Fracture Characterization of a Complex Carbonate Reservoir: Intelligent Use of Image Logs in a Major Onshore Field, Abu Dhabi, UAE

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ABSTRACT

Characterising the presence and impact of natural fracture is a challenge in many complex carbonate reservoir. This paper describes the successful integration of data across well-bore to field-wide scales of observation, from a Jurassic reservoir, onshore Abu Dhabi. Key to this exercise was the detailed structural and sedimentological analysis of image log data. Maximum value was gained from the image logs by using a customised interpretation framework, and were integrated with open-hole log data and where available, core descriptions. Analysis from key pilot and appraisal wells demonstrated that the reservoir is lithologically heterogeneous, but has a predictable vertical succession of packages, defined by image facies associations that are largely correlatable across the field. A primary litho-mechanical control from the image facies, recognised a hierarchy of bed-bound and non-bed-bound fractures identification. Most of them will not be extensive vertically and in turn are unlikely to form significant reservoir baffles. Likewise, although some vuggy fractures are observed, they are likely to augment matrix permeability only locally. These Fractures density were found to be strongly influenced by well deviation and azimuth, due to relative stratigraphic position and location. This has allowed a hierarchical conceptual model of fracture clustering with range of 10's-100's ft lateral spacing. Structural dip angle is locally increased in the southern and western flanks and correlates with changes in fracture strike and regime. The eastern flank is more affected by reverse faults while the western flank and the crest are more affected by strike-slip and traverse faults. The study did provide significant characterisation of the many traverse (WNW-ESE and WSW-ENE) faults – that are seen to be laterally discontinuous on the crestal area and typically "en-echelon" and laterally variable in their electrical response. When collated together, all such image log observations have allowed the construction of a conceptual fracture model that links individual wells across the whole field. The intelligent use of the image log data, through a customised interpretation framework, was identified as the key enabler is this process and the exercise has then been repeated for deeper, lithologically differing reservoir units.