AAPG Datapages/Search and Discovery Article #90302 ©2017 AAPG Pacific Section Annual Meeting, Anchorage, Alaska, May 21-24, 2017

Influence of Inherited Sequence Stratigraphic Geometry on the Structure of the Foreland Fold-and-Thrust Belt, Central Brooks Range, Alaska

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ABSTRACT

The south-facing ultimate shelf margin of the Upper Jurassic to Neocomian Kingak Shale in the southern National Petroleum Reserve in Alaska (NPRA) results in the stacking of three significant condensed sections, the Triassic Shublik Formation, the Lower Jurassic lower Kingak Shale, and the composite Hauterivian pebble shale unit and Barremian to Albian gamma-ray zone (GRZ) of the Hue Shale. This stratigraphically localized concentration of organic-rich shale controlled the northern limit of the master thrust detachment in the foreland during Paleogene deformation. Northward-vergent thrusting along this master detachment ramps up section to a less well-developed upper detachment to the north. The Carbon Creek Fault Zone, an oblique imbricate system whose orientation is controlled by the geometry and orientation of this shelf margin and corresponding facies changes, segments the foreland into two distinct structural domains that are expressed geomorphically as the southern and northern foothills. Imbrication and uplift are more significant in the southern foothills, but imbrication also is present in the northern foothills, with thrusts that locally ramp up to the paleo-surface. Along trend to the east, this zone transitions into a triangle zone at the Tuktu escarpment, analogously segmenting the foreland into a more deformed southern belt and a less deformed northern belt with similar detachment levels. Across the foothills structural domain in NPRA, shale-rich slope facies in the Lower to middle Cretaceous Torok Formation are structurally thickened to form distinctive fault-bend folds, with superimposed gentle detachment fold segments localized within the slope facies. The map-view geometry of these folds in southern NPRA lacks the large aspect ratio common in many foreland fold-and-thrust belts with more locally plunging and en echelon segments. Along trend east of NPRA, similarly localized structural thickening occurs in parts of the Torok Formation and in the Upper Cretaceous Seabee Formation, but with more pronounced detachment folding and duplexing in the less competent cores of larger folds. In places, imbricate stacking caused steep-limbed folds to form above roof thrusts with more continuous lateral extent. This change in the amount of thickening in incompetent units also appears to have been influenced by the presence of north-south trending lowstand sequence boundaries draped by transgressive shale in both the Torok and Seabee Formations. Subsequent north-vergent thrusting during the Paleogene preferentially detached along many of these transgressive shale drapes. Thus, folds terminate laterally at this boundary.