GEOCHEMICAL BASELINE CONDITIONS AND THE REUSE OF INDUSTRIAL BY-PRODUCTS

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In 1995–1996 a German working group compiled analytical data on heavy metal contents in soils, rocks and groundwater throughout the country. Geochemical data were included in the survey only if complete title data were known and the total contents of heavy metals had been analyzed (X-ray fluorescence for soils and rocks). By the end of 1996 about 17 000 analyses of up to 40 elements had been gathered for soils, 6827 for rocks and 9050 for groundwater. This database certainly was sufficient for a statistical evaluation, but the data were unevenly representative for assessments on the local scale. The main objectives of our effort were: to specify baseline conditions for an assessment of changes in the environment, to study transport pathways of heavy metals in the system soil–rock–groundwater, solubility and mobilization of heavy metals, to identify areas with high natural background values, to provide baseline information for law-makers, to improve our understanding of evolution of ecosystems and supply the public with information on ecosystem health status.

In the last years a number of mobilization tests using water, acid and basic solutions have been carried out in collaboration with the Federal Institute for Geosciences and Raw Materials in Hannover. The methods used included conventional soil tests (NH_4NO_3, $CaCl_2$, EDTA, DTPA), tests on usable and unusable waste (DEV-S-4, pH-stat., through, percolation) and various sequential extractions. For these tests a wide range of materials was used: soils, rocks and industrial by-products. We found that mobilization of heavy metals did not depend on the total content of these metals in the material and there was little correlation between mobilization rates and grain size distribution. Strong correlation was found between metal mobilization rates and mineralogical composition (material matrices, coatings, etc.)

In October 1996 a new law was adopted in Germany dealing with conditions of using by-products and waste as substitutes for natural raw materials (“Kreislaufwirtschafts- und Abfallgesetz”). On its basis, conditions for reuse and recycling techniques should be improved. Industrial by-products with (geo)chemical composition suitable for reuse as a substitute raw material are often produced in large amounts. Specifically, these are: excavated soil, building rubble, blast-furnace, steel-making and desulphurization slags, hard coal and lignite fly ashes and coarse ashes, flue gas desulphurization gypsum, and spray dry and dry additive absorption residues.

Two different types of reuse have to be considered: The first type of reuse is related to methods of thermally induced conversion of the mineral phase composition (e.g., cement production with blast furnace slag as a substitute, brick and tile industry using excavated harbour sludges, foam glass production for insulation purposes using waste glass). It can often be shown by geochemical and mineralogical analysis that the amount of released metals exceeds acceptable levels neither during production nor later. More controversial is the second type of reuse of by-products as landfill, backfill and road building materials. The main problem is the great variety of influences on the mobilization of metals from the soil (e.g., presence of organic phases, chemical conditions).

At present the rather complicated guidelines hinder reuse of industrial products. Introduction of a new soil protection bill in 1997 will worsen this problem. Many tests, however, have shown that even natural soil and rock samples often exceed the proposed and existing limits. Arguments based on geochemical and mineralogical investigations may be the only way to change the current situation.