**Elemental diffusion chronostratigraphy: a non-isothermal approach to magma dynamics.**

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Time-related information of pre-eruptive magmatic processes is locked in the chemical profile of compositionally zoned minerals and can be retrieved by means of elemental diffusion chronometry. However, only the timescale of the outermost rim is commonly resolved, limiting our knowledge of timescales to those directly preceding the eruption. A major obstacle is the need to accurately constrain temperatures at which diffusion occurred. This is particular difficult for multiple zoned minerals where the different compositional boundaries indicate multiple physicochemical changes of melt environments during the lifetime of a crystal.

Fe-Mg interdiffusion in pyroxenes are used as examples to reconstruct the time-dependent elemental diffusion chronostratigraphy of single crystals taking into account the non-isothermal nature of pre-eruptive processes via the Non-Isothermal Diffusion Incremental Step Model (NIDIS) [1,2]. This approach allows deconstructing the main core-rim diffusion profiles of multi-zoned crystals into different isothermal steps. Limitation, uncertainties and magma dynamics implications will be discussed. Uncertainties introduced by temperature estimates and other input data, including experimentally derived values for the activation energy *E* and the pre-exponential factor *D0*, have large effects on the accuracy of modelled timescales [3], which need to be correctly evaluated and mitigated.

Elemental diffusion chronostratigraphy can be fully resolved for crystals that have spent their lifetime in hot storage [3]. Under this condition, crystals will be kept at the temperature(s) of the eruptible magma(s), and diffusion timescales approximate the storage of the crystal in question in different melt environments allowing an in-depth knowledge of the magmatic system far beyond late-stage pre-eruptive processes.

**References**

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