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Heavy metal pollution in farmland irrigated with river water near a steel plant - detection by magnetic and geochemical methods

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The presence of heavy metals in the environment has become an increasing problem during the last several decades. It is a key scientific issue to disclose the source, degree and extent of pollution in farmland near to heavy industries. In this study the efficiency of magnetic methods for such a purpose is tested at a Chinese city (Loudi, Hunan Province) with fast developing steel industry. Lianshui River flows through the city and passes a large steel plant at the entrance of the urban area. Previous results revealed higher heavy metal contents in the vicinity of the Fe-smelting plant and in the city region[1]. Nearby farmland usually is irrigated with water from this river. We collected vertical soil profiles to about 60 cm depth within farmland nearby Lianshui River with sampling sites distributed from the upstream (before entering the city) to the downstream region (after leaving the city area). These samples were comprehensively investigated by integrating both magnetic and chemical analyses. Heavy metals (Pb, Zn, Cd etc) pollution in farmland soils in the downstream region is clearly higher than in the upstream region. Magnetic susceptibility and SIRM is correlating with heavy metals contents. The SIRM background in the upstream section of unpolluted farmland soils and river sediments is low ($< 7\times10^{-3}\mathrm{Am^2kg^{-1}}$), whereas the polluted soils at the surrounding of the steel plant reveal higher SIRM intensities (30 to $40\times10^{-3}\mathrm{Am^2kg^{-1}}$) within the topmost 20 cm. SIRM in river sediments also correlates with heavy metals contents; it is strongly enhanced (80 to $200\times10^{-3}\mathrm{Am^2kg^{-1}}$) at the same sites, from surface to 40 cm deep depth. Magnetic enhancement is found to be related to the presence of spherical magnetite particles with a diameter of 10$\sim$30 μm. These findings demonstrate that magnetic methods have a convenient practical application for detecting and mapping heavy metal pollution in farmland soils irrigated by river water from nearby industrial areas.

Reference

1. Zhang, C. X., Q. Qiao, J.D.A. Piper and B. Huang, Assessment of heavy metal pollution from a Fe-smelting plant in urban river sediments using environmental magnetic and geochemical methods. Environmental Pollution, 2011, 159:3057-3070.