

INTRODUCTORY SUMMARY

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In October 1999, the former Department of Energy and Mines underwent significant restructuring. Those branches responsible for delivery of mines related programming were incorporated into the newly formed Department of Industry, Trade and Mines. This re-alignment recognizes the importance of the mining industry to the Manitoba economy and underscores a continuing commitment to supporting initiatives that ensure the long term viability of the mining industry and mining communities in Manitoba.

In 1999, geological programming in Manitoba continued to focus on stimulating socio-economic development by fostering a positive business climate for investment in mining and exploration within the province. Other Departmental initiatives focused on this objective include the introduction of more favourable taxation policies, continuation of the Mineral Exploration Assistance Program (MEAP), the Prospectors Assistance Program (MPAP), and the launch of the new Specialty Minerals Incentive Program (SMIP) aimed at promoting development in the industrial minerals sector. In addition, work continued on the development of a partnership protocol between Aboriginal groups and the minerals industry, as well as active participation and industry consultation in the review of candidate sites for Manitoba's Network of Protected Areas.

Key to building Manitoba's competitive advantage is the provision of current and relevant geoscience information that supports the minerals industry and contributes to sustainable development and wise land management. To help meet this objective, funding levels for the Geological Services Branch (GSB) were increased in 1999 to \$3.9 million.

GEOSCIENCE PROGRAM

The 1999 geoscience program reflects a balance between providing support to the traditional mining camps, stimulating new exploration and development opportunities in the frontier areas, and supporting land use and development priorities in southern Manitoba. The program is reviewed annually by the Mineral Exploration Liaison Committee (MELC) composed of members of the Mining Association of Manitoba, the Manitoba Prospectors and Developers Association and the Manitoba-Saskatchewan Prospectors and Developers Association, as well as representation from the University of Manitoba Department of Earth Sciences and the Geological Survey of Canada.

Collaborative initiatives continue to be a key element in the delivery of Manitoba's geoscience program. These projects draw on the collective expertise and resources of various government, university and industry organizations. They provide opportunities for technology transfer and intellectual cross-fertilization, and augment the geoscience database for the province. The major collaborative initiatives currently underway are summarized below.

Partnership Programs

Region	Program	Partners
Thompson Nickel Belt	CAMIRO	Industry, GSC Univs., NSERC
N. Superior Province and SE Manitoba	NATMAP	GSC, OGS, Univs.
Southern and Central Mb.	NATMAP	GSC, Univs.
	Hydrogeology	GSC, MWRB U of M
	Red River	GSC, IJC RRFPP

GSC-Geological Survey of Canada; NSERC-National Science Research Council; OGS-Ontario Geological Survey; MWRB-Manitoba Water Resources Branch; U of M-University of Manitoba; IJC-International Joint Commission on Boundary Waters; RRFPP-Red River Flood Protection Program

This year the Geological Services Branch (GSB) held its second regional geoscience needs workshop. These workshops originated as an outcome of the Intergovernmental Geoscience Accord, in which all provinces (except Quebec) and the federal government agreed to terms of reference outlining respective responsibilities regarding geoscience programming. An outcome of this understanding was the need to establish a coordinated planning process, in which the regional geoscience needs of each jurisdiction were clearly identified. The first Manitoba workshop was held in January, 1997, but because many of our collaborative initiatives will be coming to an end within the next 2 to 3 years, it was decided to renew the process. The objective of the exercise was to initiate development of a strategic plan that identifies not only what our geoscience requirements will be over the next 5 to 7 years, but also identifies a strategy to ensure we have the skills to fulfill those requirements. An emphasis was placed on participation from industry and universities. The first phase of this exercise was completed in April and we anticipate completing a series of regional workshops this spring.

GSB's geoscience program is designed with a regional emphasis, focusing on those areas most in need of new and/or updated geological information. Programs are generally designed on a five-year cycle, which allows the geographic focus of activities to shift from area to area within the Province. Continuous improvement of geological information within geographic areas is maintained on a 20 to 30 year timeframe, generally reflecting advances in technological development and scientific thought.

FLIN FLON/SNOW LAKE

Programming in the Flin Flon area continues to build on the new concepts and interpretations resulting from the NATMAP Shield Margin Project. Fully integrated digital maps and data sets from this project will be released in 2000.

Long term objectives for the Flin Flon Belt include completion of a set of new 1:50 000 scale compilation maps. In support of this initiative a number of more detailed thematic projects are currently underway. These include:

- new 1:20 000 geological mapping in the Squall-Varnson lakes area, in the Snow Lake region. Work this summer indicates that arc assemblage volcanic rocks of the map area correlate to the south with similar rocks that are host to prominent Cu-Zn-Au-Ag-bearing VMS mineral deposits, including the small but metal-rich Photo Lake VMS deposit, just south of the map area. The area also includes the large, base metal-poor, subeconomic Cook Lake deposit. Preliminary structural mapping has identified the Snow Lake fault as a probable early kinematic thrust fault, which during subsequent deformation, could have localized dilatent zones and possible gold mineralization.

- a variety of more detailed studies focused on known areas of mineralization to identify new methods of assessing mineral potential. These include: 1) orientation surveys using phase-selective enzyme leach and mobile metal ion (MMI) analytical approaches to characterize vertical variability of the geochemical response to mineralization at Photo Lake; 2) evaluation of rare earth element (REE) signatures in rhyolites to define the origin and geochemistry of barren and ore-related rhyolites associated with VMS deposits;

- continued collection of reference sample suites from all current- and past-producing mineral deposits in the Flin Flon Belt.

LYNN LAKE/LEAF RAPIDS

The Lynn Lake Belt was the focus of extensive mapping and mineral deposit studies during the 1970's and 1980's. As a result the database for this area is one of the most comprehensive in the province. The current and long-term objectives for this area are:

- 1) to upgrade existing databases and maps to modern standards;
- 2) fill in gaps in the existing database, specifically with respect to structural geology and gold metallogeny; and
- 3) compile all data in a GIS format and develop data integration models using expert systems focused on probability of mineralization.

To this end several new projects have been initiated in the Lynn Lake

region:

- All existing 1:50 000 scale maps in the region have been digitized and edge-matched to produce seamless coverage for the belt. These maps now form the basis for new trace element geochemistry and structural interpretations;

- Re-analysis of archival sample sets has been completed and results published in November, 1999. High precision trace and rare earth element data has been used to subdivide the greenstone belt according to tectonic affinity that identifies more productive juvenile arc assemblages as a focus for VMS exploration;

- A new mapping program of detailed structural analysis of the Johnson Shear Zone (JSZ) was initiated. Metallogenic studies into the nature and origin of gold mineralization is focused on providing insight into the processes involved in the development of shear-hosted gold deposits. Detailed mapping has enabled identification of the JSZ west of Gemmel Lake, significantly extending the known extent of this prospective gold-bearing structure;

- A data compilation project has been initiated, which will focus on developing a comprehensive GIS database for the region. In addition, a data integration study will develop an "expert system", building a predictive model for shear-hosted gold mineralization.

THOMPSON NICKEL BELT/SUPERIOR BOUNDARY ZONE

Over the past year, mapping initiatives in the Superior Boundary Zone have extended beyond the Thompson Nickel Belt proper to include new mapping in the Fox River Belt and along the northwest Superior boundary in the Waskiaowaka and Stephens lakes areas.

Thompson Nickel Belt

The geology, metallogeny and tectonic evolution of the Thompson Nickel Belt (TNB) is the subject of a four-year investigation being administered by the Canadian Mining Industry Research Organization (CAMIRO). The project began in 1997 and will continue to 2001. The study integrates existing data from mining companies and government records with a wide range of new datasets, using ArcInfo GIS software as a platform for interpreting the database. Specific projects carried out in 1999 include:

- detailed mapping at Mystery Lake, along the western boundary of the TNB between Soab Mines and the Pipe Mine, and in the northern part of the Setting Lake area;

- regional structural investigations;

- thematic studies, including: examination of the petrogenetic and metallogenic significance of mafic-ultramafic dykes and volcanic sequences in the TNB; extensive sampling of basement gneisses and intrusive rocks in the exposed part of the TNB for U-Pb geochronology; completion of preliminary U-Pb age determinations for detrital zircons from all major metasedimentary sequences; and completion of an initial set of Nd-Sm isotope analyses of mafic and ultramafic rocks.

In concert with the CAMIRO project, work continued on a new 1:50 000 scale compilation map series for the TNB. This past year, lithologic map manuscripts were completed for the subphanerozoic portions of the TNB, in cooperation with Hudson Bay Exploration and Development Co. Ltd. and Falconbridge Ltd. Mapping in the Setting Lake area was also completed. Core logging will continue during the summer of 2000, with preparation of the remaining maps in this series scheduled for fall/winter of 2000.

Northwest Superior Boundary

The discovery of a segment of older crust, with elements as old as 3.7 Ga, in the Assean Lake area was the result of multidisciplinary mapping, structural, geochronologic and geochemical investigations conducted since 1997. These studies are redefining the nature and location of the Superior Boundary Zone and are being undertaken, in part, to better constrain the setting of base- and precious-metal mineral occurrences and deposits in the area. Mapping in the Waskaiowaka Lake area this summer focused on testing the hypothesis that the Owl River geophysical feature represents a significant geologic break. This mapping identified the Owl River structure as discrete, northeast-trending high-strain zones overprinting generally east-trending granodiorite to tonalite gneisses. Preliminary Nd model ages of the orthogneisses are ca. 2.6 Ga south of the "Owl River shear" and 2.2 Ga north of the structure. The new data indicates that direct eastward correlation of Trans-Hudson Orogen domains in the Assean-Waskaiowaka lakes areas needs to be reassessed.

Fox River Belt

The Geological Services Branch launched a new program in the Fox River Belt in cooperation with Falconbridge Ltd., that currently holds exploration rights to most of the belt. The Fox River Belt is the largest known continuous section of the Superior Boundary Zone rifted margin sequence. The objectives of this program are: 1) to gather new field and geochemical data to aid mineral exploration activities, and 2) provide the framework for unraveling the history of sedimentation, volcanism and plutonism within this large, but relatively unknown segment of the Superior Boundary Zone.

Work this summer focused on:

- developing the lithostratigraphic framework for platinum group element-copper-nickel sulphide mineralization in the marginal series of the Fox River Sill. Results of preliminary field work conducted this summer indicate potential for the development of Ni-Cu-PGE sulphide deposits in the Marginal Zone of the Fox River Sill. Follow-up work is planned for summer 2000;

- documenting volcanic stratigraphy of sections along the Fox and Stupart rivers. Preliminary work conducted this summer suggests the volcanic stratigraphy is more complex than previously suspected, with implications for the geometry of any potential intra-flow magmatic sulphide deposits. Discordant alteration zones and stratiform sulphide occurrences within volcanic formations indicate that hydrothermal processes were active on the sea floor synchronous with volcanism.

NORTHERN SUPERIOR PROVINCE

Manitoba's Northern Superior initiative is now in the 4th year of a 5-year program. The objectives of this initiative are: 1) to identify regional exploration targets through new geochemical surveys and compilations of geophysical data derived from assessment files; and 2) to provide the geological framework for mineral exploration through regional mapping and thematic studies. This program has also been linked to the larger Western Superior NATMAP project that is focused on defining the crustal evolution and tectonic assembly of the Superior Province west of Lake Nipissing.

The regional multimedia geochemical sampling program continued this year in the southern portion of the Knee Lake greenstone belt. Geochemical and mineralogical analysis of these samples will continue to build a multielement, multimedia database that will assist in the identification of potential exploration targets.

The geophysical compilation project continued this year with release of a second report summarizing geophysical data for the northern Gods Lake area. Work will continue this year on the Fox River Belt.

Regional (1:20 000 scale) bedrock mapping projects continued this year in the Gods Lake and Max Lake areas. Results of the multidisciplinary mapping program in the Gods Lake Narrows area include:

- identification of a regional angular unconformity between the Hayes River Group metavolcanic rocks and the Oxford Lake sedimentary subgroup;

- the boundary between sedimentary and volcanic subgroups of the Oxford Lake Group is a shear zone;

- this shear zone is folded as a result of deformation associated with the southern, belt-bounding, Gods Lake Narrows shear zone;

- the Munro Lake greenstone belt is separated from Knee Lake Belt by the Gods Lake Narrows shear zone and an older gneiss belt.

In the Max Lake area, a 1:20 000 scale mapping program was initiated in order to investigate the stratigraphy, structure and volcanic geochemistry of supracrustal rocks. This area was identified as having significant potential during the 1996 multimedia geochemical surveys. Large areas of recent burn revealed extensive outcrop displaying well-developed hydrothermal alteration zones. Preliminary results indicate that the best prospects for base metal or precious metal exploration include an alteration zone close to the northeast corner of MacVicar Lake, and related magnetiferous iron formations that display extensive surficial iron staining. Other potential targets include pyritic zones at the conjunction of the mafic volcanic terrane and gabbro intrusion at the south margin of the greenstone belt, and altered sulphide showings elsewhere at basalt/gabbro contacts.

Thematic studies in the northern Superior Province include:

- 1) structural mapping in the southeastern part of the Cross Lake greenstone belt;
- 2) study of metallogenic and petrogenetic features of Archean anorthosites and associated mafic and ultramafic rocks;
- 3) geochemical and geochronological studies of Paleoproterozoic mafic and ultramafic dykes.

SOUTHEASTERN MANITOBA

Mapping activity in southeastern Manitoba is coordinated with the Western Superior NATMAP initiative and is focused primarily on updating existing mapping. In the western Rice Lake greenstone belt geochemical and geological investigations of volcanic rocks have been conducted in the Wanipigow Lake area. Mapping in the southeast Rice Lake greenstone belt was carried out in the Garner-Gem lakes area. The program is designed to: 1) define the nature of the boundary between the Garner Lake, Bidou Lake and the Gem Lake subgroups; 2) document the nature of the contact between felsic volcanic rocks and older sedimentary and mafic volcanic rocks to the north; and 3) document the extent of komatiitic basalts southeast of Beresford Lake. Results of 1999 mapping in the Garner-Gem area suggest that an early east-trending fault system is responsible for juxtaposition of Garner Lake, Gem Lake and Bidou subgroups.

Thematic studies concerning Cu-Ni-PGE potential of mafic-ultramafic intrusions in the Bird River greenstone belt continued this year. Mineral potential studies were conducted in the Mayville intrusion and Bird River Sill. Rock types and sulphide mineralization in the Mayville intrusion are very similar to those in the lower parts of anorthositic intrusions in central Ontario (East Bull Lake) that are currently the focus of significant exploration programs. In the southern Bird River Belt, field work began on a potential feeder structure to the Bird River Sill north of the Maskwa and Dumbarton nickel mines. Other parts of the Bird River Sill warrant additional investigation for reef-type PGE deposits based on favourable geology and the existence of several PGE-rich sulphide zones.

SOUTHERN AND CENTRAL MANITOBA

The GSB continues to promote exploration and development opportunities for specialty and non-metallic minerals, such as the potential for carbonate-hosted mineralization associated with reactivation along the Superior Boundary Zone (SBZ). Mesozoic black shales were sampled within the Porcupine Hills/Duck Mountain/Riding Mountain areas, along the trend of the SBZ. Evidence of potential hydrothermal alteration was noted at several localities overlying the SBZ.

Industrial mineral activities in 1999 covered a variety of commodities including dimension stone, bentonite, carving stone, kaolin, and garnet sand. In the spring of 1999 the Geological Survey of Canada completed a seismic survey in the Sylvan area, in an effort to delineate the geometry of kaolin deposits. Results are pending; however, initial data indicate these deposits form in distinct sink holes rather than continuous channels.

The Manitoba Stratigraphic Map Series was updated, rendered in digital format and released along with the Manitoba Stratigraphic Database on CD-ROM in the spring of 1999. An update of this database is planned for early 2000 and will contain historical tops, detailed core descriptions and several updated and new maps prepared by Petroleum Branch.

The GSB is also involved in activities in the southern part of the province that are primarily related to land use in support of sustainable development. Mineral potential maps, for the northern half of the Capital Region study area, were released in March of 1999. The four maps comprising the southern half of the Capital Region study are now being prepared for release in 2000. In conjunction with bedrock mapping, the branch is also undertaking to update aggregate maps for the Capital Region. Aggregate maps for the R.M.'s of Rockwood and Springfield were updated recently in conjunction with development plans for those municipalities. Activity for 1999 also included updating sand and gravel maps for all remaining municipalities within the Capital Region area.

The GSB is involved in several large collaborative initiatives in the southern part of the province. The Winnipeg region NATMAP project, now in the 3rd year of a four-year program, is focused on 3-D mapping, emphasizing engineering and environmental geology and surficial mapping. Mapping of the Quaternary sediments in the study area is being extended into the subsurface using drillhole data including the Manitoba Stratigraphic Database and the water well database held by Water Resources Branch. Construction of a new digital elevation model (DEM) for the southern part of the province allows relatively accurate positioning of drill holes with respect to elevation. This outstanding DEM has drawn attention to many features not previously recognized and clearly identifies numerous applications that will be investigated in the future.

A multiagency study of regional hydrogeology and hydrogeochemistry of the Red River Valley/Interlake region is now in its 3rd year.

The program will develop an enhanced understanding of the dynamics of groundwater systems in the Red River Valley, resulting in better protection and management of existing resources within Manitoba and across the international boundary.

The GSB is participating in a multiagency initiative to study the history, evolution, geomorphology and stratigraphy of the Red River and its sedimentary record, in an effort to define the historical frequency of large magnitude flood events. A better understanding of the relative impact of long-term climatic and geologic controls on flooding will help to identify the risk of recurrence of extremely large flood events.

GEOSCIENCE INFORMATION SERVICES

The Geoscience Information Services section has conducted an extensive program of GIS-based map compilation at regional (1:250 000) and detailed (1:50 000) scales. Digital maps at 1:250 000 have now been produced for approximately half of the province. Detailed compilation is focused on greenstone belts, with the Lynn Lake-Leaf Rapids region the initial target area. Publishing and data distribution is evolving to CD-ROM-based "electronic reports" and print-on-demand map publishing.

The Department has been working toward developing Internet map and data distribution capabilities. Government-wide changes to computer and network systems has delayed implementation of this technology; however, work is currently underway to bring this project online. One of the first projects to be posted to the Internet will provide online access to the mining claim structure, with a direct link to the claims database. Other projects currently being developed include assessment file databases and mineral deposits.

Finally, I would once again like to acknowledge the excellent work carried out by all staff of Geological Services Branch. Congratulations on a job well done.