Mutual interaction of felsic granulite with cm-scale mantle xenoliths in HT conditions (St. Leonhard granulite massif, Lower Austria)

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Centimeter-scale fragments of (ultra-) mafic lithologies - garnet pyroxenites and peridotites - are present in the St. Leonhard granulite massif (Lower Austria) where spectacular reaction textures can be observed at the contact of these contrasting rocks. This allows to study the diffusion-related processes that appear at their borders on micro-scale.

The host felsic granulite is composed of K-feldspar, plagioclase, quartz, garnet and orthopyroxene, presence of garnet clusters with spinel and corundum inclusions indicate that kyanite used to be a part of the mineral assemblage. Garnet pyroxenite is composed mainly of garnet and clinopyroxene, garnet is partially replaced by amphibole-plagioclase symplectite with minor biotite. The xenolith and is surrounded by ~2 mm thick layer of orthopyroxene-plagioclase symplectite. This corona shows zoning with decrease of XMg in orthopyroxene (0.76→0.72) and increase of anortite content in plagioclase (47→35%) towards the felsic granulite. Garnet grains often continue across the border of the pyroxenite to the symplectite corona, implying that the symplectite layer was formed at the expanse of the pyroxenite rather than to growth from its surface towards the felsic matrix. Such garnet shows strong XMg modification from 0.72 in the xenolith to 0.48 at the contact with the quartz-rich matrix. Rare peridotite xenoliths composed of olivine are surrounded by an orthopyroxene corona sometimes accompanied by phlogopite. This layer shows pronounced zoning defined by XMg decrease (0.88→0.75) and Al increase (0.05→0.12 apfu) from olivine to the granulite. In the vicinity of the mafic xenoliths, ~2 mm wide zone depleted in K-feldspar occurs, indicating diffusion of K from the granulite to the mafic xenoliths, which is consistent with growth of amphibole and biotite inside of the coronas and xenoliths.

Assuming that the orthopyroxene-plagioclase symplectite layer is formed at the expanse of the pyroxenite as a consequence of metasomatism at the contact with the felsic host, the bulk rock chemistry of both primary and modified lithologies was compared. The most important change is noticeable loss of Ca accompanied by gain of Si. Additionally, the corona is slightly enriched in Na and Fe and depleted in Mg.

The P-T conditions of the interaction were deduced from P-T pseudosection constructed for the composition of the host felsic granulite with well equilibrated mineral assemblage (garnet, K-feldspar, plagioclase, quartz and orthopyroxene) giving ~ 870–970 °C and 11–13 kbar.

Based on the conclusion that there was considerable influx of Ca from the mafic xenoliths to the felsic matrix, P-X pseudosection was constructed showing the effect of Ca-loss on the mineral assemblage of the orthopyroxene-bearing felsic granulite. This diagram is showing that decrease of CaO contenty by c. 40% (2.94 to c. 1.80 mol. %) leads

to destabilisation of orthopyroxene and formation of kyanite in the P-T conditions of interest. This is consistent with the observation of kyanite pseudomorphs (garnet clusters with spinel and corundum inclusions) indicating that the orthopyroxene-bearing felsic rock represents originally typical kyanite-bearing felsic granulite that was chemically modified during the interaction with the mafic lithologies.

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