Tectonic Forcing, Subsidence, and Sedimentary Cyclicity in the Upper Cretaceous, Western Interior U.S.A.

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Abstract

Sequence stratigraphy is an observationally-based method for interpreting sedimentary cyclicity. Stacking patterns of progradation, retrogradation and degradation are related to the balance of sedimentary accommodation versus sediment supply. While often related to eustasy, accommodation is also controlled by tectono-subsidence. Based on over 50 global examples, regional subsidence and uplift rates are usually greater than rates of sea level rise/fall for durations greater than about one million years. Thus, in many basins, the larger scale patterns of sedimentary cyclicity are driven by tectonics.

The Upper Cretaceous of the Western Interior is an ideal laboratory to evaluate stratigraphic response to tectono-subsidence. Based on the stratigraphic framework, geohistory analyses, mapped shorelines and interpreted 2nd order system tracts, there is a strong correlation between subsidence rates and shoreline trajectories/stacking patterns. Large scale transgressions correlate with marked increases in subsidence, while strongly regressive intervals correspond to periods of low subsidence (or uplift). For example, the widespread transgression that occurs above the Turonian (e.g., Niobrara-Baxter-Cody) is associated with a large increase in regional subsidence. And the strongly progradational interval in the Upper Campanian that occurs throughout Wyoming (e.g., Ericson-Pine Ridge-Teapot) corresponds with uplift in proximal areas and reduced subsidence rate in more distal areas.

Moreover, the patterns of large-scale cyclicity changes along strike. A transect through the Green River to Powder River Basin shows a complicated large-scale stacking pattern with three complete 2nd order cycles in the Upper Cretaceous, correlative to regional subsidence/uplift events. A transect through the Uinta to North Park Basin has only two cycles, with much less complexity in the Campanian-Maastrichtian stacking and subsidence. To the south, the San Juan Basin has three cycles, but these are not coeval with those seen in the northern transects. Subsidence-driven large-scale cyclicity controls exploration play elements, especially reservoir-seal couplets. Along-strike variability in regional subsidence is important in controlling the petroleum system play elements of source, seal and reservoir. It also indicates variation in lithospheric architecture/processes. Drivers may include variations in the angle and nature of the subducting plate.

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