Mercury (Hg) isotope evidence for enhanced importance of terrestrial Hg to the global ocean during the early Jurassic oceanic anoxic event (Toarcian OAE)

XINYUAN ZHENG1, LAWRENCE PERCIVAL2, RUNSHENG YIN3, AISHA AL SUWAIDI4, MARISA STORM5,6, MICHA RUHL7, WEIMU XU8, STEPHEN P HESSELBO9 AND HUGH C. JENKYNS10

1University of Minnesota - Twin Cities
2AMGC, Vrije Universiteit Brussel
3State Key Laboratory of Ore Deposit Geochemistry, Institute of Geochemistry, Chinese Academy of Sciences
4Khalifa University of Science and Technology
5Royal Netherlands Institute for Sea Research
6Netherlands Earth Systems Science Centre (NESSC)
7Trinity College Dublin
8University College Dublin
9University of Exeter
10University of Oxford

Presenting Author: zhengxy@umn.edu

The early Toarcian oceanic anoxic event (T-OAE, ~183 Ma) was associated with widespread marine anoxia, high temperatures, significant biotic turnover, and major perturbations of the global carbon cycle. This event has been increasingly linked to emplacement of the Karoo and Ferrar Large Igneous Province. Widespread enrichments in mercury (Hg) concentrations or Hg/TOC ratios measured in marine sedimentary sequences recording the T-OAE have been taken as important evidence for volcanic eruptions [1]. However, a volcanic origin of the elevated Hg levels has not been thoroughly tested.

Here we present stable Hg-isotope results from three well-studied T-OAE sequences – the Hawsker Bottoms section and Mochras drill core from the UK, and a southern hemisphere section from Arroyo Lapa, Argentina. Measured δ202Hg values (~ -2‰ to 0‰) are variable within and across individual sections, suggesting influence of local processes on mass-dependent fractionation of Hg isotopes. Interestingly, mass-independent fractionation (MIF) of odd Hg isotopes, Δ199Hg, exhibits negative excursions reaching ~0.2‰ to ~0.4‰ over the T-OAE interval in all three sections. Such negative Δ199Hg values are typical of Hg from terrestrial sources, rather than direct volcanogenic Hg carrying a Δ199Hg signature of ~0‰. Even Hg-isotope MIF signatures, Δ200Hg, imply reduced influence from the atmospheric Hg input relative to terrestrially-derived sources during intervals of negative Δ199Hg excursions. For the Hawsker Bottoms and Mochras successions, where osmium (Os) isotope data are available, the negative Δ199Hg excursions stratigraphically correlate with positive shifts in Os-isotope ratios. Combined with a negative Δ199Hg excursion previously observed in a T-OAE section from Canada (NE Panthalassa) [2], our new results indicate enhanced influence of terrestrially-derived Hg in the global ocean during the T-OAE, which was likely associated with enhanced continental weathering in response to rapid climate warming during the event. Our results do not preclude the possibility that this terrestrial mercury was originally derived from volcanic emissions and subsequently shuttled to the ocean, but they highlight the need for an improved understanding of Hg transport pathways in ancient sediments when applying Hg as a tracer for volcanic activity.