A Review of the Age of Rifting in the Alaskan Beaufort Sea and the Nature of the Lower Cretaceous Unconformity (LCU)

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We present new data and integrate existing data to support three conclusions: (1) North Alaska continental rifting commenced at least as early as Early Jurassic, (2) the Lower Cretaceous Unconformity (LCU), a regional angular unconformity that records widespread Hauterivian (ca. 133 Ma) sub-aerial exposure and plays a crucial role in North Alaskan petroleum systems, is not the Canada Basin "breakup" unconformity, and (3) the term "breakup" unconformity should be discarded.

Toward our first conclusion, we present several seismic-stratigraphic relationships from the Alaskan Beaufort Sea that demonstrate Early Jurassic rifting. For example, we document (a) Early Jurassic events onlapping south-dipping Triassic reflections on the south side of the Orion Rift Shoulder in the Central Beaufort Sea; (b) north-dipping Middle-Early Jurassic reflections sharply downlapping onto an Early Jurassic unconformity within a rotated fault block on the north side of the Orion Rift Shoulder in the Western Beaufort Sea; and (c) Early Jurassic reflections onlapping the tilted and faulted southern side of the Dinkum Plateau. Together, these observations strongly support rifting at least as old as Early Jurassic.

In all examples, the LCU seismic marker clearly post-dates the formation of the rift structures. Similar observations have led many workers to reasonably conclude that the LCU is a classic "breakup" unconformity of Falvey (1974) associated with the onset of Canada Basin sea-floor spreading. We integrate potential fields interpretations (e.g., Grantz et al., 1998, Gurevich et al., 2006) and other data to support our second conclusion: the LCU is not a "breakup" unconformity since it formed +/- 20 Ma after spreading commenced in the Jurassic. Rather it is a post-rift feature that likely represents a response to flexural uplift (involving rift-fault reactivation) associated with Brookian orogenesis.

Similar interpretations have been made by other workers (e.g., Grantz and May, 1983; Coakley and Watts, 1991), but it currently seems underappreciated in the literature that North Alaska rifting is this old or that the LCU is not a rift-related unconformity. These interpretations have implications for hydrocarbon exploration in North Alaska and for reconstructions of the Canada Basin. For example, the Kuparuk River Formation (C member) is commonly referred to as "the" syn-rift reservoir even though that unit is not only post-rift, but very likely post-drift.

True syn-rift reservoirs must be older than the onset of spreading (Jurassic) and have not yet been targeted in North Alaska as such. Regarding Canada Basin reconstructions, a conjugate “breakup” unconformity in Arctic Canada is not expected in our interpretation because that area was unaffected by Brookian orogenesis.

Finally, as the understanding of rift systems evolves, the term “breakup” unconformity continues to cause confusion. We suggest the term be discarded because such features are not as universal (see also Peron-Pinvidic et al., 2006), as originally implied.