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Melt- rock reaction at oceanic peridotite-gabbro transition, through combined EBSD and in-situ mineral geochemistry on the Erro Tobbio peridotitic body (Ligurian ophiolites, Italy).

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Several lines of evidence have stressed that melt-rock reactions acting at the oceanic mantle-crust boundary play an important role in the chemical evolution of MORBs and the formation of the primitive (olivine-rich) lower oceanic crust. To address this issue, we performed detailed structural analyses and in-situ mineral geochemistry on the Erro-Tobbio (ET) ultramafic unit (Ligurian Alps, Italy), where impregnated mantle peridotites are primarily associated to a hectometre-size mafic body composed of troctolite to plagioclase-bearing wehrlite. The troctolitic body exhibits high complexity, with a host troctolite (Troctolite A) crosscut by troctolitic decametre-size pseudo-tabular bodies (Troctolite B). These different generations of troctolites show distinct modal compositions and textures. The host troctolite A displays a dominant millimetre-size corroded granular texture of olivine associated with dunite pods and a layering defined by poikilitic plagioclase enrichment. The contact between the mafic body and the host mantle peridotites is irregular, and defined by troctolite to wehrlite apophyses. The troctolite A shows microstructures and Crystallographic Preferred Orientation (CPO) indicative of a formation after impregnation of a mantle dunite by an olivine-undersaturated melt. This impregnation leads to olivine dissolution, associated with poikilitic plagioclase and clinopyroxene crystallization. This is indicated by a progressive randoming of the Axial-[100] CPO with olivine disaggregation and increasing melt input in the troctolite. The crosscutting troctolite B exhibits significant olivine textural variation, from fine-grained granular to deformed coarse-grained skeletal olivine. Olivine in the troctolite B shows CPO indicative of crystallization after magmatic flow, intrusive into the host troctolite A. Both troctolite types display large major and trace element variations in minerals, e.g. variation of Anorthite content (An = 54-67) in plagioclase at rather constant Forsterite content in olivine, and significant Zr, Ti, HREE heterogeneity in olivine, systematically correlated with the textural variability (e.g. corroded deformed vs. undeformed granular olivine). These features indicate that reactive crystallization had an important role in the origin of the ET troctolites. We infer that the textural heterogeneity of olivine in the troctolite B is related to variations in the degree of undercooling and cooling rate of the melt (Faure et al, 2003). The skeletal olivine crystallization could correspond to the influx of a more primitive melt into a colder host troctolite, followed by evolution of the melt leading to formation of fine-grained euhedral crystals. Overall, the results of this study suggest a poly-phase formation of this hectometre-scale gabbroic body, involving impregnation of a mantle-derived dunitic body followed by intrusion of undercooled primitive melts.

Faure, F., Trolliard, G., Nicollet, C. & Montel, J.M. (2003), A developmental model of olivine morphology as a function of the cooling rate and the degree of undercooling. Contrib. Miner. Petrol. 145:251–263.