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Determination of elemental composition of diatom opal and its implication on the geochemical cycle in the Oceans

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Settling particles play an important role in the oceanic material cycle. They contact with seawater and exchange elements during their settlement through a seawater column. Although diatoms account for over half of primary productivity in the oceans, it is almost unknown how much diatoms and diatomous opal are involved with the cycle in the oceans. According to the study using REEs, chemical alternation of siliceous matter depends on degree of aggregation (Akagi et al., 2011). Therefore, it is expected that settling particles at extremely high diatomaceous productivity keep unaltered opal as a result of increase of settling speed and decrease of surface area. This study aims to understand the chemistry of the unaltered opal and involvement in the elemental cycle in the ocean by analyzing sediment trap samples collected in the Bering Sea and North Pacific Ocean.

Concentration of 55 elements in the unaltered diatom opal could be determined (e.g. Al, Zn, REEs). This study for the first time disclosed that diatom opal contains these elements at a much higher concentration than considered. Comparing with concentration in hard tissue of coral (1/10000-1000 times concentration in the upper crust), that in diatom opal is much closer to that of the crust (1/100-1 times concentration). It might be able to understand vertical profiles by considering alternation/dissolution of diatom opal.

The behavior of elements in a water column was analyzed by a box model, which consists of four boxes of alumino-silicate, opal, dissolved matter and oxide. Assuming a steady state condition of the water column, concentration of elements in fresh diatom opal (M/Si) was expressed as a function of these in the crust and the proportion of amounts of elements incorporated to those dissolved. The formula could explain the change in the observed value in terms of chemical character of each element.

Keywords: diatom opal, vertical distribution, settling particles