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δ^{88}Sr Constraints on Strontium Cycling During Marine Carbonate Diagenesis

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Fluid-mineral interactions in marine sediment diagenesis play a vital role in the global strontium (Sr) cycle, but the elemental flux and isotopic fractionation of these processes is poorly constrained. The dissolution and recrystallisation of carbonate minerals provide a net flux of Sr from sediment to pore fluids, and precipitation of secondary minerals such as celestine (SrSO4) may be an important sink of Sr, even in low quantities. Stable Sr isotopes can record mass-dependent fractionation during diagenesis, and thus provide a means of analysing these processes and evaluating their significance for the global Sr budget [1][2].

We present radiogenic (87Sr/86Sr) and stable Sr isotope measurements of interstitial pore fluids collected by IODP from carbonate sediment from Walvis Ridge and Bahamas. Both sites have been previously characterised as carbonate systems with well documented early diagenesis [3][4]. Sr concentrations in pore fluids were determined by ICP-MS, with δ88Sr and 87Sr/86Sr determined by TIMS using the double-spike method to correct for instrumental mass fractionation and provide sufficient precision to resolve natural δ88Sr variability [5]. Sr isotopic data are complemented by existing trace element data and δ44Ca [3][4].

87Sr/86Sr is found to be close to contemporaneous seawater values throughout core profiles, using published age models for carbonate deposition in the cores. Conversely, preliminary δ88Sr values are consistently heavier in pore fluids than seawater. This likely reflects preferential incorporation of isotopically light Sr into a precipitating mineral phase, suggesting that the precipitation of secondary mineral phases such as celestine may represent an important and under-recognised control on Sr chemistry during diagenesis. δ88Sr thus provides new constraints on the behaviour of Sr in carbonate sediments and the wider Sr cycle that should be accounted for when using δ88Sr of pore waters and sediments to reconstruct the past Sr cycle and seawater chemistry.

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