OCGC Seminar

Revisiting fluvial meander-belt deposits with implications for interpretations of the McMurray Formation

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Over the last decade, a series of insightful studies have highlighted fluvial meander-belt features in strata of the Cretaceous McMurray Formation, northeastern Alberta. High-quality 3-D seismic and image-log data reveal immense point bars, while detrital zircon studies have linked these features to a continental scale drainage system. These observations have prompted further investigation into meander-belt deposits, aimed at better understanding complex facies distributions, stratigraphic architecture, and paleoenvironmental interpretations to inform our understanding of bitumen-bearing units. This study utilizes data from the lower Mississippi River and outcropping fluvial deposits of the Western Canada Sedimentary Basin to inform characterization of the McMurray Formation at Surmont, Alberta.

An unprecedented dataset consisting of 600 km2 of 3-D seismic data and over 1000 well penetrations from the Cretaceous McMurray Formation in northeastern Alberta, Canada, provides a unique opportunity to characterize an ancient continental-scale river system. Paleochannels ranged from 475 to 1180 m wide and from 35 to 50 m deep, with meander-belt width-to-thickness ratios between 100:1 and 400:1. Reconstructed paleochannel migration patterns reveal the evolutionary history of seventeen individual meander belt-elements, including point bar, counter-point bar, and their associated abandoned channel fill deposits, which have been mapped using core, microresistivity image logs, and seismic data. Results of the study show that intra-point-bar erosion surfaces bound accretion packages characterized by unique accretion directions, internal stratigraphic architecture, and lithologic properties. We provide evidence for channel-belt-edge confinement and development of a counter-point bar, as well as the deposition of side bars and preservation of a mid-channel bar during meander-bend abandonment. Analysis of changes in meander-belt morphology over time reveal a decrease in channel-belt width-to-thickness ratio and sinuosity, which we compare with observations from the lower Mississippi River and attribute to the landward migration of the paleo-backwater limit due to transgression of the Cretaceous Boreal Sea into the Alberta foreland basin.

Through the re-evaluation of fluvial meander-belt models, the stratigraphic expressions of geomorphic elements that have been previously understated in rock record interpretations are deduced. The research provides revised perspectives of stratigraphic and paleoenvironmental interpretations for the McMurray Formation, which are used to account for complex facies distributions and internal stratigraphic architecture patterns in oil sands reservoirs.

Biography

Dr. Paul Durkin received his B.Sc. from McMaster University in 2011 and his Ph.D. from the University of Calgary in 2016. His research interests are in the field of clastic sedimentology and involve the investigation of coastal plain and paralic depositional systems, with a particular focus on meandering fluvial deposits. Paul's research is primarily field oriented, which ranges from outcrop studies of ancient fluvial deposits of the Western Canada Sedimentary Basin, to modern morphodynamics and sedimentology of modern meandering river systems in southwestern Manitoba and the Andean Foreland Basins. His research combines traditional sedimentary analysis with innovative data acquisition techniques, including Unmanned Aerial Vehicle photogrammetry to create 3D digital outcrop models, as well as remote sensing of meandering river dynamics using LANDSAT satellite imagery. Results from outcrop and modern studies are applied to subsurface mapping and reservoir characterization of hydrocarbon-bearing units, including the vast Athabasca Oil Sands of northeastern Alberta. Paul has worked with and for Calgary- and Houston-based oil and gas companies, and was the recipient of the CSPG Best PhD Thesis award in 2016. The journal article associated with his CSPG Distinguished Lecture Tour presentation was recently awarded the 2017 Outstanding Paper in the Journal of Sedimentary Research. In his spare time, Paul enjoys fishing, whitewater kayaking, and playing music.

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