

Porewater chemistry of seafloor sediments based on the onboard analyses Expedition 338 at Nankai Trough

Harue Masuda^{1*}, Tomohiro Toki², IODP Expedition 338 Scientists³

¹Osaka City University, ²University of Ryukyus, ³Rice Univ. and others

During IODP Expedition 338, sediments were sampled from Site C0002 at Kumano Basin and Site C0022 on the frontal arc slope of Nankai Trough. At Site C0002, the sediments were obtained from the depths between 200 - 500 mbsf (meters below seafloor), 900 - 940 mbsf, and 1100 - 1120 mbsf. Porewater was analyzed after squeezing using the standard onboard analytical procedures. Porewater from the sediments at 1111 mbsf was extracted using GRIND method after testing the appropriateness of this method. Here, the tested results of GRIND method and porewater chemistry of the Site C0002 are described.

GRIND method was originally developed for the sediments and rocks, for which standard squeezing (standard method, hereafter) did not provide adequate volumes of pore fluid. However, it would also be applicable to extract the porewater from small volume of the sediment samples. 40 g sediment was ground with 5 mL ultrapure water in a ball mill, and the water was squeezed using the standard method. As results, chlorinity was comparable (RD <2%) with that obtained using the standard method, and major ions, Br, sulfate, Na, Mg and Ca, and minor ions, B, Li and Sr are useful if 5-10 % difference of concentration from that obtained using the standard method can be acceptable. Among the major ions, K concentration was always ca. 20 % higher and phosphate ca. 15 % lower than those obtained using the standard method. Most of the minor and trace metal concentrations (Fe, Mn, Si, Ba, V, Cu, Zn, Rb, Mo, Cs, Pb, U) obtained using the GRIND method were much larger than those obtained using the standard squeezing method, probably due to extraction of adsorbed elements onto the sediment particles via desorption in addition to the dissolved components. Thus, the GRIND method cannot be applicable for the minor and trace metals except Li and Sr, of which RD are <10%.

At Site C0002, continuous profiles of porewater chemistry are obtained down to 1050 mbsf combining the results of previous and present expeditions. 10 samples from the above former two intervals were analyzed using both standard squeezing and GRIND methods, and the deepest porewater chemistry was obtained for the sediment at 1111 mbsf only using the GRIND method.

Chlorinity decreased from 550 mM of the porewater from the seafloor sediment to 350 mM down to 400 mbsf, increased to 480 mM down to 800 mbsf, then decreased to 450 mM at 1111 mbsf. The boundary between Units I (upper forearc basin sediment) - II (lower forearc sediment) and II-III (basal (starved) sediment) are 140 and 830 mbsf respectively. The depletion of chlorinity occurs in Unit II due to the contribution of freshwater from gas hydrates. Similar depletion of the concentration in the Unit II are observed for Na, K, Mg, B, Sr, Ba and Rb. Alkalinity, phosphate and ammonium increase in Unit I and decrease in Unit II, suggesting that those are released via decomposition of organic matters and then removed by precipitation (P) and decomposition (ammonium). Br increases in Unit I due to decomposition of biogenic material (probably algae), similar to P and ammonium, while in and below Unit II, it changes in accordance with Cl. Ca and Li increase in Unit II probably due to dissolution of biogenic and/or detrital minerals. In Unit IV (upper accretionary prism), chlorinity alkalinity and Na decreased, while Ca increased with depth in Unit IV. Variations of each element correspond to the lithological units, suggesting that the porewater chemistry is partly controlled by the interaction between porewater and sediments including microbiology of each sediments, which comprise different mineralogy and chemistry.

Keywords: porewater, gas hydrate, Kumano Basin, GRIND method