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Vertival distribution of Estrogen and Nonylphenol and its derivatives (NPs) in the sediment of Teganuma

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Purpose: Insufficient information exists on vertical distribution of Estrogen and Nonylphenol and its derivatives (NPs) in lake sediments. Thus, we investigated the vertical distribution of NPs in sediment cores sampled from Teganuma.

Method: The sampling effort was made at the reference point in Shimoteganumachuuou on April 22, 2002. Sediment core samples were collected by a diver using an acrylic tube (10cmφ×100cm length) under minimal disturbance. Each core was divided into 1-cm thick samples along the depth from 0 to 87 cm. The interval for analysis was taken to be 1 cm for the core depth from 0 to 50 cm, and 10 cm interval for the depth from 50 to 87 cm. The samples were analyzed for Estrogen(E1, E2, E3),NPs (NP, NPEO, NPEC, EE2), conventional parameters, major metals, and trace inorganic elements. In addition, Pb_{210} was determined for the purpose of sediment dating.

Results: Referring to the Estrogen of human or animals origins (El, E2, EE2, E3), we observed that: 1) EE2 was not detected;2) E3 was not detected; 3) E2 was rarely detected from any of the sediment samples; 4) E1 increases gradually with the ascending depth from 47 to 30 cm; and 5) a sharp increase followed by a consistent decrease of E1 occur between 30 and 10cm, having a prominemt peak of 2 μg/kg-dry sed at 20cm (Fig. 1-A). Referring to the NPs of industrial/nonbiological sources (NP, NPEO, NPEC,), we observed the following: 1) EP and NPEO increase markedly with the ascending depth from 50 to 35 cm; 2) a prominent peak of NP exists at 8 cm (Fig. 1-B); and 3) NPEC is considerably lower than NP and NPEO, and 4) NPEC has a weak peak at 12 cm (Fig. 1-C). Based on the Pb_{210} dating, we estimate that: E1 started to increase in 1952 (47 cm); the E1's sharp increase began in 1972 (30 cm); and the E1 peak occurs in 1982 (20 cm). The human population in the Teganuma watershed increased from approx. $6x10^5$ in 1970 to $1x10^6$ in 1980. The population increase, particularly septic tank users, in this period may have caused the observed increase in E1 in the sediment. Since approx. 1980, the wastewater treatment processes in this region have significantly improved by increasing their capacities and bypassing portion of wastewater to reduce waste loads entering Teganuma. The marked decrease in E1 after 1980 is likely due to the decrease of waste loadings. We also estimated that MPs of industrial sources (i.e., NP and NPEO) increased in 1967 (35 cm), consisting with the period of the rapid industrial growth in Japan. We have observed no trend of decreasing of NP and NPEO, indicating continuing uses and discharges of these compounds. A further study is needed to identify their sources and decomposition mechanisms in sediment.