Hg in petroleum systems and sulfide: are we missing the real anomalies?

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In the past decade an enormous and enthusiasic effort has gone into defining and refining Hg anomalies in association with earth crisis events, notably the Permo-Triassic extinction[1,2], Toarcian OAE[3], and Eocene PETM[4]. Mercury concentration and to a lesser extent Hg isotopic data have been used to conclude that volcanic emissions, fly ash, and euxinic conditions in the sedimentary environment were responsible for Hg excursions in the geologic record.

Here we present new Hg concentration data from core samples of Upper Jurassic, Kimmerigian-equivalent black shales in the North Sea. Unlike the UK Kimmeridgian section that has been used as a normalization interval for Hg studies of Lower Jurassic shales[3], we find a wide range of Hg concentrations, many of them among the highest measured (>2000 ppb). Further, we documented and analyzed several varieties of bedded pyrite nodules, some markedly less and some dramatically higher in Hg than their immediately hosting shale counterpart. Some cores presented oil and bitumen which were analyzed, and leaching of residual oil in a reservoir play produced mundane Hg concentrations. Our data show variation at the stratigraphic level that exceeds any varariations measured to date. The variations observed do not necessqrily correlate with TOC, degree of maturity, or other RockEval parameters. We are presently coupling these data with Os isotopic data, and suspect external intervention beyond local pore fluids.

Lessons learned and to be further explored are **(1)** the source and mobility of Hg in the geologic record is likely far more complicated than present studies might indicate, and **(2)** modeling Hg cycling, Hg reservoirs, and Hg's elusive behavior requires understanding another large Hg reservoir on planet earth: petroleum systems. Consider the injection of Hg into seawater through degassing of methane from the seabed, or the explusion of deep marine tar balls that float around continents before arriving on welcoming shoreline[5]. Chasing Hg from source to sink has been a challenging but enlightening undertaking. Data from petroleum systems must be incorporated into discussions on Hg cycling.

[1] Grasby et al (2017) Geology **45**: 55-58; [2] Shen et al (2019) Geology **47**: 117-121; [3] Percival et al (2015) EPSL **428**: 267-280; [4] Jones et al (2019) Clim Past **15**: 217-236; [5] Scarlett et al (2019) Org Geochem **133**: 77-91.