Estimation of past intermediate water temperatures in the northwestern Pacific based on radiolarians: it’ s suitability and constrains

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The use of siliceous microfossil assemblages, such as radiolarians for reconstruct past sea water temperature were developed since decades but all the studies only deal with reconstruction of Sea Surface Temperatures (SST). The most known reconstructions are those of the CLIMAP project, reconstructing worldwide SST during the Marine Isotopic Stage (MIS) 2. In this project, SST of Southern Ocean and Pacific Ocean, were reconstructed by the use of diatoms and radiolarians applying a Q-mode factor analysis following the statistical procedure of Imbrie and Kipp (1971). Following this method, numerous studies reconstructed past SST in the Southern Ocean and Pacific Ocean. In the North Pacific, the vertical distributions of radiolarian species have been well investigated and we know that several species are living at the intermediate water depths (200- 1000 m). Therefore, the establishment of a new data-set composed of intermediate water depth living taxa would potentially enable for the first time the estimation of the paleo intermediate water temperature. In this study, we propose a new data-set of radiolarian assemblages from the surface sediment of the Northwestern Pacific for reconstruct past intermediate water temperature.
In this context, we analyzed 87 surface sediment samples covering the northwestern Pacific Ocean from 1° to 50°N and 120° to 167°E. Among, 77 samples were collected by the Geological Survey of Japan and 10 samples were collected by the Japan Agency for Marine-Earth Science. Changes in radiolarian assemblages have been analyzed on these samples. When we try to reconstruct temperature of the intermediate water based on microfossil assemblages, two major issues constrain the reconstruction. Because intermediate water species represent a much lower portion of the total assemblage, the variation of their relative abundances are less significant than those recorded in the surface and would cause some biases in the reconstruction. The second issue is that the intermediate water temperature changes greatly between 200 and 1000 m. This also create biases. For try to minimize the effect of such biases, we proposed a normalization of the data-set and tied our normalized assemblage to the temperature at water depth of ca. 500 m. This water depth has been chosen because of the relative stability of temperatures between 500-1000m, and most of our selected species cover the water depth of ca. 500 m. This enable us to estimate past intermediate water temperature at ca. 500 m within an error margin of 1.2 ℃ (R^2 =0.84), which is promising. However, some concerns remain, particularly for temperature higher than 9℃, but for temperature lower than 9℃, it seem that our method is relatively suitable (R^2=0.89).

Keywords: Northwest Pacific, Intermediate water temperature, Radiolarians

