Source apportionment of soil-contamination in Baotou City (Northwestern China) based on a combined magnetic and geochemical approach

Bo Wang\textsuperscript{1}, Dunsheng Xia\textsuperscript{2}, and Jia Jia\textsuperscript{1}

\textsuperscript{1}Zhejiang Normal University, College of Geography and Environmental Sciences, China (bowang@zjnu.edu.cn)
\textsuperscript{2}Key Laboratory of Western China’s Environmental Systems (Ministry of Education), Lanzhou University

We studied the magnetic properties and trace element concentrations (Cr, Cu, Fe, Mn, Pb, Ti, V, Zn) of urban topsoils from 111 urban sites in a large REE-Nb-Fe mining and smelting city, Baotou, Inner Mongolia, China. The results show that pseudo-single domain and multi-domain magnetite dominates the magnetic properties of the soil samples, and the magnetic concentration parameters show a large positive anomaly near the Baotou iron and steel works. The average contents of all trace metals exceeded their background level in soils in Inner Mongolia, except for Pb. The spatial distribution and correlation analysis show that magnetic parameters related to the magnetite concentration and Cr, Fe, Mn, Ti, V and Zn show similar trends of variation. In addition, the results of PCA show that Fe, Ti, and V are highly correlated with the magnetic particles derived from the Baotou iron and steel works, tailing dam, chromium plant, and cement plant. In contrast, Cr, Mn, Pb and Zn are derived from both the steel plant and traffic pollution. Using a PMF model, three potential pollution sources are identified: industrial pollution, including the steel works, tailing dam, cement plant and chromium plant, are reflected by $\chi_{\text{fA}}$, $\chi_{\text{ARM}}$, SIRM and SOFT, and they account for 71.2%; traffic pollution is reflected by Pb and Zn and accounts for 9.0%; and natural sources, reflected by $\chi_{\text{fd}}$, $\chi_{\text{ARM}}/\chi$, $\chi_{\text{ARM}}$/SIRM, HARD\%, $S_{\text{300}}$, $S_{\text{100}}$ and Ti, contribute 19.8%. The results are potentially useful for developing control measures for reducing trace metal contamination in soils in Baotou city, and in addition we conclude that a combined magnetic approach and geochemical approach is an effective means for qualitative and quantitative sources apportionment of urban surface soil pollution.