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CRACKING THE CRETACEOUS CODE

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The Early Cretaceous McMurray Sediment-Routing System

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ABSTRACT

The Early Cretaceous McMurray Formation occurs along the eastern margins of the Mesozoic foreland basin in Alberta, and is most notable for the large deposits of bitumen-dominated hydrocarbons. This presentation summarizes the results of ~12 years of research on the McMurray sediment-routing system based on >20,000 detrital zircon (DZ) U-Pb ages from Alberta, and from time-equivalent fluvial deposits in the Rocky Mountains and midcontinent regions of the United States.

McMurray deposits in Alberta are located on the eastern backbulge part of the foreland-basin system, where thick granitic crust makes accommodation a challenge. The McMurray DZ U-Pb record displays three distinct provenance signatures. The first dominates the axial south-to-north McMurray in the Cold Lake Oil Sands area of east-central Alberta, and is dominated by Paleozoic and Meso-Proterozoic age groups that represent the signal of the Appalachian Cordillera, with a minor contribution from the Mesozoic Western Cordillera magmatic arc as well. The second is present in the Ft. McMurray area 300 km farther north, and is dominated by Paleo-Proterozoic and Archean age groups from the Canadian shield. The third defines a tributary-trunk stream relationship, also in the Ft. McMurray area, and consists of a ~50-50 mix of south-derived and east-derived populations.

South-derived McMurray DZ U-Pb age distributions from the Cold Lake area are statistically indistinct from age-equivalent fluvial sandstones in the Colorado Front Range, Southwestern Kansas, and Western South Dakota in the southcentral and northcentral US, respectively, which implies a fluvial system that can be traced over a total north-to-south distance of ~3000 km. This axial system represents a mix of sediments derived from the Paleozoic Appalachian-Ouachita Cordillera of the southeastern US, and from the Mesozoic Western Cordillera.

We conclude the Early Cretaceous McMurray Formation represents a continental-scale river system, the Amazon or Mississippi of its time, with a catchment of ~5,000,000 km² during its zenith, with headwaters that extended from the southwest to southeast US, and north to the Canadian shield. The McMurray was dismembered in the late Cretaceous and Paleocene by geodynamic and other drivers that formed the Western Interior Seaway, which ultimately led to abandonment of the north-flowing McMurray system, development of a north-northeast flowing successor river system that is often called the Bell River, and eventual development of the Mississippi system that still routes water and sediment to the south and the Gulf of Mexico today.