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Methane dynamics in supersaturated lake sediments

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Sediments of lakes of high trophic level are often supersaturated with methane, a strong greenhouse gas which significantly contributes to global warming.
Lake Rotsee and Lake Lungern are Swiss prealpine lakes known for their methane emission. Relevant transport mechanisms for methane emission are mainly equilibrium-controlled degassing and diffusion. These processes can be quantified using noble gases dissolved in the porewater of unconsolidated sediments. Methane bubbles are formed in the sediments and strip the dissolved noble gases out of the porewater during their growth and their subsequent ascent towards the sediment/water interface. The corresponding noble-gas depletion of the porewater reflects the amount of released gas bubbles (see Brennwald et al., EPSL, 235, 31-44, 2005). Diffusive methane transport can be quantified using noble-gas concentration profiles and the fractionation of noble-gas isotopes (which we determined for Ne and Ar in new laboratory experiments).
In Lake Rotsee the depth range, where noble-gas depletion, fractionation of Ar isotopes and CH4 production are observed, coincide. By comparing measured and modelled gas concentrations in the porewater of the sediments we assess the relative importance of the physical transport processes triggering methane emission from the sediments into the water body of the respective lakes.