Importance of Outcrop Characterization of Unconventional Shale Resources

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ABSTRACT

These days, the development of unconventional shales has changed from drilling as many wells as possible towards drilling fewer and more efficient wells at less cost. One key element to improve the performance of new horizontal wells is to understand the stratigraphy of these shales and how the reservoir properties vary vertically and laterally within them to identify better landing zones and locations for completion stages. The objective of this work is to show the advantages and limitations of using outcrop characterization to develop comprehensive stratigraphic frameworks and build robust reservoir models. Outcrops from two unconventional plays were studied. Six outcrops of the established Woodford Shale play in the United States, and one outcrop of the emerging Brown Shale play in Indonesia. In this work, we review the use of traditional methods for outcrop characterization: outcrop gamma-ray profiles, macroscopic and microscopic facies description (using thin sections and SEM/EDX), pore type analysis, TOC/RockEval, and X-Ray Diffraction (XRD). Also, the use of newer techniques to characterize unconventional shales: X-Ray Fluorescence (XRF) and the Rebound Hammer to measure hardness of the rock. Even though core data is considered the best data to characterize unconventional shales, a comparison between the cost of acquisition/analysis of core data as opposed to outcrop data shows that outcrop characterization is less expensive, easier to perform, with unlimited samples for analyses, and more important, the lateral variability of properties and stratigraphy can be studied as well as the vertical variability. Outcrop characterization can improve the interpretation of subsurface data (well logs, core, cuttings, seismic), and the identification of organic rich intervals and ductile/brittle zones. As part of this research, an efficient workflow to do outcrop characterization and correlate to subsurface data is proposed, which can be applied to new outcrops of established unconventional shales and emerging ones, in the U.S. and internationally.