

Quantification of silicate alteration rates through porewater strontium profiles

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In-situ alteration of reactive silicate phases in marine sediments plays critical roles in both elemental budget and carbon cycling of global oceans. It is however very difficult to quantify this reaction rate on a global scale. Here we estimate rates of in-situ silicate alteration in marine sediments through a strontium mass balance approach by considering the porewater strontium concentrations and $^{87}\text{Sr}/^{86}\text{Sr}$ data a robust proxy for silicate decomposition. In our mass balance modeling, strontium can be sourced from either alteration of volcanogenic and/or clastic materials while authigenic carbonate formation is the primary sink. The bulk silicate decomposition rates can then be estimated from the knowledge of strontium content in these different phases. We report data from eight locations (Nankai Trough, off Simokita-Japan, Ulleung Basin-East Sea, the Costa Rica margin, Tuaheni-off New Zealand, Vestnesa Ridge-Fram Strait, Prins Karls Foreland-west of Svalbard, and Storfjordrenna-south Svalbard) where the in-situ alteration of silicate phases is supported by the coeval changes in porewater cation concentration and alkalinity. The low $^{87}\text{Sr}/^{86}\text{Sr}$ values reflecting the contribution of strontium from volcanogenic materials at Nankai Trough, off Shimokita, Costa Rica, and New Zealand, whereas strontium is supplied by clastic materials at Ulleung Basin, Vestnesa Ridge, Prins Karls Forland, and Storfjordrenna. We compare the estimated reaction rates with values reported in the literature and discuss the possible controls on the reactivity of these silicate phases.