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Understanding source rock contribution to hydrocarbon accumulation and natural gas leakages in the Bredasdorp Basin- a 3D basin modelling study

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To assess the total petroleum system and prospectivity of the Western Bredasdorp Basin (WBB), this study investigates the contribution of Upper Jurassic-Cretaceous source rocks to the reservoir hydrocarbons and natural gas leakages using a 3D basin modelling technique. The established 3D model is based on an integration of subsurface datasets (2D seismics, well data and cores) and links the present-day configuration and related tectonic/geodynamic evolution of the basin at a crustal scale (Sonibare et al., 2014) with the local-to regional-scale thermal histories of the Southern African continental margin. By analysing the temporal and spatial distribution of critical moment for hydrocarbon generation, migration and accumulation, we find that three periods, coinciding with the main phases of hydrocarbon generation and expulsion, characterise the reservoir filling history of the basin. The first period corresponds to the Early Cretaceous syn-rift rapid subsidence and sedimentation rates. While the second period indicates the significance of post-rift thermal subsidence and the heating effect of the Late Cretaceous-Early Tertiary hotspot-related heat flow pulse, the third period corresponds to the Miocene margin uplift and thermal perturbation. According to our results, the largest amounts of hydrocarbon accumulations and possible seafloor gas leakages are respectively contributed by the syn-rift Late Hauterivian and Mid Hauterivian source rocks. By performing a series of sensitivity tests, we further gain better insights into the timing of migration pathways and dynamics. We consider the scenario that couples faulting activity, seal bridging mechanism and facies heterogeneity as our best approximation of the probable controlling factors of migration, accumulation and leakage, as it gives the best location of discovered accumulations and observed leakages in the WBB.

Keywords: Southern South Atlantic, Basin modelling, Sensitivity analysis, Basin dynamics, Source rocks, Reservoir history, Seafloor leakage

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