Sea-level changes across the PETM in the Pyrenees, part 1: evidence from coastal plain settings

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The behaviour of the sea level during the PETM is somewhat controversial, some authors maintaining that the event took place during a sea-level lowstand, others that it was coeval with a sea-level rise. These seemingly contradictory hypotheses have been reconciled by our studies in two ancient coastal plain in the Spanish Pyrenees, the Tremp-Graus Basin and the Basque-Cantabrian Basin. Based on outcrop and borehole information we show that a sea-level fall of more than 18 m occurred about 100 – 150 ka prior to the onset of the PETM, causing a seaward displacement of the shoreline larger than 16 km, a widespread incision of valleys in the alluvial plains and the subaerial exposure and excavation of the adjacent marine carbonate platforms. The sea level began to rise about 40 ka before the PETM producing the infilling of the incised valleys, and continued rising during and after the event leading to the aggradation of the alluvial plain. However, the sea level did not regain its pre-fall position until near the end of the PETM. Therefore, although rising, the sea level was comparatively low in the SE Pyrenean area during most of the PETM. Similar changes have been reported in Egypt, the Paris Basin and the Austrian Alps, attesting to the supra-regional (if not global) scope of the PE sea level cycle.

It has been suggested that the pre-PETM sea-level fall could have contributed to the CO_2/CH_4 emission that triggered the PETM, by oxidation of organic matter in subaerially exposed marine deposits and/or by release of methane from the shelf, hypotheses that can be tested by taking into account other Paleocene sea-level changes. Four sea-level cycles of similar or even greater amplitude than the one considered here are recorded in the Pyrenees and elsewhere, none of which seems to be linked to a climatic warming, a fact arguing against a causal link between sea-level falls and thermal events. Yet, in comparison with them, the PE fall (and rise) was unusual by its rapidity, for the whole PE cycle was completed in about 400 ka, while the four preceding Paleocene cycles ranged between 1.5 and 3.5 Ma in duration. This circumstance entails that any genetic link with the PETM would rather be related to the rapid rate of the sea level fall predating the event than to its magnitude.

Alternatively, it is also possible that the PE sea-level cycle and the PETM are both a reflection of tectono-magmatic events in the north Atlantic, and therefore that their temporal concurrence are casual rather than causal.

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