The faithfulness of foraminiferal calcite as a seawater chromium recorder

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Ocean deoxygenation caused by anthropogenic greenhouse gas emissions has become a focus point of climate change mitigation efforts. Ocean deoxygenation has major implications for the marine ecosystem and the biogeochemical cycling in the oceans and it is therefore critical to understand how the oceans reacted during past warm periods. Cr isotopes are a novel redox proxy for reconstructing past oceanic redox changes. We assessed whether the Cr in foraminiferal calcite, an oft-used proxy carrier, faithfully records oceanic conditions. We have taken three approaches: 1) Sequential cleaning of foraminifera as a preliminary assessment of the location of Cr in the tests. 2) A high resolution LA-MC-ICP-MS study of individual tests to reveal the distribution of Cr in core-top, down-core, sediment trap, and cultured foraminifera. 3) Imaging potential spatial distribution patterns and effects of diagenesis by nanoSIMS. These data suggest there is a fairly uniform presence of Cr throughout the foraminiferal test. There is a clear difference of two orders of magnitude in concentrations between sediment trap and core samples. This suggests at least part of the Cr signal in foraminifera is primary, which likely has been overprinted by the remobilisation of redox-sensitive metals in pore-waters. A glacial-interglacial record from a site underneath the northern Arabian Sea oxygen minimum zone confirms that $\delta^{53}Cr$ records benthic oxygen conditions. Our data also indicate ferromanganese crusts minimally contribute to the overall Cr concentrations.