

## **Exploration Success in Northern Oman: PDO Opens up an Unconventional Oil Play**

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### **Abstract**

Across northern Oman, platform carbonate reservoirs of Cretaceous age are the dominant contributor to oil production. Conventionally trapped carbonate reservoir units of the Shuaiba Formation have been successfully explored for over four decades. However, since first production began from the Shuaiba in the late 1960's, nearly all production has come from reservoirs in the lower sequences. Across the Lekhwa area, several hundred wells have been drilled into the Shuaiba Formation, but very few produce at economic rates from reservoir units of the Upper Shuaiba. Several exploration campaigns specifically targeting the Upper Shuaiba have resulted in marginal success. Although oil charged pay is often encountered through the Upper Shuaiba, the units are usually unattractive; relatively thin (<5m), low permeabilities, and very often have unsustainable production rates of 100 bbl/d or less. In late 2000, an exploration well was drilled targeting Upper Shuaiba on the crest of the Malaan structure, and similar to many previous tests in the area, encountered oil in several thin units of very low permeability, but failed to flow at a sustainable rate. Subsequent reprocessing and inversion of the seismic, combined with a revised geological model, indicated the possibility of a higher porosity and permeability trend considerably down the flank of the Malaan structure. The trend is coincident with a top-lap truncation imaged on seismic, forming elements of a stratigraphic trap with the overlying Nahr Umr Shale.

In 2003, the Malaan-2 well was spudded approximately 3 km northwest and 30m down flank of Malaan-1, and found significantly better reservoir quality. New logging while drilling technology (LWD) from Schlumberger, used for the first time in the world in an exploration well, was critical to maintain the horizontal well path in the best quality reservoir rock. The well has been tested and tied in, with a stable production rate of over 1400 bbl/d net oil. Seismic imaging shows that the best reservoir is coincident with a narrow (500-1000m across) amplitude anomaly that extends

more than 20km in a south-westerly arc, and which is independent of mappable structural closure. Forward modeling, incorporating all well data, has allowed a match between synthetic and real seismic, and giving more confidence in the geologic model.

The trapping mechanism, and the factors controlling oil saturation, are not fully understood; the area has recently undergone regional structural tilting, and it is possible that the hydrocarbons are not yet in equilibrium. Several appraisal wells drilled in 2004 – 2005 have further delineated the extent of the accumulation and provided a better understanding of the trap. The elements of this exploration play have already been successfully applied to other similar seismic trends identified across northwest Oman.