Solution Mining Research Institute Fall 2020 Virtual Technical Conference

22-24 SEPTEMBER 2020

CHALLENGING EVALUATION OF EVAPORITE DEPOSITS IN A THRUST FAULT ENVIRONMENT IN SALTVILLE, VIRGINIA

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Abstract

Evaluation of complex lithology sequences located within a disturbed geological setting presents a significant challenge on its own. Analysis is further complicated when the lithology sequence is comprised of evaporites, carbonates and interbedded shaly sands positioned in a syncline lying in contact with a thrust fault. Such conditions are frequently encountered in the Appalachian Basin, near Saltville, Virginia.

Further complications arise during data acquisition in a salt mining environment. These salt wells are usually drilled with water based mud, with sodium chloride concentrations reaching up to 300,000 ppm. Typical response of the pulsed-neutron spectroscopy logging instruments is dominated by the contributions from the mud systems, whereas formation presents only about 10% of the signal. Nevertheless, after meticulous quality control, the tool performance was deemed acceptable for mineralogy analysis in these unfavorable borehole conditions.

During the analysis, the entire logged interval has been divided in 3 zones: 1) the lower or evaporites-carbonates beds, 2) the middle zone or thrust fault zone, and 3) the upper zone or shaly-sand-halite beds. The lower zone corresponds to a typical evaporitic environment with anhydrite, halite and some carbonates (limestone and dolostone). Uncertainty arose when the upper section was evaluated with the mineralogical data due to the presence of halite intercalated with siliciclastic minerals in a long interval, which does not represent the normal conditions for evaporites deposition. It became clear that there are two different zones in contact; using only mineralogical data, it was impossible to predict the presence of a fault, but it was readily interpreted using the borehole imaging log.

This paper shows how integrating geochemical logging, borehole imaging technologies, along with a detailed mineralogical interpretation, makes it possible to solve for the high uncertainties presented by the presence of halite layers within siliciclastic rocks. The conclusion of this study, also confirmed by the previous research in the area, is that during the thrusting process some halite blocks were dragged from the underlying evaporitic formation and towards the hanging wall, thus bringing evaporitic and siliciclastic formation in the direct contact.

Based on this analysis, it is easy to understand that the halite interbedded with siliciclastic rocks in this situation are less likely to have significant continuity away from the borehole wall and these zones are not suitable targets for mining.

Key words: Evaporites, carbonates, siliciclastic, gamma spectroscopy logging, borehole imaging, thrust fault.

* It is with great regret that we inform you that our friend and co-author, Mark Cartwright, unexpectedly passed away July 11 of this year. We would want to thank Mark for his hard work and collaboration on this SMRI paper.

Mark was a valued colleague, not only for his company, Texas Brine, but also for the entire solution mining family. He will be greatly missed.