EXAMINATION OF SOIL SAMPLES USING X-RAY METHODS

ABSTRACT

X-ray fluorescence spectrometric method was developed for analysis of the trace elements in different soils. The method was sucessfully applied for the determination of the distributions of Cr, V, Ni, Co, Cu, Zn, Sr, Ba, Rb, Cs, Zr, Y, La, Ce, Pr, Nd and Th (trace elements) in three types of soils. After an appropriate sample preparation soils were fractionated into 8 particle size ranges using sieves with meshes between 800 and 5 µm. Mineralogical phase analysis was carried out by X-ray powder diffraction (XRD). Despite their variability, particle size distributions of different soils showed some general features. Fractions of <5 µm and 20-45 µm were commonly the most abundant. Trace elements were mainly achieved int he three types of associations: (a) adsorbed onto mineral surfaces, (b) in crystallographic positions within minerals (e.g. Zr in zircon), and (c) bound to clay minerals.

THESIS

1. It was found that
   - smectite was riched in the smallest (>5 µm) particle size fraction and,
   - quartz was riched in the largest particle size region (between 315 and 800 µm) and,
   - the change of pH was the reason of the aggragation of carbonates in the deepest layer.

2. It was proved that a very close correlation exists between the main components (Mg, Al, K, Ca, Ti, P, S) and either Fe or Mn. In case of either chernozem or sand soil the correlation coefficients were decreased with the depth.

3. A closer correlation was found between the trace elements and Fe was closer than that of with Mn. In chernozem soil Fe was found to be less active than incase of other soils, due to the amount of carbonates. The presence of clay minerals helps the adsorption of trace elements.

4. Among the first group elements of sand soil Cr, Y, La, and V are pegmatofil, Co is siderofil, Ba and Cs are litofil. There are no correlation among these elements due to the sizes of their ions.. Riching of these elements in the large particle size region is only a virtual riching caused by either the decreasing of Ti or their adsorption on minerals containing very small amount of Ti accuring in the large particle size region.

5. It was confirmed that Ba and Cs belongs to the same group independent from the type of soils. A high correlation exists between K and either Ba or Cs. Theirconcentrations are higher in the deeper soil layer and in the large particle size fraction, due to the presence of feldspar.

6. It was proved that the riching and geochemical behaviour of Cu and Zn are very similar and not depends on the type of soil. These elements can be found in silicates, replacing Mg in the crystal lattice. Distribution of their concentrations are similar, their correlation coefficients are about ~0,8.

7. It was proved that the riching and geochemical behaviour of Cr and V are very similar and not depends on the type of soil. Both of them is able to replace Al in the lattice of the clay minerals. Their correlation coefficients are about ~0.98.

8. It was found that the distribution of concentration of some trace elements not belonging to any minerals differ from the other trace elements. They exist in separate, isolated phases, and cannot be detected by XRD method (e.g xenotim, monacit, zircon).