Sulfur isotope geochemistry of the Japan Sea sediments (IODP Exp. 346) 30 ~ 220 kyr ago: Implications for the evolution of Asian Monsoon climate system

*Shu Oshio[1], Kosei E. Yamaguchi[1,2], Satoshi Takahashi[3], Ryuji Tada[3], Hiroshi Naraoka[4], Minoru Ikehara[5], Asuka Yamaguchi[6]

1. Department of Chemistry, Toho University, 2. NASA Astrobiology Institute, 3. Department of Earth and Planetary Science, Graduate School of Science, The Univeristy of Tokyo, 4. Department of Earth and Planetary Sciences, Kyushu University, 5. Center for Advanced Marine Core Research, Kochi University, 6. Atomosphere and Ocean Research Institute, The University of Tokyo

Asian monsoon climate system has started about 50 Ma, after the collision of the Indian and Eurasian continents followed by uplift of the Himalaya and Tibetan Plateau. It has influenced sediments in the Japan Sea through changes in the intensity of continental weathering and ocean currents. These sediments are characterized by cm-scale alternation of C_{org}-rich dark layers and C_{org}-poor light layers which is most likely due to temporal changes in the nutrient status and/or oceanic redox conditions. In order to obtain insights into the evolving oceanic redox state and the monsoon system, we conducted sulfur speciation and isotope analysis of the marine sediment core samples recovered in the central Japan Sea by IODP Exp. 346.

The light layers have lower S_{py} (0.03~0.25 wt.%) contents when compared to the dark layers (0.26~1.49 wt.%). The C_{org} contents have similar distribution (0.34~1.10 wt.% for light layers and 1.16~3.38 wt.% for dark layers). However, the S_{SO4} contents (0.02~0.64 wt.%), the $d^{34}S_{py}$ values (-34 to -38‰) and the $d^{34}S_{SO4}$ values (0 to -10‰) did not show such light-dark distinction. Elevated S_{py}/C_{org} ratios (0.03~1.00) in the dark layers are interpreted to represent sulfide formation in the anoxic water column by bacterial sulfate reduction. During deposition of light layers, oxidation of sulfide minerals could have released sulfate without significant isotope fractionation. Regardless of the type of the sediments (dark vs. light), sulfate was not limiting during bacterial sulfate reduction, as reflected in the sulfur isotope compositions.

We speculate that, during deposition of dark layers, enhanced summer monsoon activity caused heavy rainfall and increased source-rock weathering, runoff of the Yangtze River, and nutrient input into the East China Sea and the Tsushima Warm Current. Inflow of nutrient-rich and less salty water into the Japan Sea triggered enhanced biological activity, water-column density stratification, transport of organic matter into deeper ocean and consumption of dissolved oxygen, and ultimately the creation of anoxic water body to allow bacterial sulfate reduction (syngenetic sulfide formation) to occurr. On the other hand, during deposition of light layers, enhanced winter monsoon activity caused cooling of surface water of the Japan Sea, often creating down-going oxygen-rich water mass to ventilate the deep water (and break up density stratification). Oxic condition in the deep water did not allow accumulation of massive organic matter and formed light-color sediments. Biogenic sulfide formed, if any, during diagenesis (no syngenetic sulfide formation).

