

Progress Report on a New Mapping and Resource Evaluation Program for Central Nova Scotia¹

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Introduction

During the summer of 2003, the Geological Survey of Canada (GSC) and the Nova Scotia Department of Natural Resources (DNR) began a two-year geological mapping and resource evaluation project in central Nova Scotia. The work forms part of the second phase of the Targeted Geoscience Initiative Program (TGI-2), a national program designed to assist and promote mineral and energy exploration. In addition to GSC and DNR staff, the Nova Scotia component of TGI-2 will include researchers from various Canadian universities, other government organizations, and industry.

The Nova Scotia TGI-2 project focuses on the area covered by NTS sheets 11E/05, 11E/06, 11E/07, 11E/08 and 11F/05 (Fig. 1). Our goal will be to combine new project data with formerly unpublished, high-quality historical data to produce maps and reports that will be of significant interest to mineral and hydrocarbon exploration companies.

The project includes five major components: (1) mapping, (2) mineral deposit research, (3) energy resource research, (3) seismic interpretation and reprocessing, and (5) geophysical mapping and modelling.

Geological Mapping

The majority of the study area is underlain by Carboniferous strata that are of considerable interest for hydrocarbon and mineral resource potential. Unfortunately, uncertainty about stratigraphy and structure has often hindered exploration efforts. Higher quality bedrock maps are required to develop more refined stratigraphic

and structural models to assist mineral and hydrocarbon exploration. High-quality (often 1:10 000 scale) bedrock data exist for significant parts of the study area. However, most of these data have not previously been released as maps. Digital compilation and interpretation of these data have been among the top initial priorities.

Two unpublished data sets are being used to compile new digital maps within the project area. The area covered by these mapping projects is south of the Cobequid-Chedabucto Fault Zone (CCFZ) within the St. Marys Basin (see Fig. 1). The earliest data set was collected from 1968 to 1971 as part of the St. Marys River Basin Project. This project was undertaken by the Nova Scotia Department of Mines and included geological mapping and soil geochemistry, as well as gravity, VLF and seismic surveys (see Nova Scotia Department of Mines, Annual Report on Mines 1971, p. 71-72). The original field notes and working maps are still available from this project, and they have provided excellent outcrop locations and bedding orientations. Data for the St. Marys River Basin project will be published by October 2004 as an NSDNR digital product, which may be viewed in map form using ArcView®.

The second data set was collected during 1993 and 1994 by Randy Rice and Brendan Murphy as part of the federal NATMAP program. Although some very useful publications (e.g. Murphy and Rice, 1998; Murphy, 2000) were produced by this project, the detailed mapping data have not previously been made available. The Rice and Murphy data will be published as a DNR open file map that will include all available outcrop locations and structural data. Publication of this map is planned for January 2005.

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In addition to publishing previously unreleased map data, project staff are also compiling digital versions of the major published geological maps within the TGI-2 project area. These databases will be made available for free download from the DNR website as digital products.

New geological mapping will be used to fill existing outcrop data gaps and to study specific stratigraphic and structural questions. During the summer of 2003, most of the new mapping was undertaken in the Cumberland and Mabou groups adjacent to the Cobequid Highlands. This work, coupled with new palynological sampling, helped refine stratigraphic subdivisions within the Cumberland Group and to better understand the nature of some of the major boundary faults in the study area. During the 2004 field season, mapping will focus on specific areas that contain important outcrops of the Horton, Cumberland and Mabou groups. This work will include a close look at the nature of the boundary between the St. Marys and Shubenacadie basins, further study of the Carboniferous stratigraphy throughout the study area, and detailed structural analysis of major fault zones. Palynological sampling will also be undertaken to support the mapping efforts.

In addition to the map products mentioned above, two new 1:50 000 scale geological maps of NTS areas 11E/06 and 11E/07 and eight 1:10 000 scale maps of the Carboniferous strata between Londonderry and Kemptown will be released as part of this project (see Fig. 1). These maps will include the highest quality historical information that is available, and all the new mapping data collected by this project.

Mineral Deposits Research

Assessment of specific mineral deposits, and hydrocarbon potential, will also form a component of this project. Activities include study of regional thermal maturation data and Cu-Co-Au mineralization near Mount Thom.

The presence of abundant vein and disseminated Fe-oxide mineralization with associated carbonate alteration and anomalous Cu±Co±Ni±Au along and peripheral to the

Cobequid-Chedabucto Fault Zone of mainland Nova Scotia has recently generated interest because of analogies with the IOCG (iron oxide-copper-gold) environment. In order to assess the validity and applicability of the various models proposed for IOCG mineralization globally, several aspects of the mineralizing environments and geological setting of the area of interest have to be addressed. Foremost among these concerns are the nature of mineralization, associated elemental enrichment (e.g., Co, Ni, Au, REE, Mo, Zn, etc.), mineral paragenesis, and absolute age of mineralization. The nature of mineralization in IOCG deposits is highly variable and can vary within a mineralized zone. Thus, documentation of the nature of mineralization and elemental enrichment is mandatory. The project will also address the age and nature of magmatism within and peripheral to the fault, and how these compare to magmatism in the nearby Cobequid and Antigonish highlands regions. The role and type of magmatism in IOCG deposits is debated, but its occurrence in close association with several such deposits demands that this issue be addressed. The project will study the extent and nature of alteration associated with the mineralized centres. Widespread alteration forms an integral part of the IOCG model and, therefore, it is crucial to fully characterize its chemical and geometrical aspects. A particular fluid chemistry is peculiar to IOCG deposits. Thus, characterizing the fluids associated with mineralization and alteration is an important aspect of the IOCG model. This component of the deposit environment will be assessed via fluid inclusion studies and stable isotopic analysis.

In order to address these issues a suite of samples from archived material collected from within the TGI-2 study area over the past several years has been prepared for initial study. The samples are keyed to mineralization in the Londonderry, Mount Thom and Copper Lake areas, and some lesser mineralized areas with aspects of IOCG mineralization (e.g. specular hematite). Representative samples have been prepared for petrographic and mineralogical examination, fluid inclusion study, stable isotopic analysis, and to determine the age of both the mineralization (Mount Thom, Copper Lake) and related igneous rock. Results of these initial sample sets will help

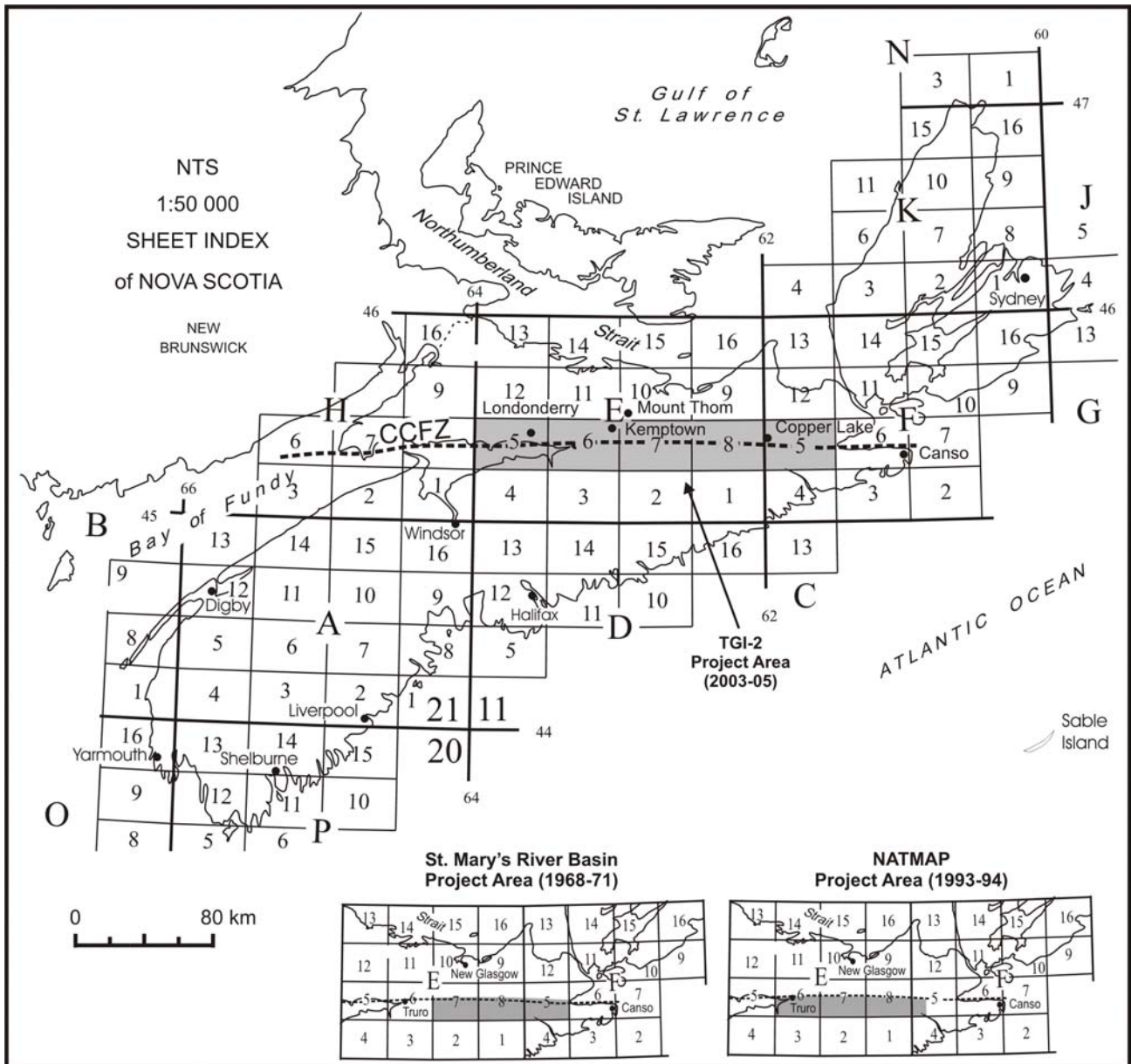


Figure 1. National Topographic System (NTS) index map of Nova Scotia showing locations of the TGI-2 and previous project areas. CCFZ = Cobequid-Chedabucto Fault Zone.

in determining the further detailed work required to address the features that are critical to assessing the validity of the IOCG model for this part of mainland Nova Scotia.

A limited, regional geochemical sampling program totalling approximately 100 sample sites is planned for the 2004 field season. Humus, soil and till samples will be collected at each sample site along three or four north-south (roadside) traverses across NTS map areas 11E/06, 11E/07

and 11E/08, plus along one east-west traverse line parallel to Trans Canada Highway 104. Geochemical results for humus, soil and till samples help characterize the regional geochemical signature of the Cobequid-Chedabucto Fault Zone for the various sample media, and further assist current exploration efforts for IOCG mineralization in the area. Strict quality assurance/quality control protocols will be followed for all phases of sample collection, preparation and analysis.

Energy Resource Research

The study area has attracted interest for both coal and hydrocarbon exploration. Industry exploration is underway for near-surface coal and large areas are currently under licence for petroleum exploration.

During the 2003 field season we studied the regional stratigraphy of coal-bearing units within the project area. Mapping, new palynological analyses, and recent industry seismic data were used to develop a better understanding of the coal-bearing strata. Our work suggests that there are at least two significant coal-bearing units, separated by hundreds of metres of non-coal-bearing strata. Coal within these units is locally of high quality. However, the lateral extent of individual coal seams is often affected by structural features and/or rapid lateral changes in coal quality. During 2004 we will undertake detailed stratigraphic and structural modelling of specific coal-bearing intervals to more closely examine local variation in seam thickness and quality.

Evaluation of hydrocarbon potential in the project area will largely be based on analysis of recent industry seismic data. However, we will include some work on characterization of source rocks and a regional maturation study. During 2004 we will compile existing maturation and source rock data for the entire project area. Additional sampling and testing will occur if more data are required.

Seismic Interpretation and Reprocessing

During 2003 we compiled the location of all known seismic surveys within the project area. This information will be released as a digital product for free download through the DNR website and will include locations of all the shot points for each survey. Steep bedding dips and complex faults make survey design and processing difficult in the study area. However, some of the more recent surveys have realized some very good results. Although the most recent industry seismic data are still proprietary we were able to obtain permission

to work with a consultant to interpret a number of useful lines in the northeastern corner of NTS area 11E/06. This information is being used in concert with mapping data to produce a series of cross-sections that extend from the Cobequid Fault to the northern edge of the St. Marys Basin.

During 2004 we plan to reprocess a number of seismic lines and work with industry to gain access to additional recent seismic data. Whenever possible, interpreted seismic cross-sections will be made available for free download.

Geophysical Mapping and Modelling

A variety of airborne geophysical data are available for the project area. Aeromagnetic and gravity coverage exists for the entire area, while VLF-EM surveys provide more local coverage. In 2003, Steve King was contracted to prepare geophysical maps for the entire project, including the following:

- Aeromagnetic (total field, calculated first and second vertical derivative)
- Bouguer gravity
- Residual Bouguer gravity
- VLF-EM line and ortho total field (local coverage only).

These maps will be made available as digital images for free download during the summer of 2004. They will also eventually be available as open file maps in a PDF format.

During 2004 we will be evaluating sites as potential candidates for detailed geophysical modelling. We are also hoping to integrate new (2004) industry airborne geophysical surveys into our geophysical coverage.

Summary

TGI-2 is providing the opportunity to undertake important research on one of the most interesting areas for mineral and energy exploration in the province. The multi-faceted approach incorporated into the project design will ensure the information generated will be of interest to a broad spectrum of

clients. Compilation and release of previously unpublished historical data, coupled with new work, will make available a large volume of data despite the relatively short duration of the project. Project results will be made available as open file maps, online digital products, reports in the annual

Mineral Resources Branch Report of Activities, and journal publications. Presentations on project results will also be given at the Mining Matters for Nova Scotia conference and the Atlantic Geoscience Society meeting. Two field trips will also be run that will be open to anyone.