GEOFILE 2005-14

THE BC ROCK GEOCHEMICAL DATABASE

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INTRODUCTION

Past release of geoscience data by the Geological Survey and Development Branch (GSDB) 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 favorable 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 twenty 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. Geofile 2005-14 describes the development of a database intended to capture the rock geochemical information and ultimately create a lithogechemical atlas for the Province (Lett and Ronning, 2005) . 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 GSDB lithogeochemical database is designed to recognize the multiple analytical methods and data sources used to generate the information over a period of twenty 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 analysed through the GSDB 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 GSDB laboratory to a batch of samples submitted for analysis. Location coordinates for each sample are in *Lat_NAD27, Long_NAD 27, UTM_East_NAD 27, UTM_North_NAD27, UTM_East_NAD 3 and UTM_North_NAD83*. The UTM Zone is also listed. The *"Notes"* in the Master Table are comments taken from the original laboratory record about the sample (e.g. the mineral property, project area) and the analytical methods used (e.g. XRD).
- **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. The

number of records (20 000) in this table reflects the size of the source database.

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.

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

There are twelve tables for raw data in which elements are grouped according a commonality of methods used for analysis (Table 2). For example, Values_oxide 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).

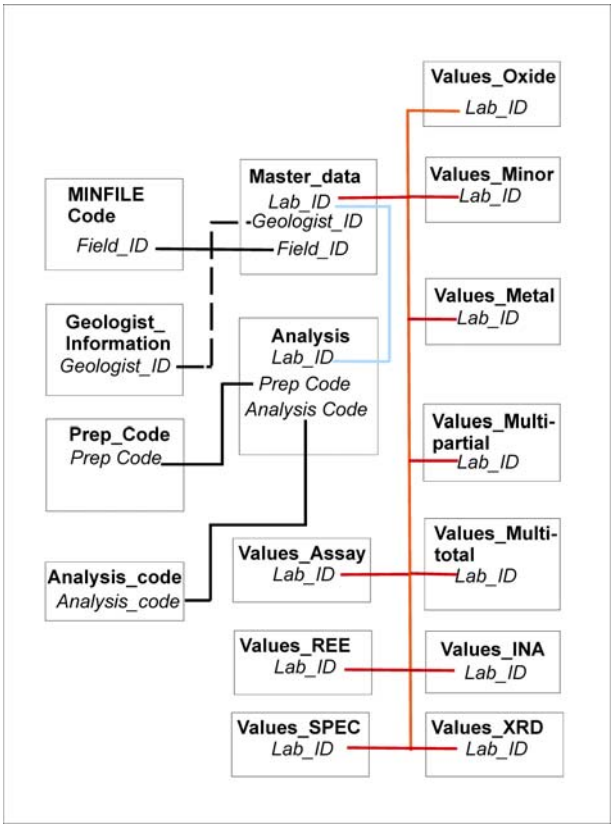

Figure 1. Lithogeochemical database structure. Some of the tables have been omitted.

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 are tables for metals measured by hydrofluoric acid digestion-atomic absorption spectrophotometry (Values_Metal), Spark Emission Spectroscopy (Values_Spec) and for minerals identified by Xray 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 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** (e.g. lithium metaborate fusion) or Multi **_partial** (aqua regia). Extraction of specific data (e.g. results for 1995 samples analysed by a combination of lead fire assay and neutron activation) from the database is accomplished using Microsoft Access™ filters and queries.

TABLE 2. ANALYTICAL DATABASE TABLES

Table	Description
tlbXRAY_DIFFRACTION	Minerals identified by X-ray diffraction (Mainly using a Phillips PW 1140 system)
tlb Values_SPEC	Minerals analysed with an spark emission spectrometer (Pre 1990 Energy & Mines)
tlbValues_PGE	Pt, Pd, Au, Rh, Os, Ir, Re by NiS fire assay collection-INAA/ICPMS finish
tlbValues_REE	Rare earth elements by sodium peroxide sinter-ICPMS
tlbValues_oxides	Major oxides by fused disc_xray fluorescence or lithium metaborate fusion_ICPES. Includes LOI, carbon and sulphur analyses
tlbValues_multi_total	Elements by "total" acid (HF) digestion – ICPES or ICPMS
tlbValues_multi_total	Elements by "partial" acid (e.g.aqua regia) digestion – ICPES or ICPMS
tlbValues_minor	Trace and minor concentrations of elements determined by pressed pellet Xray fluorescence
tlbValues_minor_NA	Minor concentrations of elements determined by instrumental neutron activation
tlbValues_NA Group	Trace and minor concentrations of elements determined by instrumental neutron activation
tlbValues_metal	Base and precious metals and lithium determined by "total" acid (HF) digestion – atomic absorption spectrometry
tlbValues_assay	Gold, Silver and Platinum values by lead collection fire assay_AAS/ICPES finish

INFORMATION SOURCES

Up to now the database has been populated with data from Geological Survey and Development Branch files and reports. More specifically, the sources of information are:

- Digital DBASE format reports downloaded from the Geological Survey and Development 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 and Development Branch geoscientists.

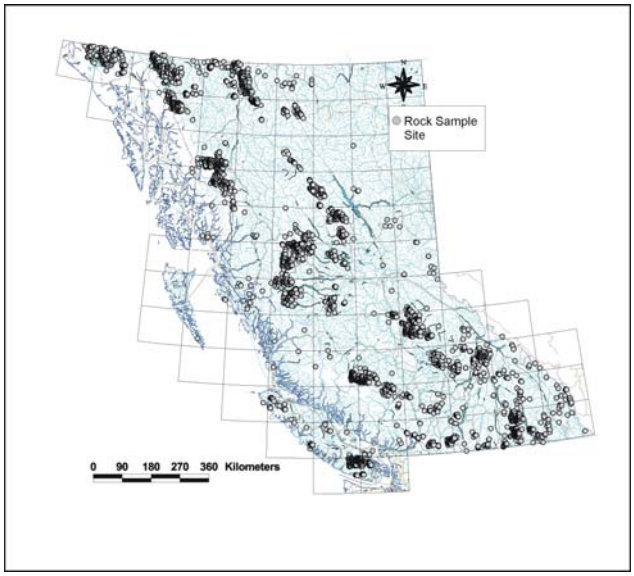

Figure 2. Geological Survey and Development Branch rock samples with locations and lithogeochemical data.

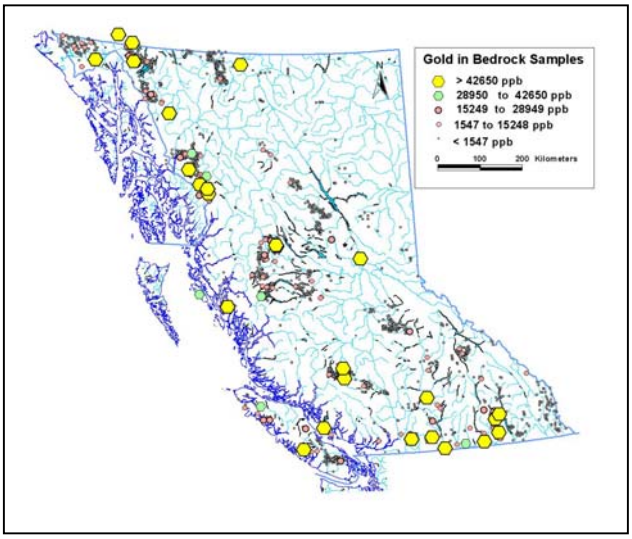

Figure 3. Gold in bedrock samples

DATABASE CONTENT

The version of the BC lithogeochemical database documented in Geofile 2005-14 contains records for 9544 rock samples, sample descriptions and location coordinates. Figures 2 and 3 show sample locations and the distribution of gold in rock samples. The source database presently has over 18, 000 rock sample records with analytical data, but only 9544 of these presently have location coordinates. The database will be updated and re-relaeased as more sample coordinates and analyses become available. The primary source of information will continue to be Ministry of Energy and Mines reports. However, data of acceptable quality from other BC geoscience sources will also be used to populate the database.

Those using this version of the database should be aware of the following cautionary remarks.

1. While every effort has been made to ensure that sample locations and analytical results have been correctly entered into the database there is no guarantee of complete accuracy. For example, the coded samples rock types are those recorded by the geologist who submitted the samples for analysis. Codes correspond to the BC Geological Survey MINFILE rock and mineral codes. The subsequent name for the rock based on petrographic analysis may be different from the initial identification. Similarly, the original locations are assumed to be based on the North American Datum (NAD) 27 although after 1995 many of the coordinates were, in fact, based on NAD 83. Where the datum has been recorded on the original laboratory report it is entered in the *Notes* column of the Master Data table.
2. Extracting information from the database can be accomplished using Microsoft Access™ filters and queries. Those less familiar with Microsoft Access™ are recommended to consult Geofile 2005-15 (Ronning, 2005). Where a table contains analytical results from the same laboratory and the same method (e.g. rare earth data) a simple query linking the sample location information (tlb_Master) can be constructed. However, more complex queries are needed to extract results from several sources and methods. Examples of several queries are included in this version of the database.
3. Rapid and simple access to rock geochemical data at this broad scale will hopefully encourage mining companies to apply new exploration concepts for evaluating larger areas of British Columbia. This version of the database is published as a CD and ultimately will be 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.

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