Sugars in the aerosols:Seasonality and size distribution

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Introduction and Method

To make progress on our understanding of chemical characterization of organic aerosols and atmospheric behaviours of bioaerosls, sugars in the aerosols were measured at urban (Yokohama) and suburban (Mt. Oyama) sites in Japan. Weekly filter samples were ultrasonically extracted with ultrapure water, and then the neutral sugars (arabinose, fucose, galactose, glucose, mannose, rhamnose, and xylose) both from free and combined forms in the extracts were determined by the method integrating an alditol acetate derivatization and a gas chromatographic analysis.

Results and Discussion

Seasonal variations in the concentrations of the sugars in fine and coarse particles are shown in Fig. 1. Size distributions of the sugars generally showed the dominance in fine mode range but shifted toward coarse mode range in the summer. Seasonal trends in the concentrations of the sugars were quite opposite between fine and coarse mode range. Higher concentrations of fine mode sugars were found in the winter, whereas coarse mode sugars increased in the summer.

The most dominant sugar was glucose at both sites. Compositions of the sugars were different between fine and coarse mode range. Contributions of the glucose to the sugars were larger in fine particles than in coarse particles. Fine mode glucose mainly consisted of combined form, but the free from increased in the coarse mode range as shown in Fig. 2. Although the sources of the sugars in the aerosols remained large uncertainties, primary biogenic particles can be considered as candidates of potential sources of the sugars. Different chemical compositions between fine and coarse mode sugars could arise from the different biogenic sources.

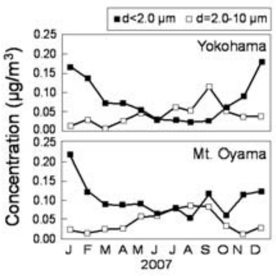

Figure 1: Seasonal trend of the sugars in the aerosols

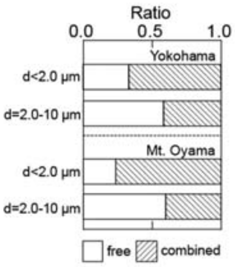

Figure 2: Comparisons of free and combined glucose

Enhanced *in situ* carbonation of peridotite for permanent CO_2 storage

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Carbon dioxide storage in deep aquifers capped by low permeability formations is considered to be one of the most promising alternatives for geologic CO_2 sequestration. The fate of the injected CO_2 within the deep aquifer after the injection will be defined by its interaction with the formation water and host rock, and therefore, the success of storage in such aquifers will be measured by the mechanical and chemical stability and integrity of the host- and caprock preventing upward leakage of injected CO_2. Geochemical reactions between the CO_2, the formation water and host rocks will lead to the immobilization and neutralization of the injected CO_2 with increasing residence time. However, the degree and rate of immobilization strongly depends on the mineralogy of the storage formation. Rocks, rich in alkaline earth metals (calcium and magnesium) have a high CO_2 mineralization and immobilization potential via mineral carbonation reactions [1].

Mineralization of CO_2 occurs naturally in tectonically exposed mantle peridotite, a rock rich in magnesium silicate minerals. Weathering of peridotite forms solid carbonates (magnesite, dolomite and calcite) during the interaction between groundwater and the minerals olivine, pyroxene and serpentine. Carbonates are deposited in veins and interstitial minerals within the peridotite, and at the surface where alkaline, Ca-rich, CO_2-poor spring waters formed during serpentinization combine with atmospheric CO_2 to form large travertine deposits. New data from the “Oman ophiolite” shows that carbonate veins within the mantle peridotite in the Sultanate of Oman are ~1000 times younger than previously believed [2]. Mapping of the extent of carbonate deposits and their radiocarbon age yields a natural CO_2 uptake in Oman via peridotite carbonation of 4×10^7 kg/year [2]. In order to be of a significant CO_2 sink, this carbonation rate has to be enhanced by several orders of magnitude. Rapid carbonation can be accomplished by taking advantage of the heat released by the exothermic carbonation reaction. This reaction can reach a self-heating regime, in which heating due to reaction balances cooling due to advection and diffusion, maintaining temperature at an optimum value for rapid carbonation. We present new results on the natural carbonation of peridotite and discuss how CO_2 fixation could be accelerated to provide a significant sink for atmospheric CO_2.

[1] Oelkers *et al*. (2008) *Elements* **4,** 333-337. [2] Kelemen & Matter (2008) *Proc. Nat. Acad. Sci.* **105,** 17295-17300.