

Geochemistry of the major elements of recent sediments of Fláje basin (Krušné hory, Erzgebirge)

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High deposition of SO₂ and consequent acidification of the environment causes the depletion of exchangeable base cations (Ca²⁺, Mg²⁺, K⁺ and Na⁺) (Pačes, 1985, 1986) and mobilisation of Al during the weathering reactions (Mulder and Stein, 1994; Reuss *et al.*, 1989; Ulrich, 1980, etc.). Laboratory experiments (Holdren and Speyer, 1987) show that under low pH (<5) Al and base cations are preferentially released from the dissolving minerals and surface layer rich in Si is formed. Geochemical features of recent sediments derived from granitic basement and formed under acid conditions reflect the changes in mechanisms of weathering reactions caused by low pH of surface waters.

Study area

The forested catchment of Fláje basin is located on the plateau of Krušné Mountains on northwest of Bohemia, at 730 m above sea level facing the high deposition of SO₂. The bedrock is composed mainly of gneiss and granite rocks resistant to the weathering, which the area liable to acidification.

Sampling and methods

Three series of samples were collected in the catchment of Fláje:

samples of the bottom sediments of the Fláje basin from different depth representing the sediments which are below water level for different time of the year.

samples of recent sediments of two streams emptying into the basin.

samples of weathered eluvium representing the material not constantly exposed to the effect of surface water.

Size fraction of the samples below 0.0063 mm was subjected to the modified sequential leaching procedure. The bulk samples were dissolved by HF and HNO₃ in the high pressure vessel. The content of Ca, Mg, Na, K, Al and Si was determined by AAS in

the following phases of the samples:

non-silicate phases:

exchangeable cations and carbonates

Fe and Mn hydroxides

the organic matter and sulphides

silicate phase (obtained by subtracting the content in non-silicate phases from bulk sample)

Results and discussion

The process of the weathering itself is similar to the weathering under pristine conditions, i.e. the base cations (Ca, Mg, Na and K) and Si are released and the residue is enriched in Al in comparison with the primary rock as indicated the composition of the silicate phase of eluvium.

Stream-sediments are however influenced by acid surface water. Al is partly released from the silicates and the proportion of the Si content increases.

In the basin itself Al and base cations are released from the silicate phase of the sediment to a greater extent than during the weathering *in situ* (i. e. in eluvium) and the residue becomes relatively enriched in Si compared to the primary rock (Figs. 1 and 2). In addition the intensity of these processes increases with the depth of the sediment. This may be due to the dissolution of the clay mineral (or its reduced formation) and the presence of higher proportion of the quartz and amorphous silica, or due to the preferential release of Al during the dissolution of the minerals and formation of the Si rich phase. It is not clear which of those processes applies. However it is obvious that the basin water, resp. the duration of the contact of the basin water and the sediment, influences the composition of the sediment.

The composition of the non-silicate phases of the basin sediments also changes with the depth - the content of Al decreases with the depth while the content of base cations (especially Ca) increases i.e. the lower content of Al the higher content of Ca and vice versa. The sediments at low depth are below the water level for minor part of the year so they are

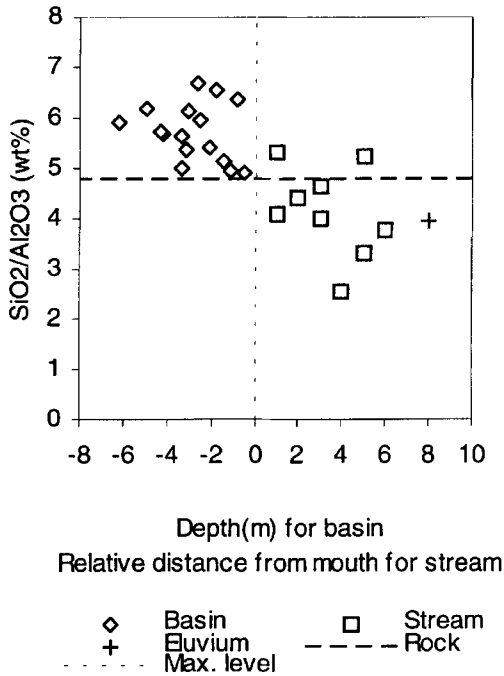


FIG. 1. $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratio in silicate phase.

more exposed to the effect of the acid deposition. If the pH of rain water is lower than pH of the water of the basin and streams (which is likely since the acid deposition is mostly due to dry deposition which is later dissolved by rain water) the replacement of base cations with Al would be more effective in these sediments. Contrary, the higher pH of the basin water (due to the artificial calcification of the basin in the early times) and the presence of dissolved base cations washed from the catchment area would result in an increase of the content of base cations bound in non-silicate phases of the deeper sediments while Al remains dissolved in water where it forms complexes

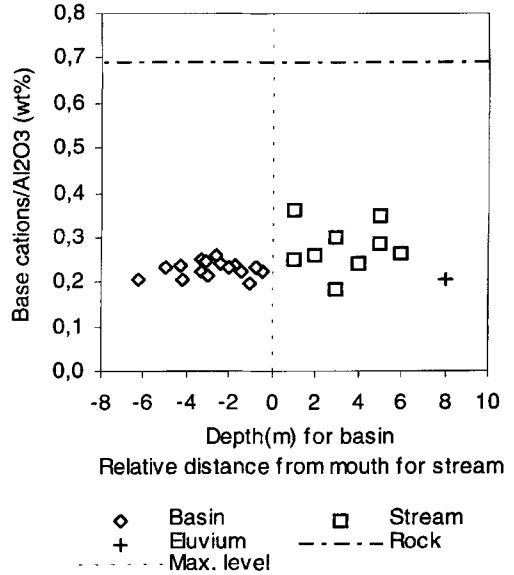


FIG. 2. Base cation/ Al_2O_3 ratio in silicate phase.

with either organic matter and OH ligands (Hruška, 1997). This corresponds to results of our analytical experiments.

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