Rock Volatiles Reservoir and Fluid Evaluation of STACK-SCOOP-MERGE in Oklahoma and Marcellus in Pennsylvania and West Virginia. New Insights from Gentle, Multi-Pressure, Multi-Extraction, Cryo-Trap Mass Spectrometry of PDC Cuttings and Cores

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Abstract

Rock Volatiles Analyses of present day fluids in PDC cuttings is a patented, new, gentle, multi-pressure, multi-extraction, Cryo-Trap/Mass Spec technology that provides a high value log with no additional logging time, and that can identify the landing zone and characterize the lateral to enable optimized completion strategies of conventional and unconventional play assets. Major oil migration pathways in Oklahoma are shown to occur on faults. Reservoir rocks adjacent to oil migrating faults are charged. Reservoirs at a significant distance to a fault migration pathway are not charged. Oil and gas, including Helium, migrate predominantly into reservoir rocks in the hanging wall above the fault plane. Basinal brines migrating with oil and containing organic acids migrate predominantly into the foot wall below the fault plane. The migration of oil and gas into fault adjacent reservoirs preserves reservoir quality. Basinal brines mixing with ancient Mississippian sea water encourage the formation of tight rocks with poor reservoir qualities in the foot wall of these faults. Woodford Shale near some faults is depleted in oil and gas that has escaped along the faults. In dry gas Marcellus wells fracture swarms are mapped using cuttings volatiles GOR. While dry

Marcellus produced gas is almost entirely methane, the Marcellus shale cuttings not near fracture swarms contain appreciable C2-C5 matrix hydrocarbons that do not migrate out of the shale with methane, and are not produced. Gas trapped in cuttings in fracture swarms is similar to produced gas in being methane dominated, with essentially no C2-C5 hydrocarbons. Hence large GOR spikes in dry gas Marcellus cuttings Rock Volatile Logs map fracture swarms. Sealed at the well cuttings analyses of a liquid rich Marcellus horizontal well in West Virginia provided prediction of about 300MBO from a 2 mile lateral before the well was completed. Oil and gas are lost from the Marcellus in this well at a fault. The Purcell Limestone member of the Marcellus shows up as having the highest mechanical strength in the borehole, and this is comfirmed via image track break out analyses. PDC cuttings with large amounts of oil and gas form from extremely tight rocks that do not significantly add to production. Good quality oil-charged reservoirs have cuttings that lose most of the oil and gas during drilling and transport to the surface. We map occurrence and composition of oil and gas, mechanical strength, permeability, total water, proximity to pay, and location of potential pay zones, fractures and faults. Separate S_w curves are generated from multi-pressure extractions of Total Water on the same well for both S_w Macro-porosity versus S_w Micro-porosity. OBM, WBM, Sealed at Well, new and old, washed and dried cuttings, and sealed at well and old core are all analyzed. On some wells both sealed at well, and washed and dried cuttings are analyzed to reveal the mobility of oil and gas.