Stable isotopes of Hg (mercury) as an oil-source rock correlation tool

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Petroleum is generated upon thermal maturation of organic-rich source rocks. Linking oil accumulations to specific source rocks is of key importance for exploration success, but oil-source correlations are often ambiguous, masked by the multitude of processes that operated in the geologic history of oil fields.

Here, we explore for the first time use of the stable isotopic composition of mercury (Hg) in oils and their known source rocks as a tool for oil-source rock correlation. Drawing upon our collection of previously dated oils and shales (Re-Os), we analyzed the Hg contents and stable isotopic compositions in oils and source rocks primarily from the Norwegian North Sea and Barents Sea, with additional samples from Italy, Sweden, and Venezuela. Mercury contents of Norwegian, Swedish, and Venezuelan oils are typically 7-11 ppb, reaching up to 27 ppb, whereas oils from Sicily, Italy [1] contain up to 730 ppb Hg. Jurassic source rocks from Norway contain 45-100 ppb Hg (North Sea and mid-Norwegian shelf) and 175-550 ppb Hg (deepwater facies, Barents Sea). Ordovician source rocks in southern Sweden have similar values. Upper Triassic-Lower Jurassic source rocks from Italy have up to 1500 ppb Hg.

Our preliminary results from ongoing analytical runs detect large variations in the Hg isotopic composition of different oils. Importantly, the magnitude of mass dependent isotopic fractionation of Hg in oils seems to closely track the isotopic composition of their respective source rocks. This promising avenue for oil-source rock correlations will be further explored by evaluating the mass dependent and mass independent Hg isotopic signatures for an expanded set of oils, asphaltenes from tar mats, bitumen and source rocks.

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[1] Georgiev et al. (2016), GCA 179, 53–75.