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Environmental magnetic responses of urbanization process: evidence from the lake sediments in the East Lake, Wuhan, China

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Detailed magnetic measurements, heavy metal, organic matter and radionuclide analyses were performed on the nine sedimentation cores from the East Lake in Wuhan city, China. Results show that concentrations of magnetic particles, heavy metals and organic matter in the upper 2∼18 cm sediment have been significantly elevated due to the input of coarse magnetite grains from industrial activities (e.g., power generation and steelmaking) and other anthropogenic activities (e.g., vehicle emissions). Concentration-related magnetic parameters, such as magnetic susceptibility (χ), saturation isothermal remnant magnetization (SIRM) and anhysteretic remanent magnetization (ARM), are significantly correlated with the concentration of heavy metals and organic matters, e.g., the Pearson's correlation coefficients are 0.928 for χ-Cu, 0.677 for χ-Pb and 0.977 for χ-LOI (loss-on-ignition), respectively. The downcore magnetic proerties of lake sediment document the pollution history caused by human impacts in the lake catchment during the urbanization process. Environmental quality of the lake was fairly good before 1960s. Magnetism of the lake sediment was weak, the concentraions of heavy metal and total organic matter were low and constant, indicating the relatively stable natural input from the lake catchment. Historical trends in status of pollution since the 1960s through time are reflected in downcore variations of magnetic properties of the lake sediment. Since 1957 when the Wuhan Iron and Steel Company and Qingshan Thermal Power Plant located in the upwind area of the lake were built and put into production, the magnetism of the sediments started increasing, especially since the acceleration of industrialization and urbanization in the East Lake in 1980s, the lake pollution was further aggravated, verified by the elevated concentration of heavy metals, and organic matter in the sediments. And the magnetism of the lake sediment has been elevating continuously since then, peaked in 1990s and keeping high level since then. These results suggest that magnetic properties respond sensitively to the anthropogenic inputs, and that magnetic properties of sediments are an excellent archive for the industrial and anthropogenic history in the urban lake catchment.