Frontier exploration in the Peniche Basin (West Iberia Margin): new insights from recent 3D seismic and Grav-Mag modeling

João Casacão, Susana Fernandes, Francisco Silva, and João Rocha

Galp Energia, Rua Tomás da Fonseca, Torres de Lisboa, Torre Galp - 5º Andar, Lisbon, Portugal

The deepwater Peniche Basin, located along the West Iberia Margin (WIM), has been one of the exploration focus areas on the southern North Atlantic during the last decade. The basins of the WIM are compared broadly to other hydrocarbon prolific conjugates, such as the Jeanne d'Arc and Flemish Pass basins, the Porcupine and Rockall Trough basins, and the Essaouira/Aaiun–Tarfaya basins. Still underexplored, the northern sector was recently surveyed with a 3200 km^2 set of 3D seismic and gravity-magnetic data, which were used to unravel distinct geological aspects over the area's main depocentre. Although the stratigraphic record should likely resemble the contiguous Lusitanian and Porto basins, some lithological variations are expected, reflecting the basinward deepening from the rift-climax phase onwards.

The opening of this half-graben trough at this sector of the Peniche Basin is controlled by horizontal and vertical interactions, between the deeply-rooted ENE-WSW Aveiro Fault, NNW-SSE and NE-SW structures. Its main rotation phase is linked with the rift-climax phases during the Late Jurassic to Early Cretaceous, probably associated with local crustal shortening. Potential field data modeling was incorporated into this study, helping to identify the main structural families and assessing the nature of the pre-Mesozoic basement. Seismic interpretation was particularly challenging due to the massive occurrences of salt pillows and diapirs, which impose strong deformation on the Early/ Middle(?) Jurassic sequences. Based on our analysis, a thick Upper Jurassic wedge sequences is developed within the hanging-walls of the Porto Seamount horst feature and the Aveiro Fault, before a more uniform Cretaceous and Tertiary cover. Complex salt tectonics accompany the higher subsidence pulses with associated thicker sedimentation, and diapiric reactivations during the Tertiary compressive phases until present-day.

Based on regionally proven petroleum systems and conjugate analogs, Jurassic and Cretaceous source-rocks were considered and maturity and expulsion models were performed. According to the estimated thermal regime, results point out for mature and over mature source-rocks, which should already have reached most of its ultimate expulsion potential.

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