 Projects

With a focus on the critical minerals needed for a low-carbon future, the Survey continued to carry out bedrock mapping, deposit studies, regional studies, province-wide studies, and advance work on information systems.

Survey critical mineral geoscience provides the knowledge that will attract investment and inform decisions, enabling British Columbia to responsibly contribute the raw materials needed to transition to a green economy and curb climate change.

Bedrock mapping and complementary studies

- Volcanogenic massive sulphide, epithermal, and porphyry deposits in the Golden Triangle with mapping in the Kitsault River area and regional examination of plutonic rocks and volcanosedimentary successions.
- Mafic and ultramafic rocks near Atlin.
- Uplift history of Hogem batholith using fission track analysis.
- Nicola Group geochronology using high-resolution CA-TIMS.
- Volcanogenic massive sulphide deposits in the Lardeau Group and the transition from the Nicola arc eastward to Ancestral North America.
- Geological relationships of Paleozoic, Mesozoic, and Cenozoic rocks near Trinity Valley.

Province-wide studies

- Revitalized mineral potential modelling of critical mineral-bearing systems.
- Modernized magmatic framework of critical mineral-bearing systems using high-precision CA-TIMS dating and isotopic tracers from intrusive rocks.
- Critical metals in volcanogenic massive sulfide (VMS) deposits.
- Digitization of assessment reports and database creation to enable extraction of critical mineral occurrences that may have originally been overlooked.
- Geoscience data repository (data lake) of historical records to enable machine learning and artificial intelligence interrogation of unrecognized critical mineral-bearing mineral occurrences.
- Whole-rock geochemical re-analysis and radiogenic isotope and trace element analysis of archived samples.
- Physical properties (density, magnetic susceptibility, porosity) of archived samples.
- Review of cobalt occurrences in BC.

Critical mineral deposit studies

- Huckleberry and Berg porphyry deposits.
- Mount Polley porphyry deposit.
- New Afton porphyry deposit.
- Ranch epithermal deposit.
- Sullivan sedimentary exhallative deposit.
- Cirque sedimentary exhalative deposit.
- Cobalt-bearing iron skarns,, Vancouver Island and Texada Island

Regional studies

- Sediment-hosted mineralization and critical minerals.
- Critical mineral stream-sediment geochemical signals from carbonatites.
- Surficial digital geology of the Interior Plateau.

Province-wide information systems

- Geoscience Spatial Data Infrastructure (gSDI) to merge geoscience and mineral resource databases into a modern system ready for applied analytics using machine learning.
- Integrating map compilations into BC Digtal Geology.
- Modernization of ARIS (Assessment Report Indexing System), which contains data from more than 40,500 industry reports.
- Modernization of MINFILE, the repository of data with more than 16,000 mineral occurrences.

Contacts

Chief Geologist and Executive Director
Adrian Hickin
250-953-3801; Adrian.Hickin@gov.bc.ca

Director, Cordilleran Geoscience Section
Marc-André Brideau
778-405-2735 Marc-Andre.Brideau@gov.bc.ca

Director, Resource Information Section
Yao Cui
250-952-0040; Yao.Cui@gov.bc.ca

Director, Mineral Development Office
Gordon Clarke
604-660-2094; Gordon.Clarke@gov.bc.ca

email
Geological.Survey@gov.bc.ca

Mail
British Columbia Geological Survey
PO Box 9333 Stn Prov Gov't
Victoria BC, V8W 9N3

Main Office
6th floor
1810 Blanshard Street
Victoria BC, V8T 4J1

Mineral Development Office
203-865 Hornby Street
Vancouver BC, V6Z 2G3

BRITISH COLUMBIA

Ministry of
Mining and
Critical Minerals

BRITISH COLUMBIA
est. 1895
GEOLOGICAL SURVEY

www.BCGeologicalSurvey.ca