

Bitumen – the zircon of petroleum systems

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Bitumen, with its generally high Re-Os concentrations, is amenable to dating, but the results can be surprising. Here we show that surprises open our minds to novel applications.

Early forays into dating petroleum made use of this tangible, naturally-occurring substance. Bitumen is a general term for viscous liquid or solid hydrocarbon. Within this bitumen box, however, a mind-boggling array of definitions and synonyms are used interchangeably by geologists, engineers, and persons paving roads and laying railroad track. In this paper, we use the term bitumen in the context of **(1)** dull to glassy solid hydrocarbon that fills small or profound fracture networks within a shale source rock (e.g. gilsonite) **(2)** a blanket of asphaltene-rich hydrocarbon whose development is sensitive to fluctuations in the water table), or encounters with other oils of lighter composition (e.g. tar mats from deasphalting), **(3)** a residue lining and accumulating in pore space as the lighter components of through-passing hydrocarbon disassociate and move away from the heavier component (asphaltite), and **(4)** a sticky solid substance oozing and migrating from a vein or in a porous interval in a sedimentary rock (ozokerite, oil seeps). While these four descriptions merge aspects of dictionary definitions, their basis is the geologic context where we have found, extracted, analyzed, and understood bitumen deposition in its natural occurrence.

Bitumen is an early product of kerogen breakdown, and may participate in and contribute to later stages of oil and gas generation. Using Re-Os isotope geochemistry (ages and Os isotopic tracer studies), we find that many solid bitumens retain the memory of their first (or an earlier) generation significant to development of a petroleum system. For example, bitumen often retains and reports the age of its source rock, even though it may have migrated significant distances and taken residency in much younger rocks or structures. In some ways, bitumen is the zircon of petroleum systems. Its role has yet to be realized in reconstructing the early stages of petroleum systems and ultimately, in fingerprinting their economic potential.

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