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Assessment of fractured reservoirs: an overview

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Recent hydrocarbon discoveries in Basement rocks over the different parts of the world have demonstrated that fractures can be solely responsible for the making of a producing reservoir (Fig. 1).

Fractured reservoirs are commonly thick, porosity is mainly secondary, the distribution of

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porosity and permeability is irregular, and production varies greatly. They may or may not have a common hydrocarbon/water contact. Among themselves, they illustrate great differences in their hydrocarbon storage capacity and they may drain juxtaposed hydrocarbon bearing formations.

Effective fracture networks are of tectonic origin (Fig. 2). Different sources of stress often create different types and distribution of fractures (Fig. 3a & 3b). Recognizing the structural style and the stress regimes of sedimentary basins is very crucial to understanding the distribution and intensity of natural fractures. However, in fault related fractures, it is very hard to estimate the width of a fractured zone that is associated to a specific fault. In that regard, it is rather risky to intersect fault planes, as they tend to be open and may result in connecting well bores to aquifers.

The brittleness of host rocks is a function of several factors that include rock type, texture, grain size, porosity, temperature and the effective confining pressure. It controls the density, the morphology and the extension of fractures.

Other than borehole imagery data and oriented cores, most conventional logs are fracture detectors without any capabilities toward defining the hydrodynamic properties and attributes of fractures. Overbalanced drilling and associated deep mud invasion affects the accuracy of open-hole log data, generates pessimistic formation evaluation results and causes sever formation damage.

A proper study of fractured reservoirs begins with recognizing the geometry, origin, morphology, density, width, trace length and porosity of the fracture system. Knowing fracture dips and orientations is very crucial toward setting successful well trajectories in exploring and developing fractured reservoirs.

Assessment of fractured reservoirs requires an integrated effort in order to properly develop and drain these rocks (Fig. 4). Cores, borehole imagery, open-hole logs, well testing and production logging data (Fig. 5) integration are extremely important for thoroughly understanding and modeling fractured reservoirs.