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Magnetic properties of soils from sites with different geological and environmental settings

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Abstract

Measurements of magnetic susceptibility of soils, reflecting magnetic enhancement of topsoils due to atmospherically deposited magnetic particles of industrial origin, are used recently in studies dealing with outlining polluted areas, as well as with approximate determination of soil contamination with heavy metals. One of the natural limitations of this method is magnetic enhancement of soils caused by weathering magnetically rich parent rock material. In this study we compare magnetic properties of soils from regions with different geological and environmental settings. Four areas in the Czech Republic and Austria were investigated, representing both magnetically rich and poor geology, as well as point-like and diffuse pollution sources. Topsoil and subsoil samples were investigated and the effect of geology and pollution was examined. Magnetic data including mass and volume magnetic susceptibility, frequency-dependent susceptibility, and main magnetic characteristics such as coercivity (Hc and Hcr) and magnetization (Ms and Mrs) parameters are compared with heavy metal contents. The aim of the paper is to assess the applicability of soil magnetometry under different geological-environmental conditions in terms of magnetic discrimination of dominant lithogenic/anthropogenic contributions to soil magnetic signature. Our results suggest that lithology represents the primary effect on soil magnetic properties. However, in case of significant atmospheric deposition of anthropogenic particles, this contribution can be clearly recognized, independent of the type of pollution source (point-like or diffuse), and discriminated from the lithogenic one. Different soil types apparently play no role. Possible effects of climate were not investigated in this study.

Keywords: Magnetic susceptibility; Heavy metals; Soils; Pollution; Atmospheric deposition; Lithology

1. Introduction

The need for fast and cheap screening and monitoring tools of industrial pollution caused that increased number of studies deal with magnetic methods as an approximate tool to detect and characterise environmental pollution (e.g., Dearing et al., 1996; Kapička et al., 1999, 2001a,b, 2003; Petrovský and Ellwood, 1999; Hoffmann et al., 1999a,b; Magiera and Strzyszcz, 2000; Petrovský et al., 2000; Hanesch and Scholger, 2002; Schibler et al., 2002; Veneva et al., 2004, and others). Measurements of magnetic susceptibility of soils proved to be suitable, under certain circumstances,

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