

**GS-14 Manitoba Geological Survey contributions to international initiatives: Red River Valley 3-D Geological Model Project, North American Soil Geochemical Landscapes Project and OneGeology**  
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**Introduction**

The Manitoba Geological Survey (MGS) has played a significant role in advancing a number of international projects during the past year. This report summarizes Manitoba’s involvement in three ongoing collaborative projects ranging in scale from global (OneGeology) to continental (North American Soil Geochemical Landscapes Project) to provincial and state (Red River Valley 3-D Geological Model Project). These projects have a direct impact on groundwater, health and geohazards management, and on international data availability.

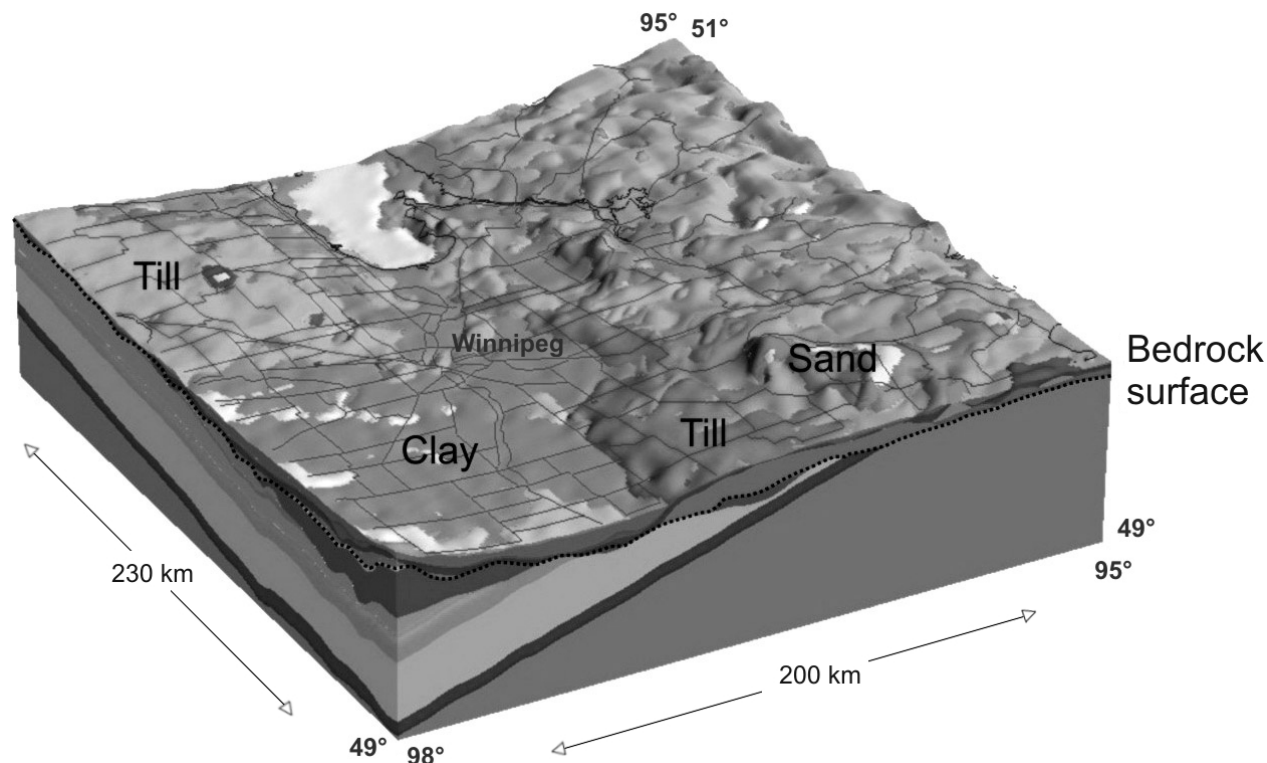
**Red River Valley 3-D Geological Model Project**

The geological surveys in Manitoba, Minnesota and North Dakota are working together to expand knowledge of the Quaternary lithostratigraphy in the Red River Valley (across the Canada–United States border). The project area is approximately 130 000 km<sup>2</sup>, extending from 95°W to 98°W and from 46°N to 51°N, and is based

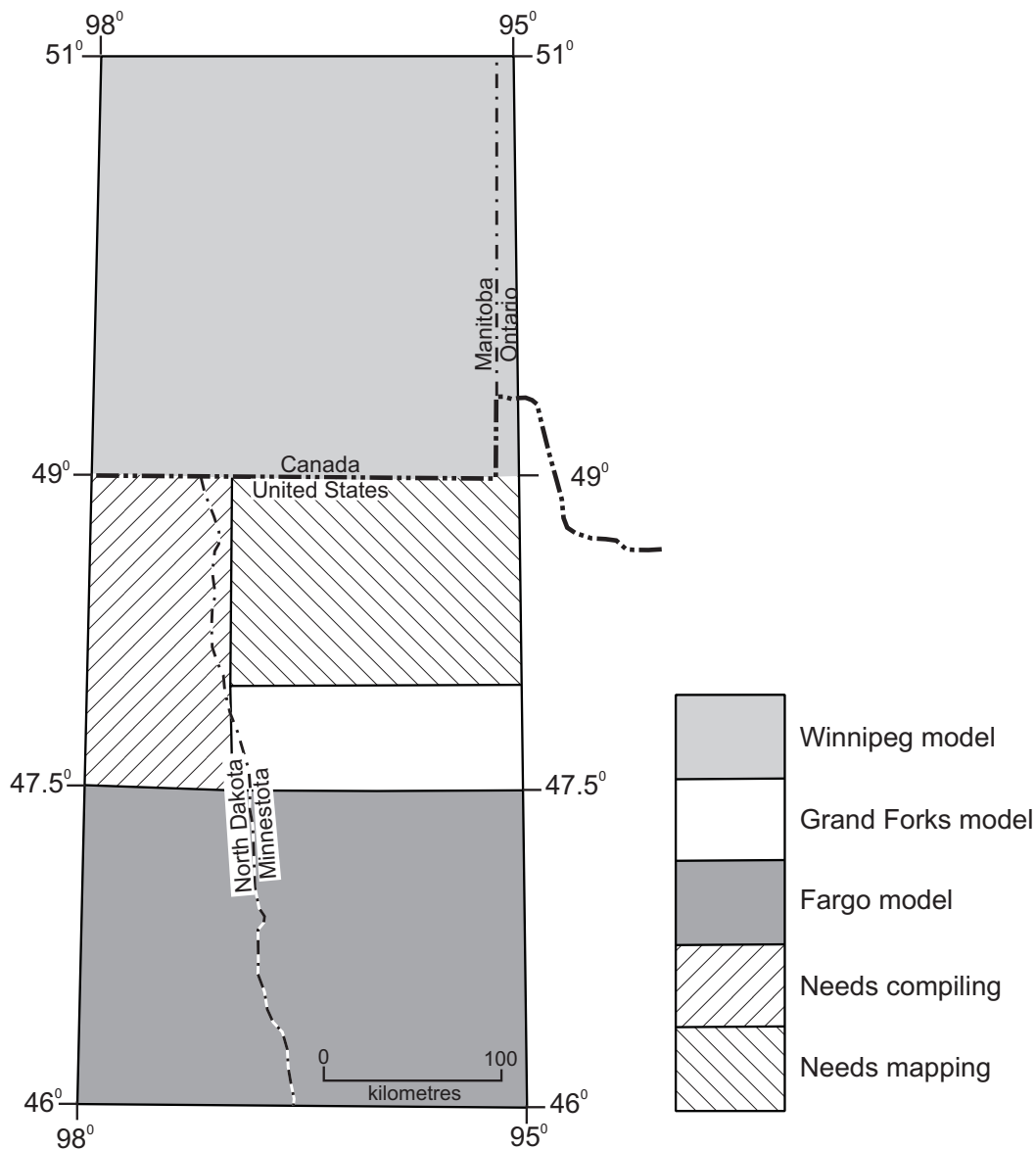
on existing 3-D geological and hydrostratigraphic models for the northern portion of the area (Winnipeg model from 95°W to 98°W, and from 49°N to 51°N) and southern portion of the area (Fargo model from 95°W to 98°W, and from 46°N to 47.5°N).

The four main objectives of this collaborative project are to generate a new seamless cross-border surficial geology map; correlate the Quaternary stratigraphy of Canada and the United States; integrate drillhole databases into the new 3-D model; and develop a Grand Forks 3-D geological and hydrostratigraphic model to be combined with the existing Fargo (Thorleifson et al., 2005) and Winnipeg (Matile et al., 2001; Figure GS-14-1) 3-D models. The contribution of the new Red River Valley 3-D model to cross-border groundwater issues will prove invaluable.

In the central Grand Forks area, both regional surficial and bedrock mapping and regional Quaternary stratigraphy have been completed for nine metric quadrangles (Figure GS-14-2). However, three of the quadrangles



**Figure GS-14-1:** Perspective view of the Winnipeg 3-D model.



**Figure GS-14-2:** Red River Valley 3-D Geological Model Project area.

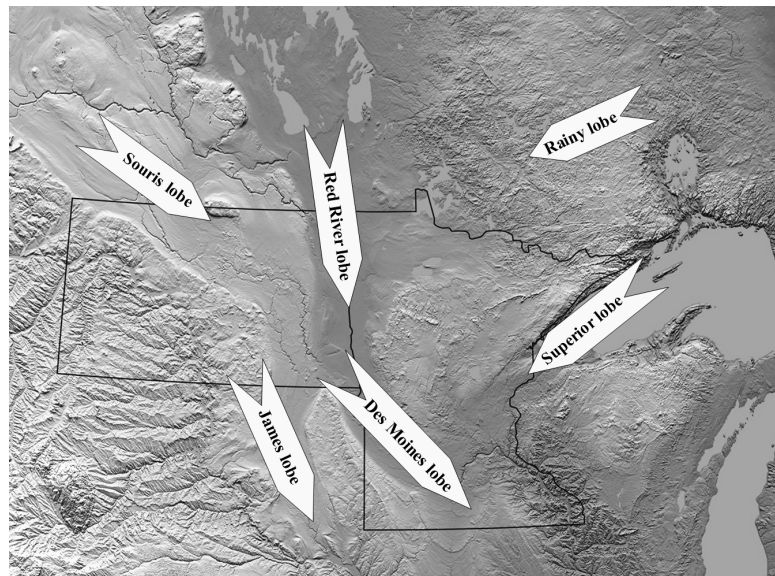
(from North Dakota) require compilation and four (from Minnesota) are in need of new, updated surficial geological mapping.

The medium being used for stratigraphic correlation in the project area is glacial till, which may be derived from up to six different source areas (Figure GS-14-3). Till samples from drillholes (Figure GS-14-4) throughout the project area have been analyzed for matrix texture (sand, silt and clay) and coarse sand lithology. To date, 1900 samples have been analyzed and a network of cross-border cross-sections has been established to help develop cross-border till correlations.

The final products of the Red River Valley 3-D Geological Model Project include seamless GIS-generated maps, cross-sections at a scale of 1:200 000, and a 3-D geological and hydrostratigraphic model based on the Winnipeg and Fargo models.

### North American Soil Geochemical Landscapes Project

The seemingly overwhelming task of mapping the soil geochemistry of all of North America has been undertaken by the North American Soil Geochemical Landscapes Project (trinational soil geochemistry survey). This multinational co-operative project (Canada, United States and Mexico) is designed to systematically characterize regional variations in soil (bio)geochemical characteristics. The project began with a series of pilot studies in 2004 in Canada and the United States. Sampling protocols were further refined in the Maritimes and United States from 2005 to 2007. The project results will contribute to a variety of applications, issues and disciplines, such as assessing and managing natural resources and environmental hazards.



**Figure GS-14-3:** In the Red River Valley, various glacial ice lobes of very different provenance contribute to the texture and lithological characteristics of the glacial till.



**Figure GS-14-4:** Samples from rotasonic drilling by the Manitoba Water Branch have proven invaluable to the till correlation process.

The national geological surveys of the participating countries are coordinating the collaborative work with their respective provincial and state geological surveys. In Canada, agencies such as Health Canada and the National Forest Inventory provide funding and/or expertise in exchange for sampling specific intervals or performing detailed analysis. Sampling sites are selected based on a grid system, with one randomly selected sample site per 40 km grid cell, totalling approximately 6100 locations throughout Canada. All participating countries follow core sampling protocols; however, protocols for additional samples vary between jurisdictions, largely because of differences in funding levels. Protocols for sampling in areas of permafrost and organic soils are currently being developed.

In June 2008, the MGS participated in a cross-Canada transect proposed by the Geological Survey of Canada (GSC) that straddled the Trans-Canada Highway.

Using the protocols set out in the Maritimes (Maritimes Soil Project), five depth intervals were sampled. These were classified as the public health interval (0–5 cm), the National Forest Inventory sample (0–15 cm) and the A, B and C soil horizons. An additional 0–5 cm sample was collected to measure natural anthrax levels in the soil. Radon gas measurements were also taken at each site. Samples from 21 sites were collected by a four-person crew comprising H. Groom and G. Matile of MGS and GSC summer students H. Byker and C. Streiber. Sampling covered an area of approximately 335 km<sup>2</sup>, from the Saskatchewan border to just east of Winnipeg and extending some 65 km south of the Trans-Canada Highway. Sample sites farther east will be sampled once the organic soil protocols have been established. Dominant soil types collected in Manitoba were black chernozems (Figure GS-14-5), with a parent material ranging from clay till in the west to sand in the Assiniboine delta and, finally,



**Figure GS-14-5:** GSC summer students (H. Byker and C. Streiber) assisting with black chernozem sample collection in southwestern Manitoba. Student in the background is measuring radon gas.

to heavy clays of the Lake Agassiz plain in the Winnipeg area.

Analytical data will be available free of charge from the GSC website [http://ess.nrcan.gc.ca/eh-esh/trinat/index\\_e.php](http://ess.nrcan.gc.ca/eh-esh/trinat/index_e.php); however, specific dates for data availability are not currently known. It is also not known if data sponsored by outside agencies will be served on the GSC webpage.

### OneGeology

OneGeology is an ambitious global initiative, concatenating digital geological map data from geological surveys around the world and serving it in a dynamic map format via the web. OneGeology is currently supported by seven international organizations and is the flagship project of the 'International Year of Planet Earth'. The vision of OneGeology, as outlined on its web portal, is to facilitate and increase the accessibility of geological map data worldwide. Currently, there are 84 nations participating in the program, and this number is steadily increasing. Each nation is represented by its national geological survey.

The Geological Survey of Canada currently provides data to the project at a scale of 1:5 000 000, while the OneGeology target scale is 1:1 000 000. This shortcoming, specific to geological surveys of large countries, prompted

the MGS to assemble four map sets, some with multiple layers, for the OneGeology portal. These four map sets, which utilize previously compiled bedrock and surficial geology maps, are

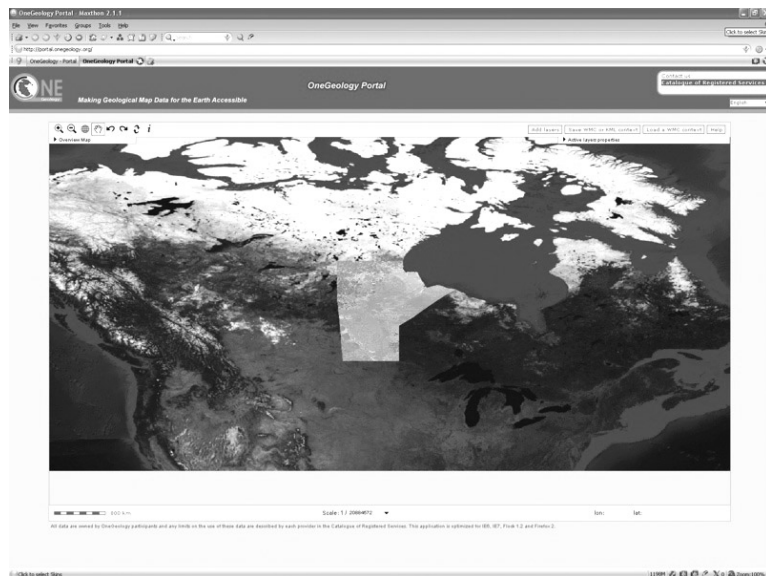
- a surficial geology layer representing the compilation of the most detailed surficial geology maps available in Manitoba (Matile and Keller, 2007);
- a bedrock geology layer representing a fusion of 1:1 000 000 scale bedrock geology polygons from the Geological Map of Manitoba (Manitoba Department of Mines, Resources and Environmental Management, 1979), and the Phanerozoic bedrock polygons cropped to Manitoba from the recently completed federal Targeted Geoscience Initiative 2 (TGI-2) Williston Basin Architecture and Hydrocarbon Potential Project in eastern Saskatchewan and western Manitoba (see Nicolas, GS-16, this volume; [www.willistontgi.com](http://www.willistontgi.com));
- a two-layer chronostratigraphy of Manitoba, which uses the same base data as the bedrock geology but with the polygons categorized by age rather than by lithostratigraphy, and including a separate Quaternary layer (Matile and Keller, 2007) that covers about 90% of Manitoba; and
- the Williston Basin chronostratigraphy, which is represented by a series of 11 layers utilizing map data derived from the Williston Basin Architecture and Hydrocarbon Potential Project extending significantly into Saskatchewan, and which is unique in that each time period is represented by a separate layer, allowing the user to remove, or 'peel' off, individual time periods.

A fifth map set representing Manitoba topography is available, but has yet to be uploaded to the OneGeology portal. The Manitoba topography layer created for the OneGeology portal allows the user to utilize the portal's transparency option to provide shaded relief for the Manitoba map sets. It can be manually added to the OneGeology portal by going to 'Add Layers'/ 'External Layers' and copying in the following URL: [http://geoapp2.gov.mb.ca/wmsconnector/com.esri.wms.Esrimap?Servicename=CAN\\_MGS\\_SRTM\\_DEM\\_WMS&](http://geoapp2.gov.mb.ca/wmsconnector/com.esri.wms.Esrimap?Servicename=CAN_MGS_SRTM_DEM_WMS&).

The MGS is presently the only regional-level agency to provide data to this global project and is currently serving the data as Web Mapping Services layers through an ArcIMS®. The OneGeology portal can be accessed by visiting [www.onegeology.org](http://www.onegeology.org) and clicking on 'Portal' (Figure GS-14-6).

### Economic considerations

Manitoba's active role as a contributor to major national and international projects has resulted in a significant contribution to the existing knowledge base relevant to modern geoscientific and social advances, including groundwater management (Red River Valley



**Figure GS-14-6:** OneGeology web-portal interface with Manitoba surficial geology map.

3-D Geological Model Project), health and environment hazards (North American Soil Geochemical Landscapes Project), and geological education and data accessibility (OneGeology). Cross-border 3-D geological mapping unites disparate datasets and combines them into a single standardized nomenclature, which is useful at an international level when dealing with groundwater management issues on both sides of the Canada–United States border. The North American Soil Geochemical Landscapes Project provides continent-wide data on background soil geochemical levels relevant to a variety of applications, issues and disciplines, such as assessing and managing natural resources and environmental hazards. The outcomes of these studies will provide further insight into the relationships between soil geochemistry, environment and health, as well as provide a framework and protocols for wide-scale geoscientific surveying of soils for health and environmental purposes. OneGeology will provide greater accessibility of geological map data at the global level. Its output is enhanced by the fact that the MGS is the first non-national geological survey to have data available on the OneGeology web portal and, furthermore, to offer it at a more detailed scale than is currently available for Canada.

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