

## GIS Analysis of Porosity and Permeability Variations in the Silurian Lockport Group, Southwestern Ontario

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### Summary

The Oil, Gas and Salt Resources Library staff in London, Ontario have compiled a database of core analysis data from 485 cored wells, of which 155 cover part or all of the lower Silurian Lockport Group. The data comprises 11,543 porosity and vertical/horizontal permeability analyses. This data set has been combined with outcrop sections, newly drilled rock cores, and geophysical well logs to create a GIS study of the regional porosity and permeability variations at the formational rank.

The Lockport Group consists of a cyclic succession of dolostones comprising, in ascending order: the Gasport, Goat Island, Eramosa, and Guelph formations. These dolostones, which form the prominent Niagara Escarpment and cuesta, are amongst the most economically significant sedimentary rocks in southern Ontario. Strata form significant aggregate/industrial minerals resources and bedrock potable groundwater resources updip in cuesta, and deeper subsurface oil/gas resources and natural gas storage reservoirs.

ArcGIS plots of the core analysis data provide a spatial distribution of formation isopachs and regional porosity/permeability changes in the deeper subsurface and provides physical data between the shallow potable groundwater zone and the intermediate depth formational fluid zone. The main goal of study is to address the continuity/discontinuity of permeable zones, relationships to hydrocarbon traps, and isolation of deeper bedrock formational waters and meteoric waters.

### Methods and Workflow

Data quality evaluation and validation has been conducted by summarizing laboratory protocols and standards from the 12 different labs and reconciling data fields with auxiliary data, such as geophysics and duplicate cores. Data have been validated on the parameters of Effective Porosity, Grain/Bulk Density and Effective Permeability. Geology QA/QC of the 155 cored wells have been performed to delineate formational top picks using geophysical logs and rock core to revise the regional lithostratigraphy. A validated core analysis database has been created with each porosity/permeability parameter plotted vertically with stratigraphic columns. Isopach maps of the recognized permeable units and depth maps of each formational top are created in ArcGIS.

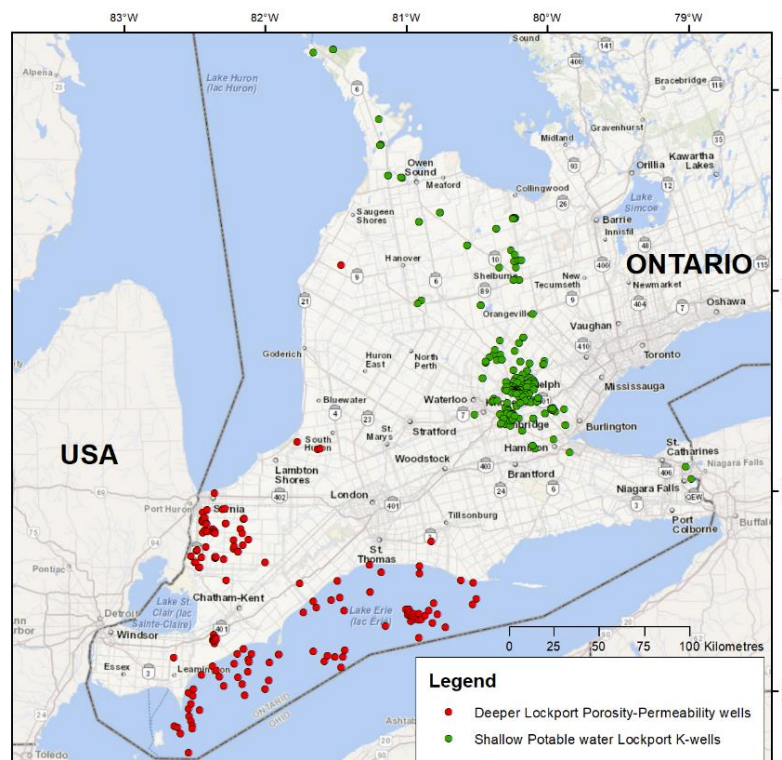
### Results

All of the core analysis data are derived from the deeper subsurface of southwestern Ontario and represent the intermediate brackish to saline sulphur water, and deep brine regimes. The inter-pinnacle facies within the Guelph Formation shows high porosity and permeability values due to

its paleokarstic nature. In the deep regime, the high porosity and permeability of the upper Guelph Formation within pinnacle structures have formed either oil and natural gas reservoirs or saline water-bearing zones. In western Lake Erie, both the karstic top of the Guelph Formation and the overlying A-1 Carbonate have variably permeable continuities. The newly compiled and plotted data reveal that in the subsurface, the porosity/permeability values are largely controlled by variations in carbonate lithofacies, diagenetic destruction or enhancement and existence of paleokarst systems. Interplay of tectophases and forebulge migration episodes and resultant differential erosion of the carbonates have influenced the porosity and permeability changes from Lake Erie across southwestern Ontario into Lake Huron.

### Acknowledgements

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**Figure:** Red dots represent the locations of oil and gas wells with porosity and permeability data in this study, southwestern Ontario. Green dots are Ontario Geological Survey water wells location with hydraulic data as controlling points.

### References

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