A Revised Stratigraphic Architecture and History for the Horseshoe Canyon Formation (Upper Cretaceous), Southern Alberta Plains

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A revised stratigraphy for the paralic-to-continental Horseshoe Canyon Formation (265 m; Upper Cretaceous; Alberta plains) highlights the varying influences of changes in relative sea level, tectonism, and climate. Five units are recognized. Unit 1: marine-to-nonmarine transitions; very coaly; east-west cross sections below a bentonite datum are tabular and thicken weakly to the west; cross-sections above the datum are strongly wedge-shaped, and thicken to the west, indicating an increase in sediment supply and subsidence. Unit 2: reduced bed thicknesses; marine transgression; evidence for a seasonally dry climate. These features indicate a rise in sea level coincident with a reduction in both sediment supply and accommodation, and an absolute reduction in subsidence. Unit 3: stacked shoreline sandstones and alluvial sandstones ubiquitously cemented with iron carbonate, suggestive of a highstand systems tract. Unit 4: non-coaly; sub-equal paleochannel-overbank representation; non-amalgamated channel deposits; coarse-grained volcanic ash; These features indicate resurgent tectonic activity with increased sediment supply to the plains. Unit 5: two coal zones; multistoried fine-to-medium grained alluvial sandstone bodies with localized lags of extraformational pebbles. These features suggest foredeep rebound, a return to a wetter regional climate, and decreasing accommodation in the plains. Conclusions: 1) a newly recognized bentonite-rich zone in Unit 1 serves as an effective stratigraphic datum in the plains region; 2) decreasing rates of subsidence in Unit 2 are most likely due to a forebulge rise in response to overthrusting and mountain building, which requires the transgressive event to be interpreted as a global-eustatic rise in sea level; 3) the co-occurrence in Unit 2 of seasonal dryness and tectonic uplift suggests that climate change was driven by regional uplift and a rain-shadow effect; 4) Although three sandstone-rich zones may have hydrocarbon potential (top of Unit 1, Unit 3, and Unit 5), Unit 5 has the best potential for exploitation.