Characterization of Reservoir Quality in Lacustrine Turbidites, Pannonian Basin: A Multidisciplinary Approach

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Abstract

Oil and Gas Development Central Ltd. has acquired four cores from two wells in the Pannonian Basin, Hungary. They were examined with a hyperspectral core imaging (HI) system utilizing both short-wave and long-wave infrared sensors to acquire mineralogical data along the core in order to identify hyperspectral rock types and relate them to depositional processes and reservoir quality. Our study combined HI data with depositional facies identification, petrographic descriptions (including modal data) and X-Ray diffraction (XRD) analysis. The cores show several facies and facies associations (mud-prone, mixed sand-mud, sand-prone) deposited by suspension settling, low- to high-density turbidity currents, linked debrites and slumps. Various parts of a slope-related turbidite system (i.e. lobe fringe, off-axis and lobe axis) were identified. Deposition occurred in water depths of several hundred meters in the brackish-water Lake Pannon during the Late Miocene. The hyperspectral imaging (HI) data was used to create rock type classifications (HI Classes), hyperspectral mineral maps and curves of continuous mineralogy, which were calibrated with the independent XRD analysis results. The reservoir quality (RQ) of these sandstones is due to a combination of differences in lithological facies and post-depositional diagenesis. The sandstones with the poorest RQ are matrix-rich sandstones deposited in the more lateral lobe settings (off-axis, fringe and distal fringe), on channel levees, or during the process of abandonment due to flow avulsion. The facies with the best RQ are sandstones that were deposited more axially. Within those lobe axis

sandstones, however, a combination of processes is at work that control RQ, including provenance (supply of mica and ferroan calcium carbonate) and burial history (compaction of micas and carbonaceous flakes and nucleation of quartz cement). The sandstones with the highest RQ are the HI class C1 sandstones in the more axial facies. Given similar volumes of carbonate cement, micaceous minerals and carbonaceous flakes, sandstone in this class always exhibit a higher porosity and permeability than the other hyperspectral rock classes, suggesting that there are textural controls on reservoir properties that the HI rock classification groups are capturing better than the discrete point count data, such as mica grain size, mica flake orientation, thickness of mica-rich laminations, and location of ferroan carbonate cement. The continuous HI mineralogical curves reflect variations between reservoir and non-reservoir rocks consistent with the described depositional facies and with the petrographic data. They all illustrate that sandstones having the lowest reservoir quality occur where the HI identifies the highest volume of illite/mica and carbonaceous streaks.