

Analysis and Comparison of Soil Phases in Forensic Practice

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In forensic practice, we often encounter requirements for analyzing soil relics - from contamination on clothing, footwear, human body, vehicle, tools, etc. Basically, these are two basic types of tasks. It can be a comparison of these traces with comparative samples of the soil from the places where these traces could arise or a more complicated task - the forecasting of the unknown place where the contamination by soil may have occurred. In both cases, this is a complex study where natural mineral phases as well as biological relics and anthropogenic contamination are analyzed.

Basic techniques are optical light microscopy in transmitted and reflected light, polarization, fluorescence, next are utilised SEM/EDS (WDS), XRF, mXRF, FTIR, Raman spectroscopy, etc. For the clay fraction, but also for other phases, the x-ray diffraction is imperative with applying conventional powder diffraction in transmission and reflected modes, scanning in a rotating capillary, and also micro x-ray diffraction, which allows to obtain a relevant structural record from the diameter around 0,1mm.

Technique of cathode luminescence (CL) capable of distinguishing material based on its genesis, thus usually also according to a different place of occurrence, were introduced to differentiate mineralogical phases of practically identical chemical composition, optical characteristics, structure and similar inclusions.

Most of the analytical techniques described above provide qualitative data for the comparison of samples. One of the options that quantitatively quantifies soil data is the systems of automatic analysis of mineral grains (based on SEM / EDS). These systems have been available on the market for several years, but so far, samples of mineral grains obtained from soil traces have always been prepared into embedded resin and then have been cut into polished section forms. Only then were samples analysed in systems of automatic mineralogical analysis. Our laboratory for the first time, in cooperation with the manufacturer of these facilities, has carried out a number of detailed experiments with the analysis of samples prepared directly from mineral grains from the soil trace. Experiments were performed first with model samples prepared from known mineral phases and then with samples from conventional soils. In the final stage, several series of random samples were taken from different locations and the ability to detect differences between the different sampling points was tested. It was found that the differences were traceable even between sampling points that were less than 20 meters apart. The sample area, which, due to the topographic surface of the mineral grains, can not be classified, is around 10%, which is acceptable when comparing the samples.

This technique, of course, is not self-sustaining, but complements the complex analysis of the soil phases. The use of new techniques significantly enhances the possibilities of classical microscopic techniques in the forensic area and enables us to obtain the necessary quantitative data in forensic analysis of soil phases, differentiation of analogous mineral phases, or the possibility of analyzing the organic phase directly in the SEM chamber (by micro Raman).

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