

Controls and Consequences of the Variations of Structural Style in North Oman

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ABSTRACT

In the Sultanate of Oman, structures play a critical role in defining the economic potential of oil and gas accumulations as they control the size and geometry of the traps, but also impact reservoir characteristics, such as reservoir quality and fluids distribution. Variations of structural style can also impact the distribution of in-situ stress in the basins. The North Oman Basin displays a diversity of structural styles. The distribution of these styles is controlled by the geometry of the collision zone, the geometry of inherited structures as well as the mechanical stratigraphy. The variations in structural pattern mirror the distribution and nature of the in-situ stress field in the region, as evidenced by borehole-derived stress indicators. We have compiled over 1000 stress orientation indicators from various sources, such as published and unpublished reports, as well as our own interpretation of image and multi-arm caliper logs, collected through the entirety of the Cenozoic to Ediacaran stratigraphy in North Oman and in the United Arabian States. We ranked these indicators following the World Stress Map Quality criteria. Overall, the dataset quality is of good quality, and offers a new understanding of the distribution of stress in SE Arabia. The stress orientations are consistent within different source of data, such as earthquake focal mechanism solutions, microseismic events recorded after the stimulation of a well in the giant Khazzan field, GPS data or drilling-induced stress indicators. The integration of this database with detailed structural observations made on seismic data reveals that the stress patterns are in agreement with the regional and local structural and geodynamic framework. For instance, the majority of the stress orientations, ranging from N-S to NE-SW, are parallel to the direction of plate convergence, evidenced by published GPS surveys. However, some deviations appear both geographically and with depth. These variations can be attributed to the influence of various local sources of stress, such as the distribution of Infra-Cambrian salt in the basins, or the close proximity of elevated topography near the Oman Mountain. This presentation highlights the value of integrating geological and geophysical data with borehole data. Our interpretations provide new insights to optimize field development strategies in areas with varying structural styles and stress patterns, in North Oman and elsewhere.