Oxygen concentration vs. sedimentation rate: Controls on redox sensitive elements from cores in the North and South Atlantic

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As a major reservoir of CO_2, the deep ocean is understood to have played a critical role in the regulation of global climate throughout the Quaternary. Exchange of CO_2 between the ocean and atmosphere may be inferred from environmental paleo-proxies such as boron isotopes incorporated into the calcium carbonate shell of foraminifera. Recent studies observing down-core U/Ca and U/Mn in foraminiferal authigenic coatings have suggested the value of these redox sensitive elements as a record of past sedimentary redox conditions, and thus deep ocean oxygen concentration [O_2], ventilation and pCO_2.

However, the post-depositional nature of this proxy may complicate its use as a direct indicator of past deep ocean oxygen concentrations. Authigenic coatings develop while the fossil foraminifera are buried beneath the sediment-water interface and redox sensitive elements such as uranium and manganese will become mobile and/or accumulate in low oxygen conditions. However, concentrations may also be enhanced if the foraminifera reside at the specific redox horizon for a prolonged period of time as a result of reduced sedimentation rate. Consequently, inferred deep-water low oxygen conditions may in fact reflect an extended period of reduced export to the deep ocean. These interpretations are further complicated by the 'delay' necessitated by burial, making it difficult to establish the phasing of sedimentary redox and particular climate events.

Here we investigate the relative importance of bottom water [O_2] and sedimentation rate on redox sensitive elements. We compare these controls in two sediment cores from the North and South Atlantic Ocean where different water mass properties and oceanic histories have left their own mark on the foraminiferal archive. In some instances deep ocean oxygen appears to play a dominant role; in others, sedimentation rate is also important. Supported by additional proxies of the carbonate system including boron isotopes, we interpret the suitability of redox sensitive elements in authigenic coatings as indicators of deep water oxygenation.