

# The Puffin Field — A Geophysical Enigma

**P. D. Grant**

*BHP Petroleum  
35 Collins Street  
Melbourne VIC 3000*

## Abstract

The Puffin Field is located within the Vulcan Sub-basin of the Timor sea, off the Northwest Coast of Australia. It lies within the offshore exploration permit AC/P2, operated by BHP Petroleum and its co-venturers. It is situated on the Ashmore Platform, an old Triassic horst which is normal faulted against the Swan Graben, a major Mesozoic depocentre and the regional source area.

Three wells were drilled in the 1970's. Puffin-1 and Puffin-3 encountered oil in "FIT" tests from within the Maastrichtian 100 ft sand, and Puffin-2 flowed over 4000 barrels of oil per day from a slightly younger 4 m sand.

On examination of the results of the Puffin wells, it was evident that there were severe velocity anomalies and differing oil water contacts in the Puffin field. The top of the 100 ft reservoir sand is at 2031.4 m subsea in Puffin-1, 2045 m subsea at Puffin-2 and 2074 m subsea at Puffin-3. The two way times to these events were 1392 ms, 1328 ms and 1398 ms respectively. The interpreted oil water contacts in Puffin-1 and Puffin-3 were 2033 and 2077 ms subsea respectively with no contact seen at Puffin-2.

In an attempt to resolve these anomalies the AC/P2 joint venture undertook a detailed seismic reprocessing project of the 1980 data with special emphasis on detailed velocity analysis. This 1987 reprocessing effort involved two passes of velocity filtering and velocity analysis at every 600 m. Velocity analyses were picked on a horizon-consistent basis, such that variations in interval velocity for key horizons could be established for later use in depth conversion. Although sceptical in using stacking functions as the input velocities to depth conversion, they were used, as no viable alternative was feasible.

Data quality was reliable to the top of the Palaeocene Calcilutite, and six horizons were picked with their respective velocities to this level. Analysis of the data indicated that the two major units exhibiting interval velocity variation were the Pliocene "low velocity layer" and the Eocene carbonates. Using the smoothed stacking velocity down to the Top Palaeocene Calcilutite the three wells tied the depth conversion with an accuracy of 0.5%. Below this horizon two constant interval velocities were used from well data as the quality of the seismic pick were not as reliable.

To verify this model BHPP also undertook a "layer-cake" velocity approach which, although confirming the anomalous zones, could not be used laterally away from the three wells, which unfortunately all lay in a straight line.

Two wells, Puffin-4 and Parry-1 were drilled in 1988 to test the resultant interpretation. The wells intersected the Top

Palaeocene Calcilutite within 1% of prognosis at Puffin-4 and within 2.2% of prognosis at Parry-1, therefore confirming the stacking velocity model used in depth conversion. However, both wells came in deep to prognosis at the deeper, objective level as a result, in the case of Puffin-4, of being on the downthrown side of a small fault, and at Parry-1 due to a thickening of the Paleocene section and seismic mispicking of the Top Palaeocene Calcilutite. Had the mispick at Parry-1 been avoided then the tie would have been less than 1.0%. Both these mis-interpretations were made in the part of the section where the quality of seismic was poorest. These two results suggest that even though the depth conversion to the Top Paleocene Calcilutite is accurate to within 1%, the magnitude of the velocity variation is larger than the magnitude of the independent depth closure.

The Puffin Field requires both better quality seismic below the Base Palaeocene Calcilutite, or the means to resolve the lateral extent and possible thickness of a 4 m sand away from Puffin-2.

Until such a method of obtaining either better quality seismic to the objective level, or to be able to define the seismic resolution of the differing sand bodies of a minimum size of 4 m, the Puffin Field will remain a Geophysical enigma.