Geophysical Research Abstracts
Vol. 20, EGU2018-18842, 2018
EGU General Assembly 2018

Si cycling and Si isotopes in the last glacial maximum from a modelling study

Christoph Völker (1), Shuang Gao (2), and Dieter Wolf-Gladrow (1)

(1) Alfred Wegener Institute for Polar and Marine Research, Biogeosciences, Germany (christoph.voelker@awi.de), (2) Geophysical Institute, University of Bergen, Norway

Variations in the silicon stable isotopic composition (δ^{30}Si) of sedimentary biogenic silica (BSi) are used to reconstruct the utilization of dissolved silicic acid (DSi) by diatoms in the geological past and to explore its influence on past oceanic biogeochemistry. A Last Glacial Maximum (LGM) climate simulation has been performed with a coupled ocean-sediment model including a prognostic formulation of silicon isotopic fractionation. The model results show a northward shift and some reduction of DSi utilization and opal export in the Southern Ocean during the LGM, compared to a present-day climate experiment, driven likely by the extended ice cover in the model. This leads to changes in the equator-ward transport of DSi in Subantarctic Mode Water and Antarctic Intermediate Water, which in turn lead to changes in opal export in the tropical Atlantic and Pacific. Opal export decreases in the eastern tropical Pacific and increases in the eastern tropical Atlantic, in agreement with estimates from sediment cores. The changes in the export pattern lead to a shift in the distribution of DSi from the deep Pacific into the deep Atlantic. The mean δ30Si value of DSi in the upper ocean shows a 0.14 per mil decrease in the LGM experiment, while there is an increase in the low-latitude Pacific compared with the present-day experiment. In the Pacific and Indian Ocean the slopes of the surface ln($Si(OH)_4$)–δ^{30}Si relation vary between LGM and PD. This is probably caused by different mixing and advection regimes, and complicates interpretation of δ^{30}Si as a proxy for $Si(OH)_4$ utilisation. The linear relation between δ^{30}Si in dissolved silicate and the inverse silicic acid concentration at 1000–3800 m depth in the Atlantic that is observed in the present-day ocean is still present in the glacial, but with a different slope; this is probably due to changes in the isotopic composition of the endmembers. Our model runs agree with some parts of the silicic acid leakage hypothesis, but disagree with other parts. Our model runs do not take into account proposed changes Si:N drawdown ratio in the Southern Ocean due to an increased iron suppy through dust; we discuss how this may have affected our model results.