GROUNDWATER GEOSCIENCE INITIATIVE: MAPPING ONTARIO'S GROUNDWATER RESOURCE

Ontario Geological Survey, Sudbury, Ontario

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The **Ontario Geological Survey** (OGS) carries out field-based investigations to understand geological processes and map earth resources. It provides public access to high quality geoscience data.

Improving the quality of life for Ontario's citizens is a high priority for the current provincial government. Readily accessible and abundant clean water is a prerequisite for healthy communities and economic growth. The Ontario Geological Survey's groundwater initiative is providing critical information that can help ensure the safe and sustainable use of groundwater as well as assist with the discovery and characterization of untapped groundwater sources.

The groundwater initiative is comprised of:

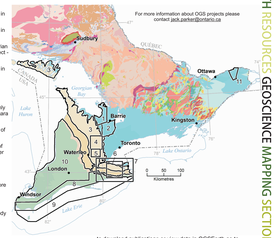
- 3-D sediment aquifer mapping
- 3-D Paleozoic bedrock aquifer mapping
- Ambient groundwater geochemistry mapping

GROUNDWATER PROJECT AREAS 2015

EARTH RESOURCES GEOSCIENCE MAPPING SECTION

GEOSCIENCE PROJECTS

1 3-D mapping of Quaternary deposits in the central part of Simcoe County
2 3-D mapping of Quaternary deposits in the southern part of Simcoe County
3 Bedrock aquifer, karst and early Silurian sequence stratigraphy mapping project - Manitoulin to Niagara Falls
4 3-D mapping of Quaternary deposits in the Orangeville-Fergus area
5 Guelph K_{fs} pilot scale groundwater study
6 Full-suite geochemical and isotopic sampling to delineate sources of highly mineralized groundwater on the Niagara Peninsula
7 3-D mapping of Quaternary deposits of the Niagara Peninsula
8 Temporal geochemical assessment of phosphorus in stream sediment, water and soil, Niagara Peninsula
9 Lake Erie Watershed Phosphorous Study
10 Upper Silurian to Middle Devonian core logging and bedrock groundwater mapping along the Onondaga Escarpment, southwestern Ontario
11 Alfred–Plantagenet Groundwater Study



For more information about OGS projects please contact jack.parker@ontario.ca

to download publications or view data in OGSEarth go to http://www.geologyontario.mndm.gov.on.ca/

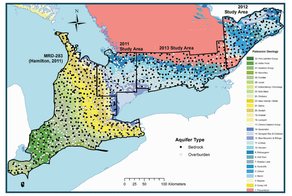
Ontario

AMBIENT GROUNDWATER GEOCHEMISTRY

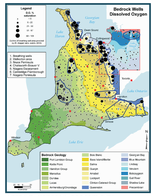
Objectives

- Mapping the natural chemistry of groundwater across the province.
- Outlining natural risks from groundwater quality.
- Providing baseline information on natural quality variations in groundwater.

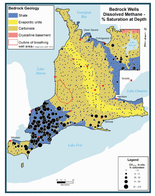
Making The Water - Bedrock Connection



Sample Locations & Study Areas



Karst Influenced Geochemistry



Water Chemistry Maps

Mapping Natural Risks In Groundwater

Oil

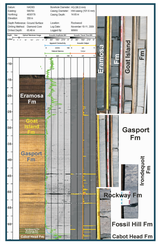
Metal

Methane

PALEOZOIC BEDROCK AQUIFER MAPPING

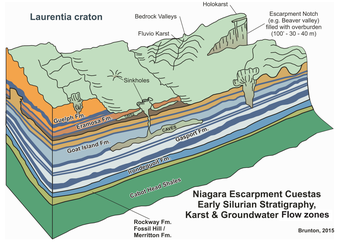
Objectives

- To systematically map groundwater in Paleozoic-age sedimentary rocks at a scale that supports the safe and sustainable use of groundwater by Ontarians.
- Develop a multi-disciplinary approach to groundwater mapping that integrates hydrogeological characterization tools with a detailed sequence-, chemo-, and bio- stratigraphic framework.
- Demonstrate importance of testable sequence stratigraphic architecture for predictive mapping/exploration of new groundwater resources.

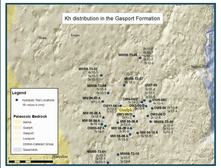


Approach

- Collection, logging and photography of PQ-HQ rock core down to regional aquitards.
- Borehole work - camera, geophysics, flow profiling, pumping tests, dye tracer tests, FLUTe® k-profiling, heat pulse.
- Sampling - lithogeochemistry, hydrochemistry, chemostratigraphy, biostratigraphy, SEM and petrography.
- Multi-level monitoring well installations for sampling and head measurements.
- Compare groundwater chemistries with various surface water chemistries to address recharge/discharge questions across cuestas.



Pilot Study: Detailed integration of Hydraulic Testing Data with Carbonate Stratigraphy



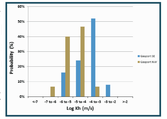
Objective

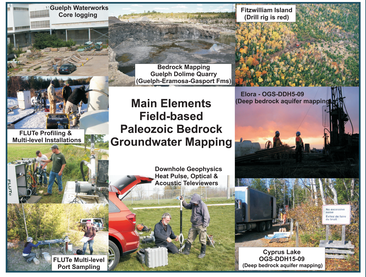
Identify the intrinsic and extrinsic controls on permeability and investigate the statistical relationship between Hydraulic Conductivity and the local Paleozoic bedrock formations.

Results

Hydraulic Conductivity varies with mappable bedrock facies changes.

The plot shows the probability distribution of horizontal hydraulic conductivity values (Kh) in the Gasport Formation (40 tests were conducted). The two distributions reflect important facies changes in the formation.





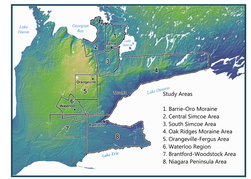
Future work

Move from Niagara Escarpment cuesta (Silurian-age bedrock aquifers) to Onondaga Escarpment cuesta (Devonian-age bedrock aquifers) and update karst, bedrock geology and topography maps.

THREE-DIMENSIONAL SEDIMENT AQUIFER MAPPING

Objectives

- Reconstruct the regional Quaternary history and develop a conceptual geological framework
- Construct a 3-D model of key sediment packages
- Characterize the properties of modelled sediment packages



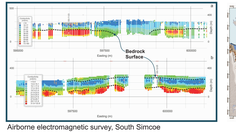
Location of 3-D studies

Basin Approach to 3-D Mapping

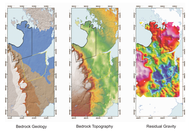
- Assembly and standardization of legacy subsurface data
- Acquisition of new geological and geophysical information
- Development of a conceptual geological model
- Interpretation of the subsurface data and creation of a 3-D block model
- Generation of both technical and user-friendly products for a wide range of clients

Sections and high quality boreholes are key for accurate model construction

Geophysical surveys delineate bedrock surfaces and sediment architecture

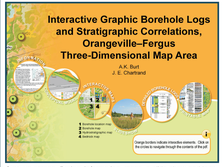


Airborne electromagnetic survey, South Simcoe



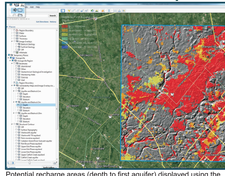
Exploiting The Digital World With Interactive Map Products

Interactive Borehole Release

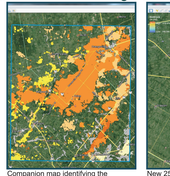


Start-up screen. Project information, maps, a slide show and logs are accessed by clicking on the bubbles.

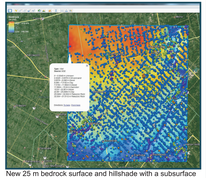
Maps and data can be viewed in Google Earth™.



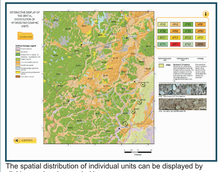
Potential recharge areas (depth to first aquifer) displayed using the interactive transparency tool in Google Earth ™



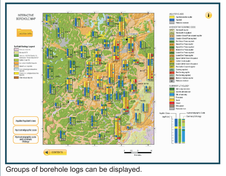
Companion map identifying the hydrostratigraphic classification of the first aquifer.



New 25 m bedrock surface and hillshade with a subsurface database that can be queried.



The spatial distribution of individual units can be displayed by clicking each colour coded box.



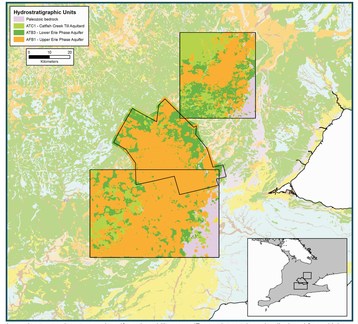
Groups of borehole logs can be displayed.

Cross-Section Viewer

Cross-sections are generated between points selected by the user. The cross-sections can be saved.

Fence diagrams can be created by importing cross-sections into Google Earth™.

GIS Grids



Isopach, structural contour and aquifer vulnerability maps (Raster datasets) can be displayed for multiple project areas. This example shows the subsurface distribution of selected hydrostratigraphic units.