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Mercury isotopes reveal local and global volcanism during the Early-Middle Jurassic

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In ancient marine systems, the enrichment of mercury (Hg) is ubiquitously linked to Large Igneous Provinces (LIPs) and invoked as potential drivers of numerous mass extinctions. In Earth's history, however, local volcanic systems have had a significantly larger impact on a regional to super-regional scale. Here, we investigate new Hg isotope records from the Early-Middle Jurassic sedimentary records from Viking Corridor, Norway, encompassing volcanic events characterized as global (Karoo-Ferrar LIP; KF-LIP) and local (North Sea Dome; NSD). Hg isotope data (mass-dependent and mass-independent) confirms a long-distance aerial transport of the KF-LIP, one of the driving mechanisms that resulted in the early Jurassic Toarcian Oceanic Anoxic Event (TOAE). We observed a 1.03‰ positive shift of δ^{202}Hg during the pre-to-syn TOAE (late Pliensbachian-early Toarcian). We used the δ^{202}Hg signal, in conjunction with a near zero Δ^{199}Hg, Δ^{200}Hg, and Δ^{201}Hg, to identify the KF-LIP and delineate a Hg source shift from terrestrial to one dominated by long-range airborne Hg. Since there is no known LIP post-TOAE (late Toarcian-middle Bajocian), we infer the consistent zero value of Hg isotope during this interval as a local, short-ranged volcanic signal generated from either a subaqueous or subaerial NSD. This local volcanic event occurred over approximately 6 million years—a significant geologic time interval. The exact age constraints of the NSD are still unknown, but its subaerial extent is well-documented to have occurred during the Aalenian and followed by an eruption during the Bajocian. Given this, we question whether Hg enrichment from the NSD during the late Toarcian-Bajocian could have had a role in driving the Bajocian CIE, a global event associated with the perturbation of the carbon cycle and cooler climatic conditions. Although the Bajocian global cooling event also requires further study, new research should consider invoking the NSD as a possible trigger mechanism. This study reveals the power of using Hg isotopes, in conjunction with other geochemical proxies, in decoupling the origin of Hg, specifically between volcanic (KF-LIP and NSD) and terrestrial settings within the Viking Corridor. We also highlight the importance of considering massive, localized events to resolve any relationship between Hg and environmental perturbations.