Holocene changes of the Japan Sea Proper Water (JSPW) inferred from marine plankton (radiolarian) fossil records

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The Sea of Japan has its own deep-circulation system, with its deeper parts occupied by cold and highly oxygenated water formed by winter convection in the northwestern part of the sea. According to recent observations, such deep convection has been weakened with the global warming. How was in the past warming before the historical period? For example, it is well known the warmer climate during the Jomon period (ca. 7,300 years ago) in the mid-Holocene. Here, we will discuss about the deep-circulation changes in the Japan Sea during the past 12,000 years (Holocene) based on marine plankton (radiolarian) fossil records.

Radiolarians are planktonic Protozoans widely distributed in the world ocean, and their skeletons composed of opal are preserved in marine sediments. Many radiolarian species are restricted to discrete depth intervals and the depths at which they dwell are closely related to the vertical water structure. As a result, radiolarian fossils prove to be useful indicators not only in the reconstruction of the surface water conditions, but also for the conditions of the water masses at intermediate and deeper depths. In the Sea of Japan, investigations based on plankton tows and surface sediments revealed that *Cycladophora davisiana* occurs in a depth interval between 1,000 m and 2,000 m (deep layer of JSPW = Japan Sea Proper Water), and *Actinomma boreale* group in depths below 2,000 m (bottom layer of JSPW).

The study of six sediment cores located in water depths ranging from 300 to 3,600 m show that the radiolarian assemblages have varied during Holocene, indicating changes in water-ventilation strength in this marginal sea. Bottom-water ventilation has been dependent on high-salinity inflow through the Tsushima Strait in the south and winter cooling in the northwestern part of the Sea of Japan. Deep water was being actively formed in the early Holocene. This bottom-water formation has resulted in relatively constant water composition since 9 cal ka BP, with the overall increase in high-salinity oceanic-water inflow, although the latter decreased transiently from 7,000 to 5,000 years ago in concert with climatic warming.

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