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GEMAS: mapping soil properties and metal concentrations in agricultural and grazing land soil at the European scale

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Geochemical Mapping of Agricultural Soils (GEMAS) is a cooperative project between the Geochemistry Expert Group of EuroGeoSurveys (EGS) and Eurometaux. During 2008 more than 4000 samples of agricultural (0-20cm) and grazing land (0-10cm) soils were collected at a density of 1 site/2500 km^2 each from Western Europe. The sample density is based on previous experiences of the Geological Surveys with comparable projects. All samples were analyzed for 52 chemical elements after aqua regia extraction, 41 elements by XRF, and soil properties like CEC, TOC, pH (CaCl2) following tight external quality control procedures. The GEMAS project thus provides for the first time fully harmonized data for element concentrations and soil properties known to influence the bioavailability and toxicity of the elements at the continental (western European) scale.

For many elements (e.g., As, Bi, Co, Cu, Li, Mn, Pb) observed concentrations in North-Eastern Europe are by up to a factor of 3 lower than in South-Western Europe. The break in concentration occurs along the maximum extent of the last ice age and is thus directly related to soil parent material. Areas with increased metal concentrations can be clearly identified and are most often associated with known mining areas. Some major cities (e.g., London, Paris) are marked by local anomalies of elements like Hg and Pb, typically linked to anthropogenic activities. Element concentrations decline rapidly towards the surrounding background with distance to any one source. For several elements (e.g. Hg, P, Pb, S, Se) the regional distribution patterns are strongly affected by climatic conditions favouring the development of organic soils. In all maps the effect of diffuse contamination remains invisible at the chosen continental scale and sample density. To reliably detect contamination, mapping at a much higher sample density - i.e. at the local scale - would be needed. Agricultural and grazing land soils show practically the same distribution patterns over Europe and very comparable element concentrations. This demonstrates the robustness of the low density mapping approach.

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