Actinium-227 as a tracer for diapycnal mixing and deep upwelling

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^{227}Ac is a naturally occuring radioactive tracer (half-life 21.8 years) that is continuously released into the overlying water by deep-sea sediments. Since the pioneering work of Nozaki (1984), it has been recognized that ^{227}Ac in excess of its progenitor ^{231}Pa ($^{227}Ac_{ex}$) has a huge potential as a tracer for diapycnal mixing in the deep sea. However, data on the distribution of ^{227}Ac are still scarce due to the difficult sampling and measurement. Recently, some additional information on the global distribution of ^{227}Ac has become available (Geibert et al. 2002), confirming the results of Nozaki, and adding new insights to the role of deep upwelling for its distribution in the Southern Ocean. There, $^{227}Ac_{ex}$ has been shown to be detectable throughout the water column up to the sea surface as a consequence of intense and rapid vertical exchange of water masses.

Here, we give an overview about the distribution of ^{227}Ac in the ocean, including new results from inverse modelling. The obtained maps of the modelled global distribution of $^{227}Ac_{ex}$ confirm that this tracer closely reflects the underlying patterns of circulation and mixing. Additionally, we give an introduction to the available measurement techniques (different α-spectrometric techniques, delayed coincidence counting of its daughter nuclides), and present the potential applications of ^{227}Ac in the near future.

References

Nozaki, Y. (1984), Nature **310**, 486-488.

Geibert, W. et al. (2002), Earth Planet. Sci. Lett. **198** (1-2), 147-165.

Improved Method For Radium Extraction From Environmental Samples For Determination By Thermal Ionization Mass Spectrometry

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The measurement of ^{226}Ra by thermal ionization mass spectrometry (TIMS)[1,2] presents several advantages compared to conventional radioactive counting methods: greater precision, smaller sample size and, by far faster time determination. This enhance the possibility of using ^{226}Ra as a chronometer in Holocene chronology, groundwater residence time estimation and as a rate tracer for large-scale ocean circulation. However, in some types of samples such as calcium carbonate for example, problems in isolating radium from other Group II elements (Ca, Sr, Ba) on cationic resin have not been resolved. This can be explained by the high ratio of Ca/Ra or Sr/Ra. For this technical reason the studies of ^{226}Ra in calcium carbonate samples such as corals or stalagmites are poorly documented. We have developed a chemical separation procedure allowing a very high efficiency of separation of Ra and Ba for matrix samples based on the preconcentration of Ra and Ba by MnO_2 precipitation, followed by Ra-Ba separation using Sr Spec resin[3]. The ability to extract radium from $CaCO_3$ matrix samples and seawater allows a deeper investigation of the use of ^{226}Ra as a Holocene chronometer for carbonate matrix samples or as a tracer of the seawater mixing. We will discuss two examples of this application, for the extraction of Ra from a $CaCO_3$ coral skeletons and also from seawater samples.

References

[1] A. M. Volpe, J. A. Olivares and M. T. Murrell, *Anal. Chem*, 1991, 63, 913.

[2] A. S. Cohen and R. K. O'Nions, *Anal Chem*, 1991, 63, 2705.

[3] F. Chabaux, D. Ben Othman and J. L. Birck, *Chem. Geol*, 1994, 114, 191