The end of aerosols: Two hundred and fifty years of aerosols and climate

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Carbonaceous and sulfur aerosols have a substantial global and regional influence on climate in addition to their impact on health and ecosystems. The magnitude and regional distribution of this influence has changed substantially over the past and is expected to continue to change into the future. An integrated picture of the changing character of the influence of black carbon, organic carbon and sulfate over the period 1850 through 2100 is presented using updated historical inventories and a coordinated set of new model projections. The historical inventories [1,2] are recently updated for use in coordinated, international modeling experiments as part of the production of new Representavie Concentration Pathways (RCPs) [3]. The future emissions projections are from the ObjECTS MiniCAM integrated assessment model [4] and include emission control changes needed to reduce pollution levels as incomes in developing countries increase[5]. The impact of climate policy on aerosol forcing will also be examined. While aerosols have had a substantial impact on climate over the past century, by the end of the 21st century aerosols will likely be only a minor contributor to radiative forcing. This outcome is even more certain under a successful implementation of a policy to limit greenhouse gas emissions emissions as low-carbon energy technologies do not emitt appreciable aerosol or SO_2, although signifiant emissions and their associated impacts can still occur in the near-term.

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Scale matters? Exploring scale effects of oxalate-mediated weathering

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In the boreal forest zone, mineral weathering and ecosystem functioning are thightly connected. In these young soils, minerals are the main primary source of most of the essential plant nutrients. Meanwhile, biotic processes, including uptake and exudation processes, are the key drivers in the weathering processes. Crucial in understanding this interplay between biota and minerals is the scale of interaction.

Oxalate is thought to be an important biological weathering agent. But measured concentrations in boreal forest soils are too low to expect a significant effect on mineral dissolution. On the other hand, important oxalate producers, like ectomycorrhizal fungi, do direct biotic-mineral actions on the level of the individual grain. With their 5-10 µm thin hyphae growing in often undersaturated soils, it is expected that oxalate exudation is a very localized process. In this study, we explore the effect of the scale of oxalate distribution on feldspar dissolution kinetics.

We present a model to explore the effect of scale on oxalate-mediated feldspar weathering. First we used fluorescent techniques to measure fungal distribution over different minerals in a boreal forest soil. We show that fungal hyphae selectively colonize specific mineral species in the soil, with fungal cover on plagioclase > K-feldspar > quartz.

Next, we used this fungal distribution data to model the effect of oxalate distribution on overall feldspar weathering. We explored the effect of the scale of fungal-mineral interaction, based on local oxalate concentrations on the different mineral surfaces.

We conclude that oxalate-mediated feldspar weathering can only be of importance if oxalate only concentrates within the µm-range of the mineral surface. Lateral concentration (concentrating on a small part of total surface of the mineral) has a negative effect on dissolution rate. This is due to the nature of kinetics, and is general for most dissolution reactions, including proton reactions.