Minnesota Geological Survey Information Systems

by

Tim Wahl, Richard Lively, and Harvey Thorleifson

Abstract

The Minnesota Geological Survey is conducting a systematic enhancement of information systems, starting with a recently completed inventory of every publication released since 1872, suitable for conversion into a database. Web-accessible, searchable PDF page scans—totaling 40,000 pages—are nearly completed. Web accessible raster scans of every map released since 1872—a total of 600 maps—are now online. Enhancements to maintenance and cataloging of collections and databases—such as heavily-used drillhole information—are planned and in progress. Major upgrades of state magnetic, gravity, and rock property databases are in progress, with the magnetic data completely revised. Compilation of a state geochemical database, a new, multi-layered state bedrock geology map, and a compilation of web-optimized geologic mapping layers for use with WMS and WFS servers is underway. Quantitative analysis of material characteristics of groundwater systems, such as fracture control of hydrogeologic properties, is moving ahead. Most important is the continuation and acceleration of the core MGS program, multi-layered County Geologic Atlases.

Enhancements of curation and cataloging of collections and databases such as the heavily-used County Well Index (CWI) of drillhole information

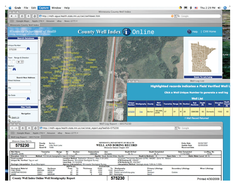
MGS collections include hand samples, thin sections, sediment samples, geochemical samples, and cuttings. MGS contributes to the DNR drill core library and mineral exploration file archive, and the University paleontological archive. MGS databases include field notebooks, hand samples, thin sections, geological mapping data, karst database, sediment textural and lithological data, geochemical data, aeromagnetic database, gravity database, rock properties database, borehole geophysical logs, the water well database that MGS co-manages with the Minnesota Department of Health (MDH), and geotechnical data. Materials and data are well stored, although document collections are vulnerable to disaster. Needed actions include enhanced cataloging, scanning, more consistent and interoperable database structures, and improved web accessibility.

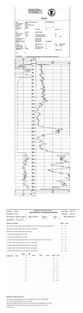
CWI--Over 440,000 well records
195,000 located and interpreted and available online

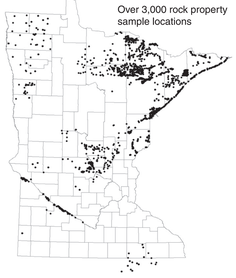
5,000 water well cuttings samples

25,000 Quaternary and Giddings samples (60,000 feet of described Giddings drilling)

About 5,000 borehole geophysical logs







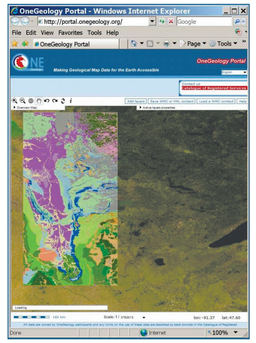
Over 3,000 rock property sample locations

Over 15,000 hand samples in storage

Over 7,000 thin sections available

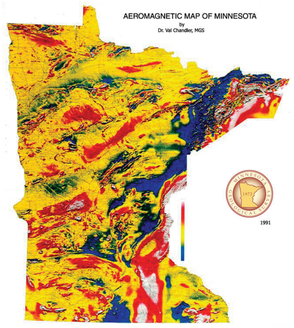
Compilation of web-optimized detailed geologic mapping layers

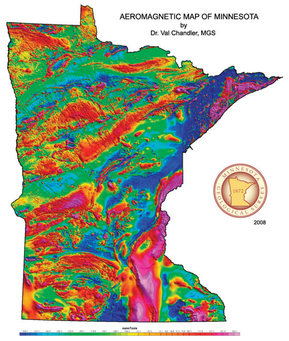
Mapping at 1:100,000 and 1:24,000 is required at the county and local scale. Paper maps are still required, although many users rely on the web to obtain information they need to do their jobs. Standard geologic maps with intricate legends, obtained by time-consuming download, are not the optimal basis for swift web queries, although these maps will remain the authored, peer-reviewed foundation of our system. New detailed geologic map layers, optimized for efficient web query and accessibility are needed for remote users, while also acting as a gateway to the more thorough documentation of standard maps and reports. Web-accessible mosaics of existing detailed surficial and bedrock geologic maps will be prepared in 2010, initially as part of One Geology, with plans for gradual integration with new and existing data.

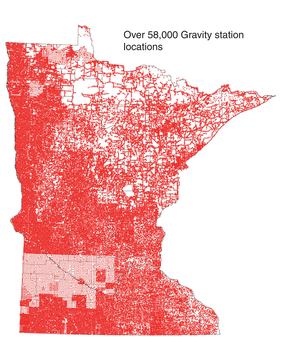


Major enhancements of state magnetic, gravity, and rock property databases

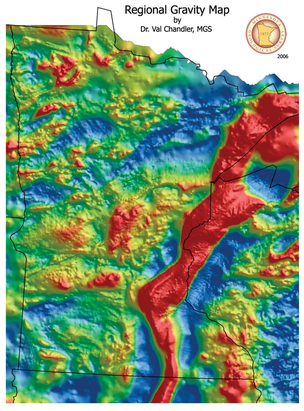
In 2007, the Minnesota aeromagnetic database was reprocessed to recover line data missing from the original digital archive, to mitigate line-leveling errors that locally caused striping artifacts, and to use the revised data to produce a higher-resolution aeromagnetic grid for the entire state, resulting in a much-enhanced ability to resolve features. In ~2010, the 58,000-site gravity database will similarly be improved by enhancing station location precision. In addition, the rock property database that provides density, magnetic susceptibility, and other data used to link geophysical surveys and geologic mapping will be enhanced by enabling vertical georeferencing and thus 3D and drillhole analyses.





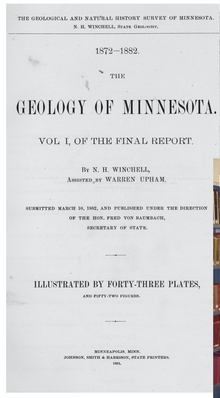


Over 58,000 Gravity station locations



Searchable page scans of every publication released since 1872 — a total of 40,000 pages

Since 1872, the MGS has published 40,000 pages of reports. These were scanned as a single batch with support from University of Minnesota Libraries, Digital Collections Unit. Pdf files with searchable OCR content will be created from the original scans and become web accessible in 2009. Eventually the scans may become digital books as soon as format evolution stabilizes. Folded inserts of maps are available as separate scans from the scanned map collection. Bound foldouts in the original publications will be part of the pdf files and digital books.



THE GEOLOGICAL AND NATURAL HISTORY SURVEY OF MINNESOTA.
N. H. WINCHELL, STATE GEOLOGIST.

1872—1882.

THE

GEOLOGY OF MINNESOTA.

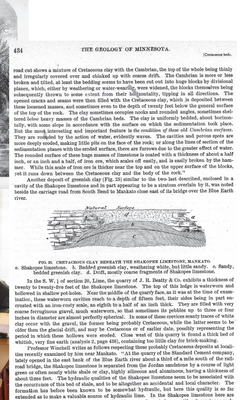
VOL. I, OF THE FINAL REPORT.

By N. H. WINCHELL,
ASSISTED BY WARREN UPHAM.

SUBMITTED MARCH 10, 1882, AND PUBLISHED UNDER THE DIRECTION OF THE HON. FRED VON BAUMBACH, SECRETARY OF STATE.

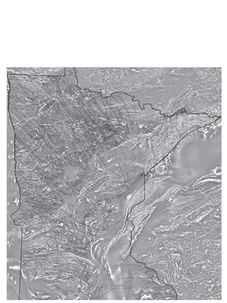
ILLUSTRATED BY FORTY-THREE PLATES, AND FIFTY-TWO FIGURES.

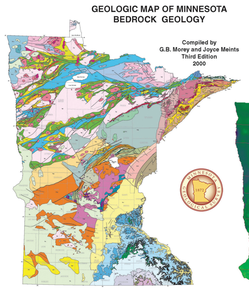
MINNEAPOLIS, MINN.
JOHNSON, SMITH & HARRISON, STATE PRINTERS.
1884.

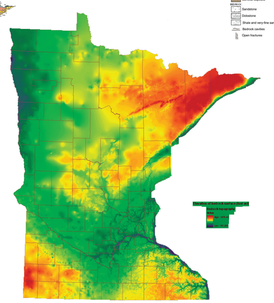


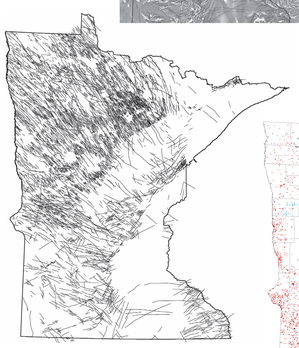
New multi-layered state bedrock geology map

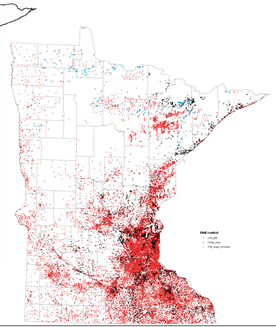
Having conducted much new geologic mapping since the last update in 2000, and having reprocessed the aeromagnetic data, a new State Bedrock Geologic Map will be produced in 2009. In GIS format, the map will have separate layers for water, Quaternary, Mesozoic, Paleozoic, and four late Precambrian units. Archean and other basement rocks will comprise the basal layers of the rock GIS themes. Additional themes will include diabase dikes and metamorphic grade, bedrock topography, outcrops and overburden thickness.

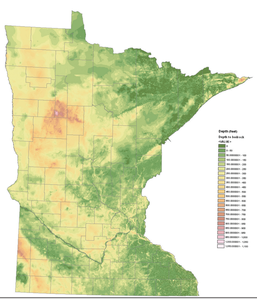






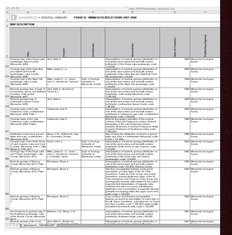


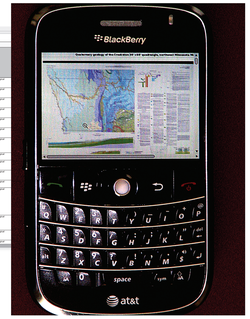




Web accessible rasters of every map released since 1872 — over 600 maps

Since 1872, MGS has published over 600 maps. These were scanned as one batch with support from University of Minnesota Libraries Digital Collections Unit. Jpg2000 files are now web accessible and pdf files are available for download. There will be ongoing effort to optimize searchable OCR content. Folded inserts from reports are included among these maps.



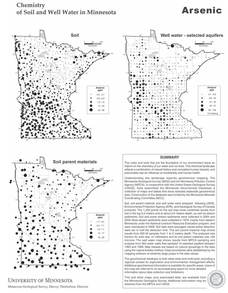


An up-to-date inventory and database of every publication released since 1872

Databases of MGS publications previously maintained in multiple and varying formats are being consolidated into a comprehensive master listing, and plans call for enhancing arrangements for submission of the listing and updates to the USGS, Georef, and the University of Minnesota Library system.

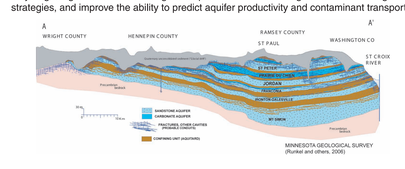
Compilation of a state geochemical database

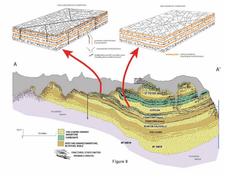
The need for documented statewide geochemical information is escalating, as exploration geochemical surveys need a reference on regional context, project permitting requires documentation of current conditions, and cleanup efforts require information about existing background levels of contaminants. The MGS is working with the USGS and the MN Pollution Control Agency to assemble and map statewide geochemical data for soil, soil parent material, and groundwater in selected aquifers.

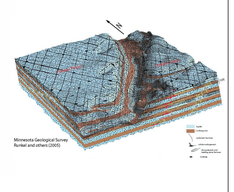


Enhancement of quantitative analysis of material properties such as fracture control of hydrogeologic properties of limestone and dolostone

Regional hydrogeological characterization of groundwater systems is an ongoing high priority activity. Increased effort is being directed at quantifying the hydrogeologic characteristics of the most heavily used carbonate and sandstone aquifers in southeastern Minnesota. Based on compilation and interpretation of a large volume of hydrostratigraphic and hydraulic data, a hydrogeologic framework is being developed that will influence ground-water management strategies, and improve the ability to predict aquifer productivity and contaminant transport.



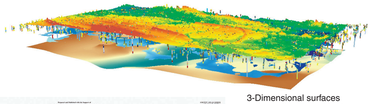




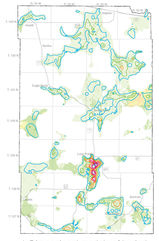
Acceleration and enhancement of the core MGS program, multi-layered County Geologic Atlases

The Minnesota Geological Survey is steadily increasing its focus of activity on the County Geologic Atlas program. These sets of 1:100,000 maps include bedrock geology, surficial geology, bedrock topography, depth-to-bedrock, and subsurface geology. The atlases have become progressively more digital and 3-dimensional. Currently eighteen counties have a completed atlas and one of the early atlases from the 1980s has been updated as a result of financial support from that county; six other counties have atlases underway and five more are in the planing stage. The Minnesota Legislature has committed itself to enhanced groundwater protection, and the County Geologic Atlas program is seen as a key to fulfilling that objective.

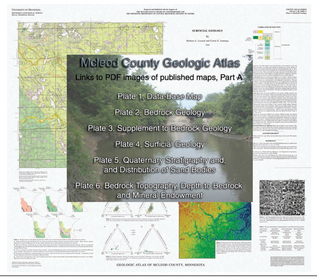
2-Dimensional cross sections



3-Dimensional surfaces water well and sand body stratigraphy



3-Dimensional models of buried sand layers



Geologic atlas plates published in offset print format, PDF images, and CD or DVD representations of the atlas in GIS formats.

Note computer demonstration of the DVD atlas product.