Reproduction of the increasing amplitude and period in the glacial cycles using a model incorporating diatomaceous activity.

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The mode changes in the glacial cycle, smaller amplitudes with 20 kyr periods before 2.7 BP; medium amplitudes with 40 kyr periods between 2.70 and 1 Ma BP; greater amplitudes with around 100 kyr periods after 1 Ma BP, remain unanswered.

Carbon cycling is closely coupled with silicon cycling in the Earth surface. Oceanic silica is supplied from weathering of terrestrial matter, which depends on the atmospheric pCO_2. The atmospheric pCO_2, in turn, is influenced by the diatomaceous biological pump. Silicon can be a crucial driver of the Earth surface environment. Oceanic silica is removed by the burial of amorphous silica produced by diatoms. We have reported that the non-linear dissolution behavior of diatom frustules, where greater diatomaceous production tends to suppress dissolution of dissolved silica forming greater-sized frustule-aggregates.

Here we have developed a numerical model expressing the carbon and silicon cycling in the Earth surface, with diatomaceous biological pump and the non-linear dissolution behavior of diatom frustules being introduced.

The results of the model runs show interesting outcomes: when the amount of circulating carbon is reduced with time, both the amplitude and period of atmospheric pCO_2increase with time. When the insolation changes by Milankovitch forcing were loaded on the model temperature, the mode changes are successfully reproduced.

We propose that the glacial cycles may be understood by the coupling of ice-sheet dynamics and change in the oceanic Si inventory.

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