A Chemostratigraphy-driven Workflow for the Analysis/Interpretation of Unconventional Core

Harry Rowe, Austin Morrell, Pukar Mainali, Santhosh Narasimhan, Nathan Ganser

Premier Oilfield Laboratories, 11335 Clay Road, Suite 180, Houston, TX 77041

Inorganic geochemical characterization of mudstones and shales using calibrated, portable x-ray fluorescence (XRF) spectrometry is increasingly utilized in core analysis, especially in shale- and mudstone-rich lithologies. If sampled at the scale of rock facies variations, chemostratigraphic results can provide a rapidly-defined and quantitative method for subdividing drill core at the sub-well log scale. A workflow is presented that includes core preparation, analytical conditions, and the implementation of a hierarchical cluster analysis of chemostratigraphic results to assign stratigraphic changes in "chemofacies" to the core that are subsequently used to 1) refine the lithostratigraphic description of the core, 2) assess the relative occurrence of geochemically similar rock types, and, 3) optimize the selection of samples for detailed analyses (e.g., SEM, MICP, triaxial, groundtruthing of well log signatures).

A synthetic gamma log is developed from the XRF results and linkages to the downhole gamma log are defined. Collectively, XRF results and XRD results from key endmember locations along the core are interpreted in order to generate and refine a mineral model at the XRF sampling interval, which is generally 5 cm in mudrock successions. In conjunction with rebound hammer analyses, the chemofacies are used to estimate rock hardness/strength measurements to a finer scale in order to create a highly resolved mechanical stratigraphy that is subsequently used for geomechanical models, and ultimately, frac-simulation modeling. An example of the core chemostratigraphy-driven workflow will be provided using several cores from the Permian-aged Bone Spring Formation, Delaware Basin, USA.