The importance of the fluid-mineral interface in the control of crystal growth

CHRISTINE V. PUTNIS[1]*, ENCARNACIÓN RUIZ-AGUDO[2],
LIJUN WANG[3], JOLANTA KLASA[1,4]
AND ANDREW PUTNIS[1]

[1]Institut für Mineralogie, University of Münster, D-48149 Germany (*correspondence: putnisc@uni-muenster.de)
[2]Department of Mineralogy and Petrology, University of Granada, 18071 Granada, Spain (encaruiz@egr.es)
[3]Huazhong Agricultural University, Hubei 430070, Wuhan, China (ljwang@mail.hzau.edu.cn)
[4]Mineralogy Department, Natural History Museum, SW7 5BD London, UK (j_klas03@uni-muenster.de)

Atomic force microscopy (AFM) experiments have shown that growth on mineral surfaces can occur from solutions when the bulk fluid composition is undersaturated with respect to the precipitating phase. The implication is that the composition of the solution in the fluid boundary layer in contact with the mineral surface must become supersaturated with respect to the new phase growing at the mineral surface. This has been reported in a number of systems, including the growth of new phases on calcite cleavage surfaces, such as Ca phosphonates [1], and on gypsum surfaces, such as Ca phosphates [2], where the dissolution of the substrate provides ions included in the new phase. The thickness of the boundary layer can be estimated by considering the following: the solubility of the solid in the fluid phase; the diffusion rate of the dissolved ions in the fluid phase; the composition of the fluid; the saturation state of the fluid with respect to all possible phases; possible epitaxial relationships between the mineral surface and the new phase.

The concept of a boundary layer becoming supersaturated with respect to another phase, which then precipitates, is essential for the understanding of coupled dissolution-precipitation as a mechanism of mineral replacement [3]. Real-time phase-shift interferometry has been used to show the steep compositional gradient at the surface of a crystal of KBr being pseudomorphically replaced by KCl [4] and this has been used as a model system for more complex Earth systems involving mineral-fluid reactions during such processes as metasomatism, metamorphism and weathering. This concept is also relevant to many industrial processes and nuclear waste management.

[1] Ruiz-Agudo E. *et al*. (2010) *Crystal Growth & Design*. [2] Pinto A. *et al*. (2010) *American Mineralogist*. [3] Putnis A. & Putnis C.V. (2007) *Journal of Solid State Chemistry*. [4] Putnis C.V. *et al*. (2005) *American Mineralogist*.

Mantle metasomatic events related to alkaline volcanism during incipient rifting: NE Eger Rift (Central Europe) example

J. PUZIEWICZ[1]*, M. MATUSIAK-MAŁEK[1],
T. NTAFLOS[2] AND M. GREGOIRE[3]

[1]Univ. Wroclaw, Poland (*correspondence: jacek.puziewicz@ing.uni.wroc.pl)
[2]Univ. Wien, Austria (theodoros.ntaflos@univie.ac.at)
[3]CNRS-UMR 5562, Univ. Toulouse, France (michel.gregoire@get.obs-mip.fr)

Mantle metasomatism is preceding alkaline volcanism at initial stages of continental rifting. The complete example of its various effects is offered by xenolith suite occurring in the Miocene Księginki nephelinite (SW Poland). The latter occurs at the NE termination of the Eger Rift, the easternmost of the rifts forming the European Cenozoic Rift System.

The lithospheric mantle was infiltrated by alkaline silica-undersaturated magma resembling the Księginki nephelinite. Olivine clinopyroxenites originated by crystal accumulation in channelized magma flow. The 'Fe-metasomatism' operated in mantle harzburgites subjected to pervasive magma flow. It lowered olivine Fo (down to 86 %) and resulted in REE patterns of clinopyroxene identical to those ocurring in olivine clinopyroxenites. The clinopyroxene megacrysts occurring in the Księginki nephelinite are the remnants of very coarse-grained clinopyroxene cumulates, uncompletely solidified and disaggregated during eruption. The fine-grained glass-bearing aggregates of olivine + clinopyroxene ± plagioclase or titanian phlogopite offer the snap-shot picture of the various stages of metasomatism and show that part of the xenoliths resided shortly in transient magma chambers located near the Moho, under pressures enabling plagioclase crystallization. Alternatively plagioclase crystallization in melt pockets could take place en route to the surface at low pressures. All the lithospheric mantle section sampled by the Księginki nephelinite was thermally rejuvenated during volcanism and shows the temperatures of 1060 - 1120 °C.