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A Virtual McMurray Formation Outcrop Tour – An Evolving Tool for Characterizing Oil Sands Reservoirs and Creating Realistic Geomodels

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Unmanned Aerial Vehicles (UAV's) are used to create high-resolution video, orthomosaic images and three-dimensional models for outcrops of any size or location. A virtual tour of the McMurray Formation type section (Figure 1), near the city of Ft. McMurray is presented, to show an example of a cost-effective and convenient method to characterize oil sands exposures for in-situ and mining applications, in addition to creating an exciting new approach to creating data sets for sedimentological studies. Although virtual tours cannot replace actually visiting the outcrop in the field, they have the distinct advantage of illustrating and teaching reservoir analogues and depositional models within the safety of the classroom or office setting. High-resolution photographs geo-referenced with appropriate latitude, longitude and elevation are now available the study of the entire outcrop, and are particularly effective for areas that are steep or inaccessible, which often represents most of the outcrop. In many instances, high resolution detailed images could not be obtained before nor could accurate measurements be made before this new technology became available.

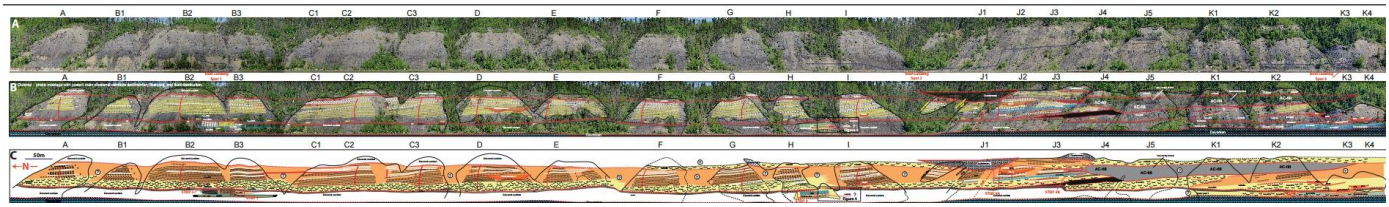

Figure 1. McMurray Formation Type Section photomontage created from river level. This outcrop is approximately 60m high and 1.8 km long. An outcrop study by Fustic et al., in press, subdivides the outcrop into individual bowls, each with unique sedimentological characteristics.

Field trip leaders will soon be using UAV 's simultaneously to complement field visits, to illustrate hard to steep or inaccessible portions of the reservoir, in addition to providing expanded views of the outcrop without the distortion associated with looking 30 to 60 m upward from the river level. These evolving tools help meet new economic realities and safety regulations for companies and universities.

The reader is invited to view a "fly-through" of the McMurray Type Section using UAV derived data by connecting to the following YouTube link: https://youtu.be/7cm2INL7HC0

Detailed sedimentology, statistics on bed lengths, measurements of geological features and reservoir characterization over the length of the outcrop can now obtained with UAV derived images and data. The UAV's can create detailed, high-resolution images from several elevations at optimal distances from the outcrop face, with minimal distortion or interference by vegetation. Previous studies were limited to side canyons where similar quality images could be obtained.

Integrated detailed studies of bowls B2 and B3 of the McMurray Type Section (Figure 2) illustrates how these two sources of data can be complementary. In this example, complementary data includes detailed measurements made by geologists who describe the sedimentology on a bed-by-bed basis (5 to 10 cm scale) for the entire 70-85 m thick section. Included in this study was a simulated gamma ray for comparison to offset geophysical log data from core holes located approximately in the vicinity of the outcrop. These data can be compared to the larger context provided by the virtual tour UAV derived measurements.

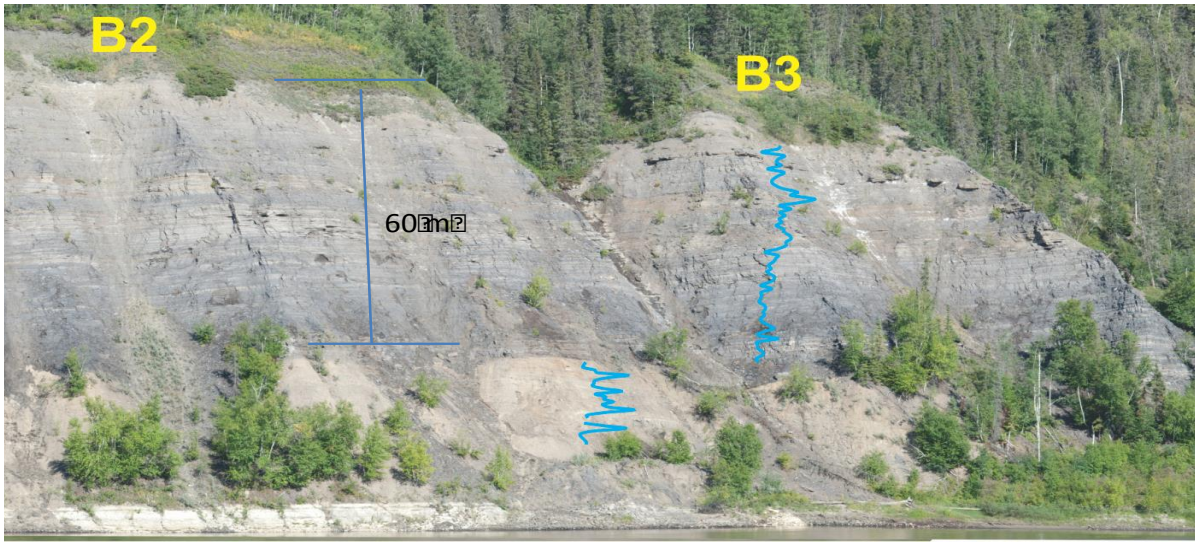

Figure 2. Bowls B2 and B3 of the McMurray Formation Type Section, illustrating previous studies of I.H.S., regional water/bitumen contacts, lean zones and other important reservoir modeling parameters (Strobl et al., 2014).

UAV's provide customized geo-referenced 3-d point cloud data. Recommended measurements for reservoir characterization purposes include the length and thickness of I.H.S., incising channel successions, mudstone-clast breccias and lean zones. Hundred's of measurements are now possible providing statistically valid data for modeling. Specific sedimentological data can be utilized by reservoir modeling and mapping software including familiar packages such as ArcGIS, Petrel, Roxar and GoCad.

References:

Fustic, M., Rudy Strobl, Martin Fowler, Bryce Jablonski, and Allard Martinius, *in press*, Field Excursion: Impact of Reservoir Heterogeneity on Oil Migration and the Origin of Enigmatic Oil-Water Contacts: McMurray Formation Type Section, Alberta, Canada, *in* Outcrops that Change the Way That We Practice Petroleum Geology, American Association of Petroleum Geologists.

Strobl, R.S., Milovan Fustic and Daryl Wightman (2015): The Athabasca Oil Sands Area from Basin to Molecular Scale - 4D Observations from Inside the Reservoir, Fort McMurray, Alberta, June 16 & 17, 2015, CSPG Field Guide, 41 pp.