Pointed Mountain Gas Field: Middle Devonian, Hydrothermal Dolomite, Nahanni Formation

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ABSTRACT

The Pointed Mountain Gas Field is located in the southwestern Northwest Territories (NWT), 18 miles (29 km) northwest of Fort Liard. The Pointed Mountain Structure is a 16-mile (26 km) long doubly plunging faulted anticline mapped from surface outcrops and 2-D seismic. Slightly sour (H_2S content 0.55%), acid (CO_2 11%) and hot (formation temperature 154° C (310° F)) natural gas has been produced from the fractured hangingwall Middle Devonian Nahanni Dolomite at a depth of 13,500 feet (4115m) at Pointed Mountain. A total of 315 BCF (8,874 10^6m^3) has been produced from the thrusted and fractured Middle Devonian Nahanni Dolomite reservoir in the period 1972-2001.

The Middle Devonian Nahanni carbonate overlies the Headless that in turn overlies the Arnica. At Pointed Mountain the Nahanni-Headless-Arnica are dolomites. Dolomitization has occurred in two stages, an initial recrystalization to a gray fine-grained dolomite and a secondary, coarse grained, sparry, white dolomite introduced into the formation by hydrothermal fluids. This secondary dolomite infills vugs, fractures and in many localities is associated with brecciation of the earlier gray fine-grained dolomite beds. The white, coarse-grained, dolomite crosscuts bedding and is referred to as the Manetoe diagenetic facies (Morrow et al., 1990). This unusual and spectacular textural association of a fine-grained, gray, matrix dolomite and the precipitation of white sparry saddle dolomite into fractures, breccias and pore space is seen in the Pointed Mountain cores.

The discovery well, Pan Am Pointed Mountain P-53-60-30-123-45, was drilled in 1966. Total well measured depth was 4370.5m (14,339 feet). 330m MD (1082.7 feet) of Nahanni, Headless and Arnica were penetrated before faulting to shale. The two initial Pointed Mountain wells, the P-53 and K-45 drilled in 1966 and 1968, were the best wells in the gas field. Together they produced (September 1972 to December 1998) 257.4 BCF or 82% of the produced gas reserves.

The reason for the prolific productive capability of these two wells may be their position on the fault sheet contacting open fractures near the leading edge at the apex of the thrust fault. Other Nahanni field wells were drilled further down the faulted limb of the structure and did not penetrate the fault plane or encountered the fault plane as the fault plunged. A fracture study by Lamb and Gillen (1997) compared oriented core from K-45 (the best gas producer) and the poorer A-55 well. They concluded that while two orthogonal fracture sets were present in each well, that both sets were open at K-45 while only one set was open at A-55.

Pointed Mountain is divided into the north, centre (P-53 and A-45) and south (G-62) structures at the Nahanni level. The watering out sequence of the wells starting with F-38 and continues through O-46, A-55, and K-45. This is consistent with the elevation of the completed intervals and structural position of the wells in the Pointed Mountain structure. Water influx into the reservoir is mainly along the flanks of the reservoir from the west and north directions. The G-62 well, southernmost of the former Nahanni gas producer, is the exception to the general water influx pattern seen in the north end of the Pointed Mountain field. Seismic and the G-62 dipmeter suggest a Nahanni location updip on the south structure. The L-68 dry hole was originally targeted for this updip location but missed the Nahanni in the leading edge thrust.

A number of geological, geophysical and reservoir anomalies can be detected at the Pointed Mountain structure that may be clues to additional gas potential in the Nahanni. Material balance calculation extrapolates to an additional 200 BCF of unproduced reserves. The prospects for capturing and producing gas reserves with infill drilling between previous productive wells are doubtful. Whipstock holes P-53A and K-25A proved unsuccessful. Faults identified on 1970s vintage seismic separate several undrilled fault blocks would have to rely on fault seals to trap any additional gas. Fault seals have not been proven from pressure or other information.

The southern part of the structure does not appear to be fully exploited and may present the opportunity of an updip leading edge thrusted gas missed by the L-68 well. Separation of thrusted Nahanni in the centre and south structure is hard to prove from limited pressure data. 3D seismic and a well are needed to test the concepts.

References

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