

Tectonic Controls On The Deposition And Preservation Of Anomalously Thick Sandstones Of The Doig And Halfway Formations And Its Implication On Exploration

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ABSTRACT

The distribution and architecture of sedimentary units are dominantly controlled by eustasy, tectonics, sediment supply, and hydrodynamic regime of the depositional basin. Exploration of the Doig and Halfway formations in the WCSB has been hampered because of stratigraphic correlation problems that warrant a revised regional depositional model with age controls. A detailed study of the Doig and Halfway formations between townships 70 and 87, west of 6th meridian to Alberta/BC border include a multitude of depositional environments, where synsedimentary and penecontemporaneous tectonics exerted the major control on creation of accommodation space and deposition and preservation of stratigraphic sequence(s), parasequences, and parasequence sets.

Thirteen sedimentary facies with distinct sedimentological characteristic are grouped into five lithofacies successions: 1) offshore/shelf, 2) offshore transition, 3) shoreface, 4) estuarine, and 5) carbonate ramp. Contrary to the general belief, the phosphate-rich lower part (the so-called amalgamated condensed section) of the Doig Formation is primarily composed of sandy and muddy siltstone, not shale, and contains at least two high order sequence boundaries (possibly 4th or higher order); one of which is thought to be the result of a eustatic sea level change. Three other potential sequence boundaries have been identified in the Doig - Halfway interval that are possibly driven by tectonically induced sea level changes. Conodont biostratigraphy has been used to discriminate age correlation within the sequences. The conodonts also serve as maturity indicators and aid in paleoecologic interpretations.

Sandstone bodies with variable thicknesses within the Doig-Halfway interval, above the phosphatic zone, are parallel to subparallel to paleodepositional shoreline. Thick (up to 30m) mudstones, commonly occur inboard of the anomalously thick barrier island sandstones, and were possibly deposited in a tectonically induced estuary. Bedforms in the anomalously thick sandstone bodies show a paleolandward migration pattern in the dip-log as opposed to the basinward migration pattern of their thin lateral equivalents. Isopach maps using the stratigraphically significant surfaces within the Doig-Halfway interval suggest a north- and west-ward shift of the depocentre through time. Most, if not all, of the unconformities within the Doig-Halfway succession merge with the Coplin unconformity toward the paleobasin margin.