Unlocking Nigeria's Deep Prospects: PVT Phase Prediction and V2V Implication Using a High-Resolution Basin Analysis Workflow

Sadat Kolonic[1], Karin Warners[2], Ilya Ostanin[2], Ronnie Schwede[2], Lorcan Kennan[2], Nick Hogg Mascall[1], Mark Newall[3], and Olaf Podlaha[2]

[1]Exploration Capability, Shell Petroleum Development Company of Nigeria, Port Harcourt, Riveres, Nigeria.
[2]Basin Modeling & Inversion, Shell Global Solutions International, Amsterdam, Netherlands.
[3]HPHT Exploration, Shell Petroleum Development Company of Nigeria, Port Harcourt, Nigeria.

ABSTRACT

Exploration for Shell in Nigeria is moving towards an onshore gas strategy supplying feedstock to domestic customers and LNG export. Unlocking exploration volumes in support of this must be done with an acceptable level of certainty on phase prediction. A deep opportunity has been identified close to existing gas processing facility in the Southern Swamps and could deliver low unit finding cost volumes. In order to explore phase predictability in a Basin that has complex phase properties a novel Basin Analysis workflow is deployed for this part of the Delta, where near field exploration (NFE) prospects are planned to be drilled in 2018 and beyond. Currently, significant ullage exists at the gas processing facilities, which have a sizeable design capacity for non-associated gas, but a limit for liquid condensates. Ongoing development drilling has encountered surprises including encountering liquids rather than predicted gas, resulting in reworking of development concepts and additional expenditure. An acceptable pre-drill de-risking of hydrocarbon charge, composition and pressures is essential for prospect selection for the drill sequence, optimal definition of well completion, surface facilities and processing infrastructure. The high-resolution workflow builds on Shell's in-house knowledge on basin modelling, quantitative seismic interpretation, rock & fluid evaluation, and stratigraphic-lithological forward modelling. The workflow quantifies and calibrates the change of rock & fluid properties through time, integrating information on the full rock column from overburden, seal, across hydrocarbon-bearing reservoirs, down to the potential source rocks. Input is derived from seismic and well data, and modelled output is calibrated iteratively with available well information from producing fields. Deliverables of this 4D analysis are: the pressure and temperature history and PVT fluid behaviour (CGR) - critical for improved V2V assessment and risk polarisation. Results indicate gas-condensate as the likely dominant hydrocarbon phase, contrasting with previous expectations of non-associated gas with low condensate yield. In this respect, if confirmed by exploration's drill bit, this high-resolution result implies significantly better deep prospect materiality suggesting a higher prospect value rank. The current model has provided the first basin-wide overpressure model in this part of the Southern Swamp and will further aid well design and HSSE mitigations.