In situ Fe-Mg isotopic analysis of zoned olivines

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Chemical diffusion profiles in zoned olivines may be used to infer the thermal history of the system surrounding them. However, diffusive transport is not the only way to produce a chemical gradient. An olivine that crystallized rapidly may produce a similar zoning pattern.

Fe and Mg isotopic analyses of bulk olivines reveal that isotopes can be used to recognize chemical diffusion in olivines [1-3]. Chemical diffusion can induce large isotopic fractionations because light isotopes always diffuse faster than their heavier counterparts [4-5]. At equilibrium, little isotopic fractionation is expected given the high temperatures of magmatic systems.

Olivines in Kilauea Iki lave lake have large chemical zoning profiles and lighter iron isotopic compositions than the bulk basalts [1]. Teng *et al*. [1] showed that in these olivines, the isotopic compositions are correlated by a slope of -3.3 in a plot of $\delta^{56/54}$Fe vs. $\delta^{26/24}$Mg, in close agreement to the predicted slope of -2.7 for binary diffusion [2]. Here we provide definite evidence that diffusive transport is responsible for the light Fe isotopic compositions measured in olivines in Kilauea Iki lava lake.

A zoned olivine ~4 mm in size was microdrilled in two orthogonal traverses for Fe and Mg isotopic measurements. Isotopic compositions were measured by MC-ICPMS. Profiles are observed with iron isotopic compositions ranging from -1.2 ‰ in the core to to -0.2 ‰ in the rim ($\delta^{56/54}$Fe deviations from IRMM-014). The variations can be explained by diffusion of Fe into olivine following magmatic evolution towards more Fe-rich and Mg-poor compositions.

In situ Fe and Mg isotopic measurements in olivines can help identify grains that are affected by chemical diffusion. These olivines may be used as tools for diffusion-based geothermometry.

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Potentially toxic metal bearing mineral phases in total suspended particles from Budapest, Hungary

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Total suspended particles (TSP) in the urban air can be both inhaled and ingested so causing health damage due to their size, shape or toxic components. In this study mineralogical (XRD, AEM), geochemical (XRF) and magnetic (MS) analyses were performed to characterize the mineral phases containing potentially toxic metals in TSP from three sampling sites in Budapest. The samples represent wide range of physico-chemical properties. Their particles are generally below 50 μm with a maximum frequency at around 10-12 μm. Between 45 and 80% of their particles belong to the PM10 fraction. They show significant enrichment in several potentially toxic metals with concentrations 1342-19 046 mg/kg for Zn, 434-3597 mg/kg for Pb, 394-699 mg/kg for Zn and 38-144 mg/kg for As. Their main mineral components reflects the geological characteristics of the sampling areas. Additionally, large amount of magentite (up to 15%) and amorphous organic matter, as well as gypsum and halite was also found in the samples.

The most important toxic metal bearing mineral phases are spherular or xenomorphic magnetite particles containing 2-3 wt% Pb and Zn. These magentite particles often form aggregates and are closely associated with soot and/or clay minerals. In samples with high magnetite content toxic metal-free magnetite spherules up to a few micrometer size also appear. The magnetic analyses showed that the sizes of the magnetite particles is rarely below 30 nm. Clay minerals and mica particles may also contain significant amount of Zn (up to 5wt%). Additionally, ZnO and $ZnCO_3$ particles were also found in the sample with highest Zn content. Magnetite particles are resistant to weathering releasing its toxic components slowly to the environment, while layer silicates may be the source of mobile toxic metals in these samples. The study was financially supported by the OTKA (K 76317 and K 75395).