Fluvial channels and paleo-tributary junctions in the Lower Cretaceous McMurray Formation, Alberta, as defined from detrital zircon signatures and subsurface mapping

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Abstract

Iberta records deposition of a northwestward-flowing fluvial system located in the distal portions of the as well as new subsurface mapping of paleovalley systems. Together, this data set demonstrates how the uggest detrital zircon signatures within fluvial strata may be useful for understanding changes in drainage basin dimensions and locating p

Introduction

ower Cretaceous (Aptian) McMurray Formation in Alberta, Canada represent one of the largest hydrocarbon accumulations in the world. Sandstones, siltstones and shales of the McMurray Formation were deposited in fluvial, estuarine, and marginal marine environments along the southern margin of the Western Interior Seaway during the Cordilleran Orogeny.

Petrographic evidence suggests much of the sand in the McMurray Formation was derived from the nearby Canadian Shield. However, paleogeographic maps imply the sand was derived from a large south-to-north drainage network that extended from the southwestern United States to northern Alberta.



Study area and sample location. Distribution of the Athabasca Oil Sands is represented by yellow stippled region. Samples were collected from 8 wells drilled in the eastern portion of the Athabasca area. Precambrian and Phanerozoic age belts from Dickinson and Gehrels (2009) are displayed on the right: (a) represents the Superi-Province of the Canadian Shield (>2.5 Ga); (b) represents the Trans-Hudson Province (ca. 1.8 Ga); and (c) represents additional ca. 1.8 Ga provinces. Other principal age belts (discussed shortly) are labeled



Methods



Stratigraphy of Lower Cretaceous deposits in the Athabasca region (modified from Fustic et al. 2012). Lower Cretaceous strata of the McMurray Formation unconform ably overlie Devonian carbonate strata. The McMurray mation is typically divided into a lowermost unit (below black line), a middle unit that contains several incised val eys, and an upper unit that contains shallow marine desits. It is overlain by the Wabiskaw Member of the Clearwater Formation. Yellow represents coarser sediments in the Wabiskaw, and grey represents shale. Samples numbers and their relative stratigraphic locations are





-~100 zircons per sample were analyzed using Laser Ablation - Multicollector -Inductively Coupled Plasma - Mass Spectrometry (LA-MC-ICP-MS) at the Arizona LaserChron Center





Results

I) Zircons of Archean and Early Proterozoic age. These are interpreted to indicate a provenance associated with the Canadian Shield.

2) Zircons of Grenville (ca. 1000 Ma) and early Paleozoic age. These ages suggest an Appalachian source original-

3) Relatively young zircons (<300 Ma) with a lesser population of Early Proterozoic ages. This is interpreted to indicate a Cordilleran provenance.











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We would like to thank Nexen Inc. for financial support and providing the samples. In particular, we thank Andrew Webb and Cynthia Hagstrom. We also thank George Gehrels, Mark Pecha, Clayton Loehn, Gayland Simpson, Nicky Giesler from the University of Arizona. We sincerely thank Milovan

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