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Magnetic susceptibility mapping of roadside pollution

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Abstract

The aims of our study are to trace the distribution and concentration of contaminants in soils along roads and highways carrying appreciable traffic by using magnetic proxies. In addition, the concentration gradients and possible accumulation of pollutants in deeper soil layers are investigated. Magnetic susceptibility is used for pollution mapping in the field (Bartington bridge). The distribution of the susceptibility values represents polluted areas strongly influenced by traffic frequency, roadside topography, meteorological conditions (e.g., wind direction) and other factors. A magnetite-like phase was found to be responsible for the enhancement of the magnetic signal in the roadside soil.

Keywords: environmental magnetism; magnetic proxies; magnetic screening; pollution of roadside soils; emissions of vehicles; magnetism of soils

1. Introduction

Pollution of soils and sediments is significantly reducing environmental quality and affecting human health. As a condition for effective protection and remediation actions, the screening and detection of soil and sediment pollution has become increasingly important. The pollutants of most concern are heavy metals and organic contaminants (such as PAH and PCB).

Magnetic techniques were shown to be highly useful in investigating industrial pollutants and other atmospheric aerosols. The intention of magnetic studies of aerosols has been the discrimination of fly-ash from other aerosols, based on the characteristic magnetic properties of anthropogenic dusts. Recent studies (Strzyszcz, 1993; Strzyszcz and Magiera, 1998; Petrovsky et al., 1999) demonstrate how a combination of simple magnetic susceptibility measurements can help to identify regions where soils contain higher than average concentrations of fly-ash and other anthropogenic dusts. In addition to fly-ash, there are numerous other atmospheric pollutants such as vehicle and aircraft emissions or dust from cement production, open pit mining and steel production. Vehicle emissions have been suggested to be a significant source of magnetic pollutants (Hunt, 1986). However, details about the origin and the composition of these particles are presently unknown.

Preliminary studies indicate a possible correlation between magnetic susceptibility measurements and mutogenetic characteristics of atmospheric contaminants (Morris et al., 1995). Particles below the PM10 limit (10 μm) can significantly affect human health as they can easily be transported into deeper parts of

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