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Using magnetic susceptibility to determin the extent of anthropogenic versus geogenic contamination of heavy metals in soil adjacent to a steel plant

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Nickel and Chromium, depending on their chemical speciation can be is dangerous for human health. They may be deposited anthropogenically or may already be present in the soil geogenically. To distinguish between geogenic or anthropogenic cause of accumulation of these heavy metals, soil taken from the locality Judaskreuzsiedlung, an area adjacent to a steel plant (Donawitz, Leoben, Austria ca. 1 km away from the plant) are studied. Magnetic separation showed that top soil (0-10 cm) in this region contains up to more than 20% magnetic particles mainly of spherical shape (seen under Electron Microprobe Analyzer). These spherical shaped magnetic particles are identified as magnetite (Fe3O4) when analyzed by Multi-Function Kappabriddge for Curie point measurement. The source of these particles can be traced to the steel plant. Moreover calcium, silicon, manganese are found attached to these spherical magnetite. Magnetic susceptibility values of separated (magnetic and non magnetic) fractions and un-separated samples were measured and their chemical analysis was done by XRF and ICP-MS. Correlation between magnetic susceptibility values and concentration of heavy metals demonstrate the idea that magnetite particles are also the carrier of nickel, chromium and other heavy metals. Studies of uncontaminated soils in the region may allow to find criteria to distinguish between anthropogenic or geogenic source of contamination in the area.
Applying means of inexpensive magnetic susceptibility field instruments allow to map contaminated areas in a fast and cost effective manner suitable for developing countries.