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Strontium Isotope Fractionation in the marine Realm: first application of a $^{87}Sr/^{84}Sr$-Double Spike

A. Eisenhauer (1), A. Krabbenhöft (1), F. Böhm (1), V. Liebetrau (1), J. Fietzke (1), N. Augustin (1), B. Peucker-Ehrenbrink (2), and H. Vollstaedt (1)

(1) IFM-GEOMAR, Kiel, Germany (aeisenhauer@ifm-geomar.de), (2) Woods Hole Oceanographic Institution, Woods Hole, MA, USA

In order to precisely determine $^{88}Sr/^{86}Sr$- and $^{87}Sr/^{86}Sr$-isotope variations in natural samples using TIMS-technique we developed a mixed $^{87}Sr/^{84}Sr$-double spike from two solutions enriched in ^{84}Sr and ^{87}Sr, respectively. After mixing the two solutions the Sr-spike ratios have precisely been determined by calibration to the NBS 987 standard. For the determination of natural $^{88}Sr/^{86}Sr$- and $^{87}Sr/^{86}Sr$-isotope variations in carbonates and silicates two TIMS measurements are required: an unspiked and a spiked run where the Sr-isotope ratios are arbitrarily normalized to a fixed Sr isotope ratio (e.g. mean of the first block). For denormalization and data reduction we adopted the algorithm for Ca isotope measurements (1) presented earlier by Heuser et al.(2003) modified for Sr-isotope measurements. It was found that best results can be achieved if the $^{84}Sr_{spike}/^{84}Sr_{sample}$ ratio is higher than about 12. The algorithm allows the simultaneous calculation of $^{87}Sr/^{86}Sr$ and $^{88}Sr/^{86}Sr$ ratios. Standard measurements showed a $\delta^{88/86}$Sr-value ($\delta^{88/86}Sr=((^{88}Sr/^{86}Sr)_{Sample}/(^{88}Sr/^{86}Sr)_{SRM987})-1)*1000$) of 0.39 for the IAPSO seawater standard corresponding to an external reproducibility of $\pm$0.012 (n=19). The IAPSO $\delta^{88/86}$Sr-value corresponds to a $^{87}Sr/^{86}Sr$-ratio of 0.709317(9). Both values are in accordance with earlier publications (2) and theoretical predictions based on the $\delta^{88/86}$Sr ratio of seawater and assuming mass-dependent isotope fractionation. This technique allows us to correct the $^{88}Sr/^{86}Sr$- and $^{87}Sr/^{86}Sr$-isotope-ratios for mass dependent fractionation during both column chemistry and TIMS measurement procedure. Furthermore a direct comparison of double spike TIMS, bracketing standard and laser-ablation MC-ICP-MS (3) results are in agreement and can be used to discuss limitation and perspectives of future Sr isotope measurements.

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