

## **Processing the Bitumen-Sulfide History in the Sichuan Basin, China**

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The Sichuan Basin, China, is home to one of the world's largest gas reservoirs situated in Neoproterozoic carbonate rocks and sourced from overlying Lower Cambrian shales. The timing of petroleum and gas generation has been the subject of at least four recent papers, all of them arriving at markedly different ages based on Re-Os dating of bitumen occurring in vugs, veins and fractures within the reservoir rock. The bitumen is direct evidence for a paleo-oil reservoir that later served as source for generation of gas. Several challenges may impact application of Re-Os chronology to petroleum systems: (1) maturation and migration occur over extended intervals of time, often controlled by vertical tectonics; (2) petroleum-bearing fluids may interact and isotopically exchange with rocks and waters enroute to the reservoir; and (3) more than one source rock may be involved. Thus, larger uncertainties are inherent when working with petroleum systems. Accuracy should always take precedence over precision.

Here we employ a sampling strategy to minimize uncertainty by targeting explicit occurrences of bitumen in veins, vugs, and fractures. While different portions of a large basin may show different timings for filling and cracking of petroleum, our approach provides a point in time for a location in the basin. In a single core sample, a well-developed 1-cm bitumen-calcite vein yields a Model 1 isochron at ~170 Ma while a younger bitumen fracture and small bitumen-filled vugs formed at ~140 Ma. Another core sample with a knobby bitumen vein structure yields an 8-point isochron at  $333 \pm 21$  Ma. Reconstructing the hydrocarbon history requires tracking the initial Os ratio, as this demonstrates “what is sourcing what” over geologic time. An increasing 187Os/188Os initial ratio through time that can be tied to the 187Re/188Os ratios for presumed precursors is necessary to build a coherent model for hydrocarbon history. Ultimately, we tie MVT mineralization to a bitumen-sulfide event at ~259 Ma (initiation of the Emeishan LIP), demonstrating the intimate relationship between hydrocarbon and metalliferous fluids in a fixed time framework.

Support from the Natural Science Foundation of China (No. U19B6003) with additional support from the AIRIE Program.