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Separating Natural from Anthropogenic Trace Element Patterns in Soils of Lefkosia (Nicosia) Cyprus

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Rapid urbanisation worldwide increases the importance of assessing potential detrimental effects of urban pollution on human health. Following release of the soil geochemical atlas of Cyprus [1,2,3] a more detailed follow-up survey has been undertaken in Lefkosia (Nicosia) to examine the relationship between soil parent material, landuse and geochemistry. The eastern side of the city is dominated by units of the Apalos and Nicosia formations and the western side by alluvium and fanglomerates. Though most of the soils have developed on calcareous parent rock or alluvium, there are zones containing material derived from the mafic-ultramafic Troodos Ophiolite to the south of the city. The southern part of Lefkosia is mainly used for agriculture with some residential areas, whereas the central part (which encloses the inner wall old city of Lefkosia) has a more complex history of landuse, going back millennia, that now largely contains commercial and residential areas. There are pockets of light industry. Soils were collected from 10-20 cm depth as composites from 4 sites within a 5m radius on a notional 250m grid across the city and analysed by ICP-MS on an aqua regia digest (*ar-*) and field-portable XRF (*tot-*). Road dust samples were also collected along a number of major and minor roads. Mineralogy of some samples was done by portable XRD.

The distribution of most elements is controlled by parent material for the soil with *tot*-Cr is generally elevated over the Apalos and Nicosia formations, whereas more mobile mafic-related elements such as *tot*-Cu, *ar*-Cu, *ar*-Co and *ar*-Mn are more elevated in the alluvial areas. Other elements display significant anthropogenic controls, with *ar*-Cd and *ar*-Zn elevated in the vicinity of industrial areas. Elevated values for *tot*-Sn and especially *ar*-Sn, *ar*-Sb and the *ar*-Pb/*tot*-Pb ratio are clustered around the old city on the northern side of the existing urban area. Some element patterns indicate the presence of exotic soils at certain cite types. Irrespective of location, most school sites contain soils whose geochemical signatures mirror those of basaltic soils observed from the national soil geochemical survey [3]. Childrens' playgrounds can be subdivided into two groups. The first (Playground 1) generally has geochemical patterns that reflect the carbonate-dominated soils of the deep marine Pakhna or Lefkara formations to the south, except for *tot*-As and *ar*-As that are significantly (but not dangerously) elevated (12 – 40 ppm) (Fig. 1), whereas the second type (Playground 2) generally has low trace element concentrations but is otherwise similar to the average calcic soils in the area.

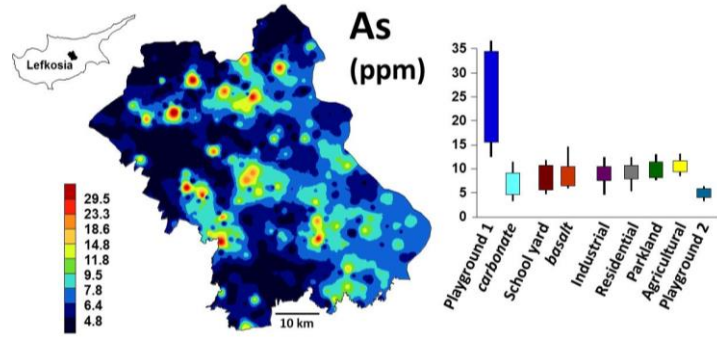


Figure 1: Spatial distribution of As in topsoil of Lefkosia and within various land use and soil types.

References:

- [1] Cohen et al. (2012) Sci Tot Environ 420:250–262.
- [2] Zissimos et al. (2014) J. Geochem. Explor. 146:1–8.
- [3] Cohen et al. (2012) Geochem: Explor. Environ. Anal 12:349–360.

