Introducing the Re-Os-Hg Trio — A Powerful New Combination for Source Rock Characterization and Predicting Hg Levels in Oils

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Abstract

The Re-Os radiometric clock applied to petroleum geology is now well established. Most recently, we have reconstructed whole petroleum systems in absolute time, including source rock age (mature and undermature), timing of maturation, oil-oil-water mixing events on migration, ages for tar mat formation, and even subtle differences between the in situ oil leg and produced crude oil [1]. Interpreting these data is not without challenges, however. Data interpretation critically hinges on a thorough understanding of the geology embracing a petroleum system and structural and biostratigraphic constraints on the oil generation and migration. Sound analytical results demand a high-level strategy for sampling, and thoughtful dismantling of the oils using solvents that yield suites of asphaltene-maltene pairs [2]. We have shown that simply analyzing crude oils to create a Re-Os isochron - without accompanying ASPH-MALT data - may yield aberrant and highly misleading ages [3]. We have now added mercury (Hg) and its isotopes to our analytical pallet. Mercury occurs as many different molecular species with radically different geochemical behaviors in source rocks and in crude oils and condensates. This is especially concerning to the petroleum industry because Hg is destructive to Al-bearing equipment during the transport and refining processes. The ability to predict, in advance, a high Hg component in source rocks is fundamental knowledge for earmarking oils produced by that source and now residing in the reservoir rock. While Hg is markedly associated with the organic component in shales, we find that pyrite-marcasite nodules are also Hg-

rich and oil-rich, thereby implicating hydrocarbon migration with sulfide formation. Equally critical for predicting Hg concentrations in hydrocarbons is knowledge of the partitioning of Hg between source rock and hydrocarbons. Further, we must understand the origin of organic-rich source rocks that either never had any significant Hg, or have apparently lost their Hg. This is fundamental work that we are currently undertaking.