A novel tracer method to provide principle constraints on seawater iodine redox chemistry

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The conditions necessary for and catalysing the formation of the oxidized and most abundant marine iodine species, iodate, are nearly completely unresolved. This gap in our understanding limits promising iodine applications towards tracing dissolved oxygen in past and present oxygen minimum zones, marine carbon cycling, and tropospheric ozone. To address this issue, we have developed a novel method for tracing iodine redox reactions in seawater. The method uses addition of the radioactive isotope I-129 ($t_{1/2}$~15.7 Myrs) to natural samples (seawater-sediment incubations) and liquid ion chromatographic separation of the two main iodine species (iodate-iodide) to trace the production of iodate. The iodine isotope ratios are measured using multicollector-inductively coupled plasma-mass spectrometry. Our method is capable of quantitatively separating iodate and iodide, and subsequent $^{129/127}$I ratio measurements reveal that no exchange between iodide and iodate occurs during sample processing. We are also able to process samples at a range of iodine concentrations, and detect I-129 at relevant levels using minimal seawater volumes. Our results demonstrate the potential for this method to ultimately constrain the mechanisms ([a]biotic?), rates, and oxidants involved in iodine redox reactions in seawater. Like the development of isotope tracers for other redox-sensitive elements, the demonstration of the I-129 method is anticipated to allure fundamental applications beyond our targeted research.