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Stepwise magnetic-geochemical approach for efficient assessment of heavy metal polluted sites

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Previous studies have shown that magnetometry can outline the distribution of fly ash deposition in the surroundings of coal-burning power plants and steel industries. Especially the easy-to-measure magnetic susceptibility (MS) is capable to act as a proxy for heavy metal (HM) pollution caused by such kind of point source pollution. Here we present a demonstration project around the coal-burning power plant complex "Schwarze Pumpe" in eastern Germany. Before reunification of West and East Germany huge amounts of HM pollutants were emitted from the "Schwarze Pumpe" into the environment by both fly ash emission and dumped clinker. The project has been conducted as part of the TASK Centre of Competence <http://www.task.ufz.de/index.php?en=17107> which aims at bringing new innovative techniques closer to the market. Our project combines in situ and laboratory MS measurements and HM analyses in order to demonstrate the efficiency of a stepwise approach for site assessment of HM pollution around point sources of fly-ash emission and deposition into soil. The following scenario is played through: We assume that the "true" spatial distribution of HM pollution (given by the pollution load index PLI comprising Fe, Zn, Pb, and Cu) is represented by our entire set of 85 measured samples (XRF analyses) from forest sites around the "Schwarze Pumpe". Surface MS data (collected with a Bartington MS2D) and in situ vertical MS sections (logged by an SM400 instrument) are used to determine a qualitative overview of potentially higher and lower polluted areas. A suite of spatial HM distribution maps obtained by random selections of 30 out of the 85 analysed sites is compared to the HM map obtained from a targeted 30-sites-selection based on pre-information from the MS results. The PLI distribution map obtained from the targeted 30-sites-selection shows all essential details of the "true" pollution map, while the different random 30-sites-selections miss important features. This comparison shows that, for the same cost investment, a stepwise combined magnetic-geochemical site assessment leads to a clearly more significant characterization of soil pollution than by a common approach with exclusively random sampling for geochemical analysis, or alternatively to an equal quality result for lower costs.