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Are authigenic iron oxides the host phase of neodymium isotopes used in paleoreconstructions?

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The reliable recovery of paleoproxies from the sedimentary record is dependent on the ability to routinely extract the element of interest from a specific host phase, often by using targeted extraction protocols. In the case of the neodymium isotope ocean circulation proxy (εNd), in order to reconstruct bottom water values this host phase must be one that forms in contact with bottom-water and does not react or exchange during diagenesis. Reductive leaching is typically used in paleocirculation studies utilising neodymium in order to recover the signature from authigenic iron (oxy)hydroxides. However, evidence of a benthic Nd flux from the sediments to the bottom water via the pore fluid raises concerns over the stability of these phases during early diagenesis. The identification of the phase or phases interacting with the pore fluids is important to understanding the magnitude and spatial variability of the flux, but also to understanding the potential for early diagenetic overprinting of the εNd signal. Concerningly, high resolution SEM imaging fails to identify these iron oxide phases in marine sediments from which a subset appeared to have been leached successfully with reasonable iron recovery accompanying the neodymium in the leachate. This suggests two potential scenarios, one in which the iron oxides are present but too small for visual identification (e.g. nanogoethite), or the importance of a different Fe and Nd-bearing host phase (e.g. clays) that exchanges during the leaching procedure. Here, we test whether authigenic iron oxide host phases recoverable through reductive leaching are present in modern sediments. We use SEM-based mineral identification in conjunction with Mössbauer spectrometry to identify the Fe and Nd host phases mobilised by reductive leaching, and discuss the relative importance of iron oxides vs other potential sedimentary host phases and the implications on proxy recover and interpretations.