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Selenium movement in soil columns and immobilisation as a function of aeration conditions

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Selenium (Se), an essential element, but also potentially toxic, is a sulfur analogue naturally present in soils with higher contents reported worldwide, associated to well-known pathologies, either naturally or of anthropogenic origins. One of its isotope, ^{79}Se, is an important component of long-lived radioactive waste, for which geological storage is currently assessed.

Selenite, the predominant species in the soil solution is weakly adsorbed onto soil constituents and is readily taken up and reduced by microorganisms under both aerobic and anaerobic conditions. The extent of immobilization of Se in soils under variable conditions of aeration, moisture and microbial activity is poorly understood undermining accurate predictions of Se mobility, necessary for risk assessment.

Our aim was to assess the vertical movement of Se in soil columns in relation to immobilization to the degree of anoxia in soils. Local anoxic conditions were favoured by initial addition of straw and the presence of a tomato plant. Throughout a three-month period, water potential and the composition of the soil atmosphere were monitored and in some cases volatilisation of methylated Se measured. At the end of this period, aggregates size distribution was calculated using image analysis and Se fractionation assessed using chemical extraction. The anoxic fraction was calculated as a function of time and depth from the aggregate size distribution, water content and respiration.

The total amount of Se lost by volatilization was small, 0.12% of the initial content. A small proportion of added Se moved up the column, with no marked influence of straw and plant growth, but no vertical movement of native Se was detected. With depth, as the anoxic fraction increased, water extractable Se decreased and non extractable Se increased.