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Evaluation of geochemical determinism of trace metals in forest soils at regional scales. Lessons from the Permanent Forest Inventory in southern Belgium.

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The natural concentration of some elements in soil varies regionally according to lithology and locally with site-specific soil forming conditions such as relief or vegetation characteristics. Knowledge of the natural total concentrations of trace metals is now considered as prerequisite for the detection and assesment of anthropogenic contaminations.

The Permanent Forest Inventory is a programme financed by the Ministry of the Walloon Region which aims at assessing and monitoring the forest condition in Southern Belgium. A part of this programme is dedicated to the implementation of a soil quality monitoring network. The observation plots are located at the intersection of a regular grid. Ten percent of the forest plots are planned to be sampled each year, which theorically supposes a time-frequency of 10 years for the monitoring considerations. Up to now, three field campaigns have been completed and 245 soil samples analyzed.

Once a plot precisely located on the field, soil is sampled by mixing twenty 20cm-deep cores taken at the perimeter of a 10m large circle. Environmental observations complete the field work. These concern the physical environment, the soil morphology and the vegetation characteristics. The following parameters are measured in the laboratory: total organic carbon, total nitrogen, pH_{water}, pH_{KCl}, exchangeable acidity and aluminium, cationic exchangeable capacity, NH_4Cl-exctractible cations, total, mineral, and exchangeable P, and *aqua-regia* extractible concentrations of Ca, Mg, K, Al, Fe, Cr, Ni, Mn, Zn, Cu, Pb, Co, and Cd. Statistical analysis were then performed on the results in order to identify the driving factors of the soil properties, especially the

geochemical determinism. Relationships between parameters and between parameters and field observations were thus investigated. Then the relevance of some classifications to differenciate the soil properties was evaluated and finally the spatial structure of the parameters was compared to the geographical distribution patterns of lithology, soil associations, or ecological territories.

Although some diversity can be found among the soil series in this survey, soils developped from shales and/or sandstones are largely dominant. The first results therefore show a large extreme-based variability and moderate variation coefficients. The exchangeable cations and carbonate–sensitive parameters are the most variable. Frequency distributions are often largely skewed. Exchangeable cations appear to be more closely linked to acidity status than organic content while pseudo-total concentrations show rather good linear relationships between each other, to the exception of Pb and Cd. Both elements seem linked to specific lithologies, the presence of limestone for Pb, some clay-rich parent material or limestone for Cd. Among the soil characteristics, the nature and the abundance of the coarse fragments associated to the fine earth is the most differenciating criteria for pseudo-total content. Finally, there are clear convergences between spatial distributions of most of the elements and lithology or small natural regions.