

Excess air as a potential tracer for paleohydrological conditions

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The formation of excess air, i.e., supersaturations of dissolved atmospheric gases in groundwater as the result of the dissolution of entrapped air in the quasi-saturated zone, depends on the environmental conditions during groundwater recharge. Excess air can therefore be viewed as a potential paleohydrological tracer for, e.g., groundwater table fluctuations during groundwater recharge.

The amount of excess air in samples of paleogroundwater from a deep sandstone aquifer in southern Wisconsin changes considerably over time. The area investigated was intermittently ice-covered during the last glaciation from about 12 to 26 kyr BP. Noble gas data, in conjunction with ¹⁴C ages and stable isotope data, indicate a soil cooling of about 6.5 to 7 °C during the last glacial period compared with the modern soil temperature.

All samples, except for those recharged before the last glacial period, show a strong correlation between noble gas temperature and $\delta^{18}\text{O}$. By contrast, $\delta^{18}\text{O}$ values of samples older than about 28 kyr BP are too heavy with respect to their noble gas temperatures. This might be due to a stronger influence of an isotopically enriched moisture source before 28 kyr BP.

The amount of excess air increased shortly before and at the beginning of the glaciation of the study area. At the same time, the degree of fractionation of the excess air with respect to the composition of atmospheric air decreased significantly. Both the increasing amount of excess air and the decreasing degree of fractionation indicate hydrological changes at the onset of the glaciation, proposing increasing fluctuations of the groundwater table in response to climatic changes or hydraulic changes due to the ice advance. After glaciation, the amount and fractionation of the excess air quickly changed to those values of modern groundwater, which is characterized by relatively few and strongly fractionated excess air.

In conclusion, the results show that excess air is a potential tracer for the pressure conditions during groundwater recharge in the past.

Study of native metals and alloys in natural deposits and soils: A contribution to the understanding of the influence of natural and industrial objects on the environment

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The application of highly sensitive (<1ppm) mineralogical methods (see details at www.natives.com) during geochemical exploration and environmental studies has revealed a wide range of native metals grains (NMG) and alloys in almost all samples of soils and natural deposits. Variable amounts of NMG have been observed in areas affected by industrial pollution, within city boundaries and also in areas remote (200-400km) from any obvious sources of pollution.

The observed NMG include Si, Cr, Fe, Co, Ni, Cu, Zn, Pd, Cd, Sn, Sb, W, Pb, Bi, which were present as pure phases and also, in some cases as alloys of two or more elements.

Qualitative and quantitative determinations of the compositions of the NMG have shown that these depend on the locations of the samples. In some cases a precise correlation between the amount and chemical composition of the NMG and the composition of underlying host rocks has been established.

The NMG and alloys generally vary in size from $n \times 1$ to $n \times 10 \mu\text{m}$, rarely reaching $200 \mu\text{m}$. Four morphological types of grains have been observed: spherical grains (are the most abundant), relatively isometric-angular grains, grains with irregular form and minor grains as peels.

Textural evidence of dissolution or supergene alteration of the NMG has not been observed, indicating that they form and exist stably under supergene conditions. The genesis of NMG requires further investigation, however the occurrence of these reduced native elements indicates that electro-chemical processes have been important in their formation under supergene conditions.

Detailed mineralogical studies of NMG and alloys in natural deposits and soils appears to be important in the evaluation of the influence natural and industrial objects on the environment, especially given that NMG can include toxic elements such as Cd, Pb etc (V. Cappuyns, *et al.*, 2006).

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References

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