Evolution of the Japan Sea hydrographic system during Mio-Pliocene, inferred from radiolarian data (IODP Exp. 346, Site U1425)

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The Middle Miocene (ca. 15 Ma), is a climatic transition from a warm to a colder phase promoting growth and stabilization of an East Antarctic ice sheet. Cause of such cooling remain controversial; however, a higher carbon sequestration and drawdown of CO_2 are likely the main contributors. Since then, the climate of Earth record a progressive cooling, excepting the Pliocene warmth, which lead the establishment of the Greenland Ice Sheet (ca. 2.7-3.2 Ma). During this interval, climate changes are mainly paced by the obliquity cycle (41 kyr) until ca. 1 Ma, when a change in the dominant orbital cyclicity occurred.
On the other hand, tectonic activity also has influences on local to regional climatic/oceanographic system. The Northwest Pacific region is characterized by active tectonism, which drastically modified its paleogeography. In this context, the Japan Sea, a back-arc basin opened by a continental rifting during the Early to Middle Miocene (ca. 25–13 Ma) is one of the consequences of such activity. In modern condition, it is known that the Japan Sea is connected to adjacent marginal seas and the Pacific Ocean by four straits shallower than 130 m. The tectonic activity of this area drastically modified the Japan Sea paleogeography for older time interval such as the sill depth of its key straits. Past studies show that during the late Miocene and Pliocene, only the Tsugaru Strait connecting to the North Pacific was opened and this strait was likely deeper during Mio-Pliocene. Therefore, by studying paleoeaconographic records in the Japan Sea, a relative impact of tectonic and global climatic events on the local hydrographic system could be evaluated.
In 2013 the IODP Expedition 346 retrieved sediment cores at different sites in the Japan Sea. In this study, we have analyzed 138 core sediments samples collected at Site U1425. This site is situated in the middle of the Yamato Bank. We selected this site because the past 10 Myr could be traced continuously without hiatuses, enabling continuous data acquisition.
Radiolarians are one of the planktic micro-organism group bearing siliceous skeletons. Their species comprise shallow to deep water dwellers, sensitive to changes in sea water physical/ecological properties forced by climate changes. Their fossils are known for well preserved in the deep-sea sediments of the North Pacific. Therefore, in this study we propose to reconstruct major changes in the Japan Sea hydrography since the late Miocene, using radiolarian fossils as an environmental proxy.
As a result, shallow water radiolarians suggest relatively warm condition between ca. 7 and 9.5 Ma. Because it has been thought that only the Tsugaru strait (northern strait) of the Japan Sea was open during this period, our data infer northern shift of the subtropical front, or the presence of a shallow strait in area south of Tsugaru Strait. The situation is also complex for the intermediate water radiolarians. Indeed, our data suggest that the sill depth of the connecting strait likely control the exchanges of water masses with the North Pacific, highlighting importance of regional tectonism, although the opening of the Bering Strait seems also to influence the hydrography of the Japan Sea.

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