[AV]Lower Cretaceous Gas Shales of Northeastern British Columbia: Geological Controls on Gas Capacity and Regional Evaluation of a Potential Resource*

By
Gareth R. Chalmers[1] and R. Marc Bustin[1]

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[1]Earth and Ocean Sciences, University of British Columbia, Vancouver, BC, Canada (gchalmer@eos.ubc.ca; bustin@unixg.ubc.ca)

Abstract

The regional shale gas potential of the Lower Cretaceous Buckinghorse Formation and stratigraphically equivalent strata have been investigated. Methane sorption capacities range between 0.03 to 1.86 cm3/g (1.0 to 59.5 scf/ton) at hydrostatic pressures between 2.9 and 17.6 MPa. The total organic carbon (TOC) content is between 0.2 and 17.0 wt%. A weak positive correlation exists between TOC content and methane capacity (R2 = 0.64). The strata range in maturity from immature to overmature with respect to the oil window (Tmax between 416 and 476°C). TOC content decreases with the maturity of the shale as more hydrocarbons are generated.

High maturities and low TOC contents exist adjacent to the deformation front. As maturity decreases, the TOC content increases towards the distal portions of the basin. The TOC content distribution is controlled by: 1) the depth of burial (maturity); and 2) sedimentation rate. An increase in the sedimentation rate has reduced the TOC content within the shale. Although TOC content is low adjacent to the deformation front, methane capacities are high because of high reservoir pressures. The distal portions of the basin have maturities too low for thermogenic gas but could contain biogenic gas due to high TOC contents, lower reservoir temperatures, and shallow depths

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Outline

- Introduction & background
- Structure and isopach maps
- Distribution of TOC content and types
- Maturity & HC generation
- Sorption, porosity & total gas capacities
- maximum gas-in-place estimates
- Conclusion
    - Controls on methane capacity distribution

Introduction

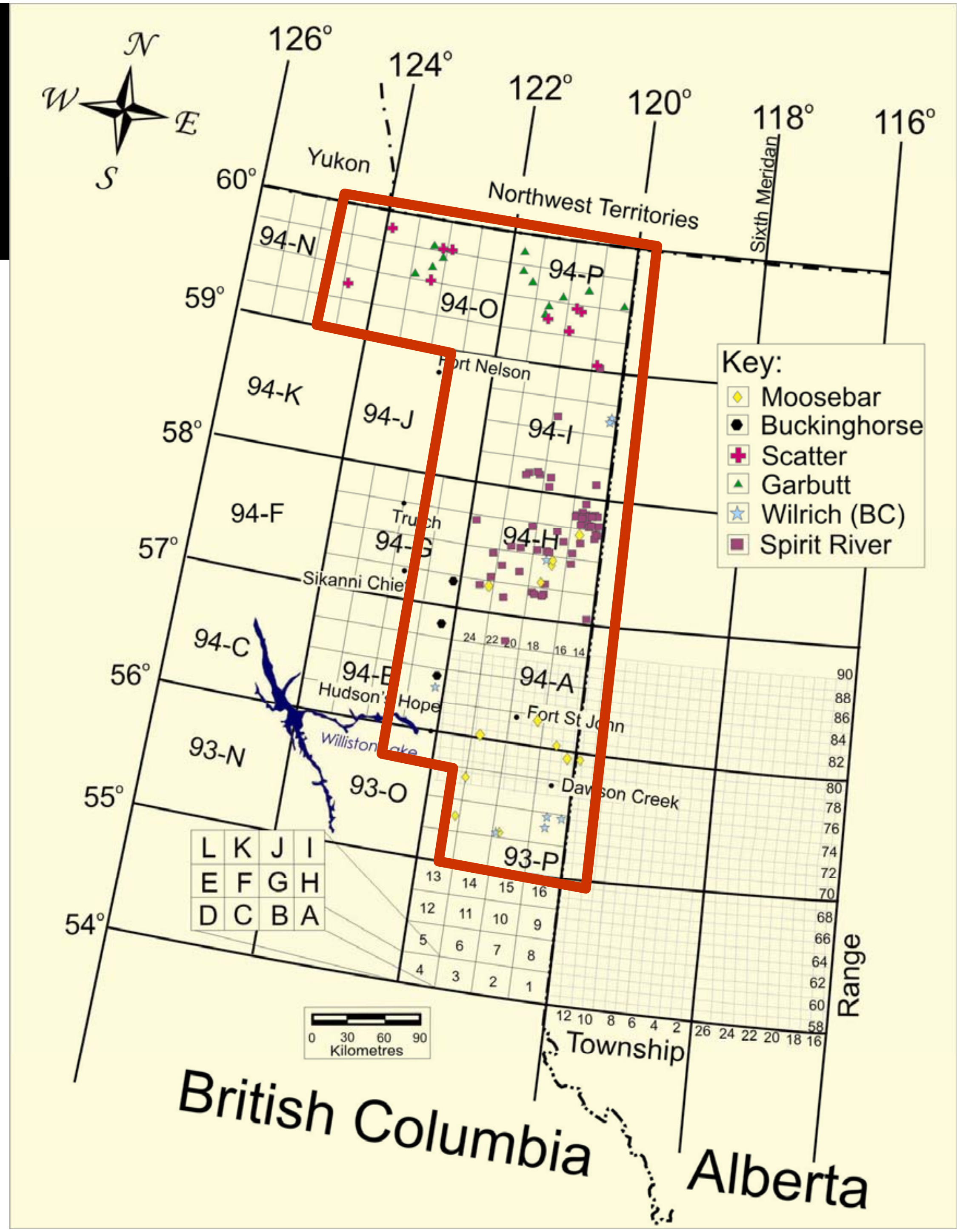
- Why investigate the Buckinghorse?
- It is < 1600 m thick, laterally extensive shale in NEBC
- TOC-rich, within the oil to gas window
- Can contain coarser-grained facies & natural fractures
- **What controls the gas capacity across NEBC?**

Major Conclusions

- Total Organic Carbon (TOC) content is the *primary* control on methane capacity of the Lower-K shales
  - Why? Because TOC increases surface area for gas sorption
  - Broad positive relationship indicates other factors
  - Mineralogy, kerogen types, maturity and moisture content
- Proximity to deformation front controls the distribution of TOC via clastic influx & maturity
- Greatest gas-in-place estimates are adjacent to the deformation front – low TOC, but high pressures and greater stratal thicknesses

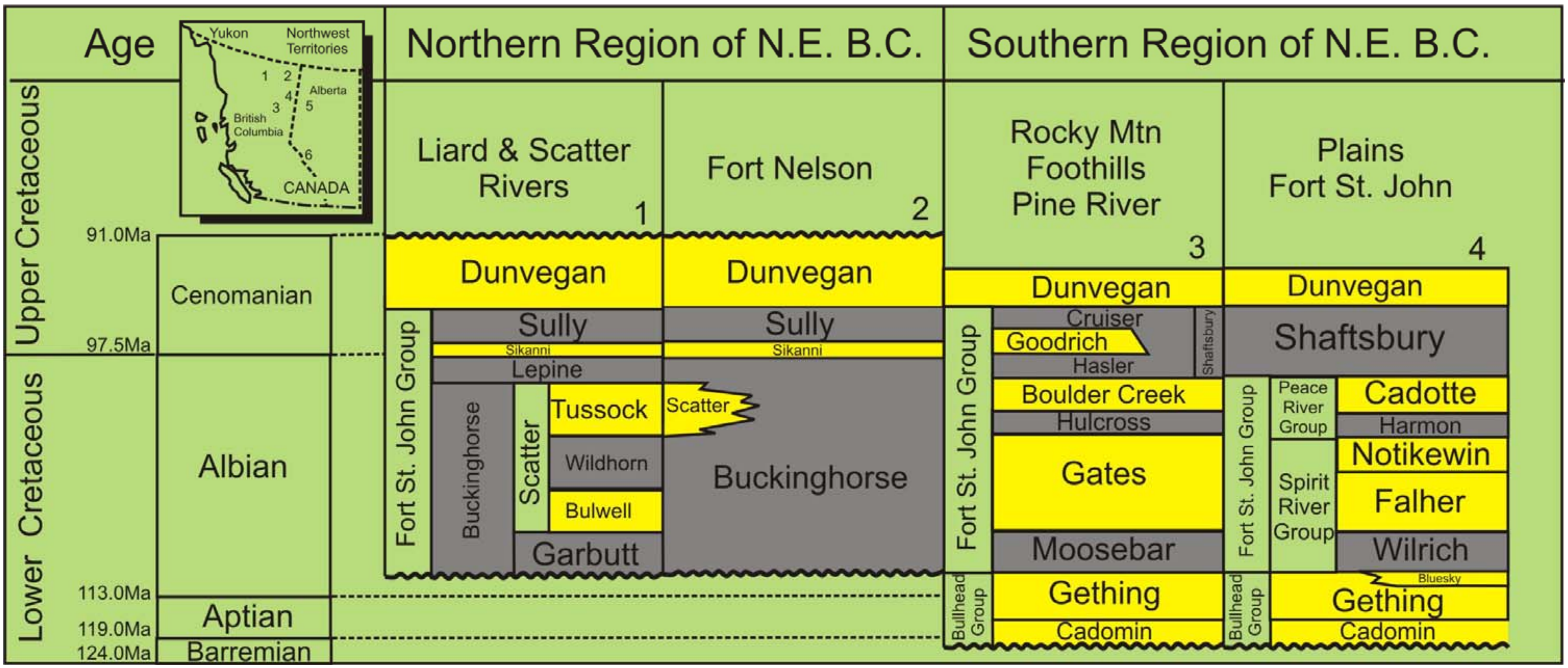
Study Area

Buckinghorse Shale is a large regional study



Lower Cretaceous Stratigraphy

- Buckinghorse Formation & equivalent strata



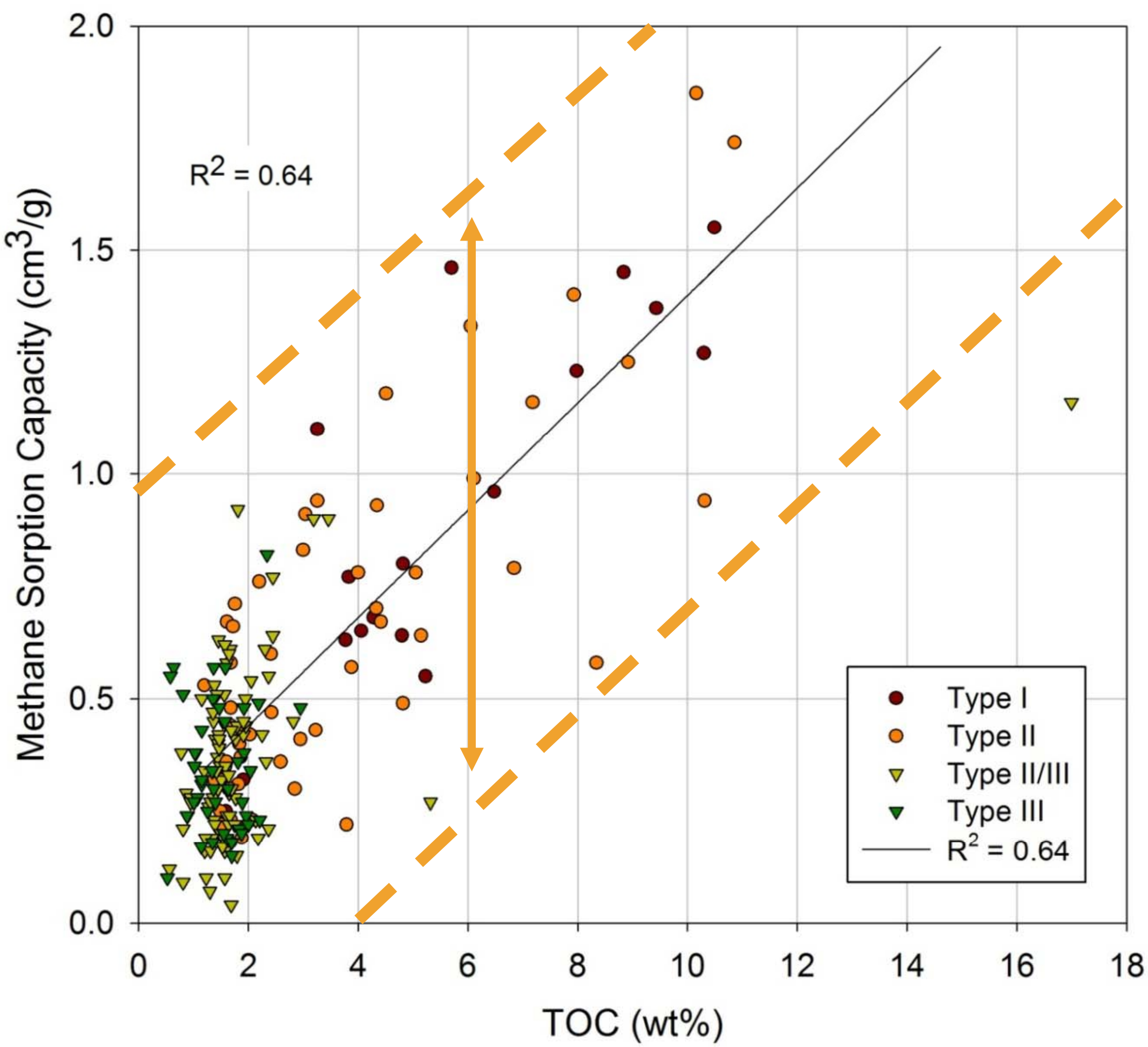
Analytical Procedures

- Multi-disciplinary approach needed to identify all possibly geological controls on CH_4 capacity & regional resource evaluation
  - Rock-Eval; organic petrology
  - High-pressure CH_4 sorption analysis;
  - He pycnometry; Hg porosimetry; N_2 & CO_2 surface area sorption analyses
  - XRD; moisture analysis
  - Geophysical log analysis

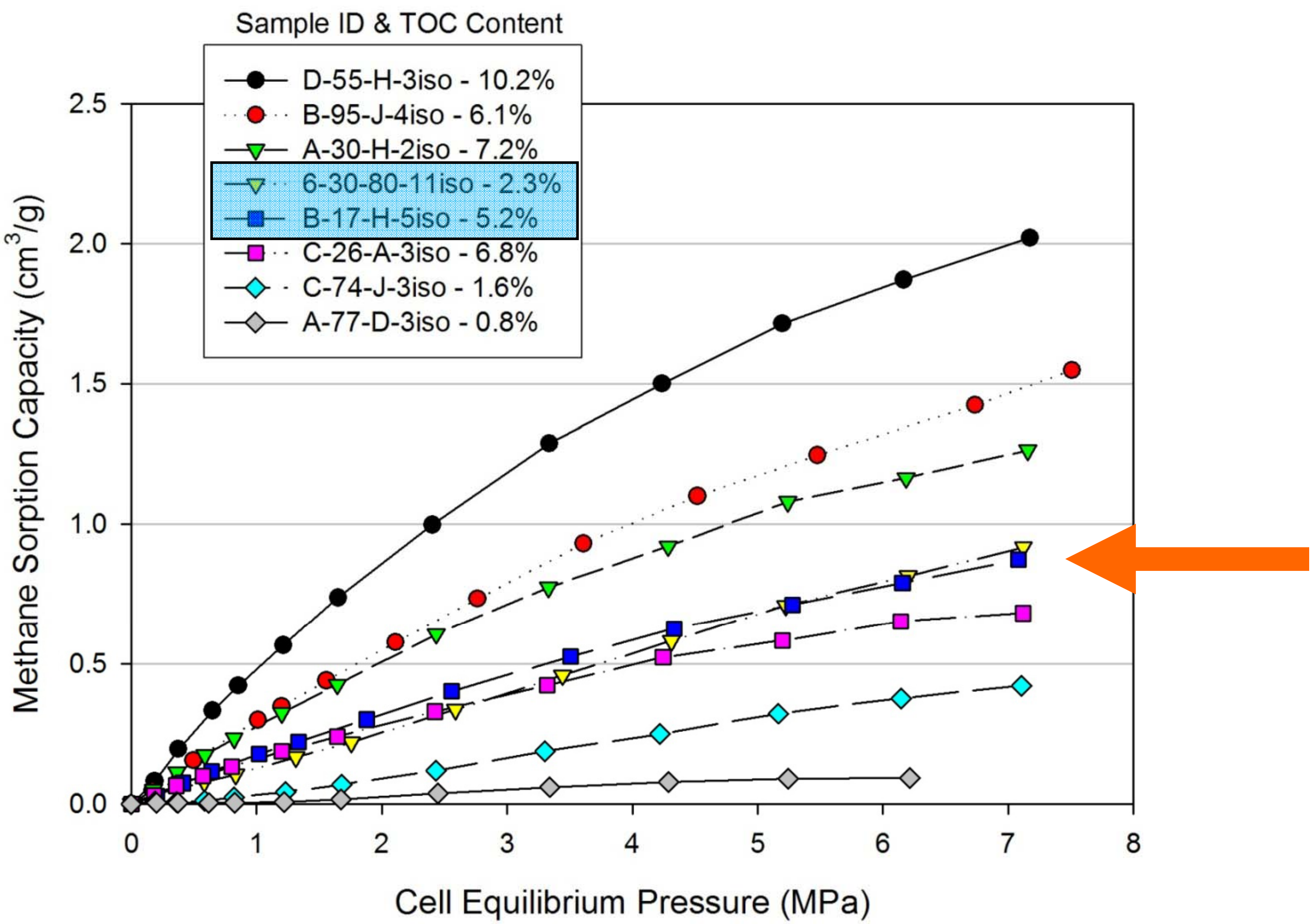
TOC vs Methane Capacity

- A positive correlation which is broad indicates other secondary factors are influencing the capacity

- Methane capacity is at 6 MPa for all samples for comparison

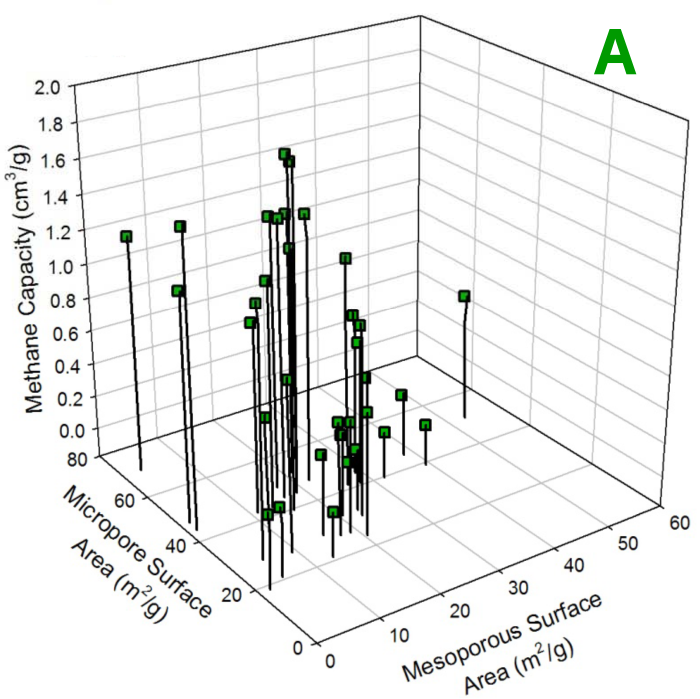


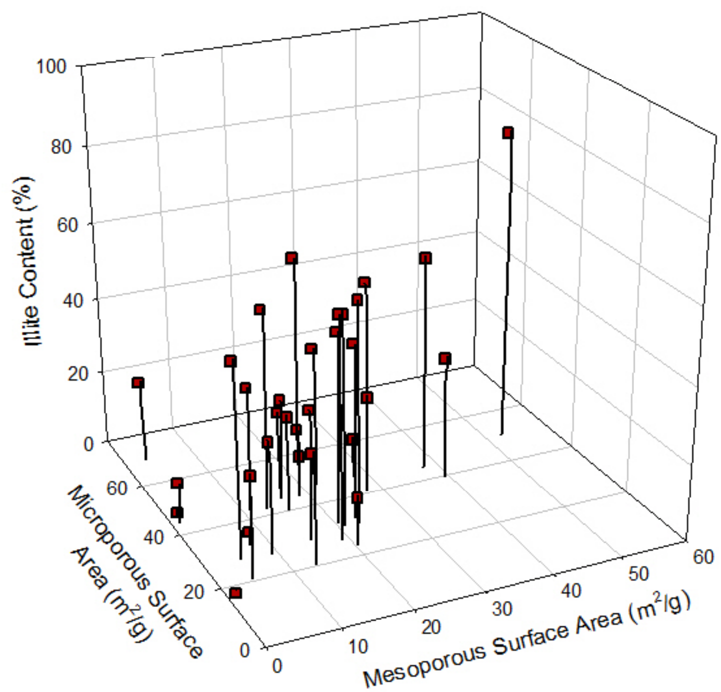
Methane Isotherms for Varying TOC Contents



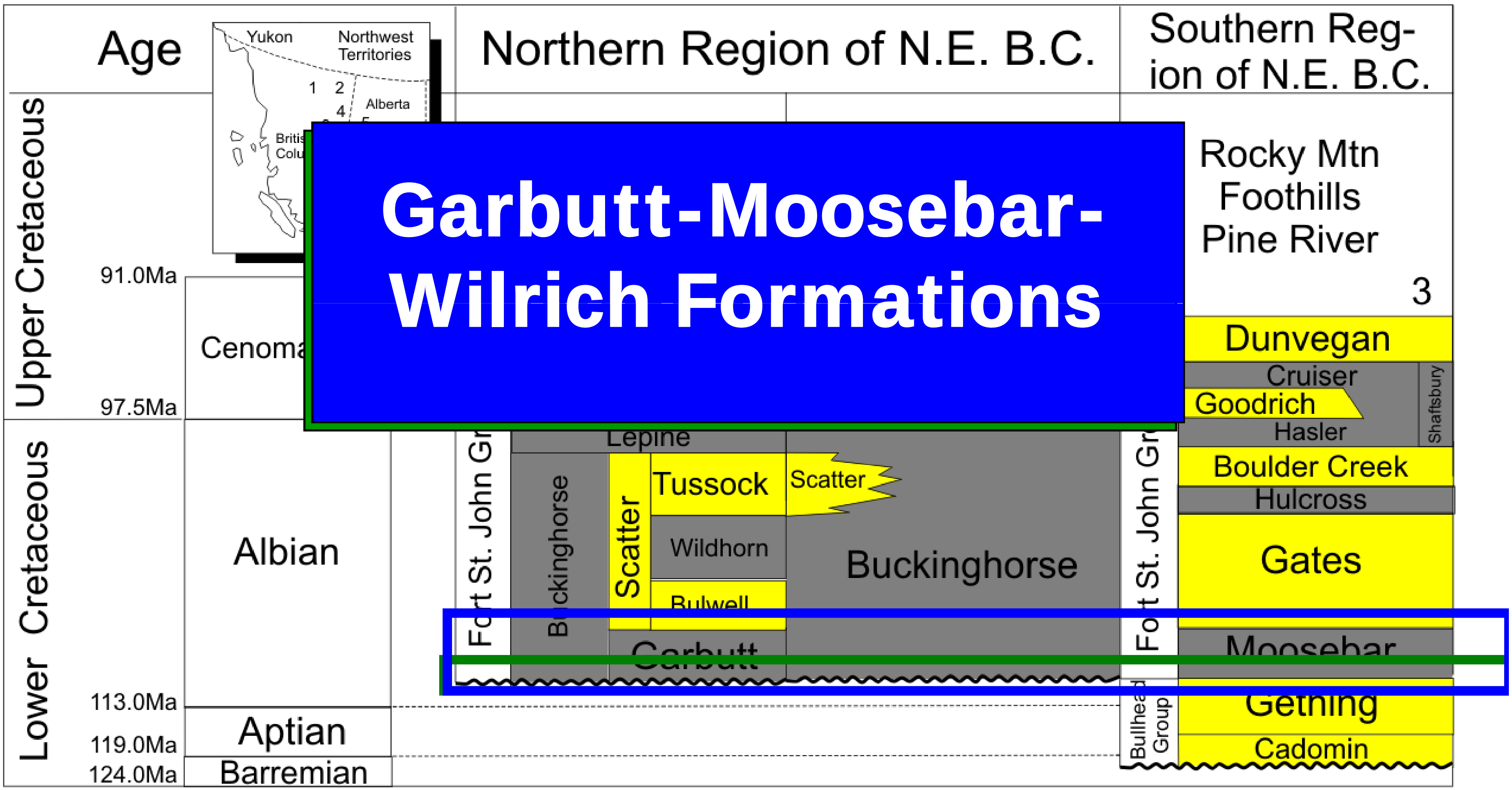
Importance of Microporosity & S.A.

- Surface area (S.A.) progressively increases with declining pore size at a fixed pore volume – i.e. S.A. increases with increasing microporosity (< 2nm)
- TOC greatest contributor to S.A. in shale
- Illite contributes to both micro- and mesoporous S.A.

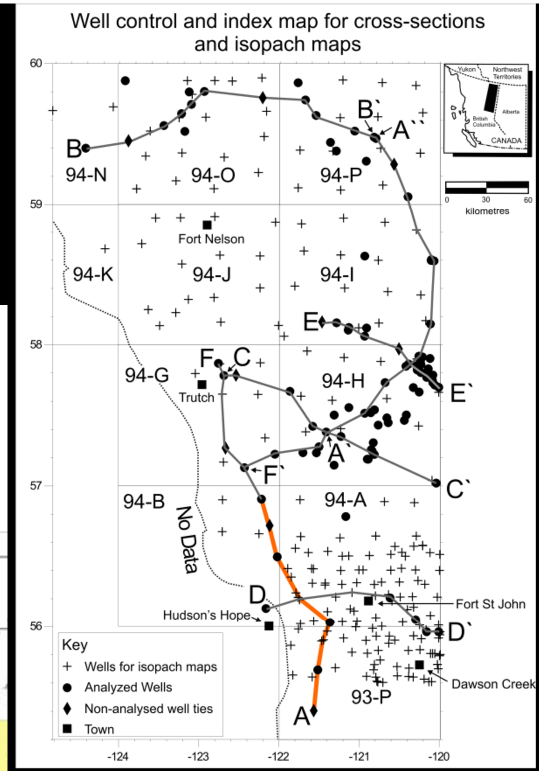


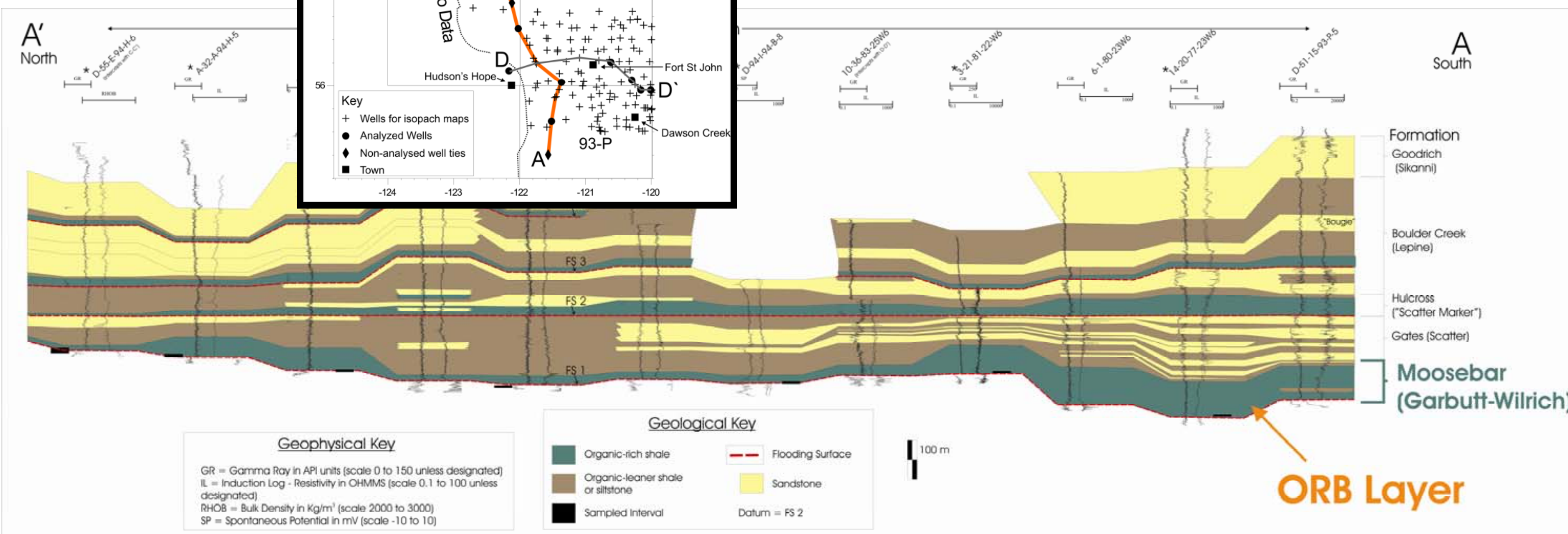


Two reservoir assessments for Buckinghorse Shale

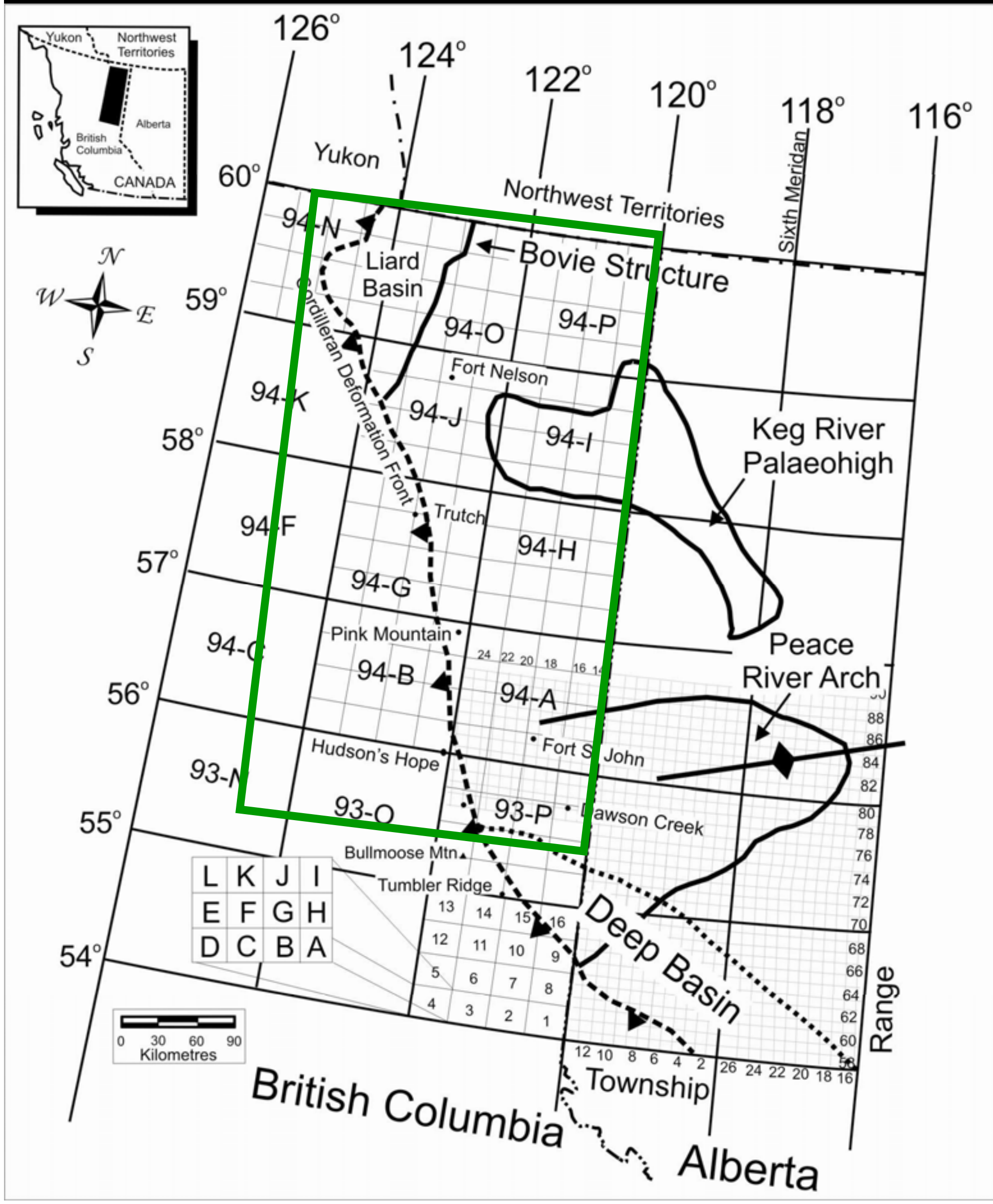


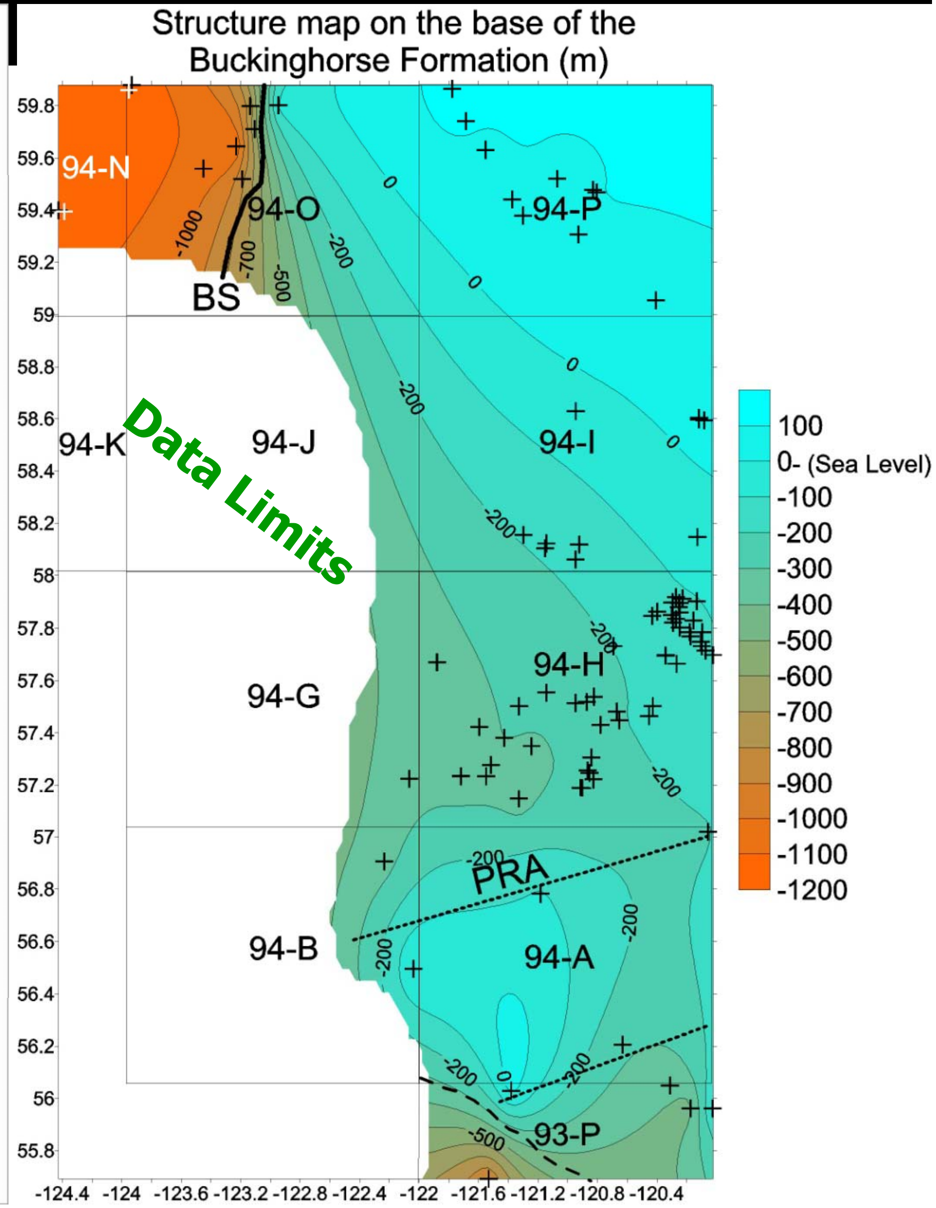
The Reservoir(s)



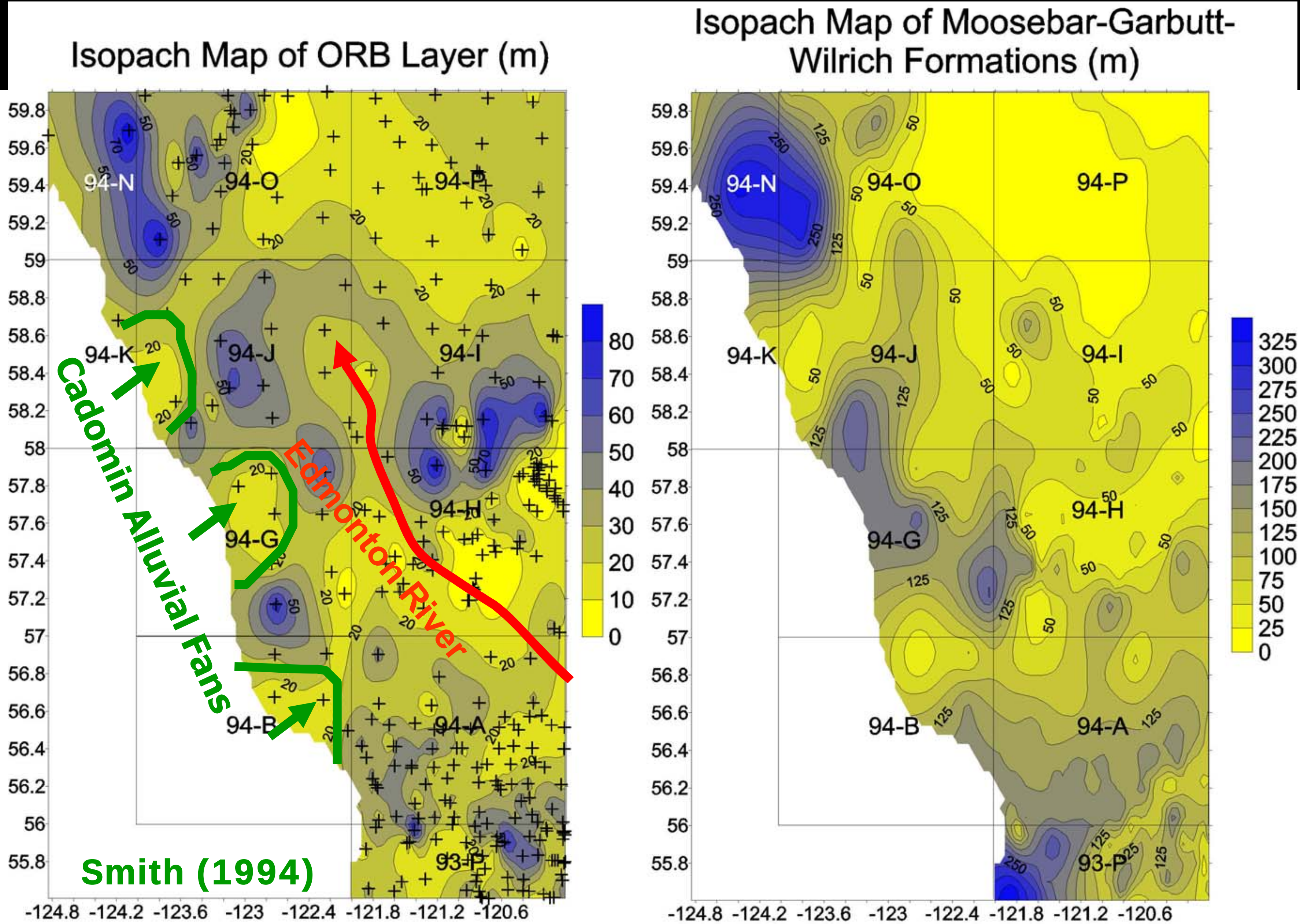


Basin Geometry & Structure

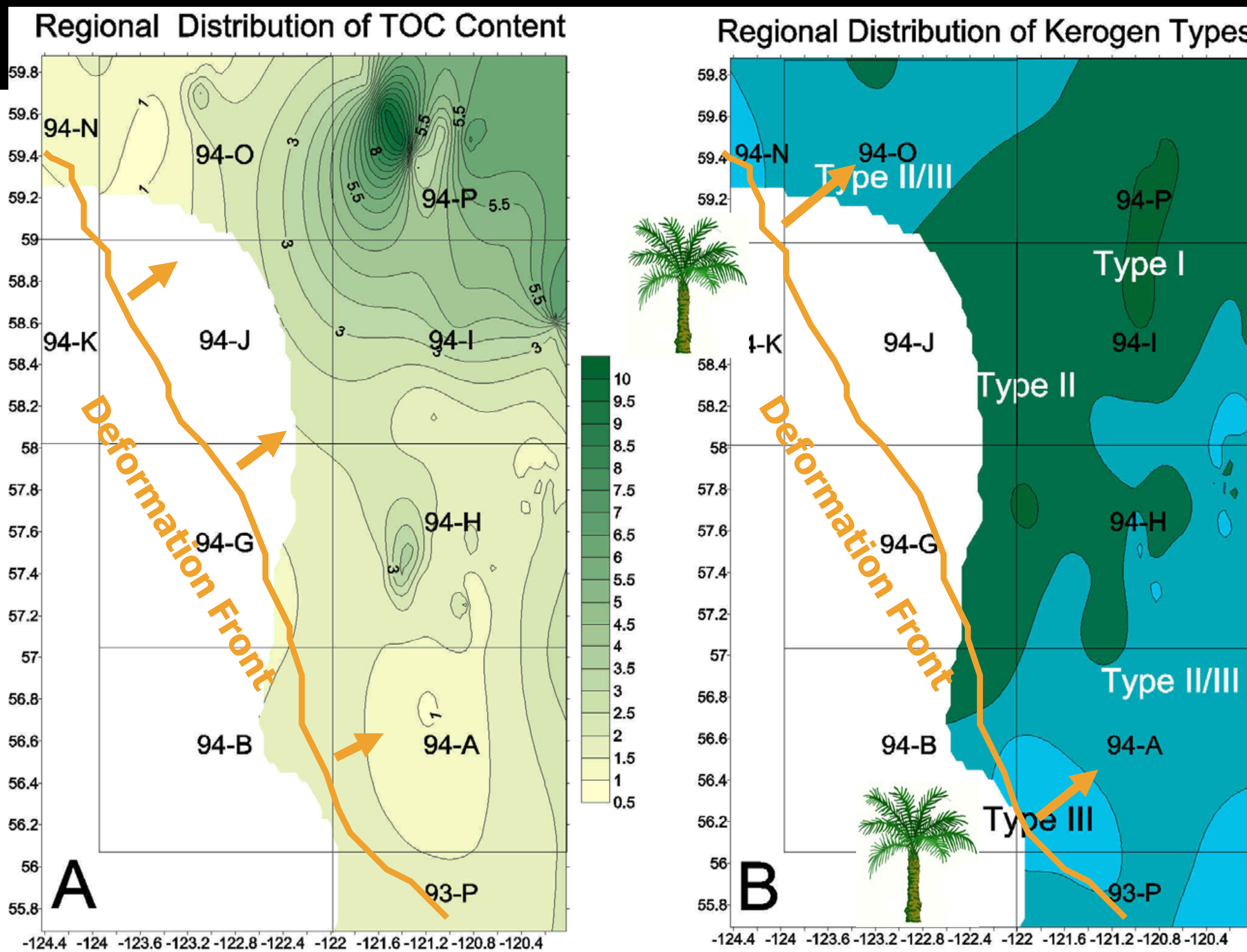




Isopachs of reservoirs



Distribution of TOC & Types



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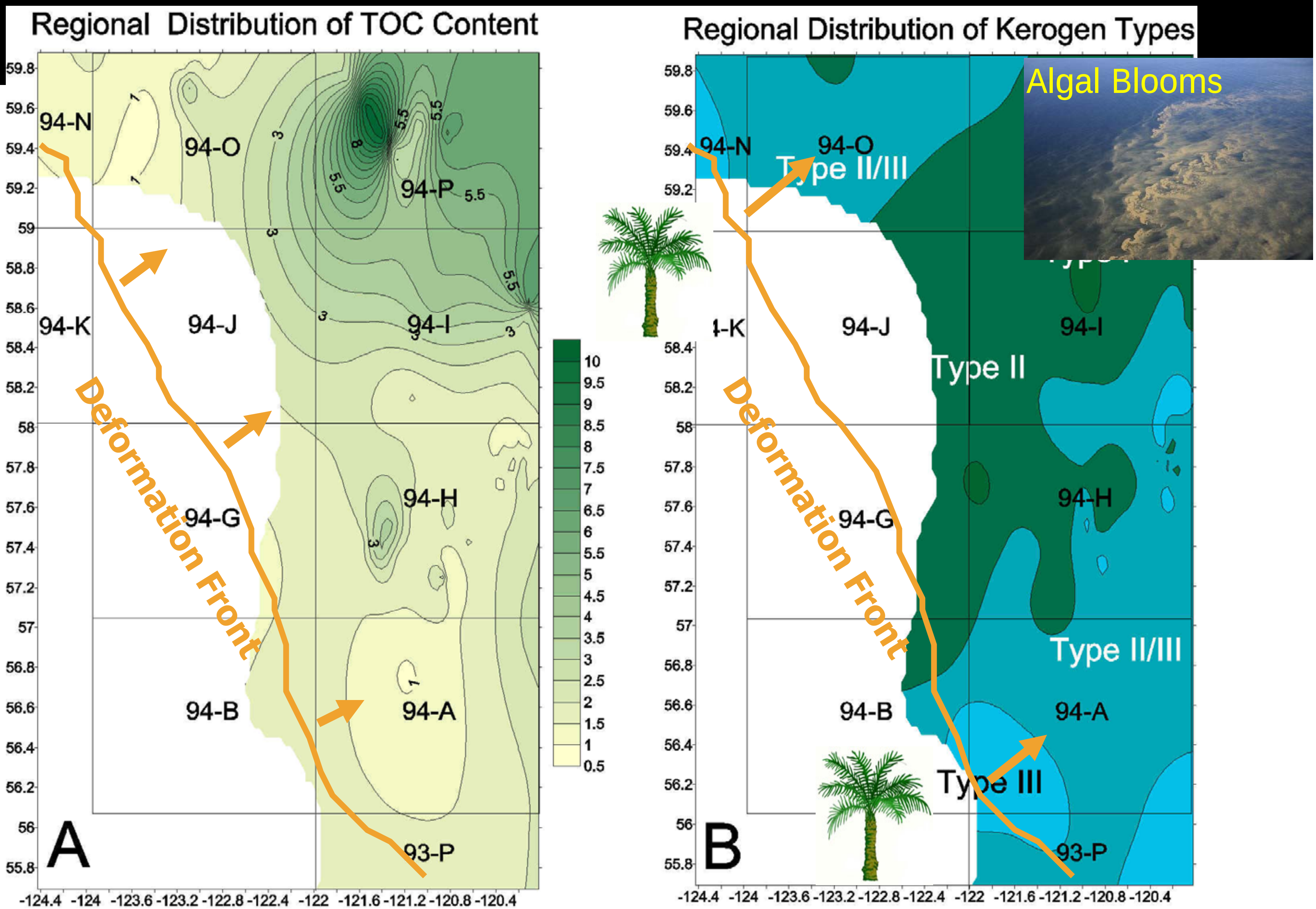
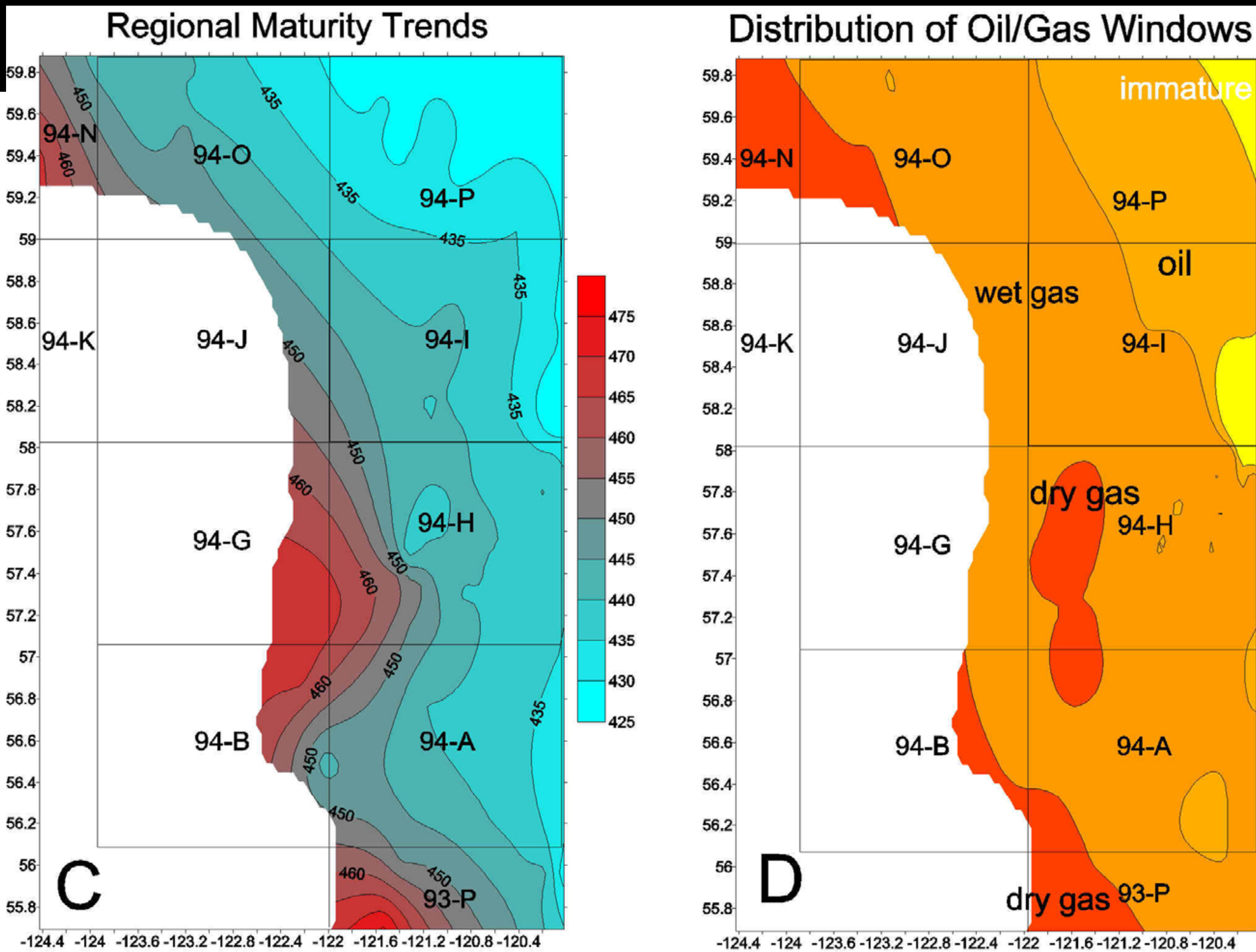
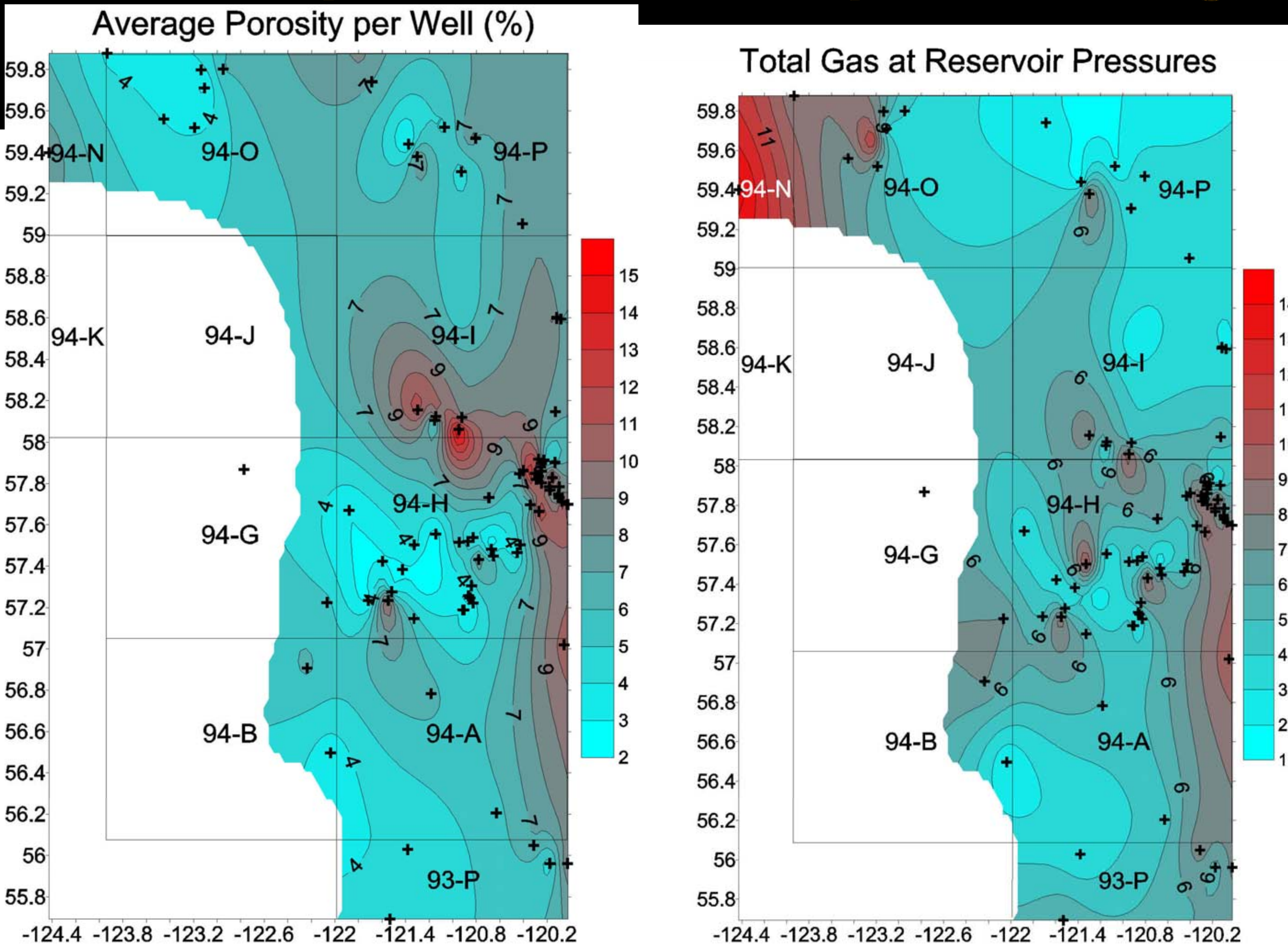


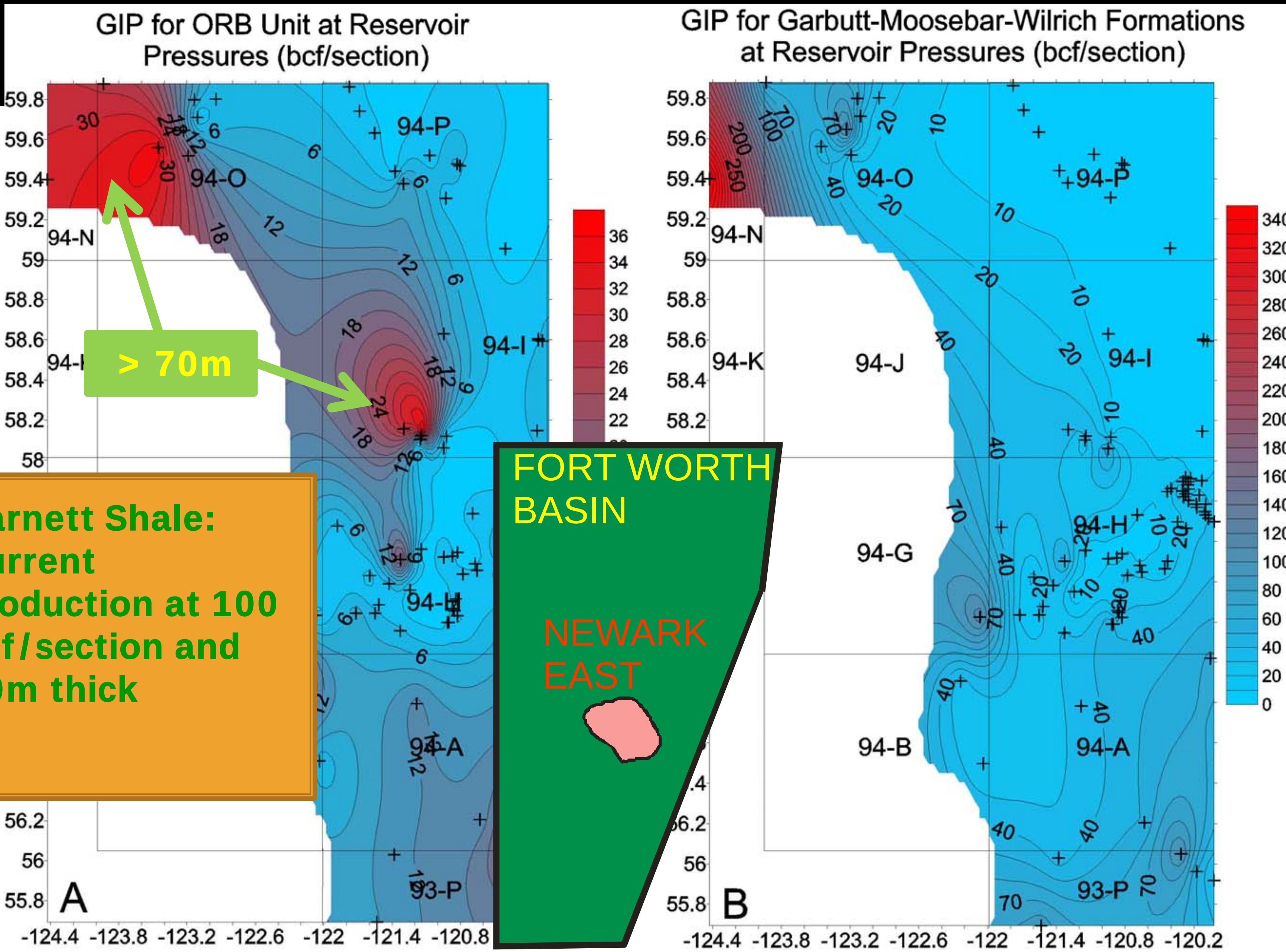
Maturity & Oil/Gas Windows



Methane Sorption & Total Gas Capacities (cm³/g)



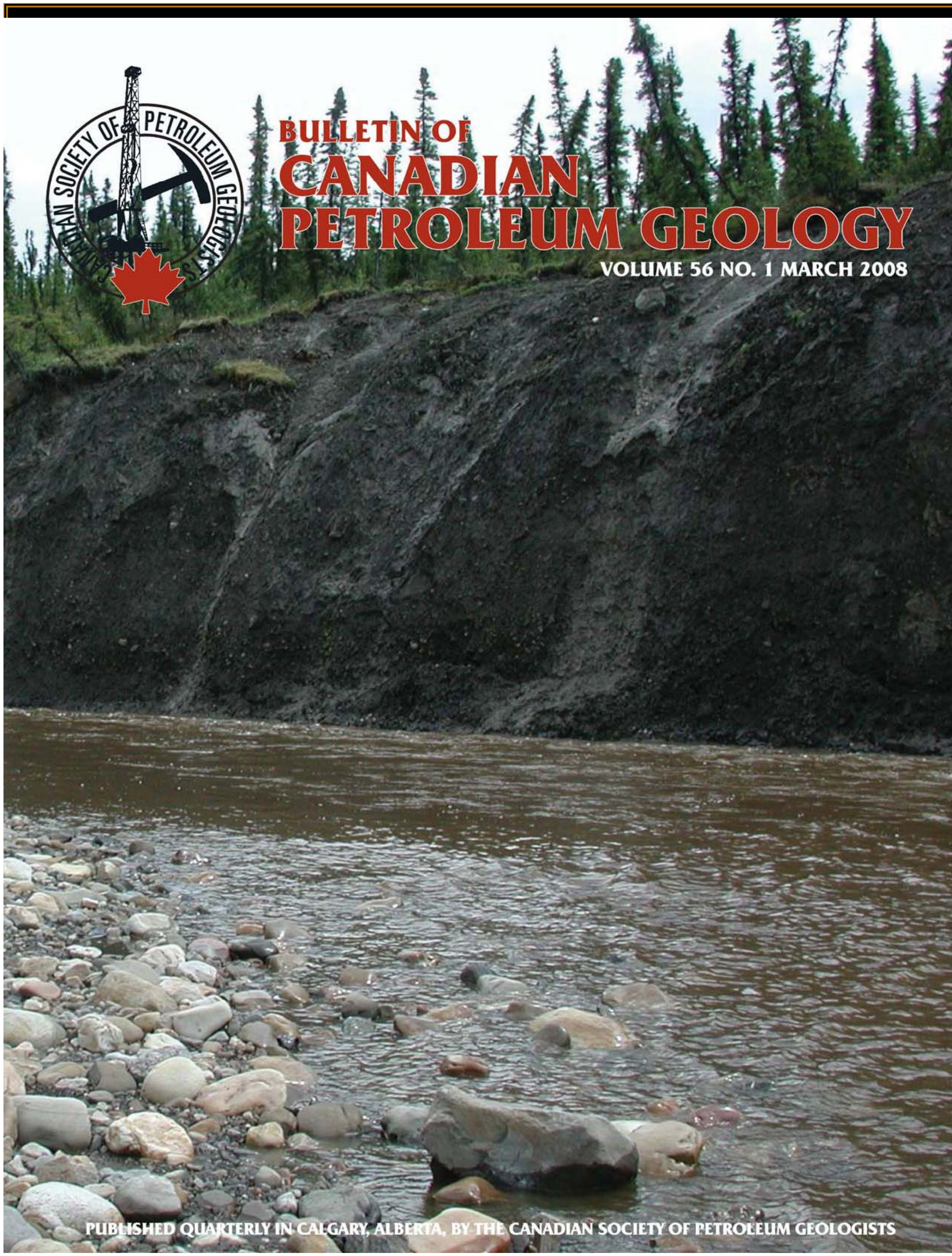
Gas-In-Place Estimates



Barnett Shale: Current production at 100 bcf/section and 60m thick

General Conclusions

- TOC dominates as control on CH_4 capacity
  - But is NOT the only control here!
- Clastic influx & maturity control the TOC distribution &, in part, CH_4 sorption capacity
  - Reservoir pressure increases sorption capacity adjacent to deformation front
- Total gas capacity was determined by sorption capacity, porosity and reservoir pressure
- GIP determined by total gas capacity & thickness



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