Si and Mg isotopic compositions of low temperature off-axis ridge fluids

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Low temperature fluids circulating in oceanic ridge-flanks play a major role in the heat and mass transfers between the crust and the ocean. In order to quantify the Mg and Si fluxes, we measured the dissolved Si and Mg isotopic compositions of pore water samples collected close to the sediment-basement interface of the eastern flank of the Juan de Fuca ridge along the E-W transect investigated during ODP Leg 168. Starting from the proximity of the ridge axis, $\delta^{26}Mg$ and $\delta^{30}Si$ first change from -1.0‰ down to -2.6‰ and +1.7‰ up to +2.1‰, respectively, but becomes heavier (up to -1.5‰) and lighter (down to +1.4‰) eastwards. These data are compatible with Mg and Si isotopic fractionations during a sequence of two types of reaction of seawater with the igneous crust: (1) uptake of Mg and Si by clays that preferentially incorporate heavy Mg and light Si; (2) a Mg lost with no major change in Si content but lighter $\delta^{30}Si$ indicative of small proportions of silicate replacement by carbonates. These isotopic shifts in the circulating fluids suggest that the coupling of $\delta^{26}Mg$ with $\delta^{30}Si$ could potentially trace the Mg-Si gains and losses generated by the low temperature alteration of the oceanic crust by the off-axis percolation of seawater. As such they could be a tool to quantify which proportion of the past changes in seawater Mg/Ca and Mg/Si might have been driven by fluctuations of hydrothermal activity and ridge flank circulation.