Halogen cycling (F, Cl, Br, I) in the critical zone

T. EPP*, H. NEIDHARDT, M.A.W. MARKS, G. MARKL, Y. OELMANN

Eberhard Karls Universität, 72074 Tübingen, Germany
(*correspondence: tatjana.epp@uni-tuebingen.de)

Halogens (F, Cl, Br and I) are ubiquituous in nature and are important nutrients for humans, animals, and vegetation [1, 2, 3]. However, systematic halogen data (especially Br and I) from different ecosystem compartments and their role and partitioning in the critical zone is sparse.

More than 200 solid soil, rainfall, throughfall, soil solution, and creek water samples from the Feldberg, SW Germany were analyzed at locations where a forest canopy was either present or absent. Irrespective of location, the concentrations of total F (F_{tot}), Br_{tot}, and I_{tot} were smaller in the uppermost organic layers as compared to mineral soil horizons. This pattern is likely caused by retention in mineral soil via sedondary minerals (clays, metal oxides). Although Br and I are contained in organic matter in soil [2, 3], our results highlight the predominant role of abiotic processes for the fate of F, Br, and I in soil. Concentrations of Cl_{tot} and organic C concentrations decreased with increasing soil depth. This is in line with microbial chlorination of organic matter reported for organic layers of forests. In addition, nutrient uplift might contribute to the vertical depth pattern of Cl. Both processes stress the importance of biotic processes as a control of the fate of Cl in soil.

The presence of a forest canopy significantly increased halogen concentrations in water reaching the soil. Leaching of dry deposition and release from organic compounds could serve as an explanation. Furthermore, halogen concentrations did not depend on soil depth or on location. Comparing the halogen concentrations of all aqueous samples, F concentrations were more abundant in creek water and may reflect the influence of host rock (gneiss) weathering.

We therefore suggest that once halogen input into the ecosystem via rainfall occurs abiotic and biotic processes contribute to the retention of halogens in the critical zone.

[1] Yuita (1983) Soil Sc. And Plant Nutr., **29**, 403-428. [2] Fuge (1988) Environ. Geochem. And Health **10**, 51-61. [3] Kabata-Pendias (2011) CRC Press, **4**, 385-401.