

New Technique for Sedimentary Texture Characterization and Permeability Anisotropy Quantification of McMurray Oil Sands by Integration of Core Data and Electrical Borehole Images

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The oil sands of the Lower Cretaceous McMurray Formation contain vast quantities of bitumen, much of which will be recovered by Steam Assisted Gravity Drainage (SAGD). Texture and permeability of these oil-bearing sands are two factors which affect SAGD well planning and performance.

Borehole images have been utilized in the evaluation of oil sands for many years. Textural changes have been identified and classified by interpreters, but only as visual features. Texture and permeability values of oil sands, calibrated with core data, can be extracted by integration of openhole logs and electrical borehole images. In addition, the same technique can be applied to wells in the same field, without any core data.

Oil sands textures, as characterized by factors such as grain size and sorting index, display good correlations with Gamma Ray and scaled electrical borehole image logs. Permeability of the oil sand depends on porosity, but also has a close relationship with grain size distribution and sorting index. Well sorted, course grained oil sands have higher permeability than poorly sorted, fine grained oil sands.

The method developed and illustrated here has been named Oil Sand Textural Analysis (OSTA). An average grain size curve based on Gamma Ray variations and depth corrected core particle size analysis is generated. The total high resolution image resistivity spectrum is then divided into 1.2-inch intervals around the well bore and converted to a grain size domain. An image based sorting index is calculated from the percentile grain size distribution spectrum. Well sorted oil sands show a narrow grain size distribution spectrum while poorly sorted oil sands show a wide variation in grain size distribution spectrum. Both grain size and sorting index play a role in oil sand permeability estimations. Based on this technique, a new porosity + texture = permeability transform is proposed for the oil sands of the McMurray Formation.