

## Mineralogical and geochemical study of airborne particulates (PM<sub>10</sub>) in an urban environment

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Airborne particulate matter (PM) is known to affect human health significantly. Especially the fine PM, with sizes <10 µm (PM<sub>10</sub>), poses a considerable health threat, due to its ability to enter human lungs. Sources of anthropogenic PM<sub>10</sub> in the atmosphere include waste incinerators, traffic, and thermal power plants. Coal-fired power plants, for example, emit various distinct phases, including several types of crystalline metal sulphates (Gieré *et al.*, 2006). Knowledge of the identity and composition of individual particles is essential to predict their environmental behaviour.

The study focuses on PM<sub>10</sub> collected in the neighbored urban environments of Strasbourg (France) and Kehl (Germany). This urban area, situated on both sides of the river, Rhine is exposed to different PM sources such as a thermal power station, waste incinerators, and a steel plant. Our interest lies in the bulk chemical and mineralogical composition of the overall PM<sub>10</sub> in the city centre of Strasbourg and in the specific evolution of these compositions as function of distance from the steel plant. Pb, Sr and Nd isotope ratios of these emissions are already precisely identified and allow to be traced over more than 3km along the prevailing wind pathway (Lahd Geagea *et al.*, 2007). Thus, in this special case study we have a direct control of the origin of the PM<sub>10</sub> and can compare the PM<sub>10</sub> compositions with those of filter dust from the plant. The bulk chemical composition of PM<sub>10</sub> trapped on teflon filters is analyzed by using ICP-MS. Identification and characterisation of the mineral phases is performed using SEM techniques, which allow us to determine morphology and chemical composition of µm-sized individual particles. Preliminary results show that, in addition to soot and various silicate particles, metal sulphates are present in the PM.

### References

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## Do fluids flow through or around mineral grains?

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A large body of evidence demonstrates that mineral transformation commonly occurs through a dissolution/precipitation mechanism where 1) the fluid moves into the parent phase from its original surface and 2) the crystal structure is preserved between the parent and secondary phase (Putnis and Putnis, 2007). The goal of this study is to assess if a similar dissolution/precipitation mechanism can transport fluids through mineral grains where the driving force is either a pressure or a temperature gradient.

Calculations were performed using dissolution rates (c.f. Gislason *et al.*, 1997; Oelkers, 2001), aqueous diffusion coefficients (Oelkers and Helgeson, 1988), and mineral solubilities calculated using SUPCRT92 (Johnson *et al.*, 1992) as a function of temperature and pressure assuming that precipitation rates are consistent with Transition State Theory and the law of detailed balancing. Results show that the degree to which fluid 'flows' through minerals depends on the identity of the mineral. For example the calculated logarithm of water permeability (in Darcy) through quartz, assuming fluid flow is driven by an isothermal pressure gradient, is -10 at 200° C, increasing to -5 at 600-700° C. In contrast, the corresponding log permeability through enstatite is far higher increasing from -6 to -3 over this temperature range. Note at elevated temperatures these latter values are comparable to that of sandstones in sedimentary basins. Moreover, temperature gradients are, in general, more effective at provoking fluid flow due to the relatively stronger effect of temperature on solubility.

These calculations suggest that large quantities of fluid flow can occur through mineral grains at elevated temperatures due to either pressure or temperature gradients. The consequences of this fluid flow in terms of 1) isotopic reequilibration and 2) stability of fluid inclusions will be detailed.

### References

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