学 位 論 文 内 容 の 要 旨

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学 位 論 文 題 名

Factors affecting arsenic content of unconsolidated sediments and its mobilization
(未固結堆積物中のヒ素含有量とその動態に及ぼす影響因子)

Arsenic (As) contamination in groundwater is a serious water resource problem in the world since groundwater is the main water sources as a drinking water in many countries. Arsenic contamination in the environment often results from anthropogenic sources such as mining and pesticide application, but recently the natural sources of As have a potential impact on water quality. The amount of dissolved As is often explained by geochemical reactions, such as dissolution-precipitation, oxidation-reduction, adsorption-desorption, and biological processes. The distribution of As in the subsurface environments is affected by mobilization of As in aquifers. However, geogenic processes related to As in alluvial sediments where groundwater As concentration is high are still unclear. This research targets two objectives: (1) factors affecting As content in areas with high concentration of As in groundwater as case studies of the Ishikari Plain and Mekong Delta, and (2) As speciation released from inorganic and organic sediments in a wide variety of chemical and mineral constituents. The results would help to understand the distribution of As content in an alluvial environment for safe drinking water. This dissertation contains 5 chapters.

Chapter 1 presents introduction, statement of the problem, objectives of the study and outlines of the dissertation. These include the geochemical characteristics of As in the environment and the geochemistry of As contamination in groundwater and sediments.

Chapter 2 describes factors affecting the distribution of As content of unconsolidated sediments in the Ishikari Plain. To understand the mechanisms triggering the enrichment of naturally occurring As, As contents in the sediments were studied. The first factor was organic matter content in the sediments, and the second was the sedimentary condition expressed by the ratio of carbon content to sulfur content. Leaching experiments and sequential extraction were used to explain mobility of As from the sediments. The results showed that higher organic matter content of sediments increased the organic fraction of As and that the higher sulfur content increased the sulfide fraction of As. On the other hand, As release from the exchangeable fraction was significant because the exchangeable fraction of As was correlated with As leaching concentration, and As mobility was enhanced under higher pH condition. In the reducing condition, both As and Fe were dissolved from the sediments. In addition, As in colloidal particles also affected As leaching.

Chapter 3 describes the As distribution of unconsolidated sediments in the Mekong Delta. The content of As in the sediments was influenced by iron, sulfur and organic matter. In this study area, the organic-rich sediment concentrated As-bearing sulfide, which enhanced the organic fraction of As. In addition, the higher exchangeable and sulfide fractions of As in the sediment were found in a saline water condition. This demonstrated that the sedimentary condition also affected As distribution and

its mobility. Higher As concentration in the leachate was also observed in the layers consisting of finer particle sizes. This means that As in colloidal particles affected As leaching. These indicate that several factors affected the As content and its mobilization.

In chapter 4, chemical characteristics of sediments affected As content in both areas. By comparing the areas, organic matter content and sulfur content increased As content in sediments. In addition, high As content was observed under saline water conditions. The As leaching in both sites was influenced by the fraction of As in the sediments, pH and colloidal particles.

Finally, conclusion, as well as recommendation of As contamination in shallow alluvial aquifers is discussed in chapter 5.