Boron isotope determinations by direct injection MC-ICPMS

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A number of studies have shown that the dominant factor controlling the boron isotopic composition of marine carbonates (such as corals and foraminifera) is the pH of the seawater in which they grew. Since pH is an important parameter within the ocean carbonate system, reconstructions of past ocean pH have the potential to shed light on a number of important issues such as the extent of recent ocean acidification, the mechanisms of glacial-interglacial CO_2 change, and the concentration of CO_2 in the atmosphere in the distant past. It is, however, essential that the boron isotopic composition of the chosen archive is accurrately and precisely measured since the shifts in ocean pH are expected to be small (0.1 pH units which equates to a ~1 ‰ shift in $\delta^{11}B$). It has been one of the ongoing goals of the isotope group at Bristol to develop new methodologies to better measure the isotopic composition of boron. What we present here is the latest effort in that persuit.

The invention of multicollector inductively coupled plasma mass spectrometers has revolutionised the way in which a number of isotope systems are measuremed. The principal advantage over thermal techniques is the stable instrumental mass bias that allows for easy and accurate correction by backeting unknowns with standards of known isotopic composition. In principal, this should enable measurement of isotopic ratios for dual isotope systems, such as B and Li, with superior accuracy and precision compared to thermal ionisation techniques. A complicating factor for boron, however, is the extended washout times necessary when using conventional sample introduction systems which leads to a degradation in precision (boric acid is volatile and a sample has to be completely flushed from the spray chamber to decrease the blank to the required level). We present here an approach using a direct injection introduction system that reduces washout times sufficiently to allow rapid sample-standard bracketting with little loss in sensitivity. Preliminary data indicate that uncertainties of 0.2 ‰ to 0.4 ‰ (2 s.d.) are achieveable on samples as small as 1 to 5 ng of B. This level of precision and small sample size, in addition to the rapid throughput of samples (1 complete analysis takes 20 minutes), makes this approach extremely well suited for palaeoceanographic studies.