Enhanced volcanism associated to the emplacement of the North Atlantic Igneous Province during the PETM evidenced by mercury anomalies in Pyrenean foreland sections

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The Paleocene-Eocene thermal maximum (PETM; ~55.6 Ma) is one of the most pronounced and the best known of the transient hyperthermal events of the Paleogene. The PETM is characterized by global warming, a significant perturbation of the carbon cycle, and a large perturbation of the biosphere. This extraordinary event is recorded by sharp negative carbon excursions (NCIE) in both oceanic and terrestrial carbonates. The sequence of events triggering this disturbance and the source of the $^{13}$C-depleted carbon for the NCIE remains controversial. External perturbation such as volcanism, associated with the setup of the North Atlantic Igneous Province (NAIP), is suspected to be one of the mechanisms responsible for this abrupt climate upheaval. One proxy for investigating the possible link between the establishment of the NAIP and perturbation associated with the PETM is to study mercury (Hg) concentrations record in marine and continental sedimentary successions.

In this study, we present new high-resolution mercury and stable isotopic records from peripheral basins of the Pyrenean orogen across the PETM. The four studies sections vary from continental to bathyal deposit environment and offer the potential to evaluate how major climatic disturbances are associated with the PETM record through a continental to marine transect.

The data obtained reveal the occurrence of two main NCIEs. Based on biostratigraphy and similarity of shape and amplitude of the isotopic excursions with global records, the largest NCIE is interpreted as the PETM. This sharp excursion is preceded by another one that we interpreted as the Pre-Onset Excursion (POE), founded in some other profiles worldwide. These two NCIEs are systematically associated with important mercury anomalies, whatever the environment
considered. Increase in Hg contents shows no correlation with clay or total organic carbon contents, suggesting that the influences of local processes or Hg scavenging by organic matter appear to be insignificant. These results show that multiple pulses of volcanism, probably associated with the emplacement of the NAIP, contributed to the onset and the long duration of the PETM. In addition, our study highlights the possibility to get reliable information about past extreme climate events from sedimentary successions even if deposited within active tectonic domains.

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