

NORMALISATION METHOD FOR EVALUATION OF METAL CONTAMINATION OF SOIL

József PROKISCH* - Ildikó SZEGVÁRI - Éva SZÉLES - Béla KOVÁCS - Zoltán GYÖRI

* University of Debrecen, Centre of Agricultural Sciences, Department of Food Science 4032 Debrecen Böszörményi út 138. Hungary

Introduction

The yttrium normalisation method is a good tool for detection of chromium contamination in soil samples (Prokisch *et al.* 2000). It gives a chance to detect 5-10 times less anthropogenic chromium contamination in soil than any of the other traditional evaluation method. The principle of the normalization is the following: elements such as chromium, aluminum and yttrium exist naturally in the soil in a strongly bonded form. In a 5-9 pH range there is no leaching of these metals in the soil profile and surface. The obtained in homogeneity of these elements originates from the resuspension and migration of the small soil particles. These metals remain in the solid phase. Therefore, in a non contaminated area there is close correlation among the concentration of these elements. If the measured Cr concentration in a sample is not on the Cr-Al trend line then the distance of plotted point from the line indicates the amount of anthropogenic chromium.

The aim of this study was to test the method for chromium and other elements (nickel, copper) on a land scale and a country scale resolution by the evaluation a huge dataset what was created in the laboratory in the last years.

Data were used for the calculations has two origin. The first soil sample set (*land scale*) were taken from a 40 ha arable land applying a 50 m grid scale. The origin of the other sample set (*country scale*) was the soil samples of Soil Information and Monitoring System (TIM), what is an independent subsystem of the integrated Environmental Information and Monitoring System (KIM) (Várallyay 1995) in Hungary.

Methods

Soil samples were prepared and measured in the laboratory of department. The determination of so called "total" concentration of elements was carried out according to the procedures of Hungarian Standard 21470-50:1998. In this method the soil is extracted by concentrated HNO_3 and H_2O_2 and measured using a Perkin Elmer Optima DV 3300 model of an inductive coupled plasma optical emission spectrometer (ICP-OES).

The *small scale* samples were taken in a 50 m resolution grid of a 40 ha area near Nádudvar, Hungary (GPS: 47°26'42.49" N, 21°13'30.33" E - 47°26'23.90" N, 21°14'01.77" E). The number of samples was 166.

The *country scale* TIM samples were taken based on physiographical-soil-ecological units 1200 "representative" observation points all over Hungary were selected (and exactly defined by geographical coordinates using GPS): 800 points on agricultural land, 200 points in forests and 200 points in environmentally threatened "hot spot" regions (representing 12 different types of environmental hazards or particularly sensitive areas, such as: degraded soils; ameliorated soils; drinking water supply areas; watersheds of important lakes and reservoirs; protected areas with particularly sensitive ecosystems; "hot spots" of industrial, agricultural, urban and transport pollution; military fields; areas affected by (surface) mining; waste (water) disposal affected spots.

Results and discussion

While applying the methods we assumed that the majority of the studied samples is not contaminated with chromium and that the element content of the samples is of geogenic origin. Figure 1. shows the connection between the concentrations of aluminium-chromium from the soils of the studied regions in the differential scale of sampling.

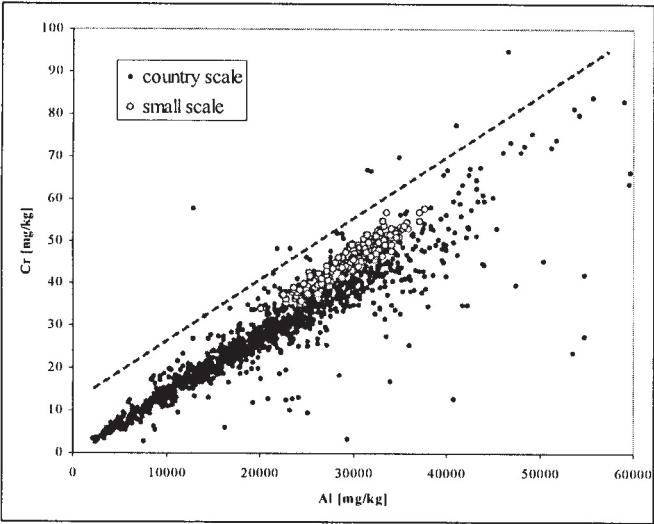


Figure 1: Correlations between the aluminium-chromium concentration of soils in small scale and country scale resolution

The correlation among the concentration data the aluminium and copper and nickel are presented on the Figure 2-3.

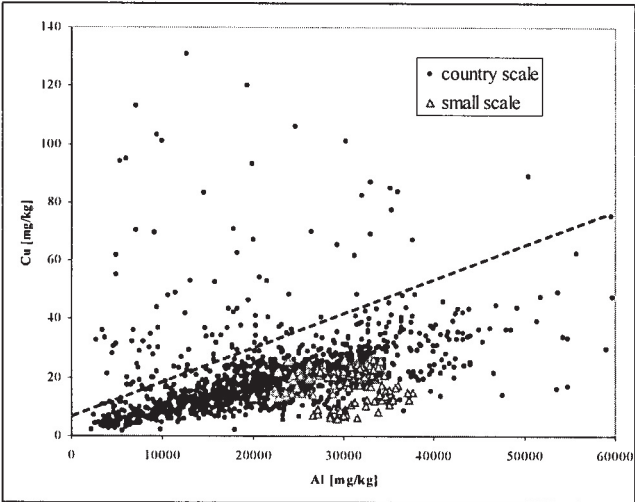


Figure 2: Correlations between the aluminium-copper concentration of soils in small scale and country scale resolution

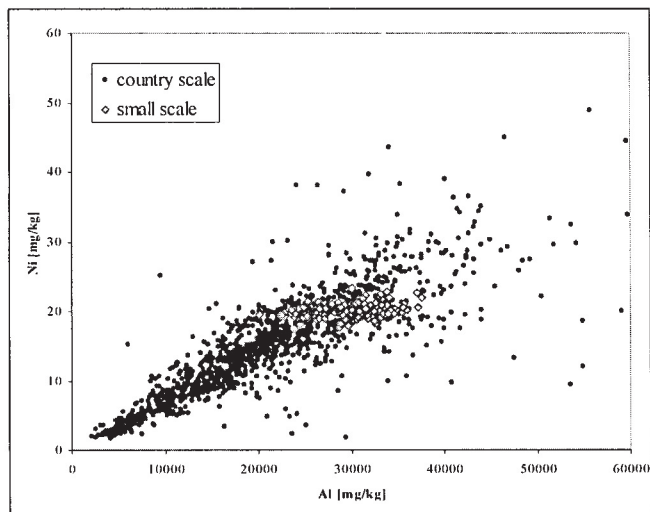


Figure 3: Correlations between the aluminium-nickel concentration of soils in small scale and country scale resolution

The geogenic chromium concentration of the studied soils can be calculated easily from the aluminium concentrations, which were established by measuring the equations of the fitted curves. Applying the method the contaminated soils (which are above the dotted line) were easy to separate. Anthropogenic chromium was detected only eight sampling site of the entire TIM database. The source of contamination was identified after the measurements for all the sampling site.

For copper and nickel the method works with higher uncertainty. The country scale sampling gives a chance for the determination of acceptable trend line for the non contaminated soils for the whole country. In the case of copper the country scale measurement shows elevated anthropogenic copper concentration at numerous site. It is fit to the expectations because of the usage of copper sulphate insecticide.

Conclusions

Normalization method applicable for determination of anthropogenic origin of some metals. The method can detect higher than 5 mg/kg anthropogenic chromium and 10-15 mg/kg copper or nickel. The permitted total concentration of these elements is about 100 mg/kg, the natural backgrounds are in the range of 5-80 for chromium and 2-40 for copper and nickel. The method can be used for identification the metal contamination of soils at an early stage and gives an opportunity for the controlling of that activity which can cause a long term effect on the soil.

Acknowledgement

This work was supported by Bolyai János Scholarship, OTKA T038450 and T042534.

References

- Prokisch J., Kovács B., Palencsár A., Szegvári I., Győri Z. (2000) Yttrium normalisation: A new tool for detection of chromium contamination in soil samples *Environmental Geochemistry And Health* 2000, 22(4), pp 317-323
- Várallyai Gy. (1995) Módszertan. Talajvédelmi Információs és Monitoring Rendszer 1. (Methodology: Soil Information and Monitoring System 1.) Ministry of Agriculture, Budapest, 4-91.
- Kádár, I. (2004): Szennyvíziszap-adagok hatása a növény (*Triticum vulgare* L.)-talaj rendszer néhány mikrobiológiai és biokémiai tulajdonságára (Impact of sludge treatments on some microbiological and biochemical properties of plant (*Triticum vulgare* L.)-soil system. – in *Hungarian*). *Agrokémia és Talajtan*. 53. 3-4. 331-342 pp
- Svetková, K.; Henselová, M.; Morvová, M. (2005): Effects of a carbonization product as additive on the germination, growth and yield parameters of agricultural crops. *Acta Agron. Hun.* 53. (3). 241-250 pp
- Tanács, L., Matuz, J., Gerő, L., Petróczi, I.M. (2005): Effect of NPK Fertilizers and Fungicides on the Quality of Bread Wheat in Different Years. *Cereal Res. Commun.* 33 (2-3): 627-634 pp