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OCCURRENCE AND STABILITY OF POLYMERIC SILICA IN ACIDIC SOIL SOLUTIONS: EXPERIMENTAL AND FIELD STUDY

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Silica is primarily liberated into soil solutions by weathering of natural minerals and rocks. In principle, both monosilicic and polysilicic acids can be generated by the dissolution of silicates in acidic solutions. However, polysilicic acids are metastable and decompose to monosilicic acid depending on several factors like temperature, pH and chemical composition of the solution. The present study aimed at the detection and characterization of polymeric silica in soil solutions collected in acidic forest soils. The concentrations in polymeric silica were measured with the ß-silicomolybdato method.

The experimental results show that polysilicic acids very likely react with aluminium to form polymeric HAS. This was confirmed by experiments with Al^{3+} and polysilicic acids in acidic solutions (pH = 3.5 and 4), which are undersaturated with respect to amorphous $Al(OH)_3$ and proto-imogolite (PI). Equilibrium with respected to PI is reached under mildly acidic conditions (pH = 4.5). Soil solutions samples in an acidic brown soil in France (Breuil, Morvan) and in a podzolic cambisol in Austria (Bruck an der Mur, Styria) were separated by drainage centrifugation. Total concentrations were measured by ICP-OES, IC, and IR Carbon-Analyser prior and after Ultrafiltration (3000 kDa). Aqueous Al-speciation pools were measured using 8-hydroxyquinoline (5-s flash extraction), and the concentrations in humic substances by UV-spectrometry. These variables were used to optimise the WHAM speciation model. Monomeric Si ($Si(OH)_4°$) is found to be the dominant form of dissolved Si. The occurrence of polymeric Si and HAS strongly depends on the field site. The cause of such a contrasted result is discussed regarding the differences in the pH, total concentrations, and speciation of the soil solutions collected in each site.

As aluminium and both monosilicic and polysilicic acids can be liberated by the dissolution of silicates in acidic solutions, the formation of polymeric HAS may be an important aspect for the mechanisms of weathering and neoformation of silicates. It is suggested from the present results that the occurrence of polymeric HAS is mostly related to the acidity of respective soil solutions. The occurrence of polymeric silica and HAS may significantly reduce the mobility and availability of silica and aluminium in acidic soil environments.