Sediment Supply vs. Accelerating Tectonic Subsidence: An Uphill Struggle for the Last Dunvegan Deltas

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Abstract
The internal stratigraphy of Dunvegan allomember A has never been resolved. An exceptionally detailed stratigraphic framework consisting of 964 wells, 15 cores, and 32 outcrops reveal that allomember A comprises seven 'parasequences' (A1-A7, oldest to youngest) that record a series of high-frequency relative sea-level changes.

Parasequences A1-A3 are typically 3-6 m thick, sheet-like bodies that extend basinward for over 200 km in dip and strike direction. They contain poorly developed shoreline sandstones oriented SSW-NNE. Parasequences A1-A3 are capped by a subaerial unconformity, marked by paleosols, and incised by sandstone-filled valleys up to 15 m deep that cut through several underlying parasequences. Parasequences A4-A6 are wedge-shaped and show progressive north-westward displacement of the lap-out limit. Parasequences A4-A6 contain one or more elongate shoreline sandbodies up to 12 m thick, 100 km long and 10 km wide that trend NE-SW. Successive sandstone bodies are mutually evasive, suggesting that accommodation was extremely limited. Parasequence A7 is muddy and fills remnant accommodation seaward of A6.

The change from tabular to wedge-shaped parasequences records renewed thrusting and attendant flexural subsidence. This resulted in partitioning of sediment into the alluvial foredeep and starvation of outboard deltas, leading to major marine trangression at the base of the Kaskapau Formation. The south-easterly thinning of successive parasequences is interpreted to record lap-out against a forebulge that was located ~250-300 km from the deformation front. Linear shoreline sandstones in parasequences A1 to A6, and in the overlying lower Kaskapau (A-X and Doe Creek units) show strong spatial coincidence, suggesting control by underlying tectonic elements, or by evaporite dissolution in the Triassic Charlie Lake Fm.