

Breaking New Ground in Collaborative Geoscience: The Lake Nipigon Geoscience Initiative

W. Rayner, P.Geo.¹ and J. R. Parker, P.Geo.²

¹Program Director, Lake Nipigon Region Geoscience Initiative, Ontario Prospectors Association, Thunder Bay, ON

²Senior Manager (Acting), Precambrian Geoscience Section, Ontario Geological Survey, Sudbury, ON

The Lake Nipigon Region Geoscience Initiative (LNRGI) is a science-based geoscience data acquisition and compilation study that commenced in 2003 and will be completed in December 2005. During the last 2 years new geoscience data has been collected to help explain the geological history of the Lake Nipigon region and to identify high mineral potential exploration targets throughout the region.

During the last 2-years the Ontario Prospectors Association (OPA) in collaboration with the Ontario Geological Survey (OGS), Lakehead University, the mineral industry and government partners have been conducting geoscience studies in the Lake Nipigon region. This initiative has received financial support (\$3.5 million) from the Northern Ontario Heritage Fund Corporation (NOHFC); in-kind support from the Ontario Geological Survey; and in-kind support (valued at approximately \$12 million) from the mineral industry.

FOUNDATIONS FOR COLLABORATION

This innovative collaboration began when the Technical Committee of the OGS Advisory Board endorsed the concept of an OGS geological project in the Lake Nipigon region. Following the OGS Advisory Board advice, mineral industry clients, at a client-advisory meeting held in Thunder Bay, defined the technical project elements. The Ontario Prospectors Association was identified as the group to manage the Lake Nipigon Region Geoscience Initiative (LNRGI). A science committee was subsequently established to guide geoscience activities for the initiative. The science committee consisted of 16 representatives from the mineral industry (5), Lakehead University (2), Ontario Geological Survey (4), mineral industry consultants (3) and First Nation communities (2). Through a request for proposal, CAMIRO was contracted to provide technical analysis for the Science Committee and technical support to the LNRGI Program Director.

GEOSCIENCE IMPORTANCE OF THE LAKE NIPIGON REGION

The Lake Nipigon Region is of interest to the Ontario, Canadian, and international geoscience community because the rocks appear to preserve evidence for the rifting of the Earth's surface approximately 1 billion years ago. The Nipigon area is presently interpreted to be the failed third arm of a major Proterozoic Rift that transects mid-continent North America beneath Lake Superior, the Keweenaw Subprovince. Documented evidence of crustal rifting processes preserved in the Lake Nipigon region will enhance the understanding of the geological history of this immediate area and the geological history of rocks preserved south of Thunder Bay and into the United States. The new geoscience data generated during the Lake Nipigon initiative will be used by the OGS as part of its 5-year core business commitment to the area. The data will be included in a joint OGS—United States

Geological Survey (USGS) compilation project to understand the geological history of the entire Midcontinent Rift system.

Elsewhere in the world, similar Earth processes have concentrated metals in the crust, including nickel-copper, platinum group metals (PGE), copper-gold, gold, uranium and rare metals, to levels where they form economically viable ore deposits. Important insights gained by studying this region will be applied to more effectively explore for mineral resources in this region and elsewhere in Ontario.

RATIONALE FOR THE PROGRAM

Several specific geoscience questions have been addressed during this study. Part of our existing knowledge gap is due to the fact that much of the study area has not been mapped or sampled in detail. For example, undocumented areas of Archean rocks have been reported from the study area, but until the character and distribution of these rocks are known, they have unknown mineral potential. Also, the Sibley Group of sedimentary rocks and the English Bay felsic intrusion contain the oldest elements of the Keweenawan rift system. These studies will aid our understanding of the relationship of these elements and their implications for resource potential. In addition, Operation Treasure Hunt (lake sediment geochemistry surveys) identified metal anomalies in the area that may be indicative of unknown mineral occurrences. Both the surficial geochemical and bedrock mapping studies will help to determine the cause of these anomalies.

Although the region has enjoyed recent exploration for Ni-Cu-PGE mineralization associated with mafic-ultramafic intrusions (1100 Ma), it is not known whether mineralization-type varies between intrusion forms (e.g. cone sheets versus sills or lopoliths). The distribution of felsic intrusions and related metavolcanic rocks (~1530 Ma) in the English Bay area is not well known, nor is the potential for iron-oxide-gold-copper mineralization in association with these felsic intrusions. The Black Sturgeon fault has been suggested to be an important controlling factor with respect to distribution of mafic intrusions, and possibly mineralization. Consequently, determining its precise location, as well as comparing stratigraphy across the fault, will be important in determining the metallogenic significance of this structure. Geochemical studies of the mafic intrusions will help in establishing the internal stratigraphy of these units, as well as aiding in determining the processes responsible for mineralization.

The acquisition of high-resolution airborne and ground geophysical data for the Lake Nipigon Region has assisted in defining potential exploration targets and will help to better define geological contacts and regional geological structures when integrated with the results of bedrock mapping.

OBJECTIVES OF THE LAKE NIPIGON REGION GEOSCIENCE INITIATIVE

The LNRGI geoscience projects will enhance the scientific understanding of the area and facilitate mineral exploration in the region by:

1. Maintaining and then increasing mineral investment in the Lake Nipigon region through the collection of high quality geological data and the provision of interpretations that meet the needs and priorities of the mineral industry and that maintain or attract mineral investment to Ontario.

2. Increase the mineral exploration discovery rate by addressing “masking and deep search challenges and skill gap” in the area.
3. Respond to, and evaluate, new and exciting mineral deposit models recently recognized for nickel-copper, palladium-platinum, uranium and gold-copper mineralization in the region.
4. Reinforce and demonstrate an innovative economic development model based on local community, industry, and government partnerships in geoscience that result in mineral resource economic development in the local communities, the region, and Ontario.
5. Provide a framework for informed future land use decisions.

KEY RESULTS

1. High quality geoscience data has been provided that meets industry needs and priorities.
2. There has been increased staking activity in response to the results of the geoscience study.
3. Diamond-drill core sampling conducted as part of an OGS bedrock mapping program and Lakehead University research thesis lead to the discovery of new platinum-palladium horizons in the Seagull intrusion. This discovery resulted in significant exploration expenditures as part of follow-up investigations.
4. Lake Nipigon geophysical surveys have resulted in several companies acquiring large areas of ground for uranium exploration in the area.
5. OGS and Lakehead University staff is transferring their technical knowledge and expertise to the exploration community through field trips, tours and technical talks and posters.

Other more medium- to long-term results are expected such as:

1. Mineral investment increases in the area.
2. The mineral industry is able to explore more effectively within and beneath the cover rocks.
3. Local and regional communities receive economic benefits from mineral exploration activities.
4. Local, regional and provincial communities receive benefits of potential ore body development.

GEOSCIENCE PROJECTS

As of April 2005, the following projects are completed or underway. Figure 1 shows the area of the LNRGI as well as the boundaries of the geoscience projects described below.

Bedrock Mapping: 1:50 000-scale bedrock mapping was completed in 2003 and 2004. The projects were designed to gather geological data over key areas in the western Nipigon embayment in order to address several geoscience problems. The bedrock mapping was completed in parks and protected areas under permit from the Ministry of Natural Resources (MNR) and Parks Ontario. Light “foot print” bedrock mapping was conducted without significant disturbance to the natural environment. Bedrock outcrops were accurately located during the mapping, sampled and described, and key stratigraphic units were sampled for geochronology. Rock property data, such as density and magnetic susceptibility, were collected for integration with the geophysical data. All data will be made public and the results of

the bedrock mapping will be integrated with other geoscience data to generate a holistic interpretation of the geological history. These data have also been used in a regional 3-D data analysis conducted by MIRARCO in collaboration with the OGS.

Aeromagnetic and gamma spectrometry: This survey was completed on August 28, 2003 and was conducted over a large area west of Lake Nipigon. The fly-over of the Gull Bay First Nation reserve was negotiated with the band council. The MNR permit also acknowledged the fly-over of the parks and protected areas in the region. The results of this project were released on April 9, 2004. Reports and maps have been provided to both the Gull Bay First Nation and Parks Ontario.

Gravity Survey: A regional ground gravity survey was completed west of Lake Nipigon and data was released to the public on September 1, 2004.

Geochronology: The age of many rock units within the region was poorly understood and determining their age was critical for the development of a comprehensive geological model. Rock samples were collected during bedrock mapping and the relogging of diamond drill core.

Surficial Geochemistry: This project is a study of the glacial history of 5 specific areas in the Lake Nipigon region. Numerous PGE and nickel anomalies were discovered during an Ontario Treasure Hunt lake water and sediment survey. The sources of these anomalies were uncertain; therefore, the objective of the study is to classify the glacial materials and to develop case histories for metal transport in glacial and surficial drainage patterns. This work has provided a better understanding of the concentration of metals in lake sediments in the area. It is expected that the results from this work will be published in early 2005.

Lakehead University Stratigraphic Mapping and Petrology Studies: The OPA provided funding to Lakehead University to support the studies of geology students at the university during the Lake Nipigon initiative. Much of this work focussed on diamond-drill core from various exploration sites in the region as well as stratigraphic mapping of vertical bedrock outcrops. Detailed sedimentary basin reconstruction and petrochemical differentiation of the mafic and ultramafic intrusions are essential components of the geological interpretation of the Nipigon region.

Geographic Information System (GIS) compilations of legacy data are underway. This work will compile and index the large volume of disparate geoscience data in the entire LNGRI area and will provide a base for further investigation and research. A large volume of proprietary in-kind data will be integrated with regional maps and databases under a common user-friendly format.

An AMT (magnetotelluric) survey was performed under the supervision of the Geological Survey of Canada (GSC) as a Targeted Geoscience Initiative (TGI) to study shallow and intermediate depth structures in the Lake Nipigon region. These data will provide deep crustal profiles across the western edge of the Nipigon Embayment. The GSC also conducted a paleomagnetic study of regional dike swarms with the intent of providing insight into Proterozoic intrusive activity in the region.

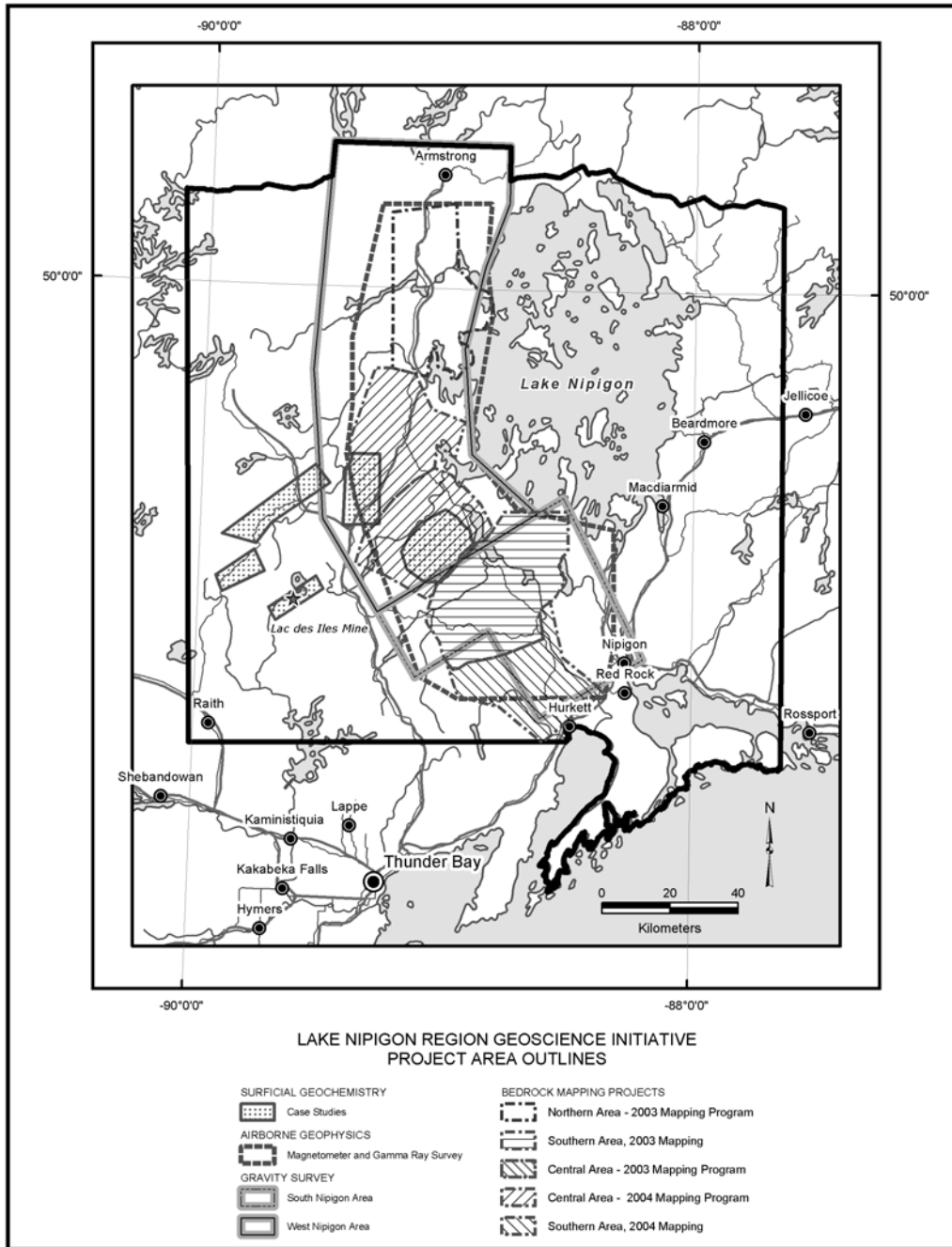


Figure 1. Area of interest encompassed by the Lake Nipigon Region Geoscience Initiative, as well as the location of the geoscience projects.

ACKNOWLEDGEMENTS

This project could not have advanced so far so rapidly without the efforts of mineral industry collaborators; the staff of the Ministry of Northern Development Mines (Ontario Geological Survey and Resident Geologist Program); the LNRGI Science Committee and Implementation Committee and their chairpersons; and the

administrative staff of the Ontario Prospectors Association. Finally, this program would not have happened without funding from the Northern Ontario Heritage Fund Corporation.