Germanium incorporation into sponge spicules: development of a proxy for reconstructing inorganic germanium and silicon concentrations in seawater.

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Measurements of germanium (Ge) are presented for sponges and for spicules isolated from a range of deep-sea sediment cores. Germanium to silicon (Si) ratios (Ge/Si_{sp}) for sponges (0.075 - 0.380 μmol/mol) are much lower than the present-day seawater Ge/Si ratio of ~0.7 μmol/mol. A plot of Ge/Si_{sp} versus estimated seawater Ge (and Si) concentration produced a linear relationship with the Ge content of spicules increasing with increasing seawater Ge (and Si) concentration. Plots of Ge/Si_{sp} versus depth for both dredged sponges and sediment bound spicules produced oceanic profiles similar to those of dissolved Ge (and Si) concentration. To explain the fractionation seen in the sponge Ge/Si_{sp} data two models are presented. The first model used to describe the data assumes that the sponge only responds to the Ge content of the surrounding seawater, that is, Ge incorporation into sponge silica is independent of the seawater Ge/Si ratio up to a Si concentration of about 100 μmol/L. The second model used to describe the data assumes that Ge/Si_{sp} fractionation results from subtle differences in the uptake kinetics of Ge and Si. While the assumptions used by each model to describe the data are different, it is possible to use sponge Ge/Si_{sp} data to reconstruct palaeo-Ge concentrations using model I, and to reconstruct palaeo-Si concentrations using both models. Palaeo-Si concentrations estimated using both models were in good agreement.