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# Preconcentration and Separation of $^{9}$Be and Cosmogenic $^{10}$Be in (Coastal) Seawater: Method Comparison and Improvement

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The ratio of cosmogenic $^{10}$Be and its stable isotope $^{9}$Be in seawater is a sensitive tracer for a wide range of oceanic processes, such as estuarine removal of reactive trace metals, pore water mobility, as well as mixing of reactive trace metals along with their incorporation into authigenic phases and their subsequent release during boundary exchange processes. Severe seawater matrix effects and very low concentrations of typically $10^{-12}$ g/g for $^{9}$Be and $10^{2}$ atoms/g for $^{10}$Be in seawater make the accurate and precise quantification challenging. Thus, the need arises to refine existing and develop new techniques for the efficient preconcentration and separation of Be from (coastal) seawater.

In a first set of experiments, we used artificial seawater and natural samples from the Amazon estuary to systematically investigate the efficiency of two existing Be preconcentration methods, namely the (i) iron co-precipitation and (ii) silica-gel method. $^{9}$Be recoveries are >90% for both methods, are independent of dissolved organic matter concentrations typically found in the open ocean and most coastal environments, and matrix effects during HR-ICP-MS analysis are negligible. Both methods are hence equally suitable for low-level detection after preconcentration of Be. We further validated the iron co-precipitation method by comparison with existing data in the Amazon estuary. We obtained $^{9}$Be concentrations in the range of 0.1-11x$10^{-12}$ g/g, showing an exponential decrease with increasing salinity. Our dataset is in excellent agreement with previously reported data from similar locations in the Amazon estuary.

In a second step, the iron co-precipitation method was adapted to evaluate a new approach for the simultaneous preconcentration of $^{9}$Be and $^{10}$Be from seawater without the need to separate $^{9}$Be and $^{10}$Be into samples splits prior to preconcentration, a technique commonly employed previously. For natural water samples from the Changjiang River estuary, the concentrations of $^{9}$Be and $^{10}$Be and the resulting $^{10}$Be/$^{9}$Be ratios from the separate and simultaneous approaches agree well with each other, documenting the reliability of the simultaneous approach. Our new simultaneous approach is less time-consuming and any potential bias on the $^{10}$Be/$^{9}$Be ratio from an unproportionate loss of $^{9}$Be or $^{10}$Be during preconcentration is avoided.