

Chemical extraction of labile metal from soils: an isotopic investigation.

Metals in soil originate from parent material, and as a result of contamination. Soil metal is present in a variety of chemical forms but, it is the labile fraction that buffers the soil-solution metal concentration. The labile metal thereby controls both leaching in drainage water, and uptake by plants and other soil organisms.

The concentration of labile metal in soil is frequently estimated by various chemical extraction methods. These methods remain widely used due to their ease of application, even though they are operationally defined by experimental variables such as chemical extractant, concentration and extraction time.

More recently, isotopic dilution methods have been developed to measure labile metal. Typically, soil is suspended in a neutral salt solution, and spiked with an isotope of the metal of interest. This allows the isotopically exchangeable metal (E-value) to be quantified from changes in isotopic abundance in solution. Isotopic dilution therefore directly determines the fraction of soil metal that controls the soil-solution metal concentration over the timescale of the measurement. However, its use is limited by isotope availability and the need for specific analytical instruments.

If a chemical extraction method can successfully estimate E-value, then it will be a cheaper and less analytically demanding alternative to isotopic dilution.

In this study, E-values for Ni, Cu, Zn, Cd and Pb were measured in soils selected for their varied contamination histories. E-values were compared with metal concentration solubilised by four common extractants: 0.43 M nitric acid, 0.43 M acetic acid, 0.05 M EDTA and 1 M calcium chloride. In addition, the chemical extraction and isotopic dilution approaches were combined, to determine the isotopically exchangeable metal concentration in soils suspended in each extractant ($E\text{-value}_{\text{extractant}}$).

Our objective was to test for the presence of adsorbed isotopically exchangeable metal in the presence of each extractant, and to quantify the extent to which soil extractants solubilise otherwise non-labile metal.