

The marine iodine system as a proxy for global deposition of organic carbon

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The biophilic nature of iodine has led to its net removal from the oceans and its enrichment in organic-rich marine sediments. We investigate the relationship between marine productivity and the accumulation of iodine in the open ocean and along continental margins. Both sediment and pore fluid fractions of sediment cores from several Ocean Drilling Program (ODP) Sites were measured using ICP-MS. This data was combined with previously published ODP data, in order to determine the distribution of iodine within different depositional environments. The majority of the iodine in the oceans is distributed along continental slopes (62%) while the next largest reservoir is in open ocean sediments (37%). In shallow sediments, iodine resides primarily in the solid phase. At sediment depths exceeding 20 meters below the sea floor (mbsf), iodine partitions primarily into the fluid phase (up to 83% of the total). Diagenetic modeling indicates that residence time of iodine in marine sediments on continental margins is on the order of several million years. Complex organic molecules are broken down at a similar rate, providing the precursor material for microbial methanogenesis. In general, the total iodine accumulation times are much longer than the calculated residence times. This would suggest that while only a few million years are required for iodine to be released from organic matter in these settings, the majority of the soluble iodide is reoxidized and reassimilated in shallow sediments, leading to a net accumulation over periods of tens of millions of years. Because iodine deposition is tied to marine productivity, it is reasonable to assume that marine margins have received a constant input of organic matter over the same time period. Iodine-129 data also support this concept of long-term iodine accumulation.

Based on the ODP core data, the total marine iodine reservoir is 4.4×10^{15} kg which is comparable with previous estimates. This is a minimum estimate, because it only considers the depth at which sediment cores were taken. Nonetheless, it is significantly larger than other major reservoirs such as the oceanic crust and continental sediments. The fact that this reservoir is concentrated on continental margins is indicative of the deposition of organic matter in the ocean over geological time.

Extraction of microgram quantities of iodine for $^{129}\text{I}/^{127}\text{I}$ AMS measurements in marine sediments

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Knie et al. have measured ^{60}Fe in a deep sea Mn crust, and interpreted an observed peak as evidence of matter from a supernova (SN) explosion deposited on the earth ~2.8 Myr ago. Then, there should be evidence of other SN products deposited at the same time. We are looking for evidence of ^{129}I in deep sea sediments, using the accelerator mass spectrometry technique (AMS) at the 2.5 MeV facility of Gif-sur-Yvette. In addition, if the ^{129}I background is low enough, the chemical procedure should be applicable for a new method of dating old sediments (>10 Myr).

The development of these applications requires that μg quantities of iodine available in reasonable amounts of sediment (a few grams) can be successfully extracted from these sediments and purified in a form appropriate for an AMS analysis, without introducing ^{129}I contamination above the level of $^{129}\text{I}/^{127}\text{I} = 1.5 \times 10^{-12}$ observed in pre-anthropogenic sediments (Moran et al., 1998).

We tested several procedures for the extraction of iodine from sediments and measured their stable iodine content by ICPMS. This allowed us to identify appropriate sediments in terms of iodine content and check that we can extract iodine from these sediments with a reasonable yield (> 60%).

After the extraction, the sample is purified using an anion-exchange column, and finally concentrated in a solid form by coprecipitation. When we performed AMS measurements, the technique gave good beam currents. However, the first blanks gave quite high $^{129}\text{I}/^{127}\text{I}$ ratios ($>10^{-11}$), which indicated an important source of anthropogenic contamination that we thought to be related to atmospheric contamination from reprocessing activities at La Hague. To test this hypothesis, we did measurements in rainwater from France which well illustrates the contamination as the measured ratio was $^{129}\text{I}/^{127}\text{I} \sim 10^{-7}$. To reduce the anthropogenic source of contamination during the manipulation, the procedure is now carried out in a glove box. Preliminary results that we are optimizing give blanks of $^{129}\text{I}/^{127}\text{I} \sim 2 \cdot 10^{-12}$.

We applied the technique to sediments. We have acceptable currents but also an important contamination in the sediment ($^{129}\text{I}/^{127}\text{I} \sim 10^{-10}$), even treated in the glove box. We found this contamination in two sediments which were stored for years in France. This is a possible explanation for the contamination. We are currently trying to clean these sediments and to measure others.

References

- Knie K. et al., (2004), Phys. Rev. Lett. 93 (17), 171103
Moran J. et al., (1998), Chem. Geol. 152, 193-203