

Oil seepage mapping in the Pernambuco Plateau, Brazil: accessing the structural control on hydrocarbons migration and accumulation

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The Pernambuco Basin represents a new exploration frontier in northeastern Brazil covering approximately 24 000 km². The deepwater region of the Pernambuco Plateau comprises deep grabens (up to 8 km) and large outer highs, and has high petroleum potential. This investigation presents results of oil seepage mapping in the Pernambuco Plateau, and an analysis of seep locations and the regional structural framework of the basin. The investigation aimed to verify the control exerted by regional structures on the migration/accumulation of hydrocarbons.

The investigation of oil seeps was based in the analyses of 58 SAR satellite images produced by the ENVISAT satellite, provided by the European Space Agency (ESA). The images cover a period from 2004 to 2007, with each comprising an area of 65 km x 65 km (4225 km²). Thirty-one anomalies were found, and multi-criteria analysis suggests that 20 are associated with natural seepage from hydrocarbon accumulations formed by an active petroleum system.

The first group of anomalies is concentrated in the northern part of the plateau, associated with the fault system that forms the eastern border of the Maracatu High that trends NNE-SSW. A second group of oil seeps occurs in the northeastern region of the plateau, around the Itamaracá Outer High, associated with the fault system controlling the western border of the high. A third group of seeps is associated with the fault system of the eastern border of the Gaibu Outer High, a basement topographic high in the central region of the plateau. A fourth group of seeps is located in the southwestern region of the plateau, near the Maragogi–Barreiros High, that trends NW-SE. A fifth group of seeps occurs along the outer border of the plateau, and probably is not related to deep hydrocarbon reservoirs. These anomalies are possibly related to hydrothermal seeps. The seepage cluster found along the border of the Maracatu High shows strong correlation with three oil exudations found through the piston-core research campaign conducted by the National Petroleum Agency (ANP) in 2005.

The mapping of natural seeps revealed the occurrence of seep clusters in the northern, southern, and central regions of the Pernambuco Plateau, and that fault systems that controlled the main depocentres probably acted as migration corridors in the basin. The results can reduce exploratory risk, as well as support future petroleum system modeling.