Reconstruction of geographical distribution changes of natural heavy metal elements for the last 10,000 years in the Nobi Plain

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[Background]In present Ise bay, heavy metal content is low in the open sea area and high near the river mouth. For the terrestrial area, the content is low in the upstream area, and high in the downstream area (Imai et al., 2004). These distributions reflect the sum of artificial and natural amount of heavy metal elements. It is necessary to clarify the natural distribution of the elements and their changes for evaluating the artificial effects correctly.

[Purpose]Purpose of this study is the reconstruction and evaluation of the geographical distribution changes of the natural heavy metal elements for the five boring core sediments obtained from the various area of the Nobi Plain by using XRF analysis.

[Materials and Methods]Five boring cores named as AN, KM, NK, KZN, and YM drilled in the Nobi Plain were used. Samples were collected at an interval of about 1m. The number of the samples is 199 in total. The element analysis (As, Cu, Ni, Pb, Zn and Al2O3) by XRF (ZSX Primus2, RIGAKU), the grain size analysis by laser diffraction grain size analysis equipment (SALD3000S, SHIMADZU), and the mineral analysis by XRD (Multiflex, RIGAKU) were performed.

[Analytical Accuracy]The analysis accuracy by XRF was examined by analyzing 20 samples with the ICP-MS (SPQ9200, SII) at JAEA. High correlations between the results of two different analytical methods above were obtained for As, Cu, Ni, and Zn.

[Existence Form]The heavy metal contents above (ppm) show clear positive correlations with (1) Al2O3(%), (2) relative peak value of the clay minerals (defined as: peak strength of clay minerals / that of quartz + that of clay minerals) , and (3) mud content (%). This suggests that the most of heavy metal contents have been adsorbed by the clay minerals. And after adsorption, heavy metal elements tend to rarely remove within sediments because there were no differences of their contents between terrestrial and marine sediments. This is concordant with the conventional insights (Komai, 2007) that the heavy metal pollution is accumulated.

[Changes of natural heavy metal content]Depth in five cores was converted into ages by using sediment accumulation curve (Ogami et al., 2006) based on the 14C dating. The heavy metal content in the five boring core fluctuated between 3-23 ppm in As, 0-51 ppm in Cu, 4-38 ppm in Ni, and 64-113 ppm in Zn during the last 10,000 years. This fluctuation reflects regional differences such as the particle size distribution of the sediment. A present range of the heavy metal content is small in As with 1-23 ppm, but that is very large in Cu with 15-220 ppm, in Ni with 8-138 ppm, and in Zn with 16-697 ppm. Such wide range suggests the possibility of human pollution.

[Geographical Distribution]By using the ranges of natural heavy metal content for the five boring core sediments, the present terrestrial and submarine sediments were able to divide into three areas, of artificially contaminated, not contaminated, and area in those middle. Artificially polluted areas are observable around the downstream region, and the area has extended to the interior part of Ise Bay via river systems, however, human pollution does not extend to the upstream area nor the open sea area.

[References]Imai et al., (2004):Geochemical map of Japan, Geological Survey of Japan, AIST, pp.157-165, Japan coast guard (2005):Report of marine pollution surveys 33,pp.16-17, Komai (2007) Journal of Geography 116 (6), pp.853-863, Ogami et al.,(2006) Abstract, 17th ISC, 143