

Micropaleontological evidence of oceanic circulation changes in the Japan Sea during Pliocene to Pleistocene transition

ITAKI, Takuya^{1*}

¹Geological Survey of Japan, AIST

Oceanic circulation in the Japan Sea is characterized by flowing of the Tsushima Warm Current and deep-water formation during the interglacial periods, while deep circulation was stagnant due to weakened deep convection with development of the low salinity surface water during the glacial periods. Such cycles of oxic and anoxic deep-water conditions recorded in sediments as alternations of light and dark hemi-pelagic mud layers occurred since ca. 2.5 Ma near Pliocene to Pleistocene transition. The results of micropaleontological studies from previous ocean drilling sites and many onshore sequences have provided various insights into oceanic changes related to global climatic and regional tectonic events during Pliocene to Pleistocene.

Fossil records of shallow dwelling plankton and shelf related benthos are composed of the assemblage associated with upper water environments. Warm-water ostracods and molluscs are rarely recognized from onshore sequences in Japan along the Japan Sea side during the Pliocene climatic optimum (3.2 to 2.7 Ma), and they were most likely associated with subtropical water mass entered from the southern strait. However, planktonic foraminiferal and radiolarian assemblages in hemipelagic sediments suggest that the warm-temperate water was originated from the northern strait during this period. Such conflict interpretation could be explained by a characteristic surface circulation, which was composed of two different water sources from the northern and southern straits. The warm water mass from the southern strait was restricted flowing along the Japanese coastal area, while another water mass from the northern strait was present offshore areas of the sea. Abundance of cold-water calcareous nannofossil species increased significantly at 2.75 Ma corresponding to the global cooling. In this period, ostracode assemblage also indicates cooling in the intermediate water. According to planktonic foraminifers and radiolarians, significant inflow of the subtropical water from the southern strait started at 1.7 Ma, which might be related to the deepened Tsushima Strait and the Okinawa Trough (ca. 2 Ma).

Deep-water environments in the Japan Sea are little known compared with that of shallow environments. Benthic foraminifers in deep-sea sediments changed their faunal composition from agglutinated fauna to calcareous fauna through 3 to 2 Ma. Similarly, deep-water radiolarians show faunal replacement from the Pacific-type deep dwellers to the Japan Sea-type deep dwellers at ca. 2.6 Ma. Such faunal changes recognized from benthic foraminifers and radiolarians imply that the unique deep-water circulation in the Japan Sea was formed with geographical isolation from the Pacific deep water. In actual, this timing is almost coincident with beginning of oxic and anoxic cycles in the Japan Sea. It is likely resulted from either the global cooling or local tectonic motion during the Pliocene to Pleistocene transition.

Keywords: Microfossils, Paleoceanography, Grobal cooling event, Tectonic event, Tsushima Warm Current, Deep water