CSPG Heavy Oil / Oil Sands Technical Division E-Talk

CRISP: A New Method for Determining Petrophyscial Properties in Athabasca Oil Sands Plays

Presenter: Graham Spray, Sr Technical Advisor, AGAT Laboratories
Location: Virtual Event

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ABSTRACT

Routine core analyses of unconsolidated oil sands often yield unreliable and inconsisitent porosity and permeability values due to the destruction of in situ textures or fabrics during core retrieval and sampling processes. To overcome the drawbacks of routine core analysis we developed a new method, namely "Cyclically Restored In Situ Petrophysics (CRISP)", for analysis of petrophysical properties of unconsolidated oil sand reservoirs. The new approach begins with a replication of in situ texture via cyclic compaction of the of unconsolidated oil sands in a uniaxial piston cell with incremental higher axial loadings that mimick historic overburden pressure cycling induced by glacial cycles through the Pleistocene. After the texture restoration the sample is flooded with various liquids and/or solvents and gases to obtain multiple porosity and permeability data points. Forward and backward flow can be applied to test permeability in both directions. After analysis the sample is dried, weighed, and the grains can be further analyzed for particle size distribution, mineralogy, or other parameters.

The preliminary test program investigated the accuracy and precision of the new method (CRISP) and compared CRISP to the commonly-used sleeved-plug net overburden analysis (NOB) method. Results indicate that CRISP permeability measurements to simulated formation brine are highly repeatable, with variance of 0.71% (mDarcy) for study of 531 samples from Mcmurray Formation, and of 0.15% (mDarcy) in a 150 sample Lloydminster Fm. study. For both sets of samples, the brine permeabilities range from 1 to 5000 mD. The preliminary results also show that CRISP outperforms the sleeved-plug net overburden method (NOB) in precision, with vastly better conformance between repeated samples, and also yields lower porosities that agree more closely with presumed in situ porosities given geological constraints and geophysical log data than the NOB method. Further, CRISP requires equivalent time for analysis as the NOB approach, and can the same format of samples. CRISP therefore represents a significant improvement for petrophysical properties analysis in unconsolidated oil sand reservoirs for better and more relastic reservoir evaluation and subsequent engineering development

BIOGRAPHY

Graham Spray is a Technical Advisor with AGAT Laboratories. He is an experienced geologist with a diverse background in hard rock mining and oil and gas exploration and development. He earned his M.Sc. in structural geology and metamorphic geochemistry from the University of Calgary, and has worked in gold, uranium, molybdenum, and oil sands geology. In 2013 Graham joined AGAT to assist in development of core logging software, and from 2014 to early 2021 was manager of the Geology department. In his new role as Technical Advisor he is responsible for R&D efforts and developing efficient analytical plans for specialized projects.