P53-MO

GEOCHEMICAL CHARACTERIZATION OF SOLID BITUMEN DEPOSITED WITHIN THE MISSISSIPPIAN SANDSTONE RESERVOIR OF THE HITCH FIELD, SOUTHWEST KANSAS

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The occurrence of solid bitumen in petroleum reservoirs is a common phenomenon in many petroliferous basins worldwide. Solid bitumen was identified within the Upper Mississippian (Chesterian) sandstone reservoir in the Hitch field, southwest Kansas (Sorenson *et al*., 1999). Within the oil column, a 30-foot layer of lower core porosity and permeability was recognized (Fig. 1). The solid bitumen was significantly enriched in asphaltenes compared with the oil-producing columns. The adjacent Etzold field has similar reservoir properties but lacks the solid bitumen, although the Hitch and Etzold fields were thought to be in pressure communication and have a common source. A suite of the Hitch and Etzold crude oils and core extracts were analyzed by various geochemical techniques to study the geological and geochemical controls on the formation of solid bitumen. A comparable study of crude oils and source rocks in the Anadarko Basin was undertaken in an attempt to relate the oils to their possible source rocks.

Based on biomarker distributions and carbon isotopic compositions, the Hitch and Etzold crude oils appear to be mixtures of hydrocarbons derived from Ordovician and Devonian (Woodford Shale) source rocks. Several processes leading to the deposition of solid bitumen (i.e. tar-mat formation, asphaltene precipitation) in a reservoir have been proposed in the literature, including gas deasphalting, biodegradation, low reservoir temperature, in-reservoir oil mixing, pressure reduction during reservoir inversion, thermal cracking at an elevated reservoir temperature, and water-flooding/CO_2 injection for an enhanced oil recovery. Geochemical evidence suggests that biodegradation and thermal alteration are not responsible for the formation of solid bitumen in the Hitch reservoir. The deposition of solid bitumen in the Hitch reservoir is more likely to be explained by the mixing of oils with different geochemical compositions, especially the addition of gaseous components and paraffinic crude oils to asphaltene-rich oils, from multiple source rocks filling the reservoir over an extended period of time. A possible reservoir filling scenario revealed that the Hitch field oils are more heterogeneous in geochemical composition than the Etzold field oils due to multiple sources. Furthermore, gas deasphalting and regional pressure and temperature drops as a

result of post-Laramide orogeny may have contributed to a phase change in the reservoir fluid to precipitate solid materials by disturbance of thermodynamic equilibrium.

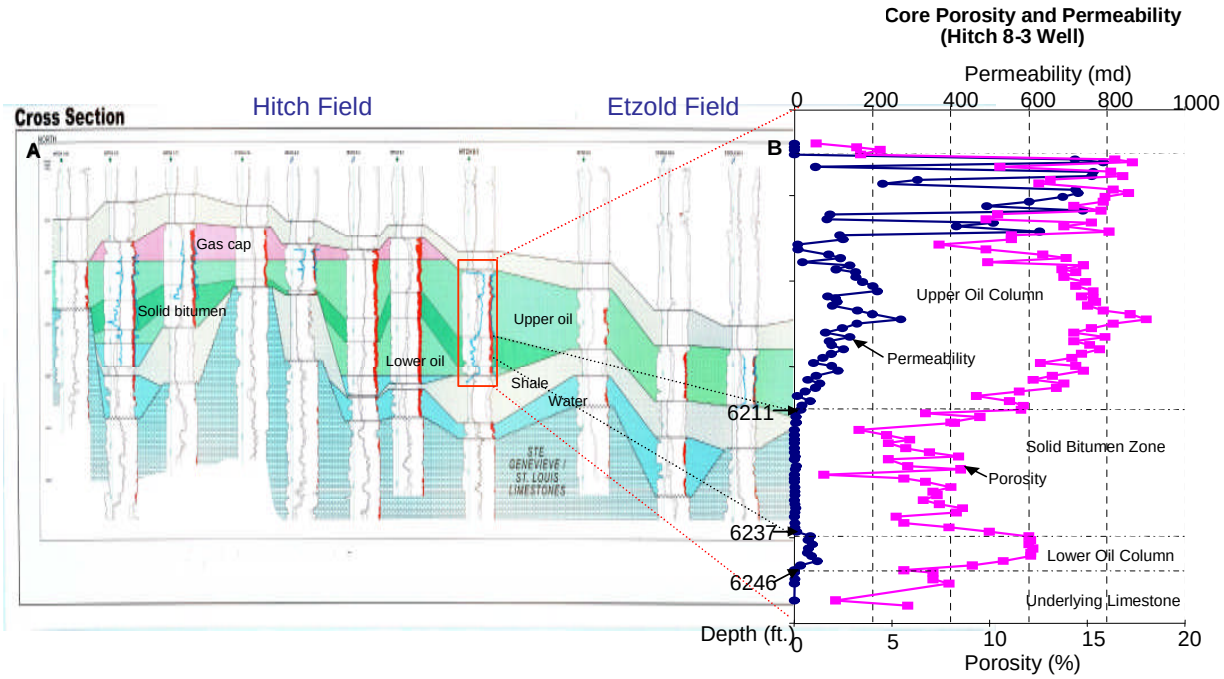

Figure 1. Schematic cross-section (North to South – A to B) of the Upper Mississippian strata showing the position of solid bitumen (dark green color) in the middle of sandstone reservoir in the Hitch field (from Sorenson *et al.*, 1999). Plot of porosity and permeability with depth in the Hitch 8-3 well, showing a vertical variation in porosity and permeability. Data were obtained from a routine core analysis.

REFERENCES

Sorenson R. P., Kelly S. P. and Cantwell D. (1999) Tar mat formation within the Hitch oil field, Seward County, Kansas. In: Merriam D. F. Merriam (Ed.), Transactions of the 1999 AAPG Midcontinent Section Meeting, Kansas Geological Survey Open-File Report 99-28, 156-165