# Towards a British Columbia Rock Geochemical Atlas

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## INTRODUCTION

Past release of geoscience data by the Geological Survey Branch (GSB) from mapping, mineral deposits studies and geochemical surveys have stimulated exploration activity in British Columbia. Bedrock geochemistry, in particular, is an important tool for identifying rock samples that could enhance the minerals potential of an area. For example, those with anomalous metal contents are commonly close to mineralization whereas samples depleted in elements can indicate hydrothermal alteration. Point bedrock geochemical anomalies commonly indicate a local mineralized source whereas regional trends confirm the extension of favourable host rock for a particular style of mineralization from map sheet to map sheet. Other applications of lithogeochemical data are for interpreting bedrock geology and the results of stream geochemical surveys.

British Columbia Geological Survey geoscientists have generated a large volume of lithogeochemical and mineral identification data from the analysis of rock samples and minerals collected throughout the province over the past 20 years. While much of this information has been reported in BC Ministry of Energy and Mines publications, these analyses have never been collected into a single database. This paper describes the development of a database intended to capture the rock geochemical information and create a lithogechemical atlas for the Province. Other Canadian geological surveys such as Ontario, Newfoundland and Saskatchewan have lithogeochemical databases (Adcock *et al.*, 1994, Saunders, 1996) and there is also a Canadian Geosciences Knowledge Network (CGKN) initiative for establishing a Canadian network of geoscience databases that would include lithogeochemical information (Adcock *et al.*, 2003).

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## DATABASE DESIGN

One of the complexities in creating a database for geochemical data collected over a long time period is that the information will invariably be produced by a variety of analytical techniques, sample preparation methods and may also come from several, different laboratories. The structure must therefore be able to relate these variables to the results in the database so that extracted information is consistent with a particular method and/or source. The GSB lithogeochemical database is designed to recognize the multiple analytical methods and data sources used to generate the information over a period of 20 years by creating a number of related Microsoft Access™ tables. The structure is shown in Figure 1. Typically, a primary key that is a unique number assigned to every sample analyzed through the GSB laboratory links the tables. The two key database tables are

- **Master Data Table**: This is the main table representing the hub of most of the relationships and containing such key fields such as *Lab ID, Field ID, Batch ID, Rock Type, Latitude* and *Longitude*. The Master data table contains all of the records in the database, sample collector, the rock type, sample location coordinates and the NTS map sheet. *Lab ID* is the primary database key. *Field ID* is the identification number assigned to the sample by the collector whereas *Batch ID* is number given by the GSB laboratory to a batch of samples submitted for analysis.
- **Analysis:** This table contains direct analytical data or is linked to tables with information about the identity of the elements determined, the method used, and the laboratory responsible for producing the results.

Other database tables include Analysis_Code, Analysis_Code_Metadata (a more detailed description of method), Prep_Code (*e.g.,* sample milling by either tungsten carbide or steel swing mill), Geologists_Code (geoscientist responsible for submitting the sample) and Interference (inter-element analytical interference). Analysis_Code identifies 23 methods (Table 1) that have been used to analyse rock samples since 1985.

There are twelve tables for raw data in which elements are grouped according a commonality of methods used for analysis. For example, Values_oxide

**TABLE 1. ANALYTICAL METHODS IDENTIFIED IN THE ANALYSIS_CODE DATABASE TABLE**

| Method Code | Method Summary |
|---|---|
| _XRF1 | x-ray fluorescence - fused disc |
| _XRF2 | x-ray fluorescence - pressed pellet |
| _AAS | Aqua Regia-Flame atomic absorption spectometry |
| _CAA | Cold vapour - atomic absorption spectrometry |
| _FAA | Lead fire assay_atomic absorption finish/ICP |
| _FAG | Lead fire assay graphite furnace atomic absorption finish |
| _FAM | Lead fire assay_atomic absorption finish/ICPM |
| _GRAV | Gravimetric determination |
| _HAA | Hydride generation atomic absorption spectrometry (HAAS) |
| _ICP | Aqua regia digestion-Inductively Coupled Emission Spectrometry (ICP/ES) |
| _ICPM | Mixed acid (HF) digestion (ICP/ES) |
| _LE | Leco combustion |
| _LIC | Lithium metaborate fusion-Inductively Coupled Emission Spectrometry (ICP/ES) |
| _LICM | Lithium metaborate fusion-Inductively Coupled Mass Spectrometry (ICP/MS) |
| _MAA | Mixed acid (HF) digestion-Flame atomic absorption spectrometry (FAAS) |
| _MS | Aqua regia digestion -Inductively Coupled Mass Spectrometry (ICP/MS) |
| _MSM | Mixed acid (HF) digestion (ICP/MS) |
| _NA | Instrumental neutron activation (INAA) |
| _NFNA | Nickel sulphide fire assay_neutron activation finish |
| _PMS | Peroxide fusion_Inductively Coupled Mass Spectrometry (ICP/MS) |
| _SE | Ion selective eletrode |
| _SPEC | Spark emission spectroscopy |
| _TI | Titration |

contains a combination of major oxides, loss on ignition, carbon and sulphur results. Values_minor indicates a suite of elements determined by x-ray fluorescence rather than the more conventional term for a geochemical element association or a concentration range (*e.g.,* minor elements).

Some of the tables have an element suite where multi-element results were produced by a single technique such as instrumental neutron activation analysis (Values_INA) or rare earth elements by a sodium peroxide sinter and inductively coupled plasma mass spectrometry (Values_REE). In other tables, the elements are grouped according to when the analysis was completed because methodologies changed over time. For example, to accommodate older (pre 1990) results there

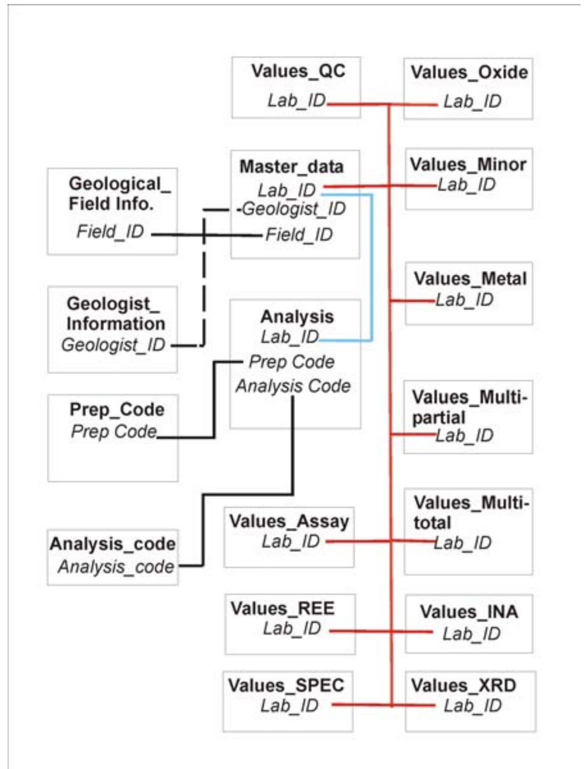


Figure 1. Lithogeochemical database structure. Some of the tables have been omitted.

are tables for metals measured by hydrofluoric acid digestion-atomic absorption spectrophotometry (Values_Metal), Spark Emission Spectroscopy (Values_Spec) and for minerals identified by x-ray Diffraction (Values_XRD). The Values_Spec and Values_XRD tables have qualitative rather than quantitative information.

For more recent (post 1990) results tables have been created (*e.g.,* Multi_Partial, Multi_Total) because element analyses were more commonly generated by multi-element methods such as inductively coupled plasma emission spectrometry and inductively coupled plasma mass spectrometry. The sample decomposition method is also indicated in these tables by the modifier Multi_**total** (lithium metaborate fusion) or Multi **_partial** (acid digestion). Results of standard and replicate sample analyses are collected in the Values_QC table. Extraction of specific data (*e.g.,* results for 1995 samples analyzed by a combination of lead fire assay and neutron activation) from the database is accomplished using Microsoft Access™ filters and queries.

## INFORMATION SOURCES

The database is currently being populated primarily with data from Geological Survey Branch files and reports. More specifically, the sources of information are

- Digital dBASE format reports downloaded from the Geological Survey Branch laboratory information tracking system implemented in 1985.
- Scanned copies of analytical reports in the laboratory archives and tables and appendices in Ministry of Energy and Mines Papers, Open Files and Bulletins.
- Digital copies of final analytical reports submitted by the laboratory to Geological Survey Branch geoscientists.

In December 2004, the database had 18,590 sample records although of these only an estimated 10,000 have location coordinates. The distribution of these samples is shown in Figure 2. The database will be updated with information from future Geological Survey Branch projects and for other sources such as Ministry of Energy and Mines assessment reports.

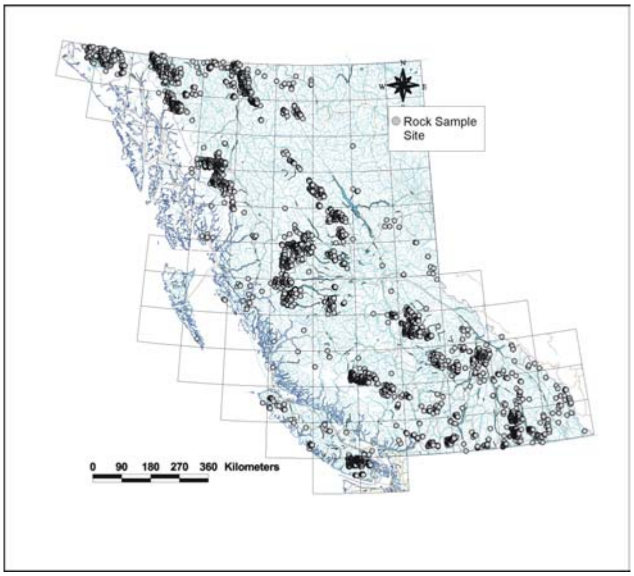


Figure 2. Geological Survey Branch rock samples with locations and lithogeochemical data.

## CONCLUSIONS

A Microsoft Access™ database containing almost 19,000 analytical and mineral identification records from rock samples collected by the British Columbia Ministry of Energy and Mines is in the process of completion. Rapid and simple access to rock geochemical data at this broad scale will encourage mining companies to apply new exploration concepts for evaluating larger areas of British Columbia. The database will be produced as a CD version and also as an atlas of element maps showing as themes on the Geological Survey Map Place portal allowing the lithogeochemical analyses to be viewed on a province-wide scale.

## ACKNOWLEDGMENTS

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