A short note on the results of geophysical logging and testing at the Kudu 9A-2 and 9A-3 boreholes

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A comprehensive suite of geophysical logs was run at both the Kudu 9A-2 and 9A-3 boreholes. The interpreted logging results indicated the presence of "Upper and Lower" Gas Sands (UGS & LGS) in the seismic marker horizon R-to-P interval in both wells. Ample core data (7 and 11 cores were cut in Kudu 9A-2 and 9A-3, respectively) were available for calibrating the geophysical logs and for petrophysical and petrographic analysis.

In Kudu 9A-2, the UGS was intersected between 4303 and 4386 mbKB (metres below kelly bushing, 30 m above sea level). The porosity ranges from 0-9% and the gas saturation calculated using the resistivity logs was 40% on average. A limestone, which separates the UGS from the LGS, was intersected between 4409 and 4425 mbKB. Porosity values range from 2-11 % and the calculated gas saturations average 50%. The reservoir sandstone is extremely tight in both the UGS and LGS and average core permeabilities are below 0.01 millidarcies (mD). Although the sandstones are thick and apparently gas saturated, no gas could be expected to flow to surface during a drill stem test (DST) due to the poor porosity and permeability characteristics. Consequently this well was classified as non-productive.

At Kudu 9A-3, the UGS (4277-4360 mbKB) is argillaceous with poor porosity (average of 7%) and permeability (average of 0.01 mD) characteristics. Gas saturations averaging 60% were calculated over this interval. The LGS intersected between 4374 and 4438.5 mbKB shows well-developed gas resistivity profiles with calculated gas saturations of 76%. The presence of gas is also confirmed by positive indications on the neutron/density log. The average porosity is 12% and the permeability 43 mD.

Two thin sandstones not encountered in Kudu 9A-1 or 9A-2 were intersected below the LGS from 4451 to 4465 mbKB and from 4478 to 4482.5 mbKB. The former sandstone is marginally gas saturated but the reservoir quality has been destroyed by the high degree of silica cementation. The latter sand showed good porosity and permeability characteristics on the geophysical logs with calculated gas saturations of 75%. Both this sand and the LGS were tested to investigate the production potential of the well.

Gas flow from the thinner sand (4478-4482.5 mbKB) was measured at a rate of 7.8 MMscf/d (million standard cubic feet per day) of gas per day during DST #lB. The initial reservoir pressure was measured at 7870 pounds per square inch absolute (psia) and a permeability thickness product (Kh) of 49 mD.ft was calculated.

An overall decline in reservoir pressure of 184 psi was measured during the DST. This pressure drop and a knowledge of the total amount of gas produced during the test was used to determine the initial reservoir volume as 0.5 Bscf (billion standard cubic feet) of gas in place. This very small volume indicates that the sandstone is probably a thin isolated unit of limited areal extent within the lavas and as such is classified as non commercial.

The second DST across the LGS recorded gas flow to surface at a rate Of 38.03 MMscf/d, the highest yet recorded in southern Africa. This flow was restricted only by the mechanical constraints of the testing equipment and the recorded wellhead flowing pressure was 1835 psia. The initial reservoir pressure was 7775 pounds per square inch gauge (psig) and the calculated Kh was 8150 mD.ft. No indications of reservoir depletion were observed during this DST and the results may be regarded as extremely encouraging.

The reservoired hydrocarbon sampled from both DSTs was a dry gas (96% methane) with a measured gravity of 0.57-0.58 (air = 1).

Reserve estimates for the Kudu gas field cannot be made with any confidence at present due to the difficulty in mapping the extent of the stratigraphic hydrocarbon trap and the limited data available from only three wells in the field.

Selected references

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