

What controls the fractionation of Cd isotopes in marine carbonates? Case studies from the Neoproterozoic strata on Yangtze Platform, South China

SIMON V. HOHL^{1,4}, STEPHEN J. GALER², SHAO-YONG JIANG^{1,3} AND HARRY BECKER⁴

¹Nanjing University, shohl@zedat.fu-berlin.de

²MPIC-Mainz, steve.galer@mpic.de

³China University of Geoscience (Wuhan), shyjiang@cug.edu.cn

⁴Freie Universität Berlin, hbecker@zedat.fu-berlin.de

Cd isotopes are used as a tool to trace nutrient utilization by phytoplankton in the modern ocean. The applicability of Cd isotopes as tracer of past marine bio-productivity is unknown as the detailed fractionation process is still debated. Most studies favour substitution of Cd for Zn atoms in carbonic anhydrase of diatoms as the main driver for the fractionation. Cd isotopic compositions in marine carbonate rocks from the Precambrian/Cambrian boundary sampled on the Yangtze Platform, South China have been analysed together with trace element variations and C isotope compositions. Cd isotopic data were obtained by using the double spike method and TIMS ($\epsilon^{112/110}\text{Cd}$ relative to NIST SRM 3108, external precision: $\pm 8\text{ppm}$). The $\epsilon^{112/110}\text{Cd}$ displays substantial variations exceeding the range of crustal rocks. In shallow water samples from the Xiaofenghe section, Cd concentrations neither correlate with P or Zn abundances. Given the experimentally derived $\alpha_{\text{CaCO}_3\text{-Seawater}}$ of 0.99955 for the fractionation of Cd into calcium carbonate, seawater in equilibrium with these carbonates should have $\epsilon^{112/110}\text{Cd}$ between 0.98 and 4.96, which is in the range of modern marine surface water. Cd isotopic compositions in the same section correlate with $\delta^{13}\text{C}_{\text{carb}}$ values, arguing for the formation of these carbonates in highly bio-productive environments. However, decreasing $\epsilon^{112/110}\text{Cd}$ values towards the upper Ediacaran in shallow water Xiaofenghe do not represent the signal expected for increasing bio-productivity short before the Cambrian explosion. These discrepancies may reflect the added effects of kinetic fractionation of Cd into inorganic carbonates and non-carbonate phases such as sulphides under changing environmental conditions (e.g. freshwater/seawater mixing and variable redox conditions), which may blur the signal of biological fractionation in marine precipitates.