

## **Pore-Scale Imaging of Solid Bitumens: Insights for Unconventional Reservoir Characterization**

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### **ABSTRACT**

Characterizing unconventional reservoirs involves the investigation of a wide range of potential source rock targets at various stages of thermal maturity. These samples may contain a mixture of kerogen, bitumen, oil and pyrobitumen within their fabric. Thus, it is critical that we properly identify and examine each organic phase in order to better understand reservoir properties. In the present study, we have selected samples of gilsonite from a naturally occurring solid hydrocarbon deposit to serve as an analog for characterizing the bitumen phase of generation.

Gilsonite is an aromatic-asphaltic solid bitumen that is found in vertical veins along the eastern portion of the Uinta Basin, Utah. It is thought to be an early generation product from oil-prone Green River Shale source beds and is similar to low maturity crude oil in composition. It has a high nitrogen content, low sulfur content, high melting point (fusibility) and is soluble in organic solvents. We have used a variety of analytic methods to characterize this material, including standard optical organic petrology and scanning electron microscopic imaging to examine the occurrence of organic porosity.

Optical organic petrology analysis using both air and oil immersion objectives show that the polished gilsonite surfaces are typically dark grey and featureless. Macerals and inorganics are absent. Visual estimates suggest that fractures make up approximately 1% of the conchoidal fracture plane, while the pencillated variety contains approximately 2% fractures along with 5% shallow pits. Scanning electron microscopic images also show the occurrence of fractures within gilsonite, but the matrix contains no evident organic porosity.

The results of our analyses suggest that, unlike pyrobitumen, pre-oil solid bitumen represented by gilsonite was found to contain no significant occurrences of organic nanoporosity within its matrix. Gilsonite does have minor pitting and fractures, but these do not represent an effective interconnected pore network and are probably artifacts of weathering/sampling. Thus, this material would not represent a potential candidate for in-situ hydrocarbon storage capacity. Whether this is typical of all naturally occurring solid bitumen is debatable, considering that gilsonite has undergone some secondary alteration via devolatilization and limited biodegradation. Nevertheless, the pore-scale imaging of this solid bitumen provides potentially important new insights for unconventional reservoir characterization.