New Tools and Approaches in Reservoir Quality Prediction

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Abstract

Reservoir quality is the main attribute that controls well productivity and field-wide performance. Yet, even though oil companies have invested significantly in techniques to understand and predict reservoir quality, it still remains a significant challenge and source of investment risk for the industry. Recent research has focused on development of a geological, first principles-based workflow that allows the quantitative prediction of reservoir quality (porosity and permeability) ahead of the bit. This workflow utilizes a variety of modeling techniques to understand, quantify and predict the geological processes that control reservoir quality. As a proof of concept pilot, we have recently piloted this workflow to predict areas of good reservoir quality - "sweet spots" - in the Permian-Carboniferous Unayzah reservoir away from areas of well control.

The Unayzah Group reservoir interval was deposited above the Hercynian Unconformity over a 56 million year period during the late Carboniferous to early Permian in central and eastern Saudi Arabia. The Unayzah Group consists of a succession of sandstones and siltstones that reflect changing climatic conditions, from glacial, peri-glacial, and lacustrine conditions in the lower Unayzah (Unayzah-C, or Ghazal Formation, and Unayzah-B, or Jaub Formation), to fluvial and ultimately eolian conditions in the upper Unayzah (Unayzah-A, or Nuayyim Formation). Stratigraphic forward modeling has been applied to predict the distribution of facies, grain size, porosity, and reservoir architecture in this diverse suite of rocks. Initial reservoir quality results from these forward models were then integrated with diagenetic (especially kinetic) models to provide quantitative estimates of present-day reservoir quality. Results from this research will help to reduce risk in exploration and development drilling.