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Modelling of ocean biogeochemical cycles toward understanding paleo climate changes

Akira Oka[1*]

[1]Atmosphere Ocean Research Institute, University of Tokyo

The ocean stores large amount of carbon (60 times larger than that of the atmosphere) and various chemical tracers, and the deep ocean circulation significantly affects the carbon and biogeochemical cycles in the climate system. Actually, the deep ocean circulation, especially the Atlantic meridional overturning circulation (AMOC), is believed to have an important role in the changes in atmospheric CO2 concentration from glacial to interglacial periods.

Paleo proxy data such as d13C and 231Pa/230Th ratio suggest that the AMOC became shallower and reduced by up to 30 % during the LGM compared with the present climate, and it is widely believed that the AMOC during the LGM is weaker than that at the present climate. However, a couple of studies using another paleo proxy data, Nd isotope ratio, imply that the AMOC during the LGM may be almost the same or even slightly stronger than the present one. This means that there is discrepancy among paleo proxy data themselves or their interpretation. Distribution of these proxy tracers is controlled by not only ocean circulation but biological and chemical processes, and careful interpretation on changes in these proxy tracers is necessary. Explicit simulation of these proxy data with ocean biogeochemical model is very helpful for interpretation of proxy data because they can quantitatively evaluate which processes are important for controlling the distribution of paleo proxy. Such simulations are also useful for validating climate model simulations directly with paleo proxy data.

In this talk, recent attempts for simulation of paleo proxy with biogeochemical model are introduced.