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Atmospheric photochemistry influence on dust dissolution rate

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It is now well known that transition metals play an important role in the atmospheric cloud chemistry. Indeed, these elements are involved both in catalytic and oxido-reduction reactions (eg Faust and Hoigné, 1990, Atmos. Environ, Vol 24A , p 79-89). Dissolution processes, leading to trace metals incorporation in aqueous phase, have already been studied and shown a great dependence on different parameters such as pH, aerosol nature and surface properties of the particles (eg Desboeufs et al., 2001, Atmos. Environ, Vol 35 , p 3529-3537). The aim of this work was to determine the impact of photochemistry on dust dissolution rate and indirectly on the speciation of the dissolved trace metals by experimental laboratory investigations. Laboratory experiments were conducted in an open flow dissolution reactor in which particles are leached by simulated atmospheric cloud or rain water. Different kind of irradiation experiments were carried out on various dust particles from arid regions (Niger, Capo Verde, Tunisia, and China) with or without added oxidant species (H2O2). Only dust from Capo Verde and Niger showed a clear dissolution rate variation in function of light parameter but only for transition metals (Fe and Mn). By example, for the manganese without added species, the lightning increases the dissolution rate up to 680 % in the case of Capo Verde particles and up to 54 % for the Niger one. The envisaged pathway leading to such variation is a light induced oxydo reduction dissolution closely linked to the nature of metal-oxide mineral. With added peroxide, experiments point out a different behavior for manganese and iron. For the manganese, the comparison between dissolution with or without H2O2 indicates an increase of 170 % of the rate whereas in the case of iron, the dissolution rate decreases by a factor 6. Finally, we have demonstrated that for dissolution rate, only transition metals are affected by light and that, in this case, the composition of the weathering solution have a contrasting impact on these dissolution rates.