Accepted Manuscript

Soil contamination compositional index: A new approach to quantify contamination demonstrated by assessing compositional source patterns of potentially toxic elements in the Campania Region (Italy)

Attila Petrik, Matar Thiombane, Annamaria Lima, Stefano Albanese, Jamie T. Buscher, Benedetto De Vivo

PII: S0883-2927(18)30201-4

DOI: 10.1016/j.apgeochem.2018.07.014

Reference: AG 4132

To appear in: *Applied Geochemistry*

Received Date: 28 March 2018

Revised Date: 19 July 2018

Accepted Date: 21 July 2018

Please cite this article as: Petrik, A., Thiombane, M., Lima, A., Albanese, S., Buscher, J.T., De Vivo, B., Soil contamination compositional index: A new approach to quantify contamination demonstrated by assessing compositional source patterns of potentially toxic elements in the Campania Region (Italy), *Applied Geochemistry* (2018), doi: 10.1016/j.apgeochem.2018.07.014.

Soil Contamination Compositional Index: a new approach to quantify contamination demonstrated by assessing compositional source patterns of potentially toxic elements in the Campania Region (Italy)

Attila Petrik[1*], Matar Thiombane[1], Annamaria Lima[1], Stefano Albanese[1], Jamie T. Buscher[2,3], Benedetto De Vivo[4,5]

[1] Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università degli Studi di Napoli "Federico II", Complesso Universitario Monte S. Angelo, Via Cintia snc, 80126, Naples, Italy

[2]Andean Geothermal Center of Excellence (CEGA), Universidad de Chile, Plaza Ercilla 803, Santiago, Chile

[3]Department of Geology, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Plaza Ercilla 803, Santiago, Chile

[4]Pegaso University, Piazza Trieste e Trento 48, 80132 Napoli, Italy

[5]Benecon Scarl, Dipartimento Ambiente e Territorio, Via S. Maria di Costantinopoli 104, 80138 Napoli, Italy

*Corresponding author: Attila Petrik
Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università degli Studi di Napoli "Federico II", Complesso Universitario Monte S. Angelo, Via Cintia snc, 80126, Naples, Italy
Email: petrik.atus@gmail.com, Mobile: +36 20 459 8118

Abstract

Potentially toxic elements (PTEs) are a major worldwide threat to the environment due to the constant global increase in industrial activity and urbanisation. Several studies have provided detailed maps and a better understanding of the spatial distribution patterns of PTEs in different matrices, but the majority of these studies have simply neglected the compositional nature of geochemical data. The aims of this study are to reveal the compositional behaviour and relative structure of 15 PTEs (subcomposition) in Campania, one of the most contaminated regions in Italy, and to quantify the spatial abundance and identify the possible origins of these PTEs. Robust compositional biplots were used to understand the natural grouping and origin of the PTEs. Ratios of specific subcompositions (balances) of PTEs were calculated to map the spatial patterns and identify the spatial variability of the PTEs. This study presents the preliminary steps needed to quantify and analyse the relative difference in the spatial abundance of PTEs by applying a compositional abundance index. In addition, a new soil contamination compositional index (SCCI) was elaborated to quantify topsoil contamination by the 15 PTEs and related subgroups following the compositional structure of the geochemical data.

The elevated spatial abundance of the 15 PTEs is related to highly urbanised (Naples and Salerno), highly industrialised (Solofra) and intensely cultivated areas (Sarno River Basin), where the high dominance of elements from the anthropogenic subgroup (Pb, Sb, Sn and Zn) and high SCCI values suggest that contamination is from anthropogenic sources. The high spatial dominance of elements from the volcanic rock subgroup (As, Be, Se, Tl and V) in these same areas is likely related to geogenic sources, including alkalic pyroclastic rocks. Although the high spatial abundance of Group B elements (Cd, Cr, Co and Ni) is related to Terra Rossa soils and shaley facies of siliciclastic rocks of the southern Apennines, these same elements can also reach high abundances and reflect contamination (i.e. high SCCI values) from urbanised and industrialised areas due to e.g., tanneries and alloy production.

Other high spatial abundances of the 15 PTEs with little or no contamination (i.e. very low SCCI values) can be related to nearby carbonate massifs, where a mixture of geogenic factors including weathering, advanced pedogenic processes, adsorption and co-precipitation with Fe-/Mn-oxyhydroxides and the presence of pyroclastic material might all be responsible for an increase in abundance.