Nutrient retention ponds in agriculture – load and efficiency

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Introduction

The application of liquid manure to artificially drained grassland soils in the Central Swiss Plateau results in excessive nutrient fluxes through the drainage system into the receiving waters. In the catchment area of Lake Sempach several artificial ponds were constructed in order to collect the mobilized nutrients from the drainage system and to reduce their transport to the lake.

Study site and methods

In 2001 we determined the nutrient retention capacity of one selected pond (volume: 1200 m^3; surface: 2000 m^2; max. depth: 0.8 m) near the farm Sonnhof which receives drainage water from a catchment area of about 204 000 m^2. The combination of regular sampling and online analytical techniques with the registration of the hydrologic regime allows us to establish a detailed nutrient budget and to detect seasonal changes of the nutrient fluxes. The concentrations of the different phosphorus species and total nitrogen are determined with conventional chemical analysis, whereas nitrate and ammonia concentrations are recorded applying a flow-through cell with ion-selective electrodes (temporal resolution: 12 minutes).

Results and discussion

First results of our study show that most of the phosphorus and nitrogen load is transported during few heavy rainfall events throughout the year (Fig. 1). The retention of the nutrients and therefore the effectiveness of the pond increases with the water residence time. On an annual basis it is possible to retain about 40 % of the total phosphorus and 25 % of the nitrogen input corresponding to approximately 4 kg phosphorus and 88 kg nitrogen.

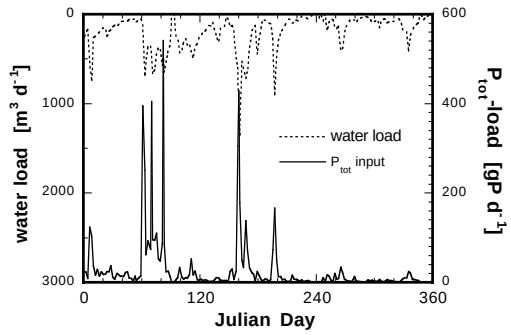

Fig. 1: Water and phosphorus load into pond Sonnhof

The effects of melt percolation on the Os isotopic systematics of the Sidamo peridotites, Ethiopia

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Os isotopes are among the most reliable tracers of ancient magmatic processes. However, there is increasing evidence that Os is more mobile in mantle rocks than originally thought. To investigate the mechanisms of Os mobility we have studied peridotite xenoliths from Sidamo, Ethiopia. These rocks record melt-rock reactions resulting from pervasive infiltration of melts at the base of the lithosphere, above a mantle plume (Bedini et al., 1997). Two textural/geochemical groups have been recognized. Granular peridotites were extensively re-equilibrated with basaltic melts in the lower, high porosity, region of the lithospheric mantle. In contrast, deformed peridotites record interaction with volatile-rich small melt fractions, highly evolved by reaction with peridotite, that infiltrated into the shallow, low porosity, mantle lithosphere.

As a group, all of the samples define a rough correlation between $^{187}Os/^{188}Os$ and Al_2O_3 content, suggestive of ancient (~ 2.7 Ga) melt extraction. Nevertheless, the granular lherzolites have Os isotopic ratios 1 to 4% higher than expected, suggesting that they were modified by interaction with the percolating basaltic melts. This mechanism is favored by the intergranular position and metasomatic character of the sulfides, which contain essentially all of the Os in these rocks. High melt/rock ratios are implied, given the contrasting Os concentrations of peridotites and typical mafic magmas. Both Os concentrations and Os isotopic ratios are quite reproducible in this group of samples. The deformed harzburgites also have higher than expected $^{187}Os/^{188}Os$ ratios, which can be highly heterogeneous within samples. These harzburgites contain no sulfides. Instead, the higher Os concentrations obtained after NiS fusion, compared to those determined after Carius tube dissolution, show that the Os is contained in highly refractory phases (e.g. Os-Ir alloys). The low porosities existing in the deformed region suggest that the Os compositions were modified by interaction with relatively small volumes of highly radiogenic fluids, perhaps derived from nearby ancient mafic layers.

References

Bedini R.M., Bodinier J.L., Dautria J.M. and Morten, L., (1997), *Earth Planet. Sci. Lett.* **153**, 67-83.