Variations of catchment P in stream water constrained by oxygen isotopes in phosphate

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Introduction

We present oxygen isotope measurements (δ^{18}Op) on dissolved inorganic phosphate (DIP) from stream water (outflow of catchment), field drains and rural sewage/waste water to trace and quantify the contribution of different sources of P to the total P discharge from a catchment in South Sweden. Recent studies by Young et al. [1] proved that δ^{18}Op values can be an efficient tool to study sources and transport pathways for dissolved phosphate. A periodic sampling was performed between March 2009 and October 2011, sample handling, and isotope measurements were done similar to the procedures described by McLaughlin et al [2]. Due to significant concentrations of DOC activated carbon powder was added prior to filtering in order to remove organic matter (modified after Gruau et al. 2005 [3]).

Results and Conclusion

δ^{18}Op values of field drains vary from +8.0 to +15.7 ‰, sewage/waste water samples show δ^{18}Op values of +12.1 to +16.2 ‰, stream water at catchment outflow shows a seasonal variation between +10.3 and +15.8 ‰, the δ^{18}Ow of the ambient water ranges seasonally between -9.0 to -13.5 ‰, all values reported relative to V-SMOW2. δ^{18}Op values of sewage and waste waters as potential contaminants are in good agreement with recent data from Young et al [1]. A comparison of δ^{18}Op with δ^{18}Ow shows that most samples are not in oxygen isotope equilibrium, thus their δ^{18}Op probably reflects the isotope signature of the P source. Isotopic variations of field drains correlate with DIP concentrations and might reflect mixing processes with different waste and/or sewage sources. Covarations in isotopic signal and DIP concentrations in the stream water (catchment outflow) are also best explained by individual and possibly changing contributions from different P sources. Interestingly δ^{18}Op in stream water shows a seasonal signal, a phenomenon only recently observed by Angert et al. [4] for soil δ^{18}Op. Further detailed geological background informations and hydrological data in particular are necessary to fit these data into a model.

[1] Young et al. (2009) *Environ. Sci. Technol*., **43**, 14, 5190-5196. [2] McLaughlin et al. (2004) *Limnol. Oceanogr. : Methods* **2**, 204-212. [3] Gruau et al. (2005) *Water Research*, **39**, 232-238. [4] Angert et al. (2011) *Geochimica Cosmochimica Acta*, **75**, 4216-4227.

3D Visualization of the Horne Hydrothermal System

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The hydrothermal architecture of the coeval Horne and Quemont deposits was visualized by 2D and 3D modelling using Kriging methods on a suite of whole-rock stable isotope and geochemical data. Hydro-thermal mapping integrated both surface and subsurface data: 416 δ^{18}O values (2.7 to 16.3‰), 4845 analyses of SiO_2, H_2O, MgO, Al_2O_3, S and wt.% H_2O, as well as SiO_2/Al_2O_3 ratios and REE data for intrusive and volcanic rocks. Zones of alteration about the steeply-dipping Horne deposit were mapped in 3D, to depths up to 2 km. The Quemont deposit is centered on the Powell pluton, which intruded into a volcanic-filled, caldera-type, or rift-graben structure, but the Andesite and Horne Creek Faults removed evidence of Horne-related up-flow zones and intrusions.

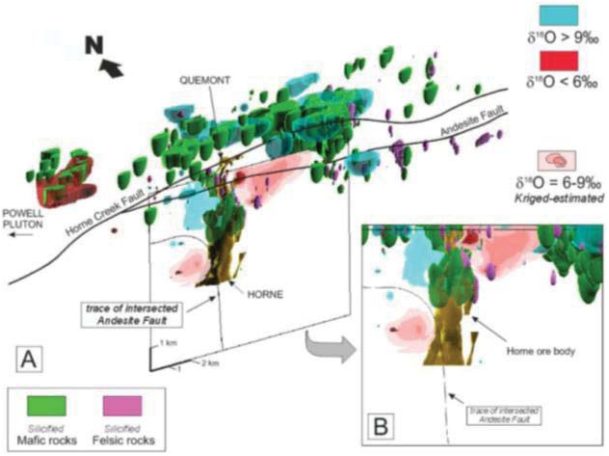

Figure 1: 3D model of the Horne hydrothermal system

Cooling of hydrothermal fluid by cold seawater in permeable rocks led to marked footwall silicification at the Horne deposit. Stratigraphic stability of the hydrothermal system may explain its large sulfide tonnage.

Separate magmatic hydrothermal systems influenced development of significant ore bodies in the area. Robust 2D and 3D data integration are needed to better understand these complex systems.