溶存鉄の除去過程としてのコロイダルパンピングのモデリング
Colloidal pumping as a removal process of dissolved iron: a model study

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Iron cycle is incorporated in many ocean models as its importance to marine organisms. The models, however, tends to overestimate dissolved iron (dFe) concentrations in large dust deposition areas. Such overestimation can be attributed to inappropriate formulation of iron removal where the rates are calculated as a first order function to the simulated dFe. Although some models assume higher order functions to estimate the removal rates, there is no scientific basis to explain the representations. It is known that adsorption of dissolved thorium (dTh) to colloids and subsequent coagulation (so-called “colloidal pumping”) is important to remove dTh. As colloidal iron is observed in various locations, “colloidal pumping” can play an important role on iron scavenging. This study aims to build a new iron scavenging parameterization based on “colloidal pumping”. A mechanistic model to calculate a coupled adsorption/coagulation process is described in Burd et al. (2000) and is applied to dTh scavenging. We firstly conducted an experiment using their model to highlight an importance of “colloidal pumping”. In this experiment, we suppose an open-ocean box having a typical ^{238}U concentration that produces ^{234}Th by radioactive decay. Colloidal particles (< 1 μm) are continuously added to the box, and the model is run to be a steady state. Increase in colloidal particles results in colloidal coagulation and thus formation of particles. Simulated outgoing ^{234}Th fluxes are mainly seen in diameters larger than 1 μm where the gravitational settling is significant. We then conducted an experiment without adsorption of dTh to colloids, namely turn off “colloidal pumping”. As dTh is removed only by adsorption directly to large aggregates, removal efficiency is much decreased and the simulated dTh concentration becomes several times higher. The result suggests that ignoring “colloidal pumping” results in overestimation of dissolved metals in ocean models.

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