High-Latitude Shoreface to Coastal-Plain Transitions: The Schrader Bluff and Prince Creek Formations at Shivugak Bluff, North Slope, Alaska

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Studies of shelf to coastal-plain-transitions are common in lower latitude settings; however, few studies address the nature of high-latitude systems. On the east margin of Alaska's National Petroleum Reserve, Shivugak Bluff contains Upper Cretaceous strata of the shallow-marine Schrader Bluff Formation (Fm) and the continental Prince Creek Fm deposited at a high paleolatitude (> 70° N). A multiyear study to record facies, contacts, architecture, and ichnofacies was initiated at Shivugak Bluff, where two successions, 54 and 124 m thick, were measured through the interfingering Schrader Bluff and Prince Creek Fms. Lithologies include very fine- to coarse-grained sandstone, siltstone, mudstone, claystone, carbonaceous shale, coal, and bentonite.

Common sedimentary structures in the Schrader Bluff Fm include hummocky cross-stratification (HCS; up to 4 m wide), symmetric and asymmetric ripples, bidirectional (herringbone) cross-stratification, planar lamination, scour and fill structures, as well as flaser, wavy, and lenticular bedding. Very fine- to fine-grained sandstone with HCS and minor interbeds of symmetrical (wave) ripples are interpreted as proximal lower shoreface deposits. Medium-grained sandstone containing conglomeratic layers and symmetrical ripples associated with bidirectional cross beds are interpreted as upper shoreface deposits. Very fine- to medium-grained sandstone with low-angle planar cross lamination, symmetrical ripples, and rare asymmetrical ripples are interpreted as beach foreshore deposits. Intervals of interbedded very fine- to fine-grained sandstone, siltstone and mudstone with flaser, wavy, and lenticular bedding are tentatively interpreted as estuary, back bay, and or interdistributary bay deposits (pending micropaleontology results).

In contrast, the Prince Creek Fm primarily contains trough cross-stratified and current-rippled sandstones containing indicators of both downstream and lateral accretion. Fine-grained facies include thin (< 1m thick) sheet sandstone, carbonaceous siltstone, organic mudstone, carbonaceous shale, and coal (up to 1.5 m thick). Multistory fine- to coarse-grained channelized sandbodies (6 to 9 m thick) exhibiting primarily downstream accretion are interpreted as braided fluvial deposits. Sandbodies (6+ m thick) containing primarily lateral accretion are interpreted as meandering stream deposits. Finer grained facies record deposition on levees and splays and in floodplain, lakes and swamps.

Field observations indicate at least four shoaling upward cycles at Shivugak Bluff based on the interfingering of shoreface successions with facies containing rhizoliths in paleosols, dinosaur tracks, and fluvial channels. These world-class outcrops are analogs for North Slope, shallow, viscous-to-heavy oil reservoirs (West Sak and Ugnu sands) and can serve as a model for a high-latitude shoreface to coastal-plain transition during the Cretaceous greenhouse.