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Arsenic distribution in porewater and coexisting sediments of Kumano Basin, Nankai Trough

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Arsenic contamination of groundwater is a serious problem in the world, especially in the deltas along large rivers originated from Himalayas such as Bangladesh and West Bengal, India. Sulfide minerals including pyrite in shales is one of the candidates of source minerals causing arsenic contamination. However, the mechanism of arsenic concentration in sedimentary rocks has not been well understood. In this study, arsenic behavior in the porewater and host sediments was determined to understand the fixing process of arsenic during early stage of diagenesis in modern marine sediments.

Porewaters and squeezed cakes were sampled at three sites (C0002, C0021, C0022) in the Nankai trough by IODP, Expedition 338. The sediments from Site C0002 is composed hemipelagic mud of distal turbidites, those from Site C0021 of mass transport deposits (MTDs), Site C0022 is dilled at right above the megasplay fault, and highly fractured zone, likely related to the megasplay faulting was found at 100 mbsf (meters below seafloor).

Arsenic concentration of the porewaters at Site C0002 was constant 0-1.1μM at 200-300 mbsf, and it increased with depth to 3μM in 300-400mbsf. The highest concentration (3μM) was recorded at 400 mbsf, and the concentration decreased below that depth. In C0021, arsenic concentration of the porewaters is 0.2μM on an average at 0-160 mbsf and give no relationship to the depths. It increased quickly to 1.2μM down to 200 mbsf. In C0022, arsenic concentration is 0.3μM on average at 0-100mbsf. The highest concentration (1.5μM) was observed at 130-160mbsf, and then drastically decreased to 200 mbsf. Arsenic concentration became constant below that depth.

Arsenic concentration of sediments is 40-120μM at 300-500 mbsf in Site C0002, 40-90μM at 100-150mbsf in Site C0022. The arsenic concentration is varied without relationship to the depth.

Mineral composition determined by XRD showed that the all sediments analyzed were dominated by quartz, feldspars, micas, calcites, smectite, and chlorite/ kaolinite. Hornblende and pyrite were occasionally observed.

Compared to the major chemical composition determined onboard, arsenic concentration of porewater correlated to pH, Fe, Pb, and Mn. It is suggested that the arsenic was accumulated in the sediments via coprecipitation with iron hydroxides/oxides at the sea floor, similar to many trace heavy metals, and was released intio the porewater by desorption under reducing environment, or by decomposition of iron hydroxides/oxides. After that, arsenic may be fixed into pyrite with depth, however, the fixing mechanism of arsenic in the deep is not clear at present.

Keywords: Arcenic, Nankai Trough, IODP