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Natural and artificial thermal maturation: effect on mercury distributions in Lower Jurassic organic-rich sediments

ASRI OKTAVIONI INDRASWARI[1], JOOST FRIELING[2], TAMSIN A. MATHER[1], DR. ALEXANDER J. DICKSON[3], ERDEM IDIZ[1], HUGH C. JENKYNS[2] AND STUART A. ROBINSON[1]

[1]Department of Earth Sciences, University of Oxford
[2]University of Oxford
[3]Royal Holloway University of London

Presenting Author: asri.indraswari@exeter.ox.ac.uk

Sedimentary mercury (Hg) enrichment has, in recent decades, been widely used as a proxy for volcanism from Large Igneous Provinces (LIPs). Naturally emitted via volcanic exhalations and other processes, Hg is globally dispersed in the atmosphere and finally sequestered in sediments. Recent works have tested the effect of extremely high-temperature exposure, such as intrusion and contact metamorphism, on Hg in sediments. However, the behaviour of Hg as sediments are exposed to moderate warming, gradual thermal maturation and hydrocarbon formation in a sedimentary basin is still underexplored.

We have conducted a series of artificial maturation experiments on immature organic-rich marine mudrocks, namely the Posidonienschiefer or Posidonia Shale (Lower Jurassic), Lower Saxony Basin, Germany. These pyrolysis experiments allow us to investigate the changes in Hg concentration in rock residues and evolved organic fluids through varying stages of maturation.

Our preliminary results show that Hg concentrations in sediments progressively decrease with increasing thermal maturity for the duration of the experiments (24 hours to 5 weeks at 325 ºC), but that the main change occurs between time-step 5 days and 15 days. However, the final Hg concentrations for the pyrolysis experiments strongly contrast with observations on Posidonia Shale core samples along a natural maturation gradient. Rather than a slight decrease as observed in the artificial maturation experiments, we recorded a trend of increasing Hg concentrations associated with higher maturity on three Posidonia Shale cores with different level of thermal maturity (immature to overmature, VR_o ~0.5%, ~1.5%, and ~3.5%). We explore the mechanisms for these striking differences between the experimental and natural maturation and how this may impact the use of sedimentary Hg as a proxy for LIP-derived volcanism and control Hg mobility during hydrocarbon formation.