

Exploring the Jurassic Carbonate Platform Margin Majunga Basin, Madagascar

Seismic Mapping of Porosity

In order to identify a location for a deep test of the Dogger age Bernaraha Limestone, it was essential to determine the most likely areas of reservoir development within this carbonate section. On seismic, the boundary between the top Dogger carbonates and overlying shales is expressed as a strong peak followed by a trough, as shown on line 90-MC-52. While this peak results from the large acoustic impedance contrast at the shale/carbonate boundary, the underlying trough exhibits more amplitude variability, which is related to changes in the uppermost Dogger rock properties.

A map of the relative amplitude of the seismic trough at the top Dogger illustrates how the trough exhibits a distinct trend of high amplitudes running parallel to the Jurassic shelf edge. Note this is significantly downdip from the tight, platform facies encountered in the Tuilerie-1 and Marovoay-1 wells, where amplitude values are much lower.

Seismic modeling of line ML-19-84 shows that less dense (more porous) carbonate near the top of the Dogger limestone, encased within tight, higher-density rock, causes an increase in the amplitude of the trough, which represents the top of the porous zone. A peak occurs at the base of the porous zone, reflecting an increase in impedance. This scenario is not observed on seismic in the Dogger section at either Tuilerie-1 or Marovoay-1.

In an attempt to better correlate the modeling results to the actual seismic data, and to investigate the significance of the high amplitude trend, acoustic impedance inversion was carried out on several dip lines running from the anomalous area to the up-dip wells. The inversion result for line 90-MC-52, which ties Marovoay-1, is shown. Red colors within the Dogger section indicate the lowest impedance values. Assuming this interval consists primarily of limestone and dolomite out to the shelf break, the low impedance zones should have a reasonable chance of correlating to porosity development. The most interesting impedance anomalies occur at CDP 760, at the shelf edge, and CDP1200, while none exist at Marovoay-1. Similar anomalies are evident on the inversion of line ML-19-84, at the same relative dip position as those on line 90-MC-52.

By comparing the low impedance zones to the amplitude map of the trough (top porosity) near the top Dogger, a direct correlation is found to exist between the anomalous high amplitudes and the low impedance values. Based on the results of the seismic modeling and acoustic impedance inversions, the amplitude map can therefore be considered as a pseudo-porosity map of the uppermost portion of the Dogger carbonates. Thus, the areas of highest relative amplitude (red and orange) were predicted to be zones having the greatest probability of porosity development. Belobaka 1 was drilled on line ML-19-84 to test this potential porosity trap.

