

Exploring for Unconventional Resources in the Turbidite Sands of the Recôncavo Basin, Onshore Brazil

Greg Soule, Nanna Eliuk and Felipe Moreira
Alvopetro Energy

Summary

The Candeais Formation is the early deepwater rift fill phase in the Recôncavo Basin, which reaches over 1200 m thickness in the deepest parts of the basin (Bruhn, 1999). In addition to the important early rift source rock member at the base of the Candeais Formation, there is also relatively low TOC kerogen distributed throughout the Candeais Formation shale. . In the grabens of the rift there is a lacustrine turbidite facies present which forms the Gomo Member. Where the sands of the Gomo Member are present they form a tight sand reservoir encased in the thick Candeais Formation shale. The elements of this unconventional play concept have been confirmed by analysis of the first two wells drilled by Alvopetro Energy in the Miranga Low of the Recôncavo Basin. Most of the producing fields in the basin are controlled by structural horst block traps hosted in Agua Grande and Sergi Formation reservoirs. The Candeais Formation in the Miranga Low graben structure, originally thought to be in the oil window, is found to have reached gas maturity.

Introduction

The Recôncavo Basin is located in northeastern Brazil and covers an area of 11,500 km². The basin is an asymmetric graben filled with Upper Jurassic and Lower Cretaceous sediments (Figueiredo et al 1994). The Recôncavo Basin is considered to be in a mature stage of exploration with over 1.5 billion barrels of oil produced to date from 86 fields beginning in 1939 (Figueiredo et al 1994). Alvopetro Energy was formed in November 2013 with a balanced portfolio of unconventional tight sand exploration as well as mature field development and conventional exploration. Mature basin expertise in seismic imaging, production and drilling practices has brought new opportunities to light. In 2014 two pilot wells were drilled to define the deep tight turbidite sand potential as well as one conventional structural prospect.

Seismic Processing

A game changer for the imaging of the sedimentary section was reprocessing the seismic database that was available from the ANP in Brazil. There were several seismic campaigns by Petrobras in the Recôncavo Basin from the 1960-1980s and most of the basin was covered in sparse 3D acquired for the structural pre-rift pool delineation in the early 1990s. The processing flow is primarily focused on noise attenuation while preserving amplitudes and applying 5D interpolation is a major benefit. (Figure 1).

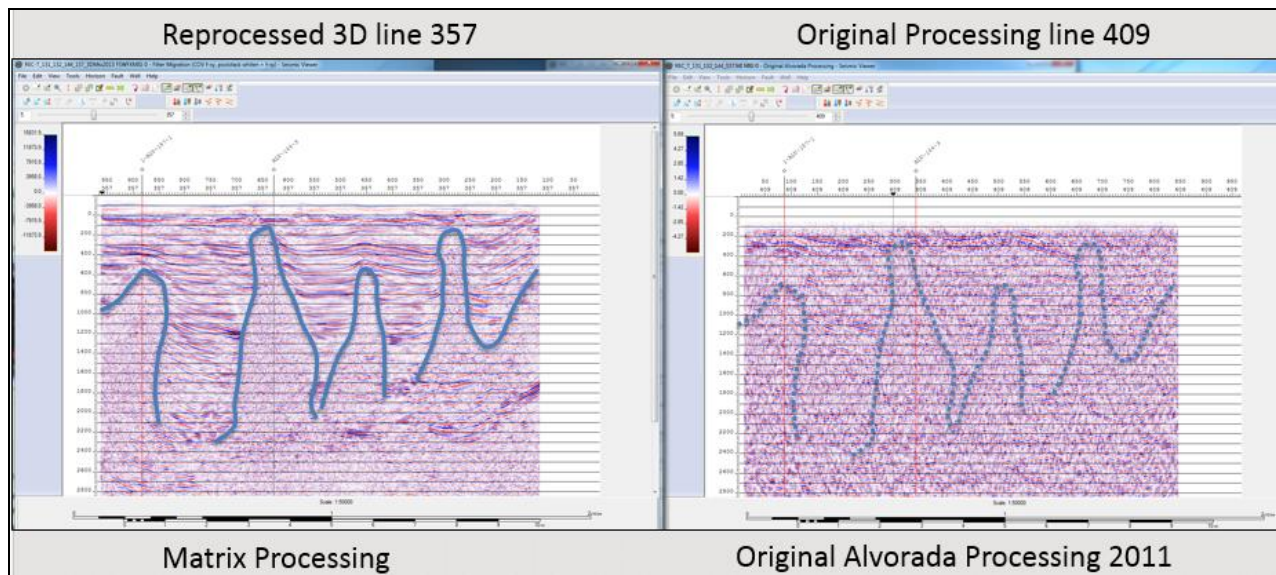


Figure 1 An example of the processing improvements on the Block131_132_144_157 3D. The sparse 3D shot in 2011 showed significant improvement due to noise attenuation and 5D interpolation.

Play Definition

The publicly available data and publications defined good potential for an unconventional trap in Candeias Formation. This Cretaceous rift basin has not only a good early rift source rock, but also TOC distributed throughout the thick deepwater lacustrine deposit that defines the Candeias Formation (Bruhn, 1999). The significant production from the Recôncavo Basin clearly demonstrates the source has reached maturity. In the few previous deep tests in the central portion of the basin the recoveries reported only drilling mud, oil and/or gas cut mud, but no formation water recovered. The target reservoir are the turbidite sands of the Gomo Member of the Candeias Formation which were found to have 6 to 15% porosity consistent with tight sands at similar depths in North America. These deepwater lacustrine turbidite deposits are present in the grabens only leading to the depositional model that the sands are encased in the shales of the Candeias which is ideal for an unconventional trap.

Well Results and Source Maturity

Alvopetro has drilled two pilot wells to approximately 3500 m depth to assess the unconventional play potential of the Gomo Member. A modern suite of specialized wireline logs including Crossed-Dipole Sonic, CMR, Lithoscanner, and image logs was acquired. Over 100 m of core was collected and analyzed for Routine Core Analysis as well as geomechanical properties, Source Rock Analysis, mineralogy, and petrography among others. One well has tested gas from the tight sands of the Gomo and other tests are pending.

Close to Alvopetro's land base there are pyrolysis TMAX data available which indicate oil generation. These data are located on more shallow structures, and Alvopetro's pilot wells from the Miranga Low are the first data known to the authors which indicate gas generation. Given the depth differences between the original data samples and Alvopetro's core, combined with the higher geothermal gradient expected at the time of rifting, these data are consistent and not contradictory.

Conclusions

Alvopetro has drilled two pilot wells which validate the unconventional play potential of the Gomo Member. One well has tested gas which is consistent with the Source Rock Analysis data from these wells. These data are the first known to the authors which document gas maturity in the central portion of the Recôncavo Basin. The close proximity of the gas and oil maturity data are a function of depth of sampling and are not contradictory. This may imply that there was short range migration of hydrocarbons in the basin given the preponderance of oil fields in the shallower structures and the presence of gas in the adjacent graben of the Miranga Low.

Acknowledgements

Alvopetro Energy for permission to show the seismic data and well results.

References

Bruhn, C.H.I. 1999, Reservoir Architecture of Deep-Lacustrine Sandstones from the Early Cretaceous Recôncavo Rift Basin, Brazil. AAPG Bulletin, v. 83, No. 9, p. 1502-1525

Figueiredo, A.M.F., J.A.E. Braga, H.M.C. Zabalaga, J.J. Oliveira, G.A. Aguiar, O.B.Silva, L.F. Mato, L.M.F. Daniel, L.P. Magnavita and C.H.L. Bruhn, 1994, Recôncavo Basin: a prolific intracontinental rift basin, in S.M. Landon, ed., Interior rift basins: AAPG Memoir 59, p.157-203