Petroleum System Modeling in the Jequitinhonha Basin, Brazil: an Integrated Deterministic-Probabilistic Approach

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The Jequitinhonha Basin, located in the eastern Brazilian Margin, covers an area of about 10,000 km\textsuperscript{2}. Sedimentary infill comprises a continental rift sequence, composed by siliciclastic sediments and evaporites (Mariricu Formation), and a marine drift sequence, comprised by Albian/Cenomanian neritic clastics and carbonates (Barra Nova Group), Late Cretaceous/Early Tertiary slope/deep basin shales (Urucutuca Formation) and Oligocene/Recent platform clastics and carbonates (Rio Doce and Caravelas formations). Rift tectonic framework is represented by a set of normal faults which limit a succession of horsts and grabens. Conversely, post-rift tectonic framework is typified by thin-skinned extension due to salt movement. Solely one significant hydrocarbon occurrence has been discovered so far, a sub-commercial field composed of a light (39.6° API) paraffinic oil (77.4% of saturates) pooled in the Aptian sandstones and conglomerates of the Mariricu Formation. The integration of all available geochemical and geological data suggests that this oil accumulation was generated by the lacustrine/marine hypersaline source rocks of the Aptian section.

This work presents the results of a modeling study performed in an exploration block (BM-J-2), located in the southern offshore Jequitinhonha Basin. 1D and pseudo-3D deterministic and probabilistic modeling techniques were applied in order to reconstruct petroleum system dynamics in the studied block. Modeling results points to the existence of two distinct pods of active source rock: one located in the easternmost portion of the block (slope/deep water area) and another in a structural low located in the shallow platform area. The age of the main phase of petroleum expulsion ranged from Late Cretaceous/Paleogene in the deepwater “kitchen” to Paleogene in the platform area. Oil and gas migration modeling indicates that the structural high located in the central-eastern part of the block could be charged by both source pods. Conversely, the westernmost structural highs could only be charged by the pod located in the platform area. Probabilistic simulations that took into account the geologic uncertainties of all the input parameters allowed an estimate of migrated oils and gas volumes in the studied block. The results of this study provided basis for a better assessment of hydrocarbon charge risk and petroleum prospectivity of the studied block.

Keywords: Jequitinhonha Basin, Petroleum System, Deterministic-Probabilistic Modeling.

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