SIEVE STRUCTURE AND SECONDARY COMPOSITIONAL ZONING IN GARNET FROM MAFIC GRANULITES OF THE GFÖHL UNIT, MOLDANIBIAN ZONE, LOWER AUSTRIA

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We report on peculiar sieve structures and associated secondary compositional zoning of garnet from mafic granulites at the contact zone towards felsic granulites found in the Gföhl unit of the Dunkelsteiner Wald. The garnets are up to a few millimetres in size and are partially replaced by plagioclase and subordinate clinopyroxene. Micro-CT revealed that in 3D the plagioclase forms several 10s of micrometres wide and several 100 of micrometres long finger-like corrosion tubes, which produce the sieve-like microstructure in 2D sections. Around the corrosion tubes a concentric compositional zoning developed in the relic garnet with a decrease of X_{gro} from 0.4 to 0.18 and a concomitant increase of X_{pyr} from 0.40 to 0.52 and of X_{alm} from 0.20 to 0.30 along traverses from the original garnet to the interface with the corrosion tubes.

This secondary zoning is ascribed to intracrystalline diffusion in the course of partial replacement and re-equilibration of the garnet. The enrichment halo of Fe extends substantially deeper into the garnet than the depletion halo of Ca, which is compatible with the notion that $D^*_{Fe} > D^*_{Ca}$, where D^* means tracer (self) diffusion coefficient. This leads to a local minimum in Mg-concentrations at the position, where Fe has already arrived and Ca has not yet left. Within the framework of vacancy mediated multicomponent interdiffusion in an ionic crystal, the observed compositional patterns allow to constrain the proportions of D^*_{Fe} / D^*_{Mg} / D^*_{Ca} . Linking these ratios to experimentally determined tracer self diffusion coefficients yields durations on the order of 10^2 to 10^4 years , depending on the choice of the experimental calibration, for the corrosion/re-equilibration event. In any case, this is extremely short as compared to what is expected for the duration of thermally controlled processes in the lower crust. We infer that the corrosion and re-equilibration of the garnet is linked to the juxtaposition of relatively hot mafic and comparatively cool felsic units in a supra-subduction zone setting. On its way to shallower crustal levels, previously subducted and now buoyant felsic material sampled fragments of the mantel during its passage through the mantle wedge. Corrosion and re-equilibration of the garnets from the mafic granulites was driven by chemical interaction of the mafic rocks with the surrounding felsic lithologies, whereby the mafic rocks hosting the garnet started to loose heat into the felsic lithology and cooled immediately after juxtaposition. The secondary zoning of garnet thus testifies to a relatively short lived thermal perturbation at generally high temperatures caused by the buoyancy driven ascent of felsic lithologies in a supra-subduction setting.