

Mid-Miocene Nd isotope record from ODP 1120: Flood basalt weathering induced $p\text{CO}_2$ drop?

*堀川 恵司¹、Khim Boo-Keun²、浅原 良浩³

*Keiji Horikawa¹, Boo-Keun Khim², Yoshihiro Asahara³

1. 富山大学 大学院理工学研究部（理学）、2. 釜山大学 海洋学部、3. 名古屋大学 環境学研究科

1. Graduate School of Engineer and Science, University of Toyama, 2. Department of Oceanography, Pusan National University, 3. Graduate School of Environmental Studies, Nagoya University,

Early-middle Miocene transition is marked by a cooling period with Antarctic ice sheet expansion. Site 1120, off New Zealand, has a sedimentary record of the early-middle Miocene transition although initial age model mentioned there is a hiatus during this period. Among mid-Miocene cores, this core is located at the shallowest intermediate depth and proximal to the Antarctica. Therefore, this core is a very unique and expected to record valuable information on a relationship between Antarctic ice sheet expansion and Antarctic intermediate water mass property.

To get information on water mass property, we analyzed Nd isotopes of fossil fish teeth/debris, which record Nd isotopic composition of the bottom water in the past. We generally pick more than 20 fragments of fossil fish teeth/debris from 125 μm size fraction of the sediment to get Nd isotope data with small analytical error. The ϵNd values ranged from -7.5 to -3.2 ϵNd during 8.5 Ma–17 Ma. Prior to 14.6 Ma, Mid-Miocene Climatic Optimum (MMCO), the ϵNd values represented very stable values around -7.5 ϵNd , whereas the ϵNd values exhibited the pronounced excursion toward radiogenic values up to -3.2 ϵNd from 14.6 Ma to 14 Ma. Although the magnitude of the variations was much smaller, the similar mid-Miocene ϵNd excursion has been reported from Eq. Pacific sites.

During 16.6 and 15.3 Ma, the Columbia River flood basalt erupted (almost 95% of the total volume) (Courtillot and Renne, 2003). Although the Columbia River flood basalt is the smallest (0.17 million km^3) of the three Tertiary LIPs, a drop in the seawater Os isotope ratio is observed during the mid Miocene (15–12 Ma) as a result of volcanic eruptions (Klemm et al., 2008).

We found the timing of the Nd isotope excursion toward radiogenic values during 14.6–14 Ma was coincident with (1) $p\text{CO}_2$ drop and (2) enlargement of Antarctic ice sheet. Therefore, we argue that emplacement of the Columbia River flood basalts must brought basaltic materials to the ocean through flood basalt weathering. Radiogenic Nd isotope excursion during 14.6–14 Ma might have been attributed to the flood basalt weathering. If this is the case, intense weathering of Columbia River flood basalts might have worked to reduce atmospheric CO_2 concentration.

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