Quantitative determination of silica content in siliceous shell plankton using Microfocus X-ray CT

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Microplankton are recognized as a key component of pelagic food webs (Calbet and Landry, 2004). Microplankton such as diatoms, silicoflagellates, and radiolarians build up their skeletons by taking up silicic acid directly from seawater. The transfer of silicic acid from the marine hydrosphere to the biosphere initiates the biological cycle of Si; it is also a way to link the cycle of this element to that of carbon. Silicon exists in the ocean as silicate, which is an important component of the marine biogenic matter that accumulates in coastal and abyssal sediments (Sarmiento and Gruber, 2006).

Radiolarians are a group of marine eukaryote protists and their skeletons are composed of amorphous silica $SiO_2 \cdot nH_2O$, which is referred to as biogenic silica (BSi) or biogenic opal (Anderson, 1983). Their skeletons may also act as ballast to carry them to deeper waters and are well preserved in marine sediments, either as complete skeletons, fragments or particles. The BSi is the sum of the specific contributions from diatoms, silicoflagellates, and radiolarians. To understand the global silica and carbon cycles, it is important to elucidate the partition of the BSi since the production and fate of BSi and organic carbon differs depending on the group of organisms (Takahashi, 1991). However, there have been only few studies to evaluate the amount of BSi due to radiolarians (e.g. Takahashi, 1991; Jacot Des Combes and Abelmann, 2009) and there have been no other way to estimate the values than using simple geometrical models of radiolarian skeletons although radiolarians have very complicated skeletal structures.

We report on settling fluxes of radiolarian skeletons in the western Arctic Ocean based on the samples collected by two sediment traps moored in the Chukchi Borderland from October 2012 to September 2013. Our study represents a new approach to partition the BSi production using Microfocus X-ray Computed Tomography (MXCT). Microfocus X-ray CT is a non-destructive three-dimensional (3D) imaging technique. Recent development of Micro-CT technology has made it possible to construct accurate 3D models of radiolarian skeletons, and therefore MXCT also enables volume measurements of the radiolarian skeletons. To calculate an estimate of the production of BSi due to radiolarians, we constructed skeletal models for each radiolarian species by using our MXCT technique.

References

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