Geophysical Research Abstracts, Vol. 7, 06711, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06711

0.1 Weathering of Silicates and the Speciation of Aluminium and Silica

0.2 in Acidic Soil Solutions

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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 characterisation of polymeric and monomeric silica as well as aluminium species in soil solutions collected in acidic forest soils.

Soil solution samples of a Dystric Cambisol in France (Breuil, Massif Central) and

of an Aceric-Dystric 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). The concentrations of polymeric silica were measured with the ß-silicomolybdato method. Aqueous Al-speciation pools were measured using 8-hydroxyquinoline (flash extraction) and the concentrations of humic substances by UV-spectrometry. These variables were used to optimise the WHAM speciation model. Monomeric Si ($Si(OH)_4^\circ$) is found to be the dominant form of dissolved silica. The occurrence of polymeric Si strongly depends on the field site. The cause of such a contrasted result is discussed regarding the differences in pH, total concentrations and speciation of the soil solutions collected in each site.

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 respect to PI is reached under mildly acidic conditions (pH = 4.5).

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 existence of polymeric silica and HAS may significantly reduce the mobility and availability of silica and aluminium in acidic soil environments.