Temporal trend in anthropogenic sulfur aerosol transport from central and Eastern Europe to Israel

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Decrease of sulfur emissions in central and eastern Europe over the past 3 decades is well documented. These changes result in a decreasing trend of sulfate aerosol and aerosol forcing over the source region, but also at a receptor site located in southern Israel, thousands of kilometers downwind. A combination of several independent observations, namely, satellite and ground-based remote sensing, *in situ* aerosol sampling, and backward trajectory analysis, was implemented to show significant downward trends in fine particle aerosol optical thickness (AOT), in general, and sulfur aerosol, in particular. MODIS-Terra observations over central Europe show 38% reduction of fine AOT. At the reception site in southern Israel, 43% reduction of fine AOT was observed by a sunphotometer and 25% reduction of sampled fine aerosols was obtained. During the corresponding observation periods, the coarse mode AOT has remained constant. The majority of the backward trajectories, where meaningful sulfur events were observed at the receptor site, are originated from eastern and central Europe. The aerosol radiative effect at top of the atmosphere has become less negative during the past decade, decreasing by 30% in Europe and 67% in Israel.

Neoproterozoic ice ages, boron isotopes, and ocean acidification

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The Neoproterozoic Earth underwent at least two severe glaciations, each extending to low paleomagnetic latitudes and punctuating warmer climates. The two widespread older and younger Cryogenian glacial deposits in Namibia are directly overlain by cap carbonates deposited under inferred periods of high atmospheric carbon dioxide concentrations [1]. Oceanic uptake of carbon dioxide decreases ocean pH and here we present a record of Cryogenian inter-glacial ocean pH, based on boron isotopes in marine carbonates. Our data document characteristically different B isotope profiles of the two Cryogenian carbonate transects that are consistent with the presence of two 'pan-glacial' climate states, but indicate that each had its own distinct environmental conditions. The Marinoan interglacial $\delta^{11}B$ profiles are systematic and remarkably consistent, and they vary by up to 11‰. This yields a relative pH variation of up to 1.5 pH units, and implies a pH of 8.5 at the onset of cap carbonate deposition, followed by a decrease in pH to ~7 and then a return to pH ~8 for the upper part of the section. The transient ocean acidification excursion and the alkaline pH condition near the start and termination of the inferred greenhouse state suggests a rapid draw-down of CO_2 initiated at the start of the deglaciation and supports inferences of a thick, global sea-ice shield with minimal air-sea gas exchange during glaciation. In contrast, largely constant B isotope values for the Sturtian-aged glacial aftermath do not indicate extreme ocean pH (~8.3) conditions and do not support a contemporaneous major ocean acidification event and associated high pCO_2 at the time of the older Cryogenian glaciation and deglaciation. That leads us to speculate that the ocean during the older glaciation was not totally frozen and that the hydrological cycle was functioning [2].

[1] Hoffman *et al*. (1998) *Science* **281**, 1342–1346.
[2] Kasemann *et al*. (2010) *Geology* **38**, 775–778.