An Integrated Data Analytics / Seismic Fault Attribute / Petrophysics Workflow for Diagnosing and Mitigating Excess Water Production in the Permian Basin

David Paddock, Sergey Makarychev-Mikhailov, Vasudhaven Sudhakar, Ryan Williams, Erik Rylander, Dean Willberg
Schlumberger

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Produced water is a major operational expense, increasing the total cost of production for Permian basin assets. All Permian basin Wolfcamp and Bone Spring formation wells produce some water, even under ideal conditions. This water is necessary for hydrocarbon production and, in some sense, can be considered “good” water. However, many wells produce excess water - increasing operating costs with no incremental increase of oil production - due to fracture completions intersecting water-bearing faults or due to the lateral being inadvertently landed in a high water-cut zone. How does one know if the observed water production is “good” and necessary for oil production, or excessive, leading to higher production costs? How can one preemptively avoid excess water production hazards on new wells by optimizing well placement, completion strategy, and hydraulic fracturing designs? The good news is that water production hazards can be identified proactively, and technologies exist to avoid these features on future wells. We demonstrate an integrated workflow employing data analytics, seismic fault attributes, and petrophysical analysis to identify and avoid excess water production hazards in the Wolfcamp and Bone Spring formations. It combines joint analysis of well production data, 3D seismic data, and wireline logs. The workflow creates value by reducing water management costs. The workflow is comprised of the following steps: a)

Completion and production data are obtained from industry databases and processed to extract production maps for major plays and/or producing zones. b) Regions and the operators affected by excessive water production are identified. c) The production maps are superimposed on 3D seismic survey maps, linking excessive water production with known faults and allowing avoidance of excessive water production from faults in future wells using simple avoidance or, potentially, pumping far-field-induced fracture diversion agents. d) Water production from wells not affected by faults is investigated (and often found to be associated with landing in a magnetic resonance-identified water-prone stratigraphic level) for the optimization of landing level. e) Finally, water cut workover opportunities are considered in existing wells affected by water influx from faulting. We outline the data analytics workflow major outcomes and discuss challenges associated with integrating data coming from diverse sources and with cross-discipline technical collaboration.