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Regional Geochemistry - an Introduction

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Building on the pioneering ideas and work of V. Vernadsky (1883-1945) and V.M. Goldschmidt (1888-1947) the Geological Surveys of Europe have more than 60 years experience with geochemical mapping at a large variety of scales. Surveys using hundreds of samples per km2 for mineral exploration projects, 1 to 4 sites per km2 for mapping the urban environment, 1 site per 2 to 10 km2 in county or country-wide mapping projects to 1 site per 1000 to 5000 km2 for mapping at the continental scale have been successfully completed. Sample materials for these surveys include groundwater, surface water, stream sediments, floodplain sediments, different soil horizons (preferably soil O, A, B and C horizon) and plant materials from moss to trees. Surveys combining several sample materials from local to sub-continental scale in multi-media, multi-element geochemical investigations reflecting the interplay of chemical elements between the different compartments (lithosphere, pedosphere, biosphere and hydrosphere) of the ecosystem have also been carried out.
These surveys provide ample empirical evidence that different geochemical processes become visible at different scales. Not all sample materials are suitable for all scales. A variety of scales in combination with a variety of different sample materials are needed to fully understand geochemical processes in the critical zone.
Examples are shown that highlight the importance of a strategy to optimize sampling density and design for the chosen scale already during the planning stages of a project. Anthropogenic element sources are visible at a local scale and the major impact of geology, mineralogy and climate (as a driving force for weathering) dominates geochemical maps at the continental scale. Interestingly, mineralisation can generate features which are visible at a variety of scales.
Some further issues that need attention when carrying out geochemical surveys at a variety of scales are (a) the need for an excellent and well documented analytical quality control, (b) the choice of the elements to be analysed (as many as possible) (c) the required detection limits (the lowest possible) and (d) the choice of extraction (several if feasible).