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Revitalizing a Mature Basin in North Oman with an Integrated Modeling Workflow to Unlock Subtle Truncation Traps in a Well-Known Reservoir

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Abstract

In Northern Oman, the Cretaceous age Natih formation is well understood and a typical reservoir target for upthrown 3-way structural closures. Although the Natih formation is truncating rapidly, which causes changes in the top reservoir unit, the regional top seal allows for a high chance of success in structural traps. However, with structural traps diminishing in the mature basin, the higher risk stratigraphic truncation traps are becoming the more appealing target due to the higher estimated reserves. However, it is an under-explored play due to the challenges in finding subtle traps. One of the key elements which contribute to the complexities of the truncation trap include two angular unconformities occurring in North Oman. The Turonian unconformity subcrops the Wasia Group under the overlying Fiqa shale of the Aruma Group. The Base Cenozoic unconformity not only erodes the Aruma, but also the Wasia Group at a higher angle than the Turonian unconformity. Both groups truncate roughly towards the west/southwest and the area with the most Natih truncation potential is the area in which Natih is overlain by the Cenozoic. As the two unconformities merge, seismic multiples from the younger Hadhramaut group distort the seismic imaging of the unconformities due to the absent Aruma group.

Lastly, variations in the Natih facies also cause complexity due to differing impedance contrasts between the lower Hadhramaut and the upper Wasia group. For proper lead identification, the difficulties in the seismic imaging, seismic interpretation, and well top interpretation need to be accounted for and addressed.

The simplest and most cost-effective way to tackle this problem was to use the most current seismic volume to create a variety of filtered volumes and angle stacks. These volumes were used to understand which reflectors could be considered robust and which are influenced by multiples. An extensive study of the well tops in areas with dense well penetrations was conducted to understand the thickness variations/ranges between the individual Natih units' reservoir-seal pairs. These thicknesses were crucial to integrate with the seismic in order to create the geologic model and quantify the uncertainty. The final model would represent a series of high- resolution reservoir-seal pairs and their expected areas of truncation.

In summary, the result of this project was a detailed model of integrated data: well tops, seismic horizon and fault interpretation, and isopach guidance. This model was used to identify, for example, where reservoirs are truncating against the top seal, how quickly the reservoir gains thickness away from the truncation, the thickness of the base/lateral seal, and probable juxtapositions across faults. The information gained could then be used to prioritize areas with more truncation potential.

Bypassed, unexplained Natih pay in previous penetrations can now be attributed to truncation traps. More importantly, new prospects can be matured with larger prospective areas and volumes due to the understanding of the stratigraphic trapping mechanism. As of 2023, several new truncation trap fields have been discovered and many more matured prospects await testing. This modeling technique has revitalized a mature basin in a well-known reservoir.