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Utilizing mine-face photography to characterize the sedimentology and stratigraphy of the Cretaceous McMurray Formation, Kearl Mine, Alberta

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The Cretaceous McMurray Formation hosts significant volumes of oil in large-scale and complex channel-belt deposits. Despite dense borehole spacing and high-quality seismic data sets, facies distribution and internal stratigraphic architecture are difficult to accurately characterize and predict. Integrating these data with mine-face exposures of previously drilled deposits offers the opportunity to improve our understanding of reservoir distribution and prediction. Studies that have published oil-sands mine-based data are few, and much of the relevant work on the McMurray Formation has been conducted on outcrops and subsurface data. These studies have relied on static data sources (e.g., river-valley outcrops, borehole and seismic data, exposed mine faces), whereas the study herein utilizes a dynamic mine-face exposure that provides novel perspectives not previously explored. Using a data set of georeferenced mine-face photographs and boreholes from Imperial Oil's Kearl mine, we investigate deposit geometry and internal stratigraphic architecture of the McMurray Formation.

The Kearl mine is a 10 x 15 km open-pit project area located within the Athabasca oil sands basin, approximately 70 km NNE of Fort McMurray, Alberta, Canada, in townships 95 – 97, ranges 7 – 8. The data set contains high quality mine-face photographs that were taken in succession as areas of the mine were excavated, providing 2-D slices in 3-D space. Photographs were georeferenced into 3D modelling software. Conventional wireline logs and core photos were used to supplement the mine-face photographs. Stratigraphic surfaces were traced between successive photos to delineate deposit geometry and provide a framework for lithofacies classification in the study area. A key outcome is the relationship between mine-face exposures and more common data forms (e.g., core, wireline logs). A goal of the project is to quantify inputs for geological models, such as the continuity of individual mudstone beds and the geometry of mudstone-clast breccia deposits. Future work will develop a workflow for integrating such data into geocellular modelling. The Kearl mine-face exposures are also an excellent analogue for SAGD production areas, and the results herein provide insight into subsurface reservoir characterization.