The A-Field Offshore Brazil: Timing of Oil Charge and its Effect in Reservoir Diagenesis

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Abstract

The offshore Campos Basin is one of the most prolific basins along the eastern Brazilian margin with more than 40 oil fields accounting for 89% of the total Brazilian reserves. Operated by Petrobras, the A-Field is an offshore field located at the southwest region of the basin; the reservoirs of the Albian aged Quissam Formation has reported unexpected high-porosity (~22%) in uncemented graintones that progressively decreases from the top of the structure, despite the homogenous lithology. These diagenetic differences are thought to be produced by the presence of oil charge retarding chemical assisted compaction and cementation. The tectono-stratigraphic evolution and the petroleum system of the Campos Basin, have been integrated through bi-dimensional basin models, to evaluate the timing of oil charge into Quissam Formation and the control exerted by salt tectonics and extensional faulting during the migration phase; thereafter, this analysis was used to assess the theory that early oil charge reduced cementation and preserved porosity in the reservoir. The simulated models integrated seismic, geological and geochemical data to recreate the sedimentary, thermal and fluid evolution at basin and field scales. The rapid subsidence rate experienced by the basin during the Early Cretaceous affected the geothermal gradient and led to early petroleum generation towards the deepest zones of the basin; field-scale simulations indicate that the source rock is insufficiently rich to account for the present-day petroleum accumulation in the field. The basin-scale simulations suggested that the system is currently in the oil window and the petroleum started to generate and expel from deeper zones of the Lower Atafona Formation at ~118 Ma; for the hydrocarbon to enter and stop cementation by ~80 Ma, extensional dilatant faults permitted the vertical migration through the thinning evaporite layers and salt welds formed by gravitational salt movements initiated 20 million years before; with the oil onset into the ~700 m buried reservoir, the diagenetic cementation should be significantly reduced, preserving the higher range of porosities that are present-day observed in the field.