ABSTRACT

St. Leonhard and Dunkelsteiner Wald granulite massifs (Bohemian Massif, Lower Austria) are dominantly formed by kyanite-bearing felsic granulites hosting mantle bodies (from a few cm to several km) including garnet clinopyroxenites. Their contact is sometimes accompanied by intermediate and mafic granulites traditionally interpreted as the metamorphic products different to protoliths of kyanite-bearing felsic granulites. According to the detailed petrography, phase-stability modelling, and whole-rock geochemistry and Sr–Nd isotopic data, this research suggests the metasomatic origin of at least some of these transition granulites as the consequences of the metasomatic interaction between kyanite-bearing felsic granulites with garnet clinopyroxenites.

The evidence of metasomatism in garnet clinopyroxenites are Ba- and/or Cl-rich minerals in the matrix or as a part of multiphase solid inclusions (MSI). The presence of Ba-, Ti-, and Cl-rich micas (Ba-rich phlogopite to chloroferrokinoshitalite to oxykinositalite), Cl-apatite, goryainovite, and carbonates indicating high-Cl and -CO_2 activity and low-H_2O activity in metasomatizing fluids/melts. According to the whole-rock geochemistry and Sr–Nd isotopic composition, garnet clinopyroxenites show signs of derivation from mantle peridotites due to metasomatism by fluids derived from the oceanic part of the subducting Saxothuringian plate with variable overprinting by fluids and/or melts coming from the Saxothuringian felsic metaigneous crust (presumed protolith of the felsic granulites), which could have caused the transformation some of the garnet clinopyroxenites to mafic granulites.

The formation of mafic granulites required movement of Mg, Al and, especially, Ca from the garnet clinopyroxenites to the kyanite-bearing felsic granulites and migration of K and Na in the opposite direction, which caused the breakdown of clinopyroxene and formation of symplectite textures (plagioclase ± clinopyroxene ± orthopyroxene ± amphibole). For the formation of intermediate granulites, the addition of Mg, and especially Ca to the kyanite-bearing felsic granulites from garnet clinopyroxenites was required, leading to the breakdown of the Al_2SiO_5 phase and stabilization of orthopyroxene. The migration of K from the felsic host to garnet clinopyroxenites is reflected by K-feldspar-poor haloes around small mantle xenoliths and K-rich net along plagioclase in the matrix of mafic granulites.

The metasomatic interactions associated with the growth of the reaction textures and changes in mineral associations are estimated to ~900–1100 °C and 1.0–1.5 GPa. The duration of coronae growth around mantle xenoliths up to several cm across was 13–532 ka.