

Arsenic contained in the pore water of the natural sediments in the northern part of the Nakagawa Lowland, Japan

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The Kanto Plain is the largest lowland in Japan. Marine sediments are found over a wide area here, even more than 50 km inland from the present shoreline, because of the global cyclic changes in sea levels. The dependence on groundwater to meet the water needs in this area is relatively high. In particular, groundwater is the source of approximately 40 % of the municipal water supplies. Arsenic levels, greater than those permitted by the environmental standards of Japan, have been detected in the groundwater of this area. Therefore, measurements were conducted to evaluate the occurrence of arsenic and other related elements in the pore water contained in the natural sediment layers. We measured the levels of various inorganic chemical substances, such as arsenic (As), iron (Fe), and sulfur (S), and major dissolved ions, such as sulfate (SO_4^{2-}), calcium (Ca^{2+}), and sodium (Na^+). The pore water was collected from sediment samples, obtained by drilling from the river bottom down to a depth of 44 m. The pore water samples were obtained immediately after the extraction of the sediments. The sedimentary facies shown in the vertical profile are continental, transitional, and marine, including two aquifers. The upper aquifer (15~20 m) contains fine to coarse sand, whereas the lower aquifer (37~44 m) contains fine to coarse sand and gravel. The concentration of arsenic and other inorganic elements was measured by an inductively coupled plasma mass spectrometer (ICP/MS) and an inductively coupled plasma atomic emission spectrometer (ICP/AES). The concentration of major dissolved ions was measured by an ion chromatograph analyzer. The total chemical element content was measured by X-ray fluorescence analysis, using solid sediment samples. We obtained the following results. The arsenic concentrations in the pore water of the marine silt and clay sediments (approximately 40 mg/L) were about five times higher than those in the continental sediments (approximately 8 mg/L). The highest concentration of arsenic (74 mg/L) was detected at a depth of 13 m, which is immediately above the upper aquifer. Visual observations confirmed oxidizing conditions for this level. Therefore, it points to arsenic being adsorbed to iron hydroxide in the sediments. In contrast, in the top part of the section, from the river bottom to a depth of approximately 3 m, the arsenic concentrations in the pore water were clearly high, and decreased gradually and continuously with depth. This is ascribed to the anthropogenic impact on the river.

Keywords: Heavy metal, Arsenic, Water-rock interaction, Pore water, Leaching, Pollution