Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.14703

Unveiling early Si diagenesis in Ulleung Basin using Si isotope

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Marine sediment is a critical reservoir for global Si cycle since it receives biogenic and lithogenic Si phases through ocean. Moreover, the subsurface Si phase alterations have been shown that are linked to the C cycle of marine sediment and ocean through producing or sequestering CO_2 over geological time. In order to assess the impact of early Si alterations on the C cycle, we study Si isotopic signatures from sediment and porewater retrieved from Ulleung Basin, offshore Korea. UBGH2-1_1 sampled the upper 217 meters below seafloor (mbsf) and has a maximum of porewater alkalinity of 128 mM; UBGH 2-6 reached 227 mbsf with the highest alkalinity of 70 mM. The various Si phases (biogenic silica, reactive silicate and neoformed Si phase) in the sediments are separated through a sequential leaching protocol with Si isotopic signatures analyzed from the leachate and mineral composition determined from the residual materials. We identify three different diagenetic zones from both cores based on geochemical results. In the shallowest first zone, $d^{30}Si$ of porewater ($d^{30}Si_{porewater}$; 0.2 to 0.3 ‰ for 2-1_1 and 0.2 to 0.4 ‰ for 2-6) and $d^{30}Si$ of neoformed Si phase ($d^{30}Si_{neoformed}$; -2.4 to -0.9 ‰ for 2-1_1 and -0.8 to -0.2 ‰ for 2-6) increase with decreases in dissolved Si, K and Mg concentrations. The following second zone is the interval where the porewater alkalinity increase sharply. The decreases of $d^{30}Si_{porewater}$ (0.4 to -0.6 ‰ for 2-1_1 and 0.4 to -0.1 ‰ for 2-6) and $d^{30}Si_{neoformed}$ (-0.9 to -1.5 ‰ for 2-1_1 and -0.2 to -0.6 ‰ for 2-6) are accompanied by the increase of dissolved Si and K concentrations and in the second zone. The deepest third zone features increasing values of $d^{30}Si_{porewater}$ (-0.6 to 1.2 ‰ for 2-1_1 and -0.1 to 0.7 ‰ for 2-6) and dissolved Si concentration and decreasing and dissolved Si and K concentrations. We hypothesized that phase neoformation, silicate ($d^{30}Si$ values: -0.8 ‰ for 2-1_1 and 2-6) dissolution and biogenic silica ($d^{30}Si$ values: 1.5 ‰ for 2-1_1 and 1.6 ‰ for 2-6) dissolution are the main processes in the first, second and three zones, respectively.