Solvothermal transport of Zr in volcanic systems and its relevance for technical applications

S. HEUSS-AßBICHLER, D. AßBICHLER*, K. T. FEHR AND D. MÜLLER

Ludwig-Maximilians-Universität München, Department of Earth and Environmental Sciences, Theresienstraße 41, 80333 Munich, Germany, *d.assbichler@lmu.de

Sanidinites are volcanic ejecta and contain mainly sanidine and sodalite group minerals. The very porous fabric of these rocks is an indication of their aggregation from a gaseous magmatic phase. The large sanidine crystals (up to several centimeters) are mostly interlocking, creating large cavities between some crystals (Fig. 1). In these pores Zr crystallizes as oxide baddeleyite (ZrO_2) or silicate (zircon $ZrSiO_4$). The euhedral shape is a further indication of the formation of these minerals out of the gas phase.

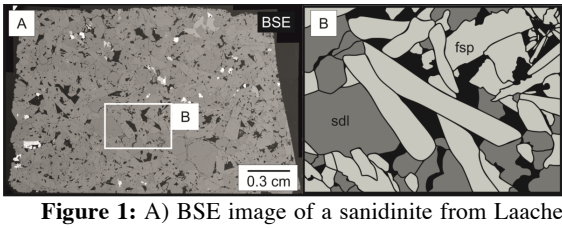

Figure 1: A) BSE image of a sanidinite from Laacher See (Germany), B) Sketch of the marked section in A) with the main mineral phases sanidine (fsp) and sodalite (sdl)

The formation of sanidinites is suggested to be an example for solvothermal processes in natural systems. Solvothermal processes imply the solvation, transportation and recrystallization of refractory elements and HFSE (high field strength elements) like Zr in the gas phase. In particular interest for technical application is the "densification" of sanidinites by the growth of Zr-minerals in the cavities.

A novel technical application of this process is the solvothermal densification of Y-stabilized Zr-oxide ceramics as protection layers against corrosion of the steel superheater in waste incineration plants. The main gas phases in waste incineration plants are H_2O, CO_2, sulfate and Cl; they are comparable to the gas composition in magma chambers.

Preliminary results obtained from whole rock analysis from sanidinites from Laacher See (Germany) show a positive correlation between LOI, sulfate, Cl, and Na with the HFSE like Zr. The results of this study can be used to improve the reaction conditions for the densification of synthetic Zr-oxide ceramics by solvothermal Zr-transport processes.