Arsenic concentration due to the phytoplanktonic activity in the estuary sediments of Yamato River, Osaka Prefecture

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Highly arsenic contaminated groundwater locally appears in the Quaternary Osaka Group sediments in the Osaka Plain. The marine clay layers in the Osaka Group formation is known to concentrate more arsenic than the fresh water sediments, suggesting that the marine clay layers would be sources of arsenic in the aquitards of this area. However, appropriate mechanism has not been obtained to explain the arsenic concentration into the marine clay layers of the Osaka Group formation. It has been known to concentrate arsenic in estuary sediments. Thus, we could expect to observe arsenic concentration process in the sediments in the estuary of Yamato River, which runs into the Osaka Bay. In this study, the river water and surface sediments were taken in the day of flood tide in August and October. The samples were taken from 6 and 10 points for the August and October, respectively, from the center of the river along 6 km long measurement line. The origin of the measurement line was set at the lowermost point beside the Kamome Ohashi, and the intervals of the sampling points were about 500m each. Water samples were taken from the 3 different depth in the downstream where the water depth was more than 2m, and 2 in the middle, and 1 from the upstream less than 1m depth. Major and minor chemical compositions including arsenic and chlorophyll a were analyzed in the laboratory.

Based on the chloride concentrations, salt wedge was observed in the river. The edge of the wedge, where the 80% of water occupied the seawater, was located between 2500 and 3500 m from the estuary on the river bottom surface in the August, and 3000 and 3500 m in the October. Arsenic content in the water was higher in the downstream (larger than 2ppb) than in the upstream (about 1ppb or less in the August, and less than 1ppb in October). Higher arsenic content in the downstream was due to the higher arsenic concentration in seawater than in the fresh river water. While, higher arsenic concentration of water in the August than in the October would be due to the biological concentration of that element. In the August, the waters containing high arsenic appear along the salt wedge. Only one water sample, taken from the bottom at 3000m from the estuary in the October, contained high amount of arsenic among the water samples of October. Total iron content was also high in that water, suggesting that the arsenic was associated with iron hydroxide or other particulate matter.

The highest concentration of chlorophyll a was about 60ppb, and the muximum concentrations of chlorophyll a were observed along the salt wedge in the August. While, the chlorophyll a was lower than 10ppb expect one sample, taken from the uppermost edge of the salt wedge at the bottom of 3000 m from the estuary, in the October.

Total arsenic content of the surface sediments decreases from the estuary to the upstream from 7 to less than 2ppm. However, the maximum concentration peak was observed in the sediment from 3000m in the August, where the high arsenic contents was observed in the river water in the October.

The coincidence of the concentration of arsenic, chlorophyll a, and total iron in the water samples and arsenic distribution in the surface sediments suggest that the arsenic is behaved with the activity of phytoplankton and that the skeletons of the phytoplankton and the following adsorption on the particulate matters are the sources of arsenic in the sediment. In the estuary, phytoplankton can be expected to be active on the boundary between seawater and fresh water, where nutrients derived from both of seawater and fresh water can be obtained. In such a condition, arsenic concentration occurs in the surface sediments.