Subsurface Visualization of Karst Features Induced by the Late Aptian Emersion - Examples from Qatar

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Abstract

The Aptian top surface of the Arabian plate corresponds to an emersive surface that is estimated to represent several million year gap in the stratigraphic record. The emersion is related to a worldwide sea level drop caused by the storage of water in extensive ice sheets in the high latitudes: an indication of a global climate cooling. This climate shift led to clastic Albian deposits, unusual in the region's carbonate-dominated stratigraphy. Abundant precipitation during this period caused erosion of the Arabian shield, contributing to the formation of deltaic sands, notably in the Burgan field in Kuwait. The Arabian plate being entirely emersed, the carbonate Aptian deposits have consequently been exposed to erosive processes. In this warm and rainy conditions, karstification often take place.

Though evidence of intense karstification have not been reported to our knowledge in the Oman Aptian outcrops, different methods of subsurface investigation indicate that a karst landscape developed on the top Aptian surface in the Qatar area. A wide variety of karst features have been identified:

1. Numerous channels can be well identified from seismic data, including a 5km wide incised valley previously cored (Raven, 2010).
2. Dolines can be interpreted from seismic and their geometries defined from deep resistivity investigation while drilling: they correspond to 100’s feet diameter sinkholes that are aligned towards the direction of the main incised valley.
3. Chaotic landscape can be inferred from high resolution borehole images.
4. Fissure occurrences are also observed from well logs.

The distribution of the karst features does not appear to be randomly distributed, but instead, follows the depositional facies distribution. The facies distribution in this area is quite complex, with the presence of a heterogeneous grainy barrier, a lagoon with multiple facies, and a Forced Regressive Wedge with shaly intercalations. All these facies exhibit a wide range of textures that control the initial pre-karstification permeabilities. The relation between karst feature type and depositional facies is believed to be controlled by the initial permeabilities impacting the response of the carbonate rock to the leaching processes and water run- off.

These findings have a direct impact on the dynamic behaviour, field production and the development strategy: well completion and drilling strategy are adapted location wise, in response to the karst features distribution.