Isotope geochemical study of ammonium dissolved in the interstitial water obtained from core sediments drilled in Guaymas Basin, Gulf of California by IODP Expedition 385

*Toshiro Yamanaka[1], Arisa Sakamoto[1], Ji-Hoon Kim[2], Lucie C. Pastor[3], Teske P. Andreas[4], Daniel Lizarrald[5], Tobias W. Höfig[6], IODP Expedition 385 Scientific Party

1. Tokyo University of Marine Science and Technology, 2. Korea Institute of Geoscience and Mineral Resources, 3. French Research Institute for Exploitation of the Sea, 4. University of North Carolina at Chapel Hill, 5. Woods Hole Oceanographic Institution, 6. Texas A&M University

International Ocean Discovery Program (IODP) Expedition 385, Guaymas Basin Tectonics and Biosphere, has been targeting to reveal carbon cycle trough the basaltic magma-driven hydrothermal activity where is covered by thick organic-rich sediments with sill intrusions on the flanking regions and in the northern axial graben in Guaymas Basin. It means that the carbon cycle is strongly related with abiological and biological processes. During the processes, nitrogen, which is another important biological essential element, is also cycling between Earth’s surface and solid Earth.
Nitrogen is supplied from within the deep mantle to the Earth’s surface, hydrosphere and atmosphere, mostly through volcanic activities. The nitrogen from deep sources is considered to migrate as dinitrogen or ammonia gases depending on the physico-chemical condition. On the other hand, nitrogen recharge from the Earth’s surface into the mantle has been accepted through subduction of ammonium-bearing sediments because of the similarity of charge and ionic radius between ammonium ion (1.43 Å) and potassium ion (1.33 Å) that often substitutes in the interlayers of the potassium-bearing minerals. Nevertheless, the detailed mechanisms as related to the interaction between nitrogen compounds in the ascending hydrothermal fluid and ambient minerals during the path through the lithosphere are not fully understood. The sediment filled in Guaymas Basin is expected to provide suitable sample for reveal behavior of ammonium because abundant sedimentary organic matter supply enough amount of ammonium for stable isotope geochemical study.
During the expedition, high ammonium concentrations (up to 39 mM) in the interstitial water (IW) were appeared, reflecting mineralization of abundant organic matter in the sediments. Ammonium concentrations are generally increasing with burial depth, after reach the maximum at a certain depth, the concentration is decreasing. Such decrease of ammonium concentrations has been considered scavenging by clay minerals related to illitization. In fact, corresponding phase transition of minerals was observed at the depth in the core sediments. For post cruise analysis, the authors measured nitrogen isotopic ratios (δ^{15}N values) of IW ammonium for understanding behavior of nitrogen isotopes during early diagenetic stage. As a tentative result, the δ^{15}N values of ammonium were reflect that of ambient organic nitrogen (total nitrogen; TN) at the surface layer where the ammonium concentration was increasing, while the vertical profiles of ammonium δ^{15}N values were different from that of TN δ^{15}N values and ammonium concentrations. The changing point of δ^{15}N trends for ammonium is possibly corresponding with phase transition of minerals during diagenesis (opal A to CT, precipitation of carbonate mineral, illitization, etc.).
In the presentation, I will introduce the details of nitrogen behavior in the core samples and the geochemical characteristics of IW obtained from magmatically active basin.

Keywords: Nitrogen isotope, ammonium, interstitial water, Guaymas Basin, IODP Expedition 385

