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Use of exploratory data analysis (EDA) for pedogeochemical mapping of Cr, Ni and Cu in soils of NE Spain

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The concentration and spatial distribution of potentially toxic elements (PTE) depends on parent materials, climate, soil types and different soil uses. The anthropogenic mismanagement of industrial and mining resources or abusive use of agrochemicals could alter the normal levels of PTE in soils and cause contamination. However, due to the large variability of th given factors it is important to be informed of the "local values" (background, baseline and threshold) of PTE and their distribution before discussing the possibility of contamination. The global generic reference values are often inadequate as the do not reflect the true local conditions.

The aim of this study is to estimate the levels and distribution of Cr, Ni, and Cu in the soils of NE Spain. The studied region has a surface area of 7731 Km 2. The geology is varied: granites and Palaeozoic shales predominate in SE-E. and Mesozoic and Cenozoic limestones, dolomites, marlstones, gypsum and sandstones in the remainder of the the studied area. 319 top soil samples (0-20 cm) were collected at 5 km intervals on a regular grid, dried and sieved (2 mm). General soil properties were analysed by standard methods. *Aqua Regia* digests (DIN 38414-S7) of Cr, Ni and Cu were determined by polyscan 61 E spectrometer (ICP. ES.

Statistical treatment of the data was carried out using SPSS 12.0 and Statgraphics Plus 5.1. Exploratory data analyses (EDA) was used to obtain box plot diagrams, his-

tograms and scatter grams of data sets that included the essential descriptive statistical parameters. We compared the behaviour of Cr, Ni and Cu in different data sub-sets (for altitude, geographical districts, soil particle size distributions, parent materials, pH, organic carbon, etc. The ESRI Arc view 9.0 desktop was used for colour mapping (1:700.000 scale). The classes chosen to represent the data were percentiles (5^{th}, $25^{th,}$ 50th, 75^{th}, 90^{th}, 98^{th}) except for pH and the textural classes. We also established maps of the "limiting values", with regulatory classes, including the new C level (intervention value, Dutch Soil Protection Act 1993).

Some results are: Cr mg/kg min 2.5, max 250.1 med 21.8, MAD 4.8, 98^{th} 55.5 lowest med.14.6 (sandy), highest med. 27.8 (clayey).

Ni mg/kg min 2.3, max 186.6 med. 19.4, MAD 5.6, 98^{th} 49.5, lowest med. 7.9 (sandy), highest med. 22.9 (clayey).

Cu mg/kg min 2.5, max 1153 med 16.7, MAD 6.7, 98^{th} 172.3 , lowest med 14.1 (sandy) highest med 18.4 (coarse silty)

Ni , Cr and Cu versus pH reaches the max conc. at pH 5-5.5. And versus lithology the minimum value was found in granite bedrock. Lowest metal values are observed at the highest altitudes. Highest conc. of Cu and Cr are appreciated in the Barcelona area and Ni in Bages district

The combination of EDA and pedogeochemical mapping is a useful tool for estimating baselines, thresholds and standards of PTE essential in environmental regulation