Lower Cretaceous Shelf-edge Trajectories, Shelf-indenting Canyons and the Potential Transfer of Coarser Clastics into Deeper Water, Sable Subbasin, Offshore Nova Scotia - Part 1

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Dogma:

"Sand is trapped on the shelf and there is little sand in deepwater parts of the Sable Subbasin off Nova Scotia"

...but there is a large, very sandy Lower Cretaceous delta system on the shelf ("Sable Island Delta"), and the identification of canyons that erode sandy delta topsets, coupled with an improved understanding of existing deepwater wells, implies that there is no plausible mechanism for the long-term trapping of sands on the shelf.

Overview:

The Cretaceous shelf-to-slope transition in the Sable Subbasin, offshore Nova Scotia, is commonly poorly imaged on seismic profiles. In part this is because of the complex structural geology across this important boundary. Even the simple mapping of shelf-edge trajectories has been problematic and there is significant uncertainty about how to correlate shelf strata onto the equivalent slope. Consequently, there has been disagreement about paleogeography and shelf-slope gross depositional environments.

In this poster we present two composite seismic profiles that provide type sections for stratigraphic correlation in the central and western Sable Subbasin. Line locations were carefully chosen to avoid salt structures and areas affected by large amounts of listric faulting while still remaining within the coverage of better-quality 3D seismic data-sets. The type sections demonstrate that correlation of seismic markers from the shelf into deeper water is possible when care is taken to select a route that avoids geologic features that degrade seismic imaging. Using a combination of 2D and 3D seismic data-sets, tied to available wells, this poster also provides a summary of the key Lower to mid-Cretaceous shelf to deepwater stratigraphic elements identified in the Sable Subbasin.

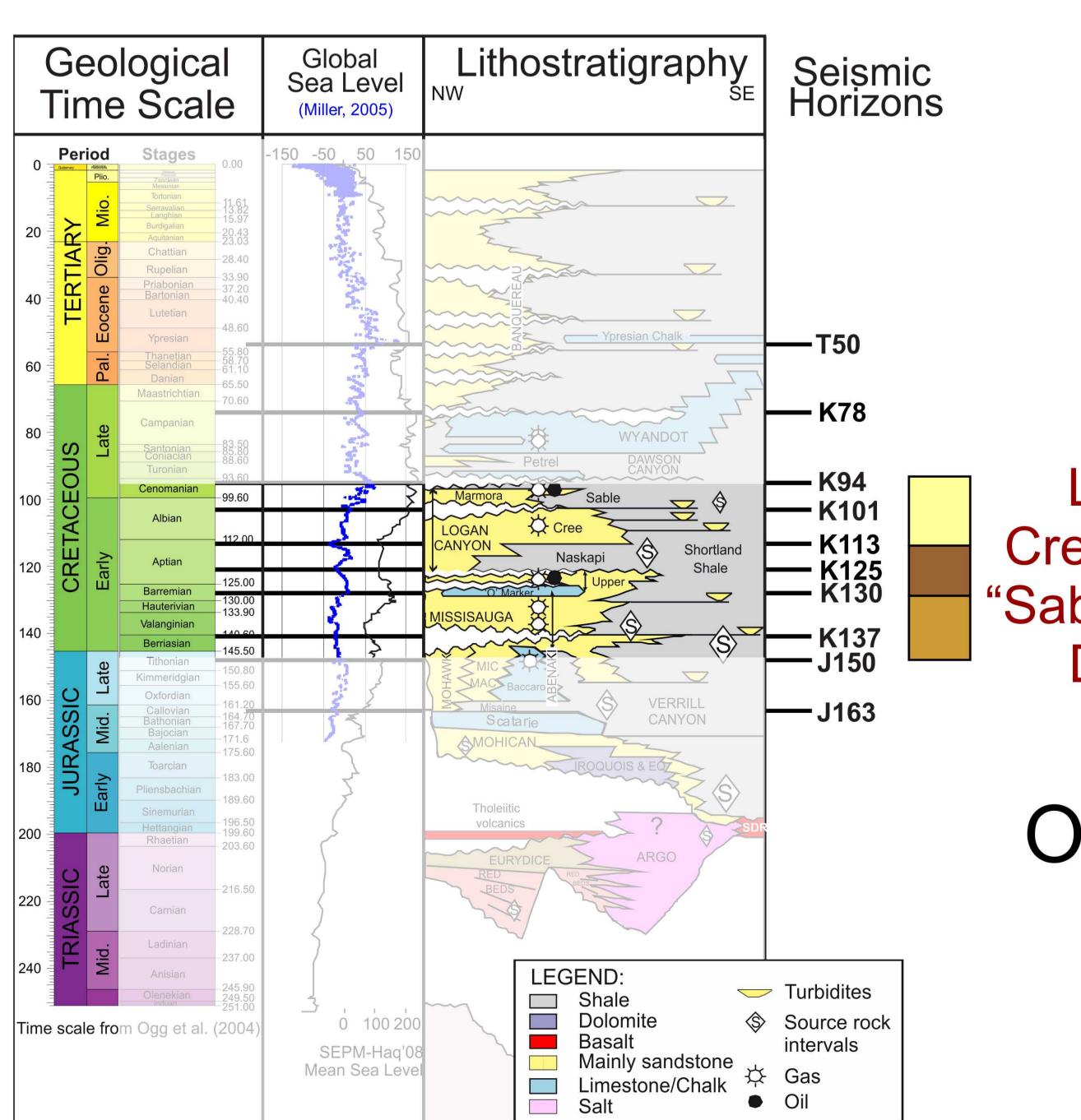


Figure 2 - Litho-chronostratigraphic chart for the Scotian Margin, modified from OETR Association (2011). Stratigraphy adapted from Wade and MacLean (1990) and Tankard and Welsink (1989).

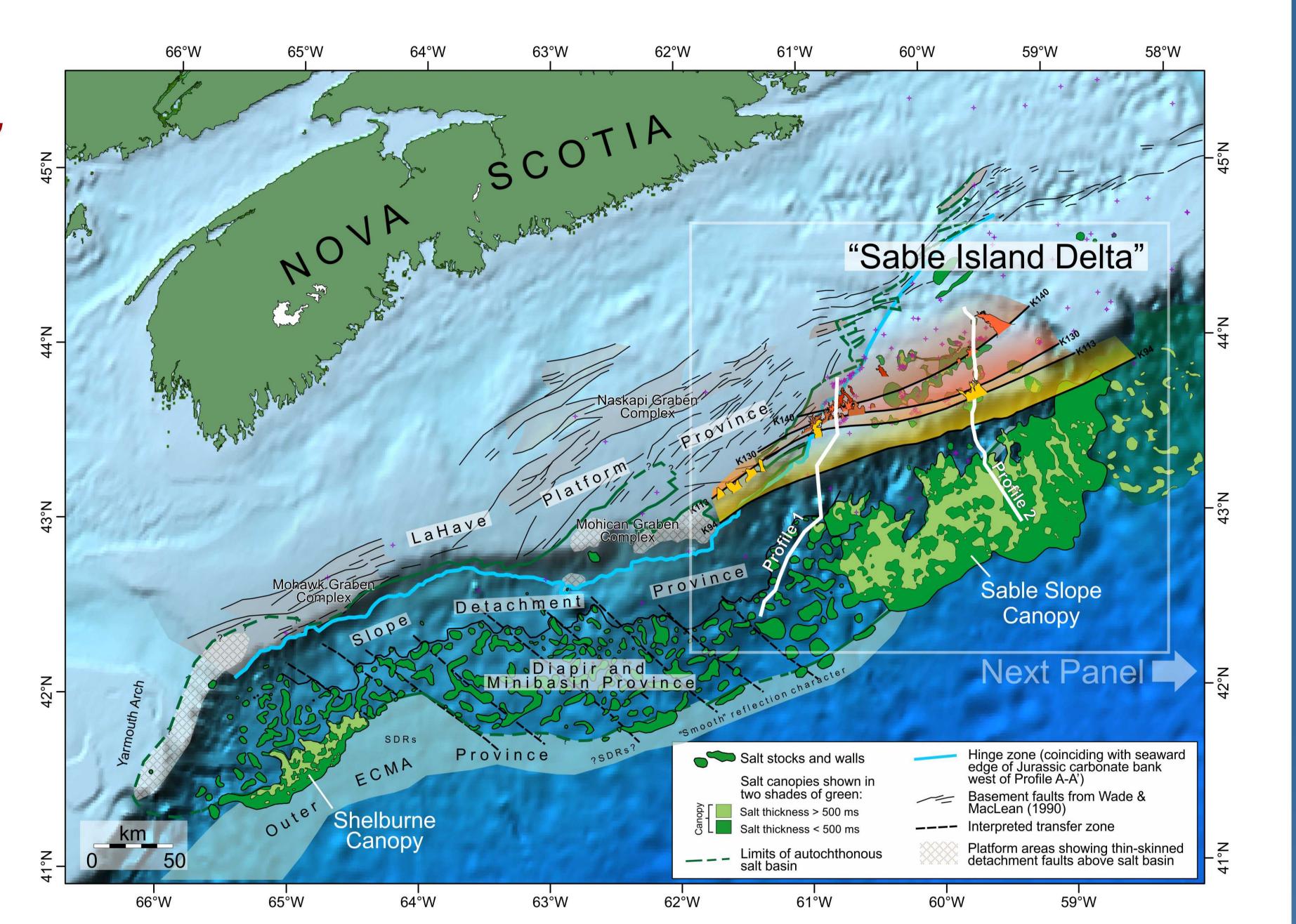


Figure 1 - Regional basemap showing distribution of salt bodies, key structural provinces and location of "Sable Island Delta" (see also Deptuck and Kendell, 2012).

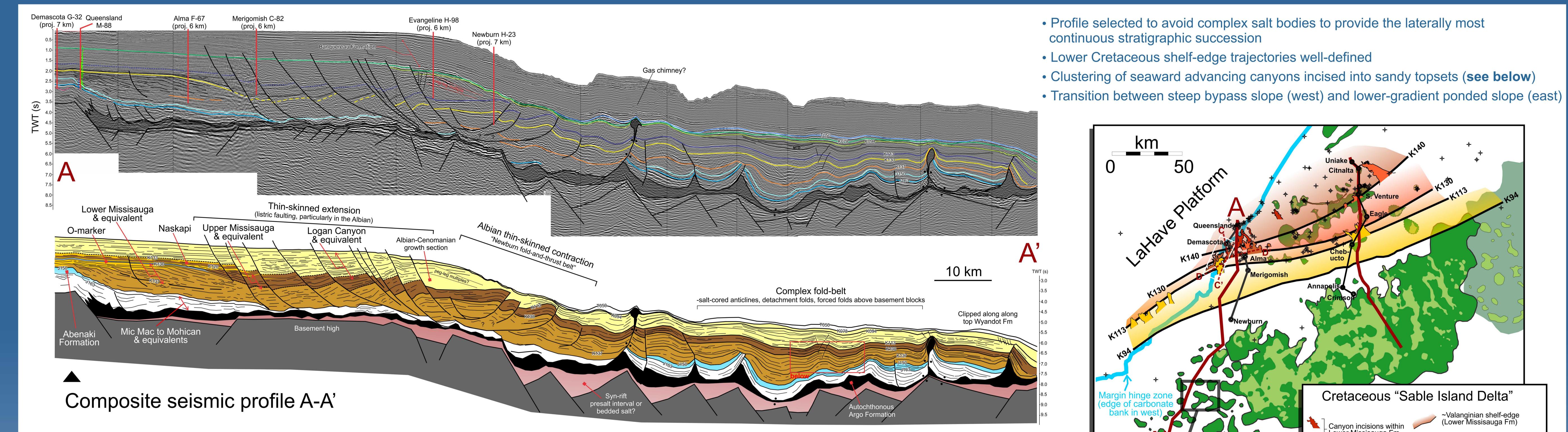
Both profiles show the broad-scale seaward advance of the Lower Cretaceous shelf depositional systems (i.e. south or southwest progradation of the "Sable Island Delta"; Figure 1). The temporal evolution of shelf-edge trajectories is based on a number of observations that include mapping the seaward-most extent of fluvial-deltaic channels from 3D seismic horizon slices, recognition and mapping of subtle offlap geometries on vertical seismic profiles (corresponding to potential shelf-edge locations), and the identification of numerous canyon heads that erode back onto the outermost shelf. In addition, listric growth faults commonly nucleate above some of the more prominent shelf-edge positions, offsetting progressively younger strata moving in the seaward direction, providing additional constraints. Our results are consistent with previous work by Cummings and Arnott (2006).

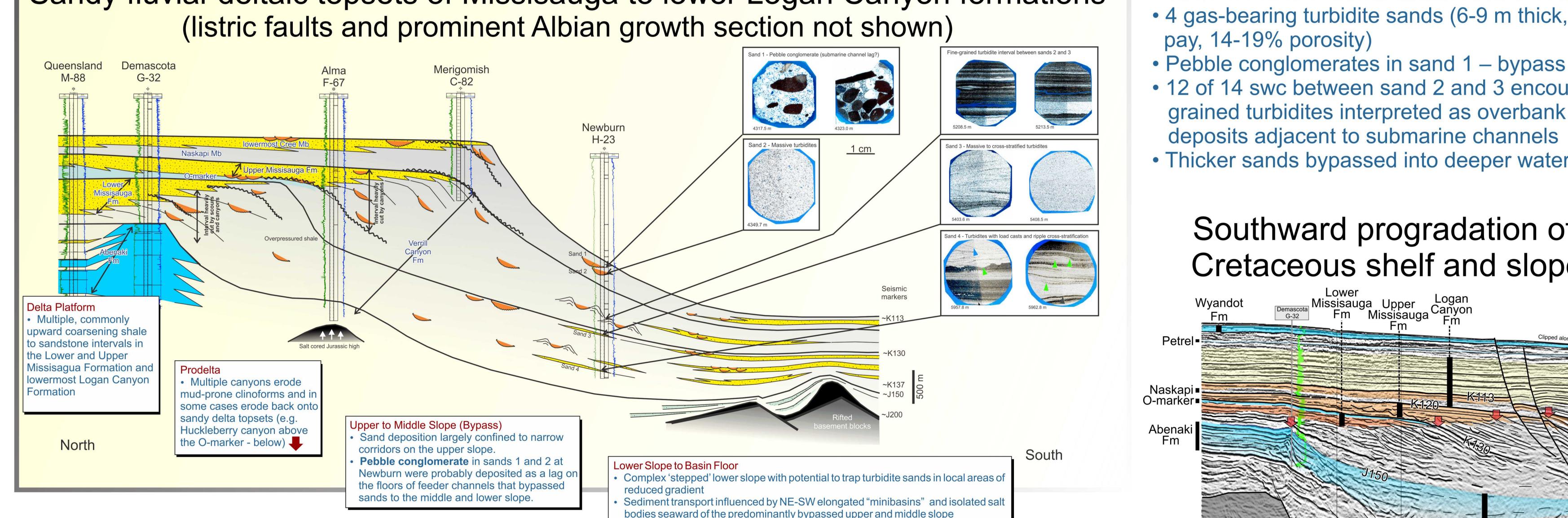
Improved understanding of the style and distribution of fluvial-deltaic channels on the shelf, combined with the mapping of shelf-edge trajectories and the identification, orientation, and timing of shelf-incised canyons, provides a basis for evaluating the potential for sand transport beyond the shelf-edge and into deepwater. Loop-scale 3D seismic facies work, coupled with time-thickness maps, provide additional constraints for defining sediment transport corridors seaward of shelf depositional systems. This information also provides a clearer understanding of slope morphology at the time of deposition, and helps explain why the five existing Lower Cretaceous deepwater wells outboard the Sable Subbasin failed to find thick intervals of high net:gross turbidite reservoirs (see second panel). Ultimately this approach should help reduce uncertainty and improve the prediction of deepwater reservoir presence and architecture in the Sable Subbasin.

Objectives:

- Using canyon head positions, maximum extent of fluvial channels (from 3D seismic), and stratal geometries, to present an improved understanding of Cretaceous shelf to slope gross depositional environments, and in particular Cretaceous shelf-edge trajectories.
- To provide context for the few wells that penetrate Lower Cretaceous deepwater strata and to help explain why they failed to find thick turbidite sands.
- To dispel the myth that the deepwater strata seaward of the Sable Island Delta are "sand lean". There is ample evidence that indicates coarse clastics on the shelf were indeed periodically transferred into deepwater in the Lower Cretaceous.

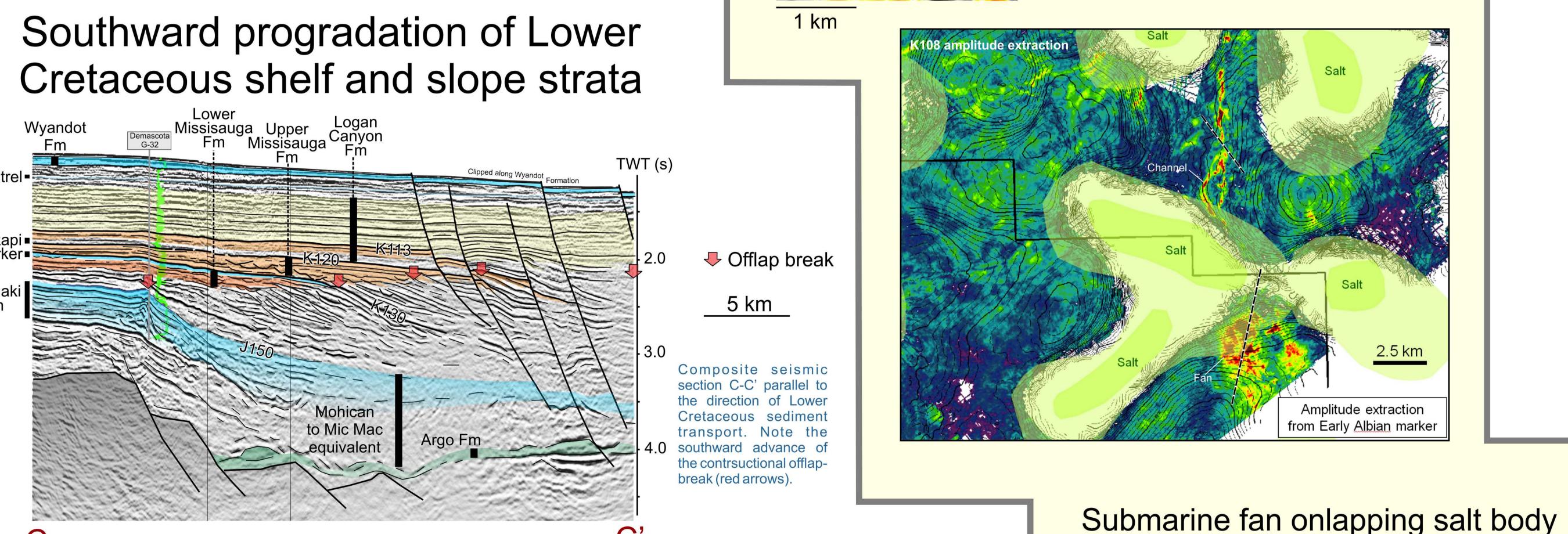
Westernmost Sable Subbasin





Multiple periods of canyon erosion near shelf-edge

- Sandy fluvial-deltaic topsets of Missisauga to lower Logan Canyon formations 40 m net sand in Lower Cretaceous succession • 4 gas-bearing turbidite sands (6-9 m thick, 8 m total
 - pay, 14-19% porosity) Pebble conglomerates in sand 1 – bypass channel lag
 - 12 of 14 swc between sand 2 and 3 encountered finegrained turbidites interpreted as overbank (levee)
 - Thicker sands bypassed into deeper water?



Submarine channel

Shingled to baselapping reflections and inverted minibasins

with 3-way closure (bottom image).

Cretaceous "Sable Island Delta"

Lower Albian

Submarine Fans

edge (lower Cree Member)

~Latest Albian to Cenomania

shelf-edge (Marmora Member