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Hydrology and vertical Transport of a meromictic mining Lake traced with SF_6 on the Background Level

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Lakes, that have formed after open pit mining, often show a permanent, chemically induced density stratification. A chemocline separates the mixed layer from the deep water body (monimolimnion), that is virtually not mixed (meromixis). Typically, the monimolimnion is anaerobic and can act as contaminant source. Knowledge about vertical mixing pattern is therefore crucial for the intended use of such lakes and for possible remediation and renaturation strategies.

The common approach is measurements of quasi-conservative tracers in the water column and the surrounding groundwaters. We show, that the man-made gas SF_6 creates temporal and spatial signals that can be used to describe lake mixing and groundwater inflow. SF_6 increases in the atmosphere since the 1950's and behaves conservative in aquatic environments. The signals are produced by this increase and by the temperature dependence of its solubility. That means, SF_6 could be useful to extract time information (apparent water ages, exchange times) as well as estimates of turbulent exchange in the water column applying balancing methods (flux gradient method). Therefore, "underground" SF_6 is an interesting extension to common techniques as, for example, the widely used stable isotopes.

Samples are taken monthly at a small mining lake and measured for SF_6. High resolution CTD-profiles document the density stratification. The concentrations in the epilimnion and hypolimnion (1.7–3 fmol/l) show a seasonal development according to the solubility equilibrium. However, within the chemocline at $\sim$10 m depth, SF_6 drops instantly to very low values (0.3–0.07 fmol/l). This indicates that the chemocline acts as efficient barrier for vertical exchange. The low SF_6 must be the result of an exchange with old groundwater ($\geq$40 y) or the detachment of the monimolimnion from the atmosphere for a similar time scale or a combination of both.