



TOWARDS COMPREHENSIVE DIGITAL GEOSCIENCE DATA COVERAGES FOR NEWFOUNDLAND AND LABRADOR

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The period 1972 to 1996 saw an exponential expansion of the geoscience database for Newfoundland and Labrador under the aegis of a series of Federal-Provincial Mineral Development Agreements. Digital techniques are essential to manage this information and apply it effectively to mineral exploration. Furthermore the current exploration boom in Labrador, which followed the 1994 announcement of the Voisey's Bay Ni-Cu-Co discovery, is producing an even greater volume of geoscience data, much of which is now submitted in digital form to the provincial government for assessment credit.

To provide an integrated framework for the organisation of geoscience data, a series of seamless, province-wide, digital coverages is being compiled from published (mainly government) sources for the key data types, including:

1. bedrock geology (1:25 000 to 1:250 000 resolutions);
2. surficial geology (1:50 000 to 1:500 000 resolutions);
3. regional aeromagnetic field (800 m line-spacing, GSC surveys);
4. regional Bouguer gravity survey (10–12 km spacing, GSC surveys);
5. regional drainage sediment geochemistry (1 site per 6 to 13 km²);
6. mineral deposits.

These databases are being compiled and integrated using Caris GIS, and will be linked to other more specialized information sources such as radiometric age databases from government and literature sources. More restricted and more detailed geophysical and geochemical coverages are also being added from government and industry surveys, and digital indexes with associated attribute databases are being prepared showing the areas covered by reports and maps, and the locations of diamond drill holes.

DATA STRUCTURE

Levels of detail vary among and within the main data coverages. To be integrated and used effectively, each data type has to be generalisable from its original full level of detail through an appropriate data structure. The approach to data generalisation is dependent on the type of data, and each has to be treated separately.

Bedrock geology

For most geoscientists, lithological units as two- (or three-) dimensional objects are the main key for the whole geoscience database, and provide the reference for all the other data layers. The individual units can be arranged not only in geographic space but also in temporal or other geological association through a geological legend. A schema to accomplish this, GeoLegend, has been devised by Colman-Sadd *et al.* (1996). In this approach full detail is captured by digitising all unit polygons from the most detailed and up-to-date maps for a region. Polygons are re-assigned to a uniform legend structure that conforms to the North American Commission on Stratigraphic Nomenclature (1983). As this legend structure is hierarchical, it can be used to generalise by grouping the most detailed units into larger stratigraphic or lithodemic divisions such as group level (Figure 1). The associated database software generates legend information specific to the units falling within any chosen area and at any specified level of stratigraphic generalization. The original information for each input geological polygon retains its original boundaries (contacts) and has a unique ID which allows it to be linked to a table of source documents and other information.

Most other features from a geological map (such as structural observations) can be related to geological units. Methods to generalise them can be by random sub-sampling, or both objective and subjective hierarchies of importance, or some combination. Faults, isograds and alteration zones can be independent of geological units.

Surficial geology

Quaternary geology maps have a very different legend structure. The landscape is subdivided into polygons of contrasting surficial sediment assemblages on the basis of genetic class and landform modifier. There is no overall hierarchical stratigraphic relationship between these units. Commonly in 1:50 000 scale Quaternary maps in Newfoundland and Labrador, 10 genetic classes, and 15 landform modifiers are used. In any single polygon up to three genetic classes may be recognised (dominant, secondary and tertiary), each of which may have an associated landform modifier. The polygon is labelled by a composite descriptor, and boundaries between adjacent polygons are commonly gradational. A database

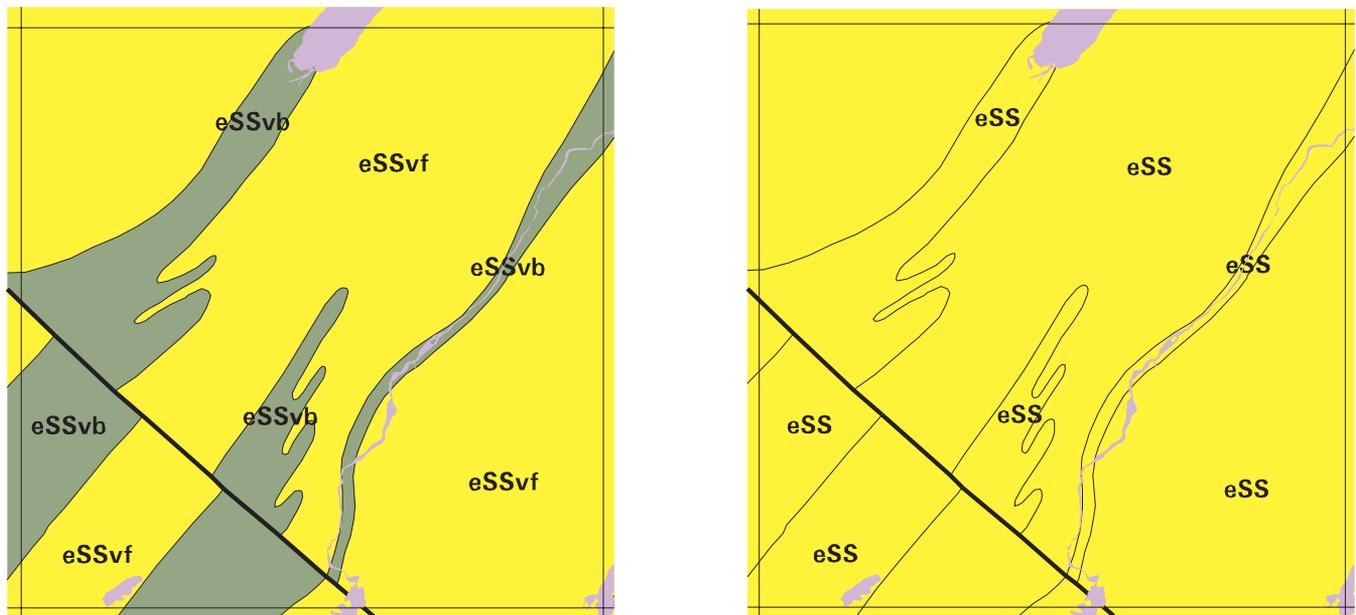


Figure 1: Part of a geological coverage from northeast Newfoundland showing geological units of the Springdale Group: (a) subdivided by lithological subunits, with formation labels (eSSvb and eSSvf, basic and felsic volcanic units respectively), and (b) at the group level, with group label eSS. The internal boundaries within the group and complex can be removed. The grid is 10×10 km.

structure is required that allows this information to be generalised in various ways to permit its effective use in a GIS.

Glacial striations are not directly associated with the surficial sediment units, although they are important in reconstructing ice-flow history. These have been organised as a separate point database (Taylor *et al.*, 1994) that contains, together with essential information (e.g., azimuth), a field allowing the selection of a subset of summary observations. This summary subset has been edited to provide a representative regional overview of ice flow of broader areas.

Regional geophysical surveys

The two types available for the whole province are aeromagnetic and gravity surveys. The former were carried out entirely by the Geological Survey of Canada (GSC). A regional framework of gravity stations was established by the GSC, to which have been added data from localized, more detailed surveys by a number of agencies.

The regional Bouguer gravity values (one station per 100 km^2 in Newfoundland and one per 150 km^2 in Labrador) have been interpolated to a 1 km grid, from which histogram-equalised colour and colour shaded-relief images have been prepared, as well as a vector layer of line contours at 0.5 mgal intervals. A database of the gravity and associated data is also tied to a point data layer.

Aeromagnetic data are from surveys flown with 800 m line spacing. Interpolation to a 200 m grid provides satisfactory images for regional overviews for most purposes. High resolution data are available for cen-

tral Newfoundland (GSC), and for several small areas throughout the province from industry sources. These high resolution data sets are interpolated to 50 m grids. To allow the detailed data to be overlain on the regional aeromagnetic grids (Figure 2), rectangles of the regional data large enough to enclose the more detailed survey are regridded to the finer scale and the common elements are replaced by the high resolution gridded data. This is more efficient than re-interpolating the entire regional data set to a 50 m grid, which would result in very large image files.

Regional drainage sediment geochemistry

Regional geochemical surveys cover the entire province. Lake sediment data are available for Newfoundland at a density of one site per 6 km^2 , and for Labrador south of $58^{\circ}30' \text{ N}$ at a density of one site per 13 km^2 . Stream sediment data at a density of one site per 13 km^2 complete the coverage of northern Labrador.

Three methods of presentation are used to portray geochemical variation. Broad crustal features are displayed most effectively as relative element variations in colour images of generalised interpolated geochemical surfaces. At intermediate scales, line contours provide an effective way to portray regional geochemical variations quantitatively. At the most detailed level, individual sites can be shown, and geochemical variation displayed through a variety of symbols to represent different element concentration levels. Data from detailed surveys by methods compatible with the regional mapping are being added to the reconnaissance point data file, with a field to allow them to be distinguished as necessary. Data from different media are kept separate.

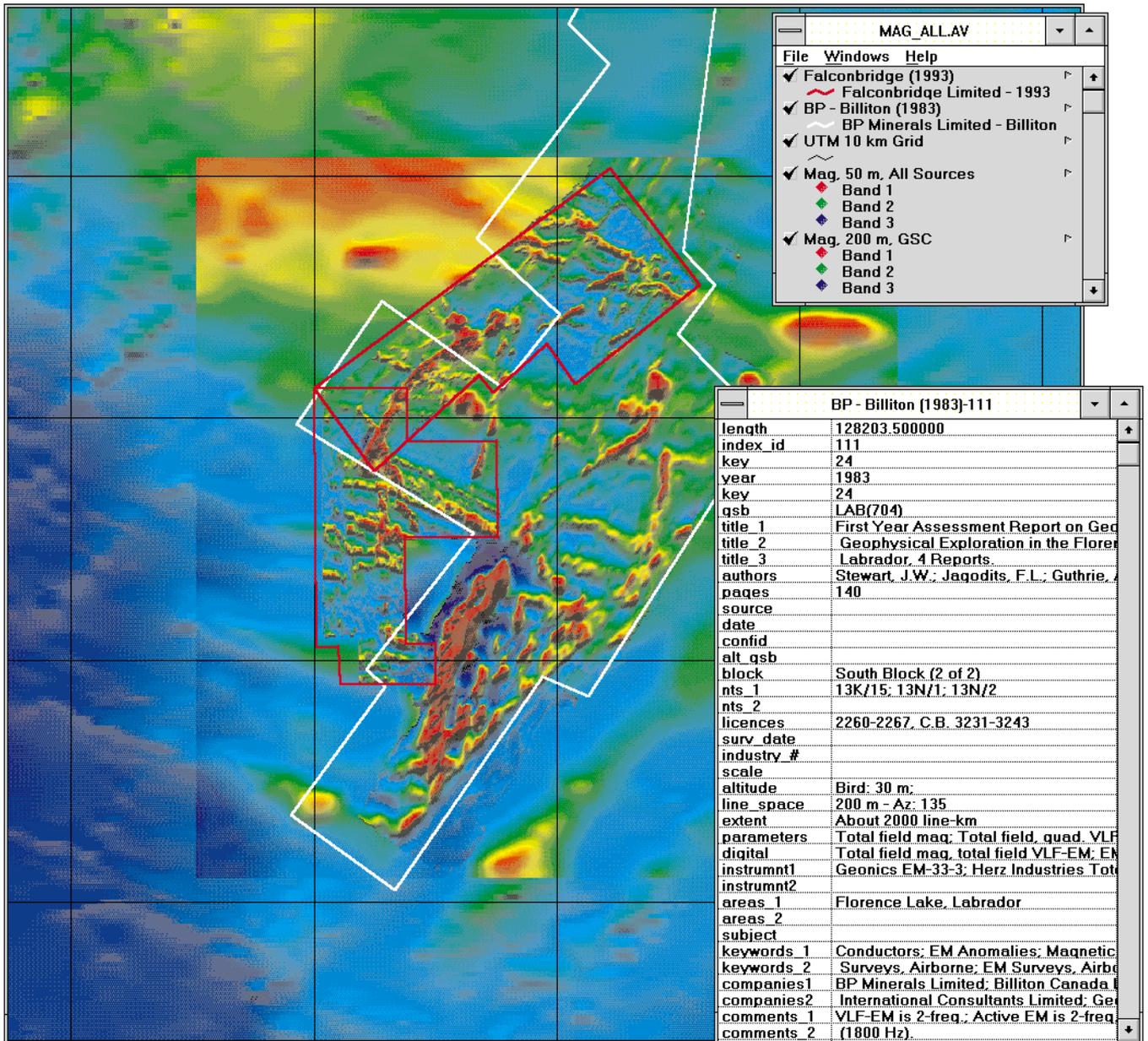


Figure 2: Regional aeromagnetic image (200 m grid) for part of the Archean Hopedale block, Labrador, over which a 50 m grid of combined regional and high-resolution data from exploration surveys has been superimposed. The outlines of the exploration company surveys from an index of assessment files are shown in white, with a window showing information from the assessment file database for the survey outlined in white. The grid is 10 × 10 km.

Mineral deposits

An inventory of mineral occurrences for the province is maintained in a Mineral Occurrence Data System (MODS), which is maintained as a digital database that with slight modification can be used in a GIS. The database contains systematic keywords, descriptions and key references.

Indexes

A series of indexes is being developed that link the areas covered by more detailed and localised geo-referenced information (e.g., an index of mineral assessment files by exploration companies, Figure 2). Similar indexes of published government maps, reports and open files have been prepared, and the associated databases will indicate whether the information is available as digital coverages. An index of diamond drill hole locations and related descriptive information is available for parts of the province, and will be extended.

Output and atlases

This will be a multi-year project and significant computer resources will be required to utilize the resulting databases. In addition to releasing individual parts of the database in generic digital formats, topical compilations of parts of the larger project are being produced as "digital atlases" (geoscience data and indexes prepared with documentation for an included data viewer) to run on a PC. Two digital atlases have been released to date, one a geochemical atlas (Davenport *et al.*, 1996a) which focuses on the regional lake sediment geochemical database for

Newfoundland, and the second a digital geoscientific atlas of the Buchans-Robert's Arm volcanic belt (Davenport *et al.*, 1996b). This latter contains all the published digital geophysical, geochemical and mineral deposits information for six 1:50 000 NTS sheets, together with digital compilations of bedrock and surficial geology, and a series of indexes. Three similar compilations are nearing completion for Labrador. These atlases provide access to the digital data at very modest cost for prospectors, small exploration companies, and large mining corporations alike.

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