

Mass transfer and trace element redistribution during hydration of granulites in the Bergen Arcs, Norway.

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The Bergen Arcs located on the Western coast of Norway are characterized by Precambrian granulite facies rocks partially hydrated at amphibolite and eclogite facies conditions. Over an area of ca. 1000 km², relict of granulite facies lenses make up only ca. 10% of the observed outcrops. At Hilland Radøy, granulite displays sharp hydration fronts across which the granulite facies assemblage composed of garnet (55%) and clinopyroxene (45%) is replaced by an amphibolite facies mineralogy defined by chlorite, epidote and amphibole. The major element bulk composition does not change significantly across the hydration front, apart from the volatile components (loss on ignition, LOI) that increases from 0.17 wt.% in the granulite to 2.43 wt.% in the amphibolite (Centrella et al., 2015). The replacements of garnet and clinopyroxene are pseudomorphic indicating a perfect preservation of the parent crystal shape. The textural evolution during the replacement is consistent with the coupled dissolution-precipitation mechanism where garnet is replaced by chlorite, epidote and pargasite and clinopyroxene by hornblende and quartz. Based on the observations of an isovolumetric replacement, the mass loss during hydration was estimated at 13%.

This study is based on the trace element redistribution during the hydration using the same samples as Centrella et al. (2015). The local mass transfer during the replacement process determined from the major element is also confirmed by the trace element redistribution. The LILE, HFSE and REE losses and gains in replacing the garnet are approximately balanced by the opposite gains and losses associated with the replacement of clinopyroxene. Because the hydration involves reduction of rock density, the volume preservation (isovolumetric reaction), together with the mass balance calculations, requires a significant loss of the mass of the rock to the fluid phase: 13% based on the major element redistribution and around 20% based on the REE losses. This suggests a mechanism for coupling between the local stress generated by hydration reactions and mass transfer, dependent on the spatial scale over which the system is open.

Centrella, S., Austrheim, H., and Putnis, A., 2015, Coupled mass transfer through a fluid phase and volume preservation during the hydration of granulite: An example from the Bergen Arcs, Norway: *Lithos*, 236-237, p. 245–255, doi: 10.1016/j.lithos.2015.09.010.