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Permian–Triassic boundary volcanism: Hg isotope and elemental Hg proxies in the Meishan and Guryul Ravine successions

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High-resolution carbon isotope ($\delta^{13}C$), Hg-isotopes, and Hg stratigraphy investigations were carried out across the Permian–Triassic successions in Guryul Ravine (India) and Meishan D (China) to infer the source of the preserved Hg, and implications on mass extinction. Hg/TOC (total organic carbon) patterns in Late Permian Mass Extinction (LPME) and the Earliest Triassic Mass Extinction horizons document abrupt environmental changes during the Permian–Triassic transition. Out of the three Hg-spikes observed in Meishan, only the spike I could stand the TOC and total aluminum (Al) normalization. The third Hg/TOC spike indicates a change from anoxic/euxinic to fully oxic conditions, along with corresponding Hg/TS and Hg/Al peaks during transition from the framboidal pyrite-bearing (Bed 26) to oxygenated sediments (Bed 27). Four Hg/TOC spikes in the Guryul section are noted in Bed 46 (spike I), at the base of the framboidal pyrite-rich Bed 49 (spike II), at the PTB (spike III), and LPME horizon (spike IV). The spike I could stand normalization to TOC, TS and Al, spike II to TOC and TS, and III and IV to TOC and Al. These observations reveal oxic conditions during spike I, anoxic during spike II, and oxic again, in the upsection (spike III and IV). Both sections demonstrate a clear link between deposited Hg and organic matter, while a minor role of sulfides was limited to locally anoxic conditions in framboidal pyrite-bearing horizons. The pre-LPME samples display odd, positive-MIF values while LPME–PTB interval samples display negative values that return to positive levels, above the ETME horizon. The Hg-isotope patterns either were controlled by the relative depth of deposition of atmospheric Hg or reflect stages of Siberian Traps Large Igneous Province (STLIP) magmatism across the PTB. In the latter scenario, a complex of sills intruded the coal-bearing sediments during Stage 2 (LPME–PTB interval). Both sections have negative $\delta^{202}Hg$ values, compatible with volcanic-emission. The $\Delta^{201}Hg$ signals seem primary and controlled by STLIP signals, and Hg MDF become more negative when influenced by terrestrial Hg influx. The $\Delta^{199}Hg$ vs total Hg and Hg-isotope patterns reflect the depth of volcanic Hg deposition and Hg isotope distribution.