Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11935

Lower crustal differentiation processes and mineral growth in silica-rich magmas: results from experimental phase equilibria and diffusion in garnet

OTHMAR MÜNTENER

University of Lausanne

Presenting Author: othmar.muntener@unil.ch

Estimates of the bulk chemical composition of Earth continental crust are highly variable and range from 56-64 wt% SiO_2 and even more so (48-64 wt% SiO_2) for the lower crust [1]. Analysis of global datasets, however, cannot readily disentangle the relevant processes that control the composition of the crust, and in particular the lower crust. A crucial issue are changes in composition over time. Studying this aspect on near-complete crustal sections may provide new insights. The Ivrea zone represents a Paleozoic continental crust section that is affected by Permian transcrustal magmatism on all crustal levels, allowing for evaluation of the temporal evolution of continental lower crust and how this evolution might be linked to the ascent of siliceous magmas.

Major element chemical trajectories indicate that the of pre-Permian Ivrea crust is dominated by crustal reworking (mechanical mixing trends). The Permian magmatic addition closely follows phase equilibria controlled major element geochemical trends as derived from experimental studies on crystallisation differentiation. These experiments indicate that the cumulate line of descent (CLD) of hydrous systems is fundamentally different from dry systems [2]. CLD's from experimental studies on lower crustal differentiation in H_2O bearing systems are comparable to the magmatic evolution in the Ivrea zone, yet dry ('damp') crystallization and/or moderate amounts of assimilation may provide similar results. Complexly zoned garnets in shallow crustal siliceous plutonic rocks contain cores derived from the lower crust and magmatic overgrowth at shallow pressure [3]. Major and trace element zoning of such garnets provide insights into mineral growth rates, and ascent rates of hybrid siliceous magmas from the lower to the upper crust.

(1) Hacker, Kelemen & Behn (2015), *Annual Reviews of Earth and Planetary Sciences* 43, 167-205.

(2) Müntener & Ulmer (2018), *American Journal of Science* 318, 64-89.

(3) Devoir, Bloch & Müntener (2021), *Earth and Planetary Science Letters* 560, 116771.