Reaction textures in contact-metamorphosed xenoliths; implications for the tectonothermal evolution of the Seiland Igneous Province, Norwegian Caledonides

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Abstract: Contact metamorphosed pelitic xenoliths in metagabbro from the Seiland Igneous Province, North Norwegian Caledonides, contain high-T assemblages which include orthopyroxene, cordierite, spinel, garnet, quartz, ilmenite, corundum and feldspars. Re-equilibration of the contact metamorphic assemblages include the development of sillimanite coronas on spinel, ilmenite and corundum, the replacement of cordierite and spinel by garnet and sillimanite, and the partial replacement of cordierite by symplectites consisting of orthopyroxene + Al$_2$SiO$_5$ + quartz. The reaction textures are consistent with a substantial pressure increase after cooling from the peak conditions. Compositional zoning in garnet and adjacent cordierite is characterized by decreasing $X_{Fe}$ where the minerals are in mutual contact, which is consistent with a $P$-$T$ evolution involving compression. In nappe terranes such as the Caledonides, loading may be interpreted in terms of crustal thickening during overthrusting. The compression is interpreted as recrystallization in response to emplacement of structurally higher units on top of the Seiland rocks during the Caledonian orogeny.

Key-words: Caledonides, contact metamorphism, granulite, phase relations, $P$-$T$ path, reaction textures, Seiland Igneous Province (Norway), thrust emplacement.

Introduction

Deep-seated mafic and ultramafic plutons of the Seiland Igneous Province (Fig. 1), North Norwegian Caledonides, were emplaced in metasediments and paragneisses at various stages during late Precambrian and early Cambrian. The intrusions commonly contain inclusions of the host paragneiss, which range from small xenoliths to larger rafts (several tens of meters in length). In the south-eastern part of the Seiland Igneous Province contact metamorphism of the xenolithic inclusions and the host paragneiss took place at crustal levels corresponding to 5-7 kbar (Elvevold et al., 1994). The contact aureole of the host paragneiss has re-equilibrated to post-peak temperature assemblages comprising biotite, sillimanite, garnet and K-feldspar in addition to quartz and plagioclase. Relics of contact metamorphic phases (spinel + quartz) are only present as inclusions in porphyroblasts of garnet and sillimanite (Elvevold et al., 1994). The mineral assemblages in the pelitic xenoliths enclosed in metagabbro reflect higher equilibrium temperatures than those of the contact aureole. This paper presents new microtextural and phase equilibria data on contact metamorphosed pelitic xenoliths within a metagabbro in the Øksfjord-Langfjord area (Fig. 2). The early high-$T$ assemblages within the xenoliths are well preserved and include orthopyroxene, cordierite, spinel, garnet, quartz, ilmenite, corundum and feldspars. The complex mineralogy in the xenoliths reflects local equilibrium domains and incomplete recrys-