TEMPORAL DYNAMICS OF URBANIZATION-DRIVEN ENVIRONMENTAL CHANGES EXPLORED BY METAL CONTAMINATION IN SURFACE SEDIMENTS IN A RESTORING URBAN WETLAND PARK

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Introduction

Urbanization has been one of crucial anthropogenic activities that drive global changes (UNFAPA, 2007). Spatial patterns of metal distribution along urban-rural or multi-city gradients indicate that the urbanization process directly lead to metal enrichment and contamination in the environments. However, it has not yet looked at homogenization dynamics of an urban-rural gradient pattern over time with urbanization process in an area. Findings from this study might be of significance for urban environment management by identifying metal emission origins and strategizing energy structure and policy.

Methods

This study monitored anthropogenic metals (Cr, Cu, Pb, and Zn) in surface sediments from channels of a newly-opened national wetland park to elucidate the urbanization-driven dissolution of urban-rural gradient pattern between 2008 and 2011. Sixty-eight surface sediment samples were taken from these channels in July of both 2008 and 2011. Pseudo-total contents (thereafter shorten as total content) of Cr, Cu, Pb, and Zn in surface sediments were measured using an ICP-MS (7500 CX, Agilent, USA) after an acid (concentrated HNO3–HClO4) digestion (Li et al. 2011). Stable lead isotope ratios in the surface sediments were measured exactly following the procedure of Li et al. (2011) using the NIST 981 (Common Pb Isotope) as the standard reference material. The HQ of metal contamination was calculated according to Piva et al.(2011).

Results

Both spatial and temporal patterns of metal loadings in surface sediments were found in the Xixi National Wetland Park, China by the comparisons among channels (adjacent to urbanized and urbanizing zones, and inner channels with/out touring) and between two investigations in 2008 and 2011. Anthropogenic metals, Cu, Pb, and Zn, showed remarkable urbanization effects in content, excess percentage on both China and USA sediment quality guidelines, and specific hazard quotient. In 2008, the Xixi National Wetland Park opened to public when the urbanization-driven spatial distribution pattern was evident for metal loadings in surface sediments. With the development in the surrounding area of the park in 2011, however, surface sediments in the inner channels, including the inner touring channels, loaded more metals (Cu, Pb and Zn) via air depositions, urban runoffs, and channel water exchange and diffusion, which faded out the spatial distribution pattern driven by urbanization. The lead stable isotope ratio analysis identified anthropogenic Pb origins from vehicular exhausts, cements, and coal flying ashes, which elevated metal contents in the inner channels via atmospheric deposition. Specific hazard quotients

of the metal contamination in surface sediment were also assessed and enhanced over time in the study wetland park.

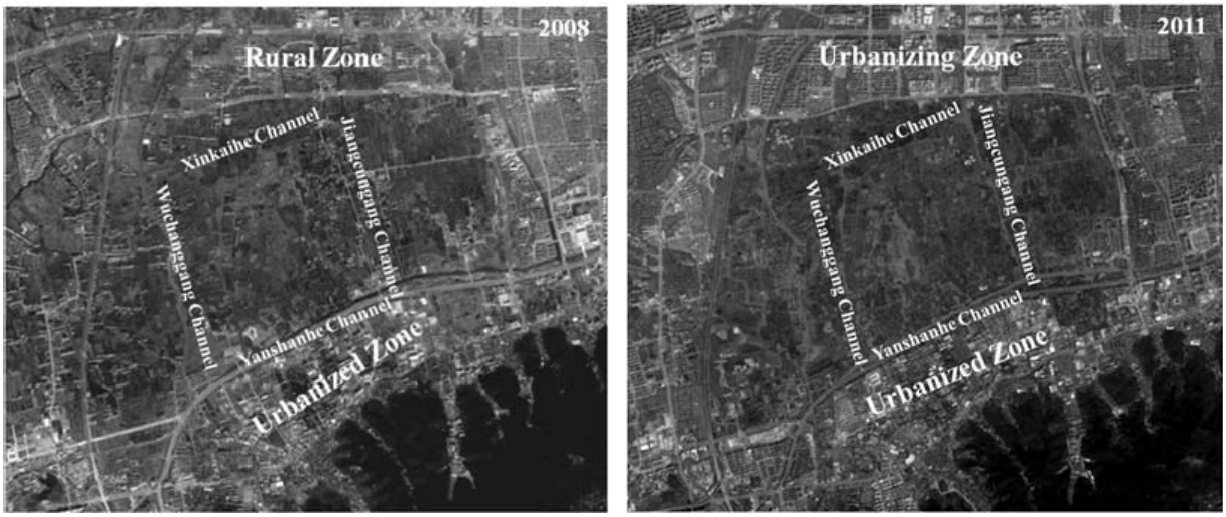

Figure 1. Images of the Xixi Wetland Park and surrounding areas in 2008 and 2011. In the urbanizing zone, new residential communities were evident in 2011 where was rural in 2008.

Conclusion

In short, a spatial distribution pattern of total metal contents along the gradient of urbanization influence, evident in 2008, was homogenized in 2011 with the area development. Meanwhile, origins of the anthropogenic metals were identified from vehicular exhausts, cements, and coal flying ashes by the lead stable isotope ratio analysis. On the other hand, Cr decreased its content in surface sediments over the period. These findings suggest that emissions from traffic, construction, and energy generation contribute metal loadings in the urbanizing environment.

References

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