Sea surface environmental changes during the early to middle Miocene in the Indian, Atlantic and eastern equatorial Pacific Oceans based calcareous nannofossil assemblages

*Kotaro Ide[1], Koji Kameo[1]

1. Dept. of Earth Sciences, Chiba Univ.

During the early–middle Miocene, global ice volume was smaller than today and seawater temperatures in the oceans were likely higher until the Middle Miocene Climatic Optimum (MMCO: approximately 17 to 15 Ma). After the MMCO, global cooling had developed due to strong glaciation of the Antarctica and enhanced thermohaline circulation associated with deep water cooling (Shevenell et al., 2008; Billups and Schrag, 2002). This study investigates calcareous nannofossil assemblages of ODP cores in the southern Atlantic, Indian, and eastern equatorial Pacific Oceans in order to clarify sea surface environments during the early–middle Miocene. Calcareous nannofossil zones from CN1 to CN5a (Okada and Bukry, 1980) were identified in the investigated ODP cores and corresponding numerical ages are approximately 23 to 12 Ma. *Cyclicargolithus*, *Discoaster* and *Reticulofenestra* specimens dominantly occurred throughout the cores. Generally, an inverse relationship of relative abundances between *Discoaster* and *Reticlofenestra* seems to be observed. *Reticulofenestra* dominated assemblages imply that turbulent conditions of sea surface waters with rich nutrients occurred and they correspond to the time during low $\delta^{18}O$ conditions. Conversely, abundant occurrences of *Discoaster* indicate that well-stratified sea surface waters with poor nutrients developed in the time of high $\delta^{18}O$ values (Sato and Chiyonobu, 2009). In the examined sites, abundant occurrences of *Reticulofenestra* with fewer *Discoaster* specimens were found in approximately 21 and 15 Ma and they correspond to the beginning of the glacial periods Mi-1a and of Mi-2 (Billups et al., 2002), respectively. It suggests that these variations had mainly been controlled by cyclic developments of the Antarctic ice sheets. Moreover, calcareous nannofossil floras in each ocean were influenced and modified by local environmental changes, e.g. upwelling in the equatorial regions and/or western margin of Indian Ocean.

References

Billups, K., Channell, J. E. T., and Zachos, J., 2002. *Paleoceanography,* **17**(1).
Billups, K., and Schrag, D. P., 2002. *Paleoceanography*, **17**(1).
Okada, H. and Bukry, D., 1980. *Marine Micropaleontology*, **5**, 321–325.
Sato, T. and Chiyonobu, S., 2009. *Fossils*, **86**, 12–19.
Shevenell, A. E., Kennett, J. P. and Lea, D. W., 2008. *Geochemistry, Geophysics, Geosystems*, **9**, Q02006.
Zachos, J., Pagani, M., Sloan, L., Thomas, E. and Billups, K., 2001. *Science*, **292**, 686–693.

Keywords: Calcareous nannofossils, Miocene, Upwelling, Stratification, ODP

