What were the drivers of the Paleocene carbon isotope maximum?

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The Paleocene epoch (66.02 – 55.98 Ma) is a critical interval spanning the post-extinction reassembly of marine ecosystems up to the dawn of the last hothouse period. It also saw one of the largest positive carbon isotope excursions of the Phanerozoic – the mechanisms for which remain uncertain – and a major step change in the Li isotope composition (δ^7Li) of seawater, commonly interpreted as a shift towards highly-weathered, peneplained continents. Despite this, the Paleocene has received little scientific attention relative to the charismatic events that bookend it. In particular, estimates of atmospheric CO_2 concentration over this interval are scant, meaning that the Paleocene often appears as anomalous in terms of global climate sensitivity. Here we present boron isotope-based records of Paleocene ocean pH and atmospheric CO_2, complemented by records of benthic and planktic foraminiferal δ^7Li that inform as to changes in global silicate weathering. We observe a steady decline in atmospheric CO_2 levels from the K-Pg towards the middle Paleocene, before CO_2 rises once more into the Eocene greenhouse period. We find no evidence for a state change in the weatherability of continents in the early Cenozoic, with continental weatherability broadly static over the Paleocene interval. Previous reconstructions of the δ^7Li of seawater are likely driven by variable foraminiferal 'vital effects' over the Cretaceous-Palaeogene mass extinction. Coupling of these constraints on weatherability and carbon cycling with iLOSCAR inverse carbon cycle modelling, points to large fluxes of organic carbon burial. This organic carbon was then likely oxidised and returned to the ocean-atmosphere system to sustain the early Eocene hothouse climate.