Analysis of δD and $\delta^{18}O$ in clay minerals for reconstructing paleoenvironmental parameters

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Clay minerals in Molasse sediments are potential proxies for the stable isotope composition of Neogene paleowaters in the circum-Alpine region. To use this proxy requires the formation of clay minerals in weathering zones in equilibrium with ambient surface waters and no post-formational diagenetic nor low-grade metamorphic exchange with the fluid phase. Knowledge of the water-mineral fractionation factors at temperatures of formation permits an estimation of the isotopic composition of the paleowaters and allows to reconstruct paleoaltitude, paleoclimate and paleotopography.

The isotope analysis of clay minerals, however, proves to be a challenging task. In particular members of the smectite family are highly hygroscopic, leading to potentially falsified results of the isotope measurements if the adsorbed water is not removed. A number of tests and experiments were conducted in order to validate the most accurate as well as economical procedure of sample preparation. While $\delta^{18}O$ values are readily analyzed using a CO_2 laser fluorination line, the adsorbed water fraction may pose problems for the hydrogen isotope analyses using the TC/EA method. Prior to H-isotope analyses, it proves advantageous to evacuate the samples at elevated temperatures before rapidly transferrring them to the TC/EA for measurements. Additional analytical methods including XRD, TGA, SEM, and studies of organic matter within the sample material have been applied for actual samples as well as for standard materials in order to evaluate the effects of sample treatment on final measured values. The results were also cross-checked through an inter-laboratory comparison of the results obtained.

Once established, this modified preparation technique will be applied to clay mineral separates from stratigraphically distinct Molasse sediment horizons, as well to samples from recent soil profiles in the Swiss Alps, and bentonites from volcanic ash layers in Switzerland. The present results from Molasse clay minerals are in agreement with proxies of changes in paleoclimate from marine sediments and also with related isotope studies on material from high-Alpine fault zones of similar age.

Which emission sector is winning the mitigation competition when direct, indirect and semi-direct effects are investigated seperately?

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Attention has been drawn to black carbon aerosols, as a target for short-term mitigation of climate warming. Regulating soot emissions could, as a short-term action, potentially buy time by slowing global warming until regulations for long-lived greenhouse gases are set in place. The scientific community debates the impacts of such mitigation measures, and mitigation modelling studies show incoherent answers. One of the main reasons for the disagreement are semi-direct aerosol effects, that are neglected in some studies and included and dominating the overall results in others. In this study we apply the GISS/MATRIX model, a global climate model including detailed aerosol microphysics, to understand the single contributions of aerosol forcings and feedbacks. The study goes beyond black carbon mitigation by investigating the whole suite of aerosol sources and sectors of the CMIP5 emission data sets.

Our study finds a regionally divers picture. For example aerosol-cloud effects over the United States lead to reduced cloudiness through semi-direct effects and increased cloudiness by the indirect effect and the reversed phenomena is simulated over Europe. This response will be explained by the chemical composition of the emission mix in the different regions and its impact on black carbon coatings. The most promising emission mitigation sectors differ greatly between geographically regions and even among industrialized countries.