Petrology of variscan low-pressure granulites and migmatites from the Moldanubian Superunit, Upper Austria

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Introduction

The investigated low-pressure granulite facies rocks from 1. the Danube valley (west of Linz), 2. the Muehlviertel area (northwest of Linz) and 3. the Sauwald area (south of the river Danube) represent characteristic migmatitic parageneses of the Bavarian Unit, parts of the Moldanubian Superunit with a late low-pressure/high-temperature overprint. Most of these rocks underwent high degrees of melting forming meta-anorthosite ("Perlogneise"). Al-rich metamorphic migmatites (cordierite-garnet-sillimanite-granulites) with partly cm-sized garnet porphyroblasts can be found in some of these units. The migmatite parageneses and the cordierite-garnet-sillimanite-granulites as well as some mafic granulites were used for geothermobarometry (Stoffregen Version 2.34, Berman, 1991) (Figure 2.3-5.6). Metamorphic conditions of around 770°C to 850°C and 0.5 to 0.6 GPa were obtained. Particularly the cordierite-garnet-sillimanite bearing felsic granulites were used to calculate pseudosequences (PerpleX 6.6.8) for determining the P-T evolution of the granulites. The consumption of garnet and formation of cordierite, sillimanite and spinel is compatible with temperature increase at near constant pressure. Peak conditions are around 750°C to 850°C and 0.4 to 0.6 GPa.

1. The Danube valley

The samples taken along the Danube valley (red samples in Figure 1) are the typically Al-rich cordierite-garnet-sillimanite-granulites and contain the largest garnets of the investigated samples. Two of the samples (MA-3 and MU05-16) were used to calculate metamorphic PT-conditions (Figure 2, 3). A sample with large garnets displaying conspicuous zoning (Figure 4) was investigated in detail. A chemical zoning profile across the ca. 6 mm large garnet displayed elevated Ca-Ma-content (XGPa=0.23, XSpr=0.12) in the central part which decreased continuously towards the rim to XGPa=0.03 and XSpr=0.01. Alm and pyrope component in the core are XGPa=0.65 and XSpr=0.03, respectively and increase towards the rim to XGPa=0.85, XSpr=0.10 which is opposite to the granulite and spessartite components.

2. The Muehlviertel area

The Muehlviertel is the northern part of the investigated area (green samples in Figure 1), northwest of Linz and north of the river Danube. Compared with the samples from the Danube valley most of the garnets are consumed by cordierite. The small garnet grains (<500μm) have a homogeneous almandine rich composition. They display a single-phase growth, a slightly increase of iron and decrease of magnesium at the rim typical for retrograde diffusion zoning during cooling. Four of these samples were used for geothermobarometric calculations (Figure 5, 6).

3. The Sauwald area

The investigated samples from the Sauwald area (blue samples in Figure 1) are the typical "Weramock" migmatites (Figure 7) and contain no garnet, but a high amount of cordierite and biotite. The metamorphic conditions in this area were obtained by Tropper et al. (2006). The values of the peak conditions of 750°C, 840°C and 0.29-0.53 GPa, which are similar to the calculated conditions of the Danube valley samples (Figure 2, 3).

Figure 1. Geothermobarometric map of the Danube valley, Muehlviertel and Sauwald with the three key-facies systems of this area (black, fuchsi and blue-facies) and positions of sampled locations. The small SGM shows the shape of the federal state of Upper Austria.

Figure 2. Geothermobarometric map of the Danube valley, Muehlviertel and Sauwald with the three key-facies systems of this area (black, fuchsi and blue-facies) and positions of sampled locations. The small SGM shows the shape of the federal state of Upper Austria.