Tracking changes in ocean redox during the PETM using Cr isotopes

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Previous deoxygenation events in the geological record may provide insight into the dynamics of changing oxygen levels in the Earth's oceans already underway[1]. The Palaeocene-Eocene Thermal Maximum (PETM) at ~55Ma is a ~150 kyr period of intense global warming with evidence for at least local-scale, ocean oxygen depletion[2,3]. To track seawater oxygenation during the PETM, we use the stable Cr isotope composition of marine carbonates, a new palaeo-redox proxy, which hasshown potential when applied to modern and ancient carbonates [4,5].

Here we present δ^{53}Cr, trace element and REE data of foraminifera through the PETM interval from DSDP Site 401 (North East Atlantic), hosting exceptionally well-preserved foraminifera. ~150 mg of foraminifera were taken from the 63-150μm size fraction and species count data indicate that the relative proportions of dominant species do not change significantly over the event[6]. Systematic changes occur in Cr concentration and δ^{53}Cr throughout the event with a positive δ^{53}Cr excursion of 1.7‰ coincident with the onset of the negative δ^{13}C excursion. This reflects an increased reduction of Cr(VI) and thus a change to more reducing conditions in the water column at the onset of the event. Chromium concentrations of the foraminifera decrease leading into the PETM, and do not recover, indicating either a reduction in seawater Cr concentrations, a change or a change in Cr geochemical cycling during the event.

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New Zircon U-Pb and Hf-isotope data of the Birimian Terrane of the West African craton

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In order to explore whether the West African Craton was formed by the accreation of Archean terranes [1], zircons from 22 igneous rocks collected from across SW Mali and Burkina Faso were recently dated using SHRIMP and analysed for in-situ Lu-Hf isotopes by laser ablation MC-ICPMS. The SHRIMP ages for the samples range from 2195 Ma to 2074 Ma. The intrusion ages suggest two domains: (1) SW Mali where the dated samples range between 2130-2074 Ma; and (2) Burkina Faso with ages between 2195-2100 Ma.

The εHf in zircons at the inferred emplacement age ranges between 0 and 7.5. Three εHf groups can be broadly correlated with age groups: (1) εHf<3, ages 2130-2074Ma; (2) 3<εHf<5, ages 2170-2115 Ma; and (3) εHf> 5, with ages 2195-2140 Ma. Combined, the U-Pb and Hf isotope data define two major periods: (1) an alternation between increasing and decreasing Hf values with decreasing U-Pb ages between 2195-2140 Ma; this reflects periods of addition of juvenile magmas and reworking of slightly older crustal material; and (2) falling Hf values with decreasing U-Pb ages 2140-2074 Ma. Slightly higher εHf values are observed towards the end of this period. These trends imply the dominance of reworking of slightly older crustal material.

This new insight into the architecture and evolution of the WAC suggests that the craton was formed mainly by the assembly of juvenile material with sporadic episodes of reworking. This conclusion, along with that of a study conducted in the northern portion of the craton [2], helps to constrain the poorly understood tectonic history of the Birimian period of West Africa.

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