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Mercury enrichment indicates volcanic triggering of the Valanginian environmental change

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The Valanginian stage (Early Cretaceous, ∼137-132 Ma) recorded an episode of pronounced palaeoenvironmental change, which is marked by a globally recorded positive δ13C excursion of 1.5 to 2‰ amplitude, also known as the "Weissert event or episode". Its onset near the early/late Valanginian boundary (B. campylotoxus-S. verrucosum ammonite Zones) coincides with a phase of warmer climate conditions associated with enhanced humidity, major changes in the evolution of marine plankton, and the drowning of tropical and subtropical marine shallow-water carbonate ecosystems. The globally recorded excursion indicates important transformations in the carbon cycle, which have tentatively been associated with Paraná-Etendeka large igneous province (LIP) volcanic activity. Incertainties in existing age models preclude, however, its positive identification as a trigger of Valanginian environmental change.

Since very recently, mercury (Hg) chemostratigraphy offers the possibly to evaluate the role of LIP activity during major palaeoenvironmental perturbations. In this study we investigate the distribution of Hg contents in four Valanginian reference sections located in pelagic and hemipelagic environments in the Central Tethyan Realm (Lombardian Basin, Breggia section), the northern Tethyan margin (Vocontian Basin, Orpierre and Angles sections), and the narrow seaway connecting the Tethyan and Boreal Oceans (Polish Basin, Wawal core).

All records show an enrichment in Hg concentrations at or near the onset of the Weissert Episode, with maximal values of 70.5 ppb at Angles, 59.5 ppb at Orpierre, 69.9 ppb at Wawal, and 17.0 ppb at Breggia. The persistence of the Hg anomaly in Hg/TOC and Hg/phyllosilicate ratios shows that organic-matter scavenging and/or adsorbtion onto clay minerals only played a limited role.We propose that volcanic outgassing was the primary source of the Hg enrichment and conclude that an important magmatic pulse triggered the Valanginian environmental perturbations.