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Rapid Communication

Environmental Geochemistry in Soil Exploration

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Soil contamination by Potentially Toxic Elements (PTEs) is one of the most recognized forms of environmental pollution and its persistence depends on both natural pedo-geochemical background and anthropogenic activities [1-4]. It is an undesirable change in the physical, chemical, or biological characteristics of soil, which can harmfully affect health, survival or activities of humans or other living organisms.

The content, the distribution and the behaviour of the chemical elements (both major and trace) in soil depend mainly on factors related to the mineralogical and geochemical features of the bedrock [5,6] the development and intensity of weathering and soil formation processes (physical, chemical and biological). Among them, the mineralogy is the predominant factor controlling the mobility of major and trace elements. Ultrabasic and basic rocks, which solidified first from the molten magma, incorporated bio-essential trace elements such as Co, Ni, Zn and Cr by isomorphous replacement of Fe and Mg in ferromagnesian minerals, while acidic rocks, the last to solidify, tended to be richer in other elements such as Ba and Pb [7]. Moreover, the weathering process contributes to redistribution of trace elements in soil. The weathering reactions vary widely and are controlled by many variables such as parent-rock type, topography, climate and biological activity; they are irreversible because they take place primarily as a result of disequilibria between the rocks and their current physico-chemical conditions. The mobilization and redistribution of trace elements during weathering are particularly complicated because these elements are affected by various processes such as dissolution of primary minerals, formation of secondary phases, redox processes, and transport of material, co precipitation and ion exchange on various minerals [8,9].

On the other hand, the occurrence of the soil pollution phenomenon is also correlated, anthropogenically, with the degree of industrializations, intensity of chemicals usage, mining, smelting procedures and agriculture [10]. In addition, soil is the “recipient” of large amounts of PTEs from vehicle emissions. Several studies on the pollution in soil along highways indicate that the roadside soils are mainly polluted by lead, zinc and copper [11].

The concern over soil contamination stems primarily from health risks, from direct contact with the contaminated soil. In urban areas, dust from the soil may have toxic effects because of inhalation or ingestion by humans, particularly children, which poses major health, hazards [12]. There is a very large set of health consequences from exposure to soil contamination depending on pollutant type, pathway of attack and vulnerability of the exposed population. PTEs are either beneficial or detrimental to plants and animals. For essential micronutrients such as zinc, manganese, copper and nickel, insufficient uptake leads to deficiency-related health problems while excess uptake could cause toxicity. Roles of some other PTEs such as cobalt, vanadium, chromium, cadmium and lead are more complicated. At trace level, they may be beneficial to some species; nevertheless, they are generally considered toxic at larger concentrations and are carcinogenic to all populations but are especially hazardous to young children, in which group there is a high risk of developmental damage to the brain and nervous system [13].

In addition, soil contaminants can have significant deleterious consequences for ecosystems. As result of this soil pollution, a microbiological activity disturbance occurs, which is expressed by a significant depletion of bacteria.

Mapping the contaminated soils and the resulting clean-up are time consuming and expensive tasks, requiring extensive amounts not only of geology and geochemistry skills, but also of geostatistics. Soil quality data sets typically contain many variables measured at several spatially scattered locations. As the variables are generally correlated, it is natural to presume that they reflect some common underlying factors. The geological characteristics or the types of land use are possible factors that govern variations in soil chemical composition. Some of these factors are likely to have a long-range action whereas other ones operate at shorter spatial scales. As result, variables must be expected to correlate in a way that is scale dependent. The study of the scale-dependent correlation structure of the variables requires statistical methods that combine classical factor analysis and geostatistics: the first one provides tools for exploring the correlation structure of multivariate data sets whereas geostatistics allows one to take into account the regionalized nature of the variables [14,15].

Assessing the environmental geochemical conditions, deriving from natural and anthropogenic agents ratio in soils,and mapping the spatial distribution and the probability of exceeding given regulatory values for soil PTEs concentrations, by powerful geostatistical approaches, are the main results developing during geochemical soil surveys.Numerous cases of these outcomes,gotten in urban and peri-urban soils, are reported in [1,16-18] for a their detailed presentation,interested readers should refer to the texts.

These findings can be considered a useful contributionto identifying polluted areas and proposing remedial actionaimed at reducing health risk above all to people.

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