Changing the Exploration Perspective in the Sea of Oman

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Abstract

The Sea of Oman (Sohar Basin) lies west of the Cretaceous Ophiolite that forms the Oman Mountains. Key exploration uncertainties have been clarified by Searchers 2022 reprocessing of a set of late 1990's 2D seismic lines that traverse this basin. Throughout the Cretaceous, the shrinking Neo-Tethyan ocean caught this margin in a plate tectonic vice, at first folding and then over thrusting the Cretaceous and Early Tertiary sediments. As the eastern margin of contracting Neo-Tethys approached, this created accommodation space for both the sediments passing axially south-east through the Sea of Oman and those eroded off the mountains to the west. A steepening basin floor finally triggered a large gravity driven fold and thrust belt (GDFTB) that created spectacular extensional wedges upslope and toe-thrusts downslope. The nature of the pre-decollement sequences, and the heterogeneous crust in the deep basin has not previously been clear on legacy seismic. It is the re-imaging of the basin through reprocessed data that is key to understanding the new exploration potential of the basin.

Only three wells have been drilled offshore in the Sohar Basin in Block 18 (Levell et al., 2021). The deeper basin has never been explored, due to four issues; the quality of the available seismic, the assumed presence of oceanic crust underlying the basin, a lack of a source rock and lack of reservoir models. Utilizing reprocessed legacy 2D seismic has alleviated the first issue and revealed that a simple oceanic crust model is inadequate for the Sohar basin (the second issue). Evidence from the seismic of a source rock (Type IV AVO) beneath (and perhaps causing) the GDFTB decollement, in addition to geothermal gradient analysis (from Well data and BSR) indicating effectiveness as an oil source have been collated and will be presented. A significant study of course clastics in the onshore wadi outcrops illustrates that very soon after obduction, the ophiolites are incised down to granitic basement providing an abundance of coarse clastic sands which were then deposited in the deep basin. Here they provide traps ahead of the GDFTB, in addition to structural traps below the decollement. Within the terrains imaged in the deep basin, syn-rift carbonate build ups are proposed providing a second, deeper set of targets. New seismic data and re-evaluation of received exploration risk element assumptions allow us to refute the four assumed exploration issues with the basin and propose a new exploration paradigm. In the southern part of the Sohar Basin (Blocks 41 and 59), adjacent to the Indian Ocean, the clastic sections are still very thick though much less deformed. Here shallow gas accumulations in clastics are very well defined, lying in close proximity to on-shore gas-export infrastructure. Even here the deeper sections are poorly understood, despite intriguing deep carbonate plays and the abundance of indications of hydrocarbons (Ninkabou et al., 2021).

There are very few remaining thick sedimentary sections adjacent to prolific hydrocarbon provinces left on earth that are so underexplored and yet have such tantalizing indications of the presence of hydrocarbons. Previous exploration has been handicapped by poor seismic, however, new imaging technologies and a re-evaluation of the assumed knowledge that constrained previous exploration has revealed new geological marvels – and exciting exploration potential offshore Oman.