

Preliminary Results of a Shale Gas Assessment Project in Ontario, Canada*

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Search and Discovery Article #50390 (2011)

Posted March 14, 2011

*Adapted from oral presentation at AAPG Eastern Section Meeting, Kalamazoo, Michigan, September 25-29, 2010

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Abstract

Shale gas plays have recently been proven in various states and provinces of northeastern North America bordering on Ontario. Only one shale gas exploration well has been drilled to date in Ontario despite the presence of the same organic-rich shales. Consequently, the Ontario Geological Survey (OGS) has initiated a multi-year project to assess the shale gas potential of southern Ontario.

Potential shale gas units include the Ordovician Collingwood Mb, Eastview Mb, Blue Mountain, Billings, Georgian Bay and Carlsbad formations as well as the Devonian Marcellus and Kettle Point formations. The main objective of the project is to examine the potential of these strata by obtaining new crucial data. The first component of the project in 2009 involved the compilation of existing information and data, followed by Rock-Eval analysis of rock samples from outcrops and from drill core and cuttings samples stored at the Oil, Gas & Salt Resources Library of the Ministry of Natural Resources. In April 2010, two diamond drill holes were completed in the Kettle Point Formation to obtain samples for desorption, gas composition, permeability, porosity, mineralogy, total organic carbon and maturity analyses. Both wells intercepted shale thicknesses of more than 80 meters. Gas shows were observed in both wells, mostly concentrated in the lower member of the unit. Additional testing is currently underway. Geophysical logs were run in both holes.

To date, the research has focused on the Kettle Point Formation; however, the OGS plans to examine all potential shale units.

References

Armstrong, R., 1986, Northwestern Utilities Limited's salt cavern natural gas peak storage facility: Fifth Canadian Gas Association National Technical Conference, Ontario, Canada, February 9-12, 1986, 21 p.

Thériault, R., D. Rodriguez, E.A. Konstantinovskaya, D. Kirkwood, and L.B. Harris, 2009, Effects of basement structure, sedimentation and erosion on thrust wedge geometry: an example from the Quebec Appalachians and analogue models: CSPG Bulletin, v. 57/1, p. 34-62.

Preliminary Results of a Shale Gas Assessment Project in Ontario, Canada

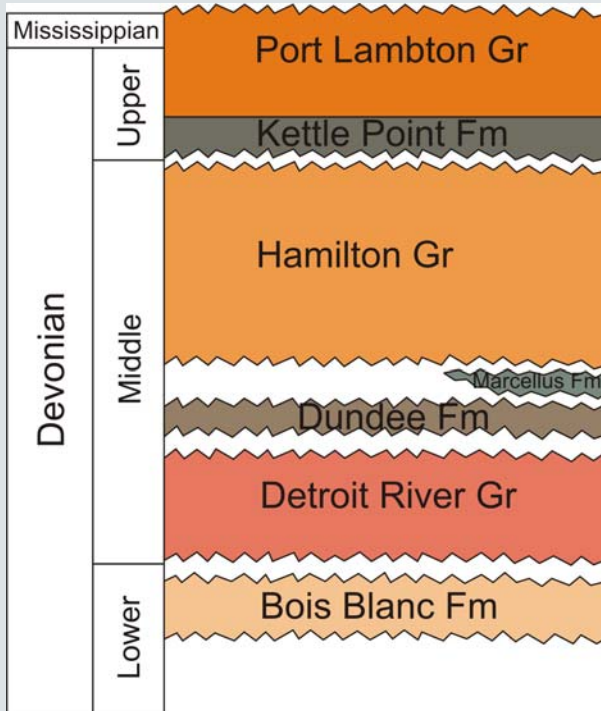
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¹: Ontario Geological Survey, Sudbury, ON

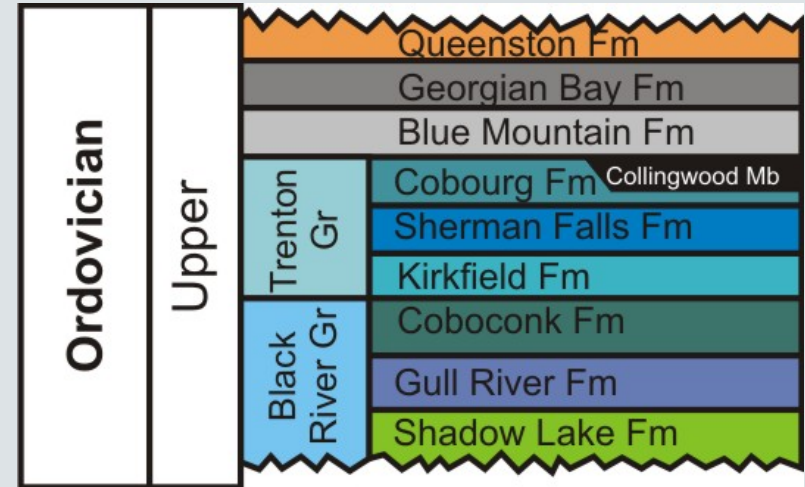
²: Ontario Ministry of Natural Resources, London, ON

- Introduction to the project
- Presentation of potential units
- Preliminary results of Kettle Point drilling program
- New Ordovician shale drilling program

Various Potential Shale Gas Units



- Devonian:
 - Kettle Point Fm
 - Marcellus Fm



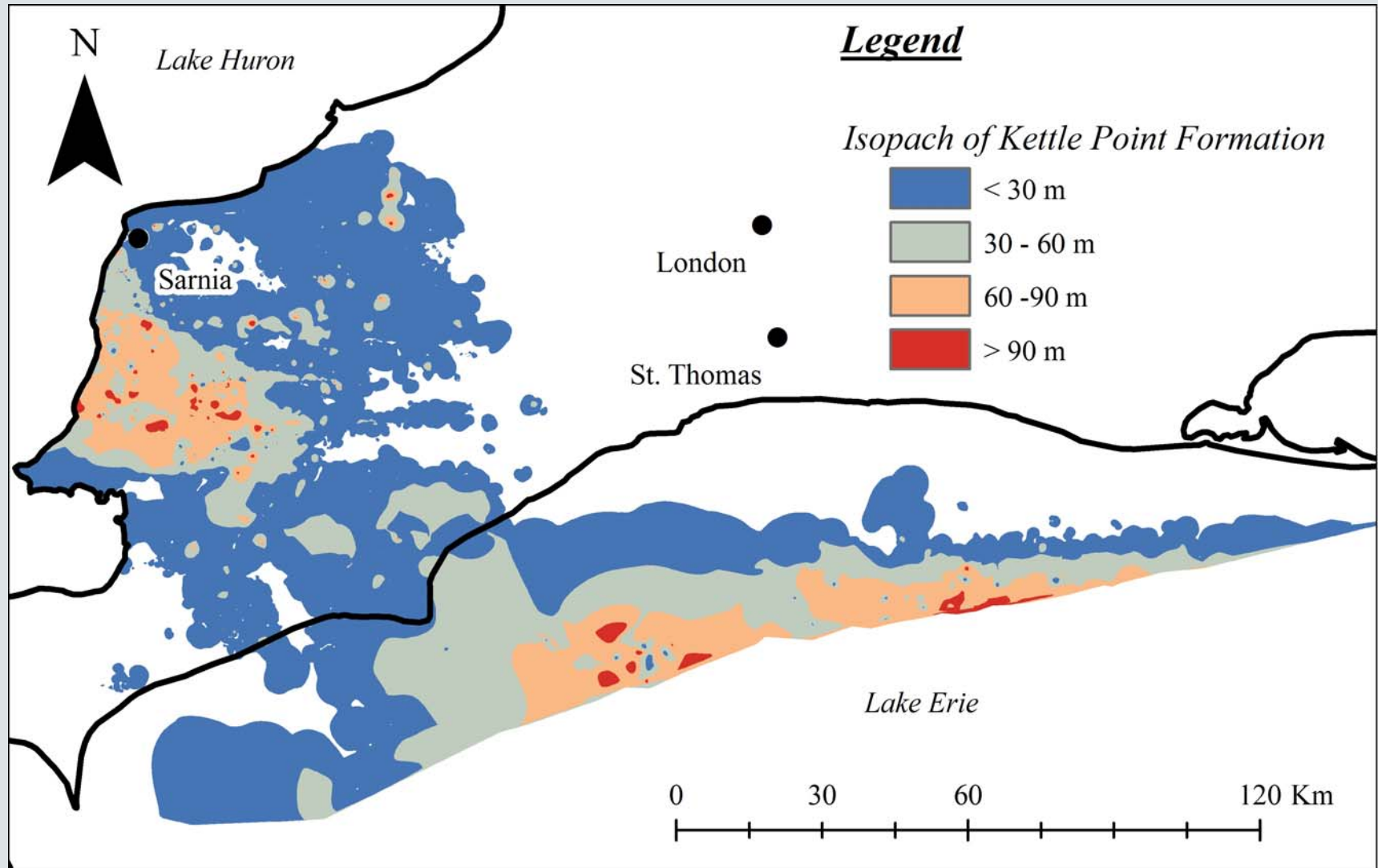
- Ordovician:
 - Georgian Bay-Blue Mountain Fm
 - Collingwood Mb (Lindsay/Cobourg Fm)

Kettle Point Fm - Description

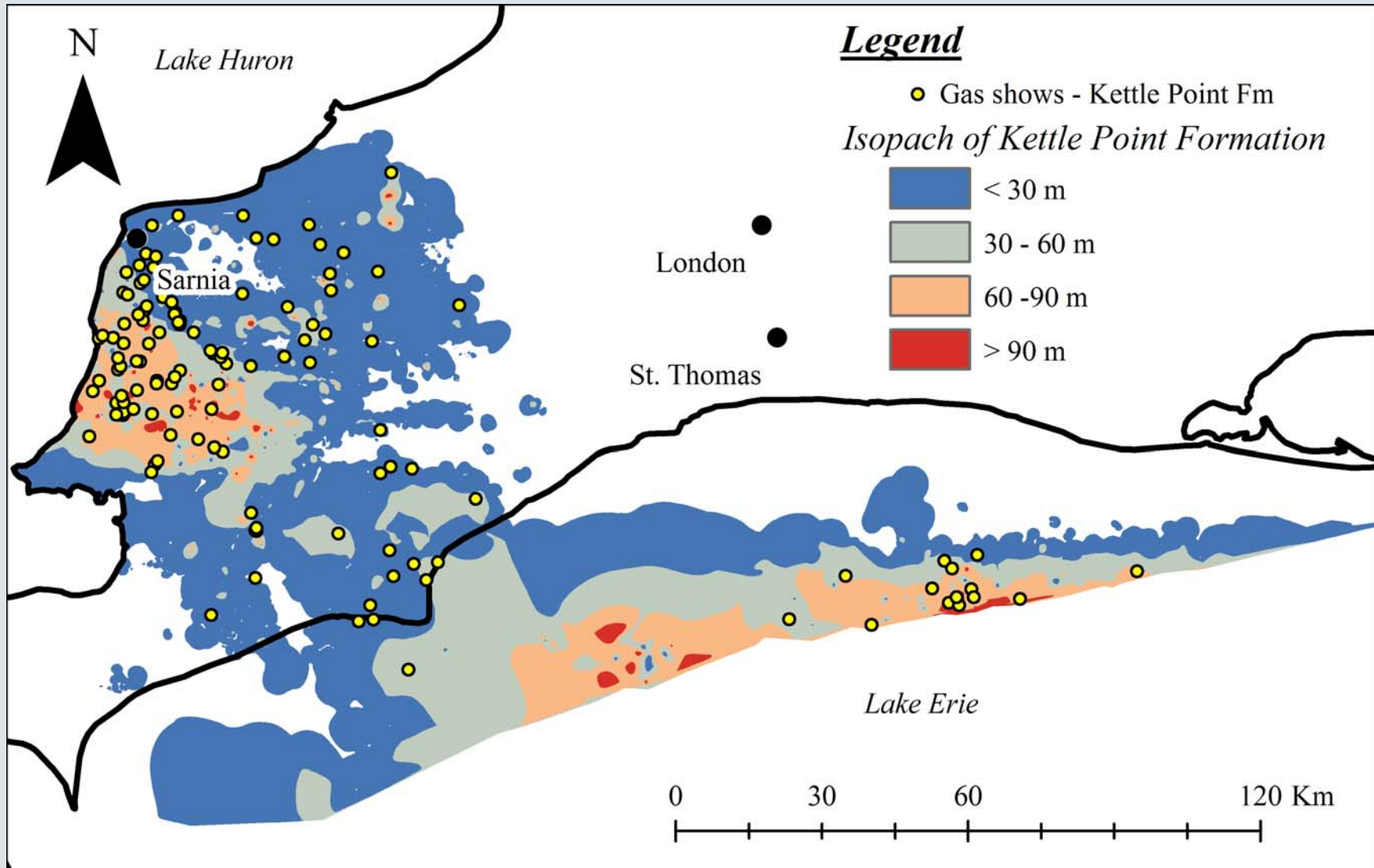
- Black and green shale unit
- Devonian age
- Antrim equivalent
- TOC: up to 14.6%
 - Armstrong (1986)
- Thermally immature
- Numerous gas shows in wells



Ministry of Northern Development Mines and Forestry

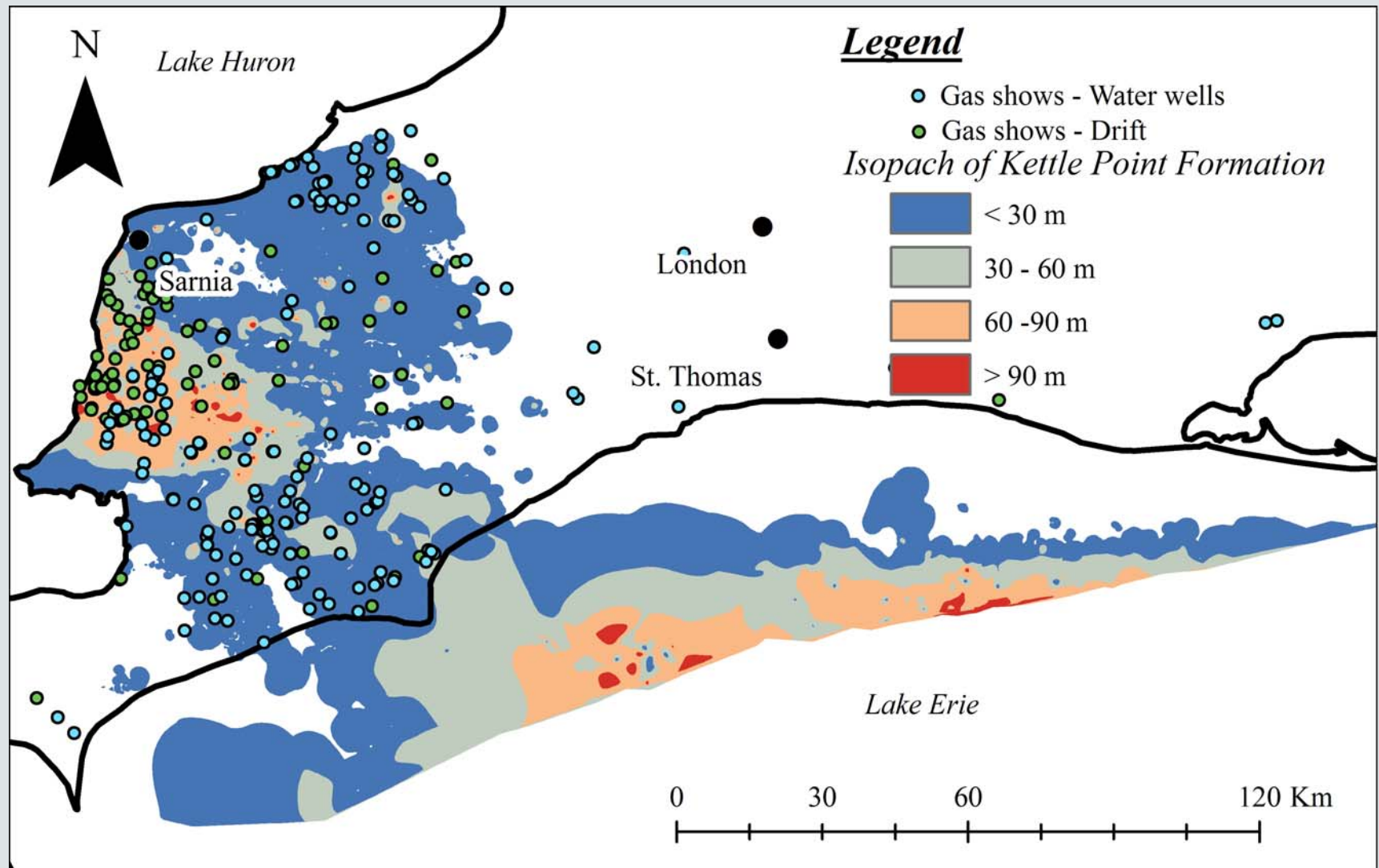


Kettle Point Fm - Gas Shows



Kettle Point Fm

Gas Shows in Drift and Water Wells

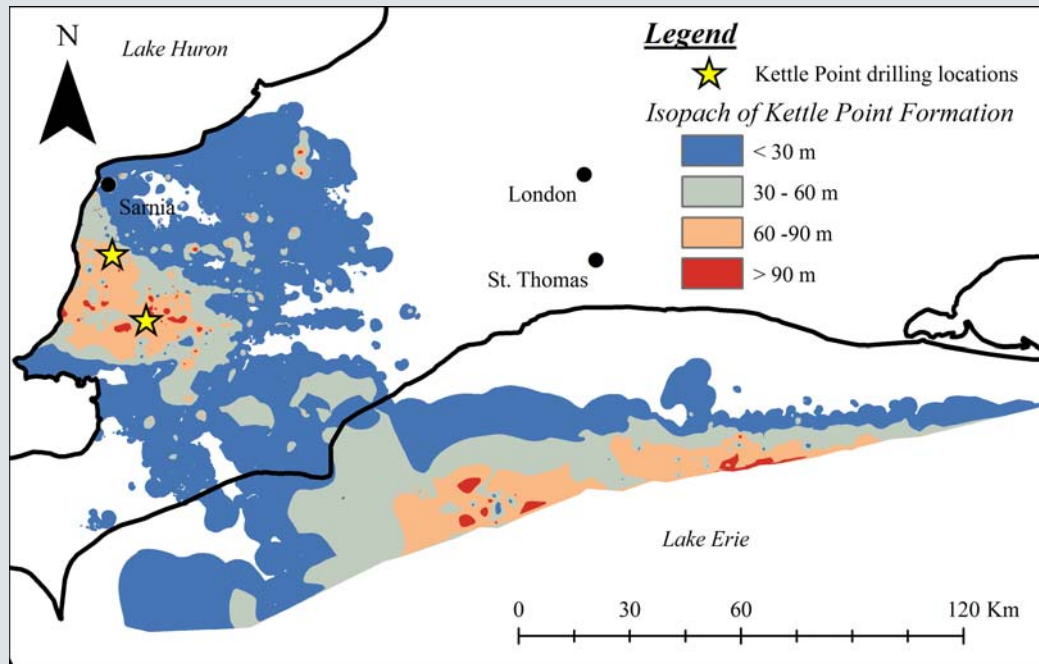


Kettle Point Fm - Drilling Program



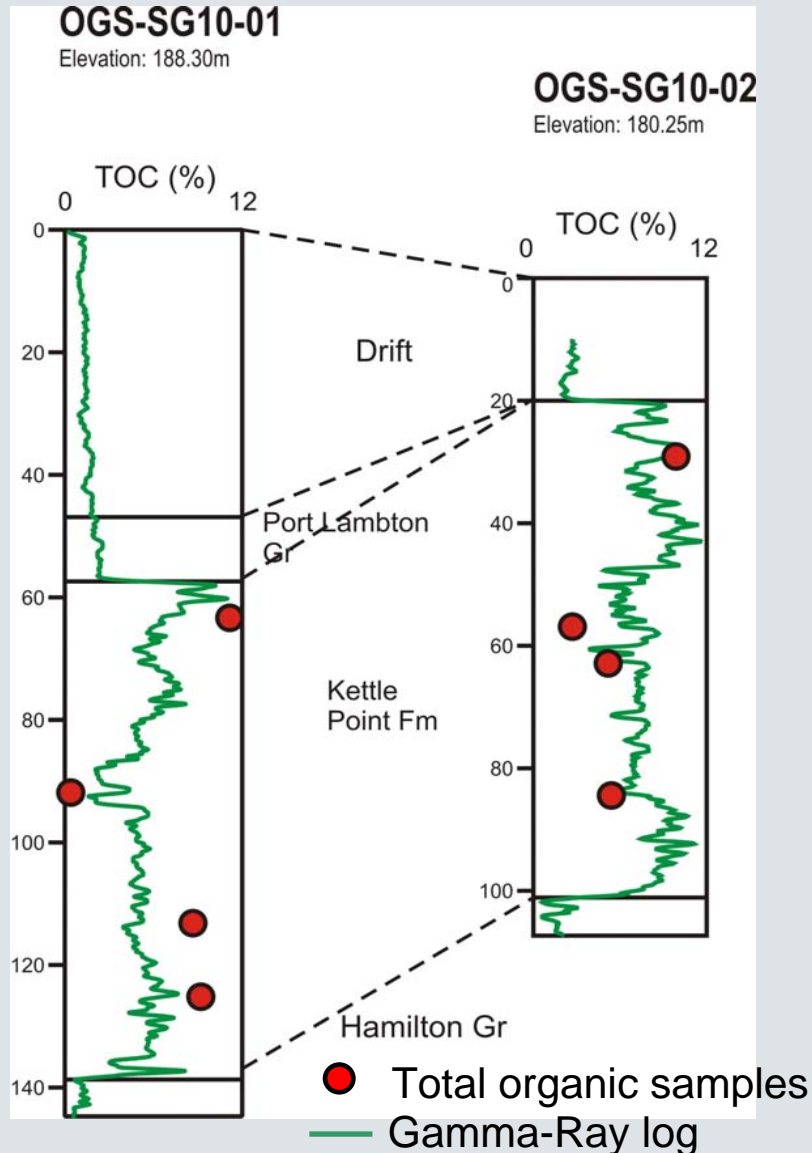
- Drilling
 - Coring of 2 wells
 - Down to Hamilton Group
- Sampling
 - Core canisters
 - Gas analyses
 - Content over time
 - Composition
 - Isotopes of methane
 - Isotherms
 - GRI, TOC, XRD
 - Thin sections
- Geophysics

Kettle Point Fm Drilling - Well Locations



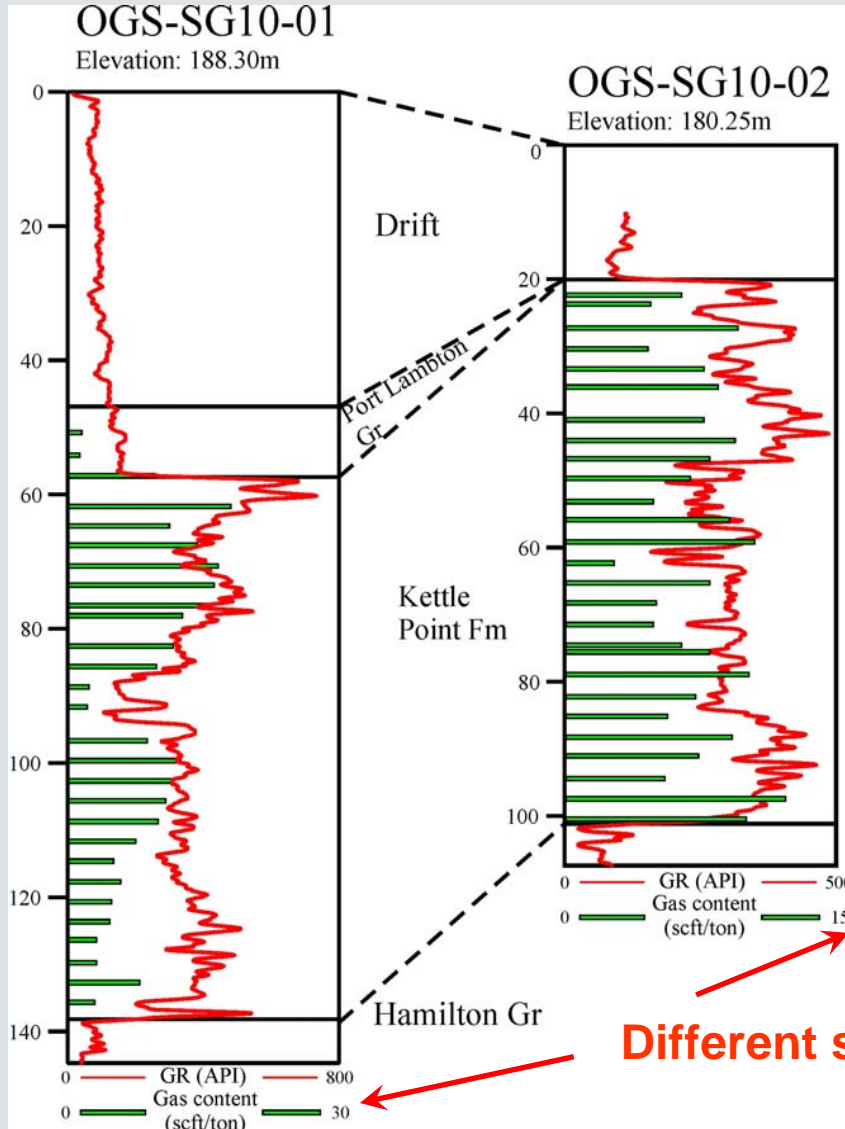
- Private land
- Initial prognosis:
 - Minimum of 70m of Kettle Point Fm
- One well close to extent limit of Port Lambton Gp

Kettle Point Fm Drilling - Geology



- About 80m of Kettle Point Fm per well
- Port Lambton Gp is present in OGS-SG10-01
- Presence of fractures
- Gas shows

Kettle Point Fm Drilling - Gas Content Results



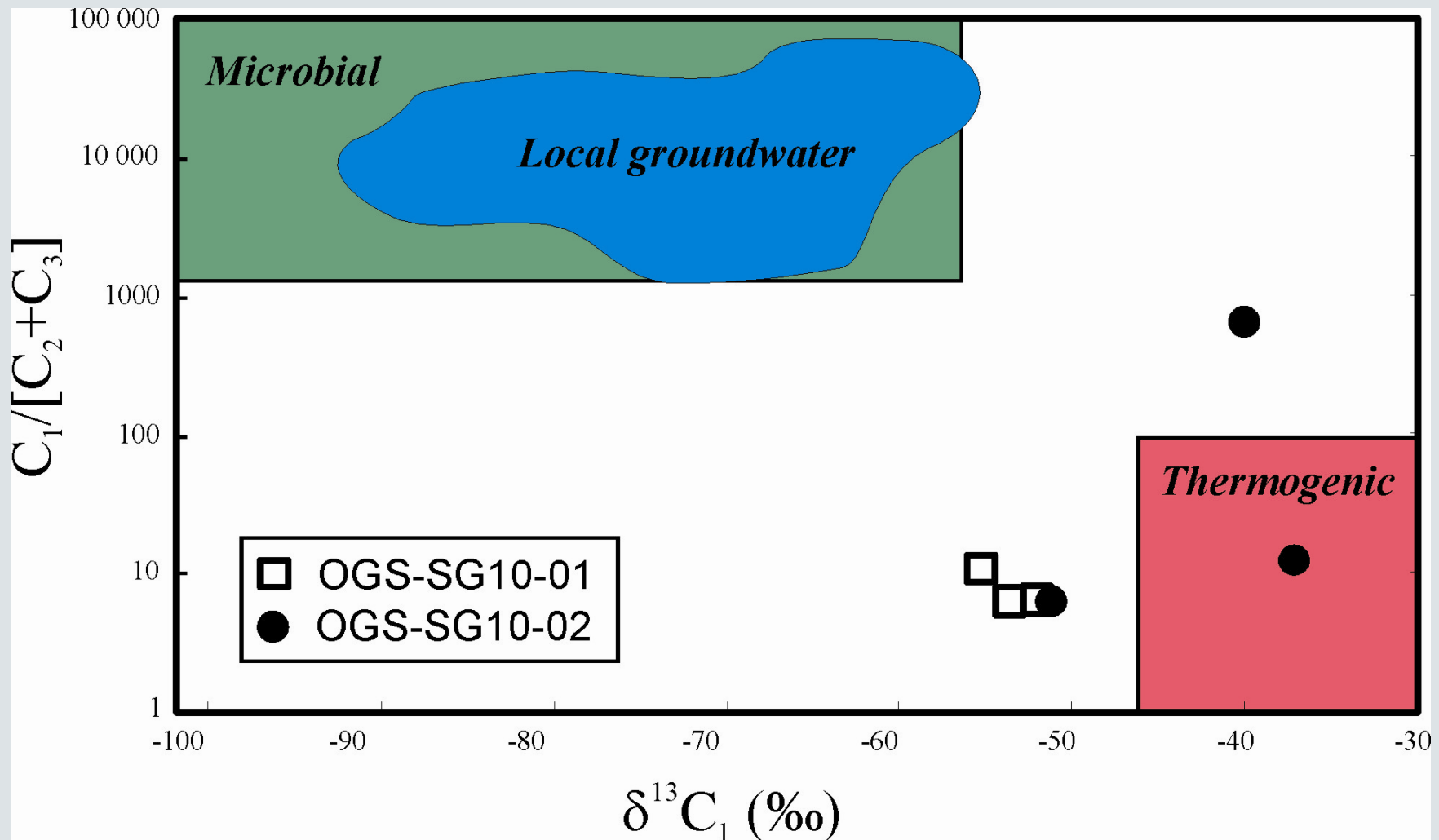
- **OGS-SG10-01**
 - More gas than OGS-SG10-02
 - Strong correlation between GR and gas
 - Shallower depths
- **OGS-SG10-02**
 - Lower gas levels than OGS-SG10-01
 - Weak correlations between GR and gas

Kettle Point Fm Drilling - Equivalent Productive Units

<i>Property</i>	<i>Antrim</i>	<i>Ohio</i>	<i>New Albany</i>	<i>Kettle Point*</i>
Depth (ft)	600-2400	2000-5000	600-4900	0-300
Gross thickness (ft)	160	300-1000	100-400	<360
TOC (%)	0.3-24	0-4.7	1-25	11.2
Total porosity (%)	9	4.7	10-14	5.1-12.5
Gas-filled porosity (%)	4	2	5	0.5-6.7
Water-filled porosity (%)	4	2.5-3.0	4-8	3.1-8.4
Gas content (scf/ton)	40-100	60-100	40-80	2.1-18.3

** Data from current study only*

Kettle Point Fm Drilling - Isotopic composition

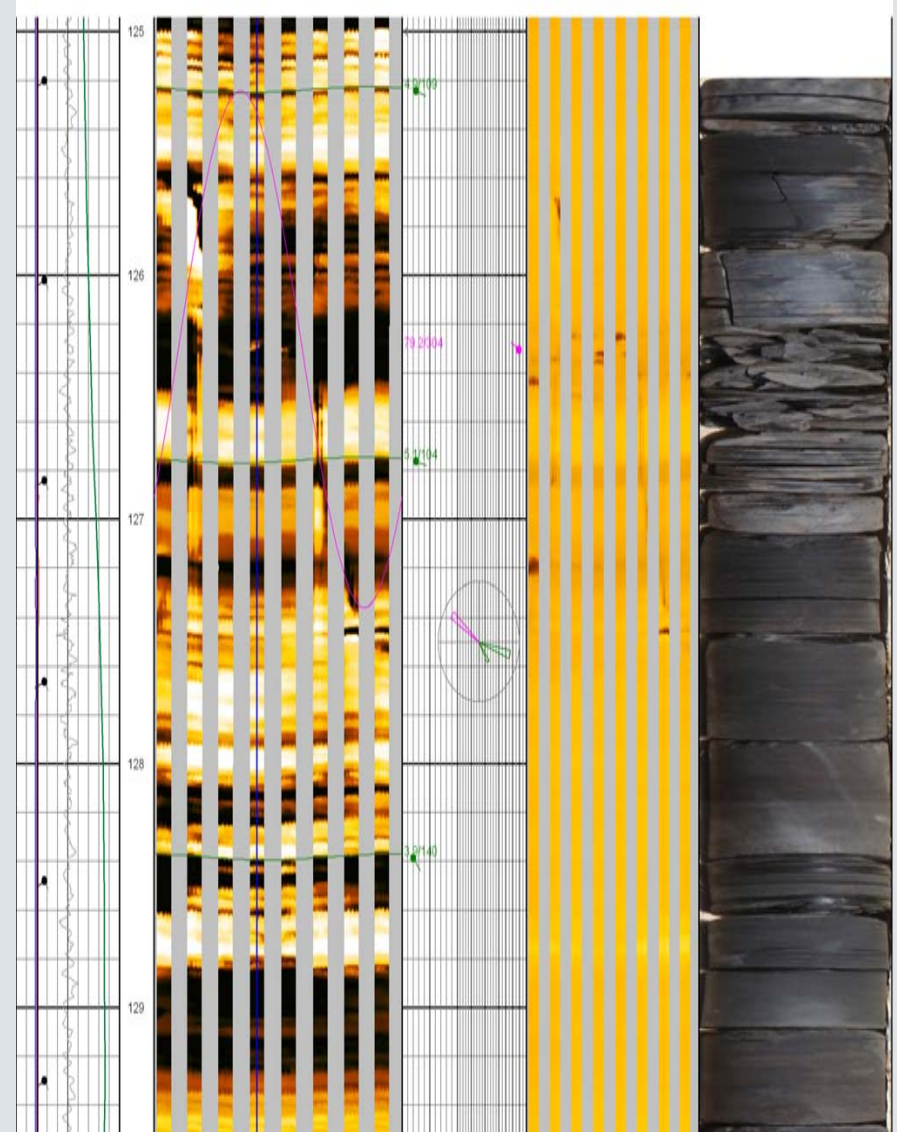


- OGS-SG10-01
 - Mixing of thermogenic and biogenic
 - Biogenic gas could explain:
 - strong relation (GR/TOC – Gas content) in upper section
 - Higher gas content than OGS-SG10-02
 - Lower gas content at depth
 - Saline fluids at depth prevent microbial gas production

- OGS-SG10-02
 - Thermogenic (+/- biogenic)
 - Could explain:
 - Lower gas content than OGS-SG10-01
 - No clear correlation of gas content with
 - GR-TOC
 - depth

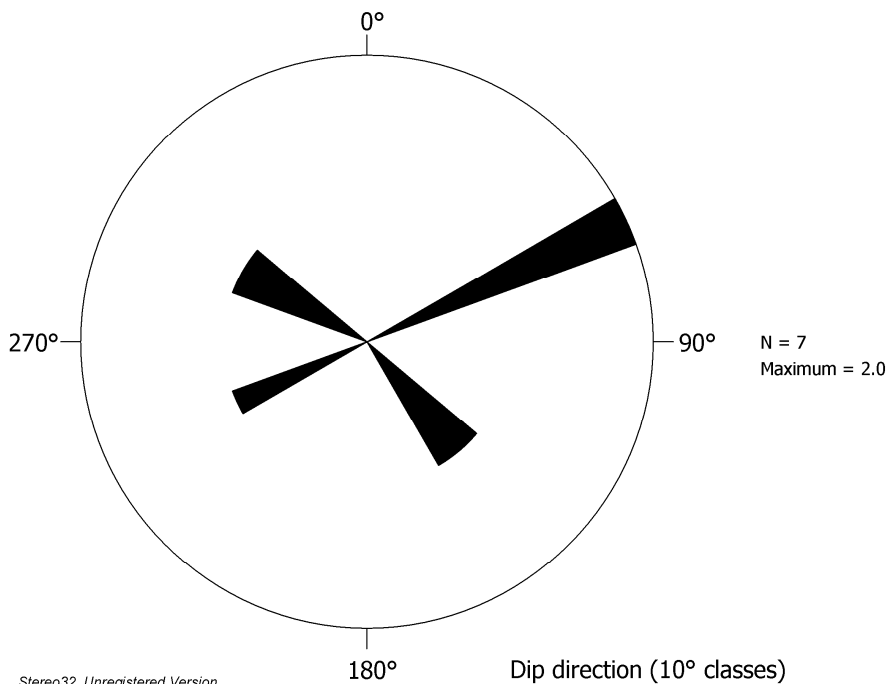
Kettle Point Fm Drilling - Fractures

- Fractures linked:
 - In core
 - By televiewer
- Mostly open fractures
- Some healed fractures
 - In well OGS-SG10-02

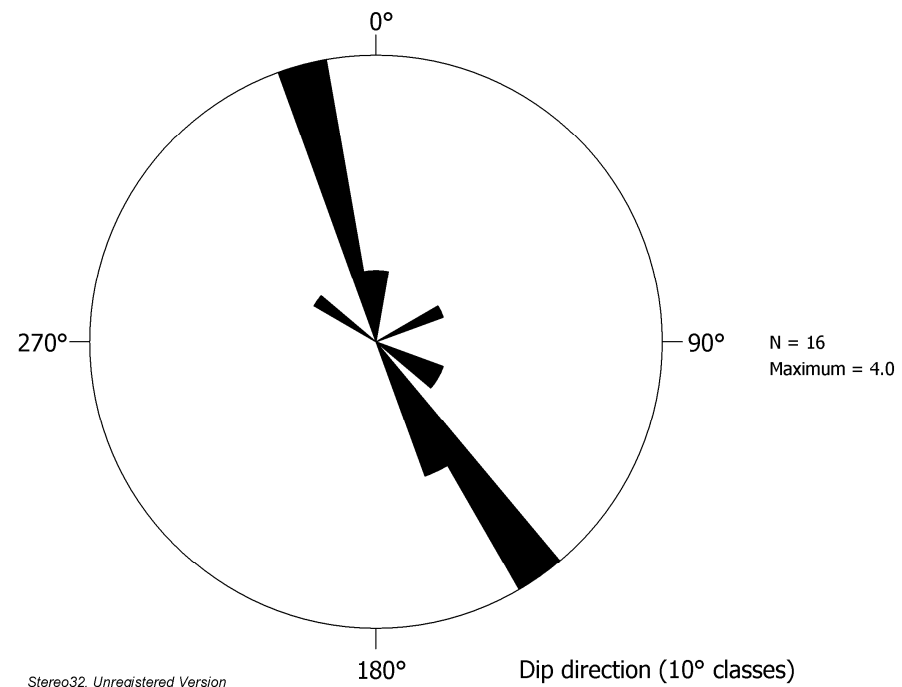


Kettle Point Fm Drilling - Fractures

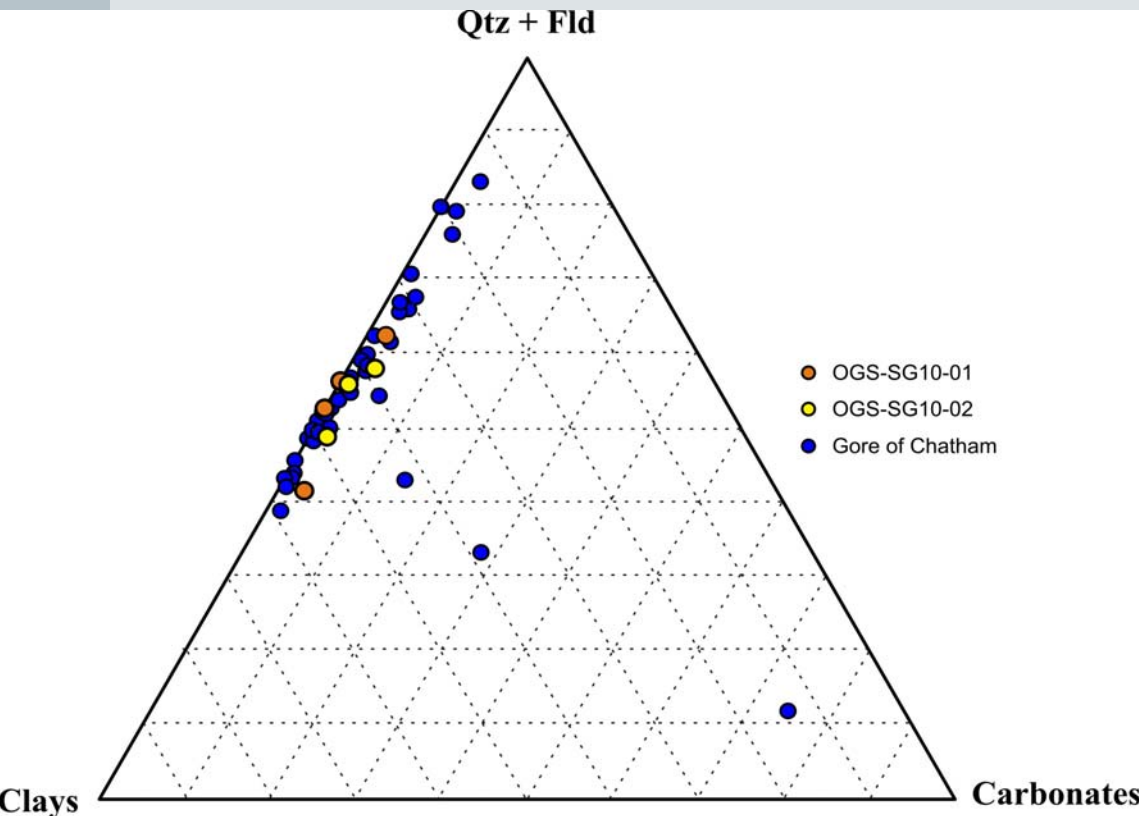
OGS-SG10-01



OGS-SG10-02



Kettle Point Fm Drilling - Mineralogy



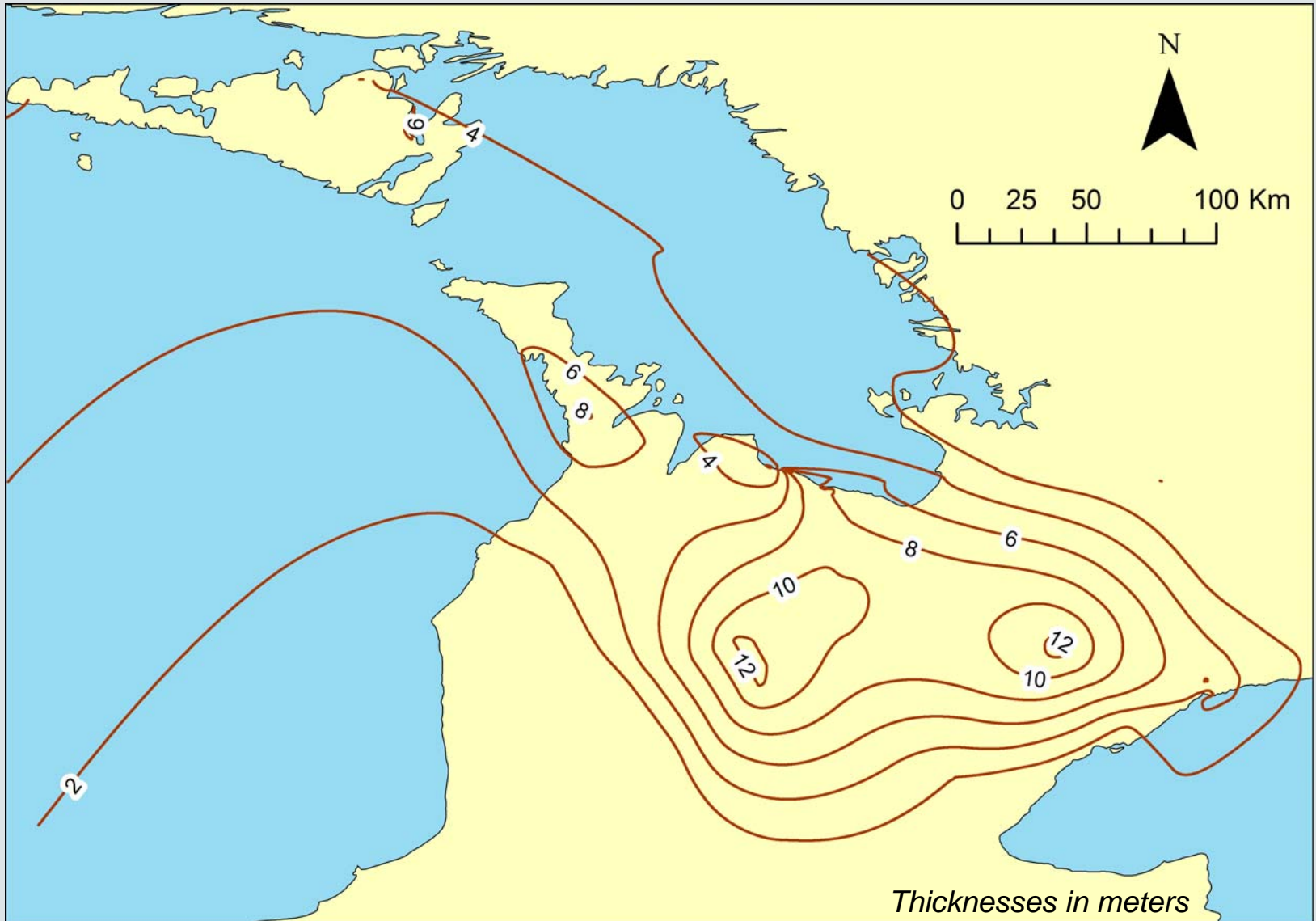
- Qtz+Fld: >40 wt%
- Carbonate: Tr
- Fe-sulfides: <16%
- Clays (30-50%):
 - Smectite: 2-3%
 - Illite: 60-80%
 - Kaolinite: 10-20%
 - Chlorite: 10-15%

Kettle Point Fm Drilling - Conclusion

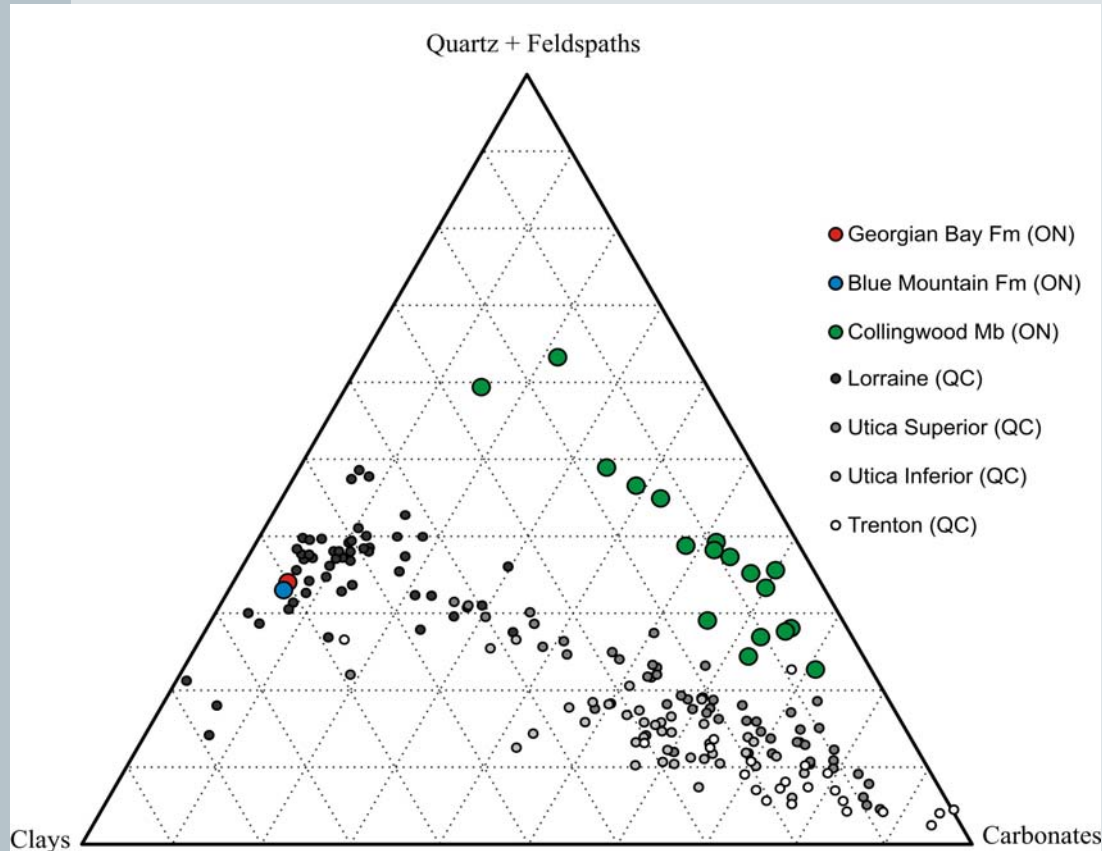
- Kettle Point Formation can be considered as a shale gas generative unit
- Economic viability of the formation remains to be established
- Hydrogeological studies of the Kettle Point Formation should be initiated
 - possible connection between hydrology, geochemistry, microbes and gas production

- Investigation of Ordovician strata
- Drilling within the next 2 months
- Still in tender process (ends Sept 28)
- Coring from Georgian Bay Fm to Cobourg Fm
 - Most interesting interval:
 - Rouge River Mb (Blue Mountain Fm)
 - Collingwood Mb (Lindsay Fm)
- About 500-600m deep

Ordovician Shale Gas Units - Collingwood Isopach Map

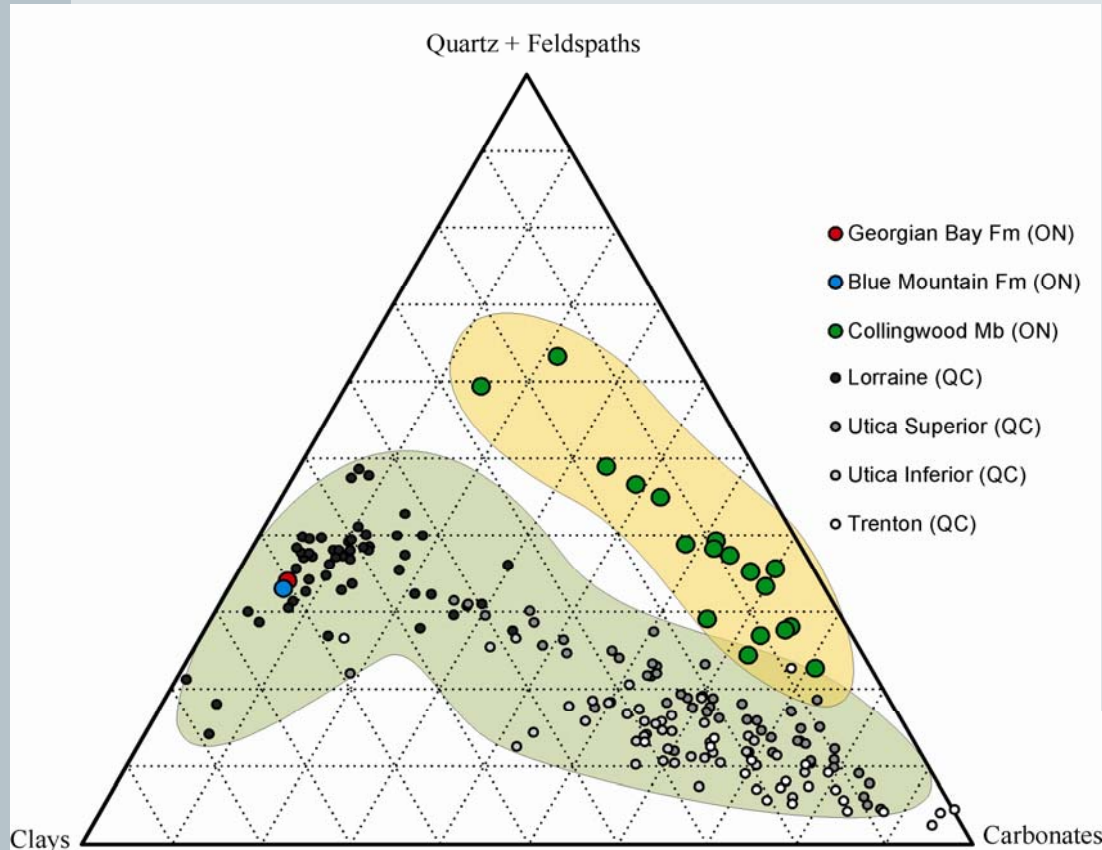


Ordovician Shale Gas Units - Mineralogy



- Quebec:
 - Presence of trend from Trenton to Lorraine
- Ontario:
 - Blue Mountain and Georgian Bay fms fit the trend
 - Collingwood contains more Qtz+Flds than age equivalent unit (Utica shales)

Ordovician Shale Gas Units - Mineralogy



- Quebec:
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Ordovician Shale Gas Units

Collingwood-Blue Mountain Contact



Collingwood – Blue Mountain contact in OGS CLGD No.1 showing phosphatic concretions



Utica-Lorraine contact in Quebec (Well A206) (From Thériault, 2009)

- Unconformity
 - Between Collingwood Mb and Blue Mountain Fm
 - Presence of phosphate bed (2-3 cm thick)
 - Mineralogy analyses needed
 - Between Utica and Lorraine Groups
 - No presence of such bed?

Ordovician Shale Gas Units - Conclusion

- Difficulty to get accurate data (depth, thickness) on Collingwood
 - Industry identifies the Rouge River Mb as the Collingwood
- Difficulty to confirm equivalence of units:
 - Collingwood versus Utica
- Drilling within months (2010)