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THE DELTAIC SHORELINE OF LARAMIDIA

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Introduction and Background

During the mid-late Cretaceous, North America was split into two landmasses by the north-south oriented Western Interior Seaway (WIS), which developed in the backbulge depozone of the Sevier retroarc foreland-basin system in response to dynamic topographic processes. The western landmass has been referred to as Laramidia, with the eastern landmass referred to as Appalachia. This presentation focuses on the extent, common facies relationships, and geochronology of the deltaic shoreline that formed on the east side of Laramidia, and is included in the Cretaceous Dakota Group.

The Dakota Group sits unconformably on the Jurassic Morrison Formation and related stratigraphic units in the Colorado Front Range, and consists of basal fluvial sandstones of Aptian age that both incise, and rest on, the sub-Cretaceous unconformity (SCU). The Skull Creek formation, representing mudstones of the Albian Kiowa-Skull Creek cycle of the WIS, overlies the basal Cretaceous fluvial sandstones, and is overlain by the Albian to Cenomanian Muddy sandstone. The Muddy (commonly referred to as the "J" Sandstone in the subsurface), has a lower deltaic unit called the Ft. Collins Member, and an upper fluvial unit called the Horsetooth Member. The sharp erosion surface that underlies the Horsetooth member, and separates the Horsetooth from the Ft. Collins, has traditionally been interpreted as a classically-defined sequence boundary, which implies that it represents an unconformity, rather than a simple autogenic scour surface created by extension of fluvial systems across a delta plain.

Detrital zircon (DZ) U-Pb data from the Muddy sandstone fluvial and deltaic components provide insight into provenance and facies relationships, and enable a test of whether facies relationships represent large-scale forcing by sea-level fall, or simple and common autogenic processes like avulsion. DZ U-Pb samples were initially collected from the fluvial Horsetooth Member over a north-south distance of >800 km, from Wyoming to New Mexico. More recently, DZ U-Pb samples were collected from the deltaic Ft. Collins Member at four locations along the Colorado Front Range over a distance of ~125 km, to test how much time is represented by the erosion surface that has been interpreted as a sequence boundary unconformity.

Results and Conclusions

The following results emerge from our study. (a) DZ U-Pb provenance data makes it clear that the Ft. Collins Member represents deltaic facies that are related to at least 2 separate river systems with headwaters in the Sevier Highlands in Utah, Nevada and Arizona. (b) These ancient river systems represent the descendants of long-lived drainages that were at one time, prior to formation of the WIS, major parts of the tributary network that contributed to the Aptian McMurray Formation in Alberta. (c) DZ U-Pb geochronological data also place constraints on the numerical ages of the Ft. Collins and Horsetooth Members. Without exception, all outcrops of the fluvial Horsetooth sandstone yielded maximum depositional ages (MDAs) of ca. 98-100 Ma, with all MDAs overlapping statistically with each other. (d) Also without exception, all

outcrops of the deltaic Ft. Collins Member yielded MDAs that are statistically indistinct from each other, but also statistically indistinct from MDAs of the Horsetooth Member. (e) These relationships indicate that fluvial and deltaic components of this extensive shoreline are the same age within limits of our geochronological data, and very likely represent a relatively short period (i.e. a 100 ky Milankovitch cycle?) of shoreline progradation and aggradation in the very latest Albian and earliest Cenomanian. (f) The surfaces between the Ft. Collins and Horsetooth Members represents simple autogenic processes caused by the inherent lateral migration and high-frequency avulsions that are seen on modern deltas, rather than large-scale sequence boundary unconformities that represent forcing by sea-level fall, and long periods of time.