DIPRA: A new user-friendly program to determine the timescales of magmatic processes from diffusion modelling of multiple elements in olivine

Társilo Girona, Fidel Costa

Earth Observatory of Singapore, Nanyang Technological University, Singapore

E-mail: tarsilo.girona@gmail.com

One recent advance in igneous petrology has been to be able to quantify the timescales and rates of magmatic processes. This provides a lot of valuable information about a wide range of phenomena, such as the residence times of magmas in shallow reservoirs before eruptions. A methodology to determine these timescales is modelling the concentration of different elements in minerals, which is based on chemical diffusion within the crystals. However, despite the good knowledge of diffusion coefficients and the ease of measurements of chemical gradients, the use of this technique is not widespread yet. This could be due in part to the lack of a user-friendly tool that allows modelling the chemical zonings in crystals easily. We have developed an interface-based computer program (DIPRA: Diffusion Process Analysis) that allows modelling intuitively the diffusion of Fe, Mg, Mn, Ni, and Ca in olivine (one of the most widespread minerals in igneous rocks) by performing an automatic and quick fit to the natural chemical profiles. DIPRA accounts for most variables that affect diffusivity, such as temperature, oxygen fugacity, and anisotropy, and initial and boundary conditions can be chosen as complex as the user requires. The program also calculates the uncertainties of the diffusion time based on the uncertainty of the data and temperature. DIPRA is very versatile and, besides being a working tool for petrologists, it could also be useful for teaching kinetics of chemical re-equilibration and timescales of magmatic processes in higher education courses. The program can be downloaded from www.tgirona.com.