EVOLUTION OF UPPER MANTLE BENEATH BOHEMIAN MASSIF, LOWER AUSTRIA AND BENEATH AUSTROALPINE BASEMENT IN ULTENTAL, NORTHERN ITALY: A COMPARISON

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Bohemian Massif: The peridotitic rocks are mainly garnet lherzolites, garnet-spinel lherzolites and harzburgites containing occasionally phlogopite and amphibole. They occur as lenses within granulites. Generally peridotites are highly serpentinized and therefore a textural characterization is difficult. However, specimens with very low degree of serpentinization from Weitenegg and Meidling im Tal exhibit protogranular and transitional porphyroclastic to equigranular textures respectively. Fine grained garnets are in many cases totally kelyphitized whereas coarse grained up to 5 cm garnets are only randomly kelyphitized. Common garnet inclusions are ol, opx and cpx. Cr-rich spinel (Cr/Cr+Al = 0.33) enclosed by garnet has been found only in peridotites from Meidling im Tal. Garnets are typically pyrope-rich with Py_{66} and with Cr_2O_3 up to 2.8 wt % in the spinel-free rock type and up to 0.72 in the garnet spinel rock type. Temperatures and pressures were estimated by simultaneously applying selected geothermometers and geobarometers as discussed by BREY & KÖHLER (1990) and KÖHLER & BREY (1990). Core garnet and orthopyroxene composition yield T-P-equilibrium conditions for garnet-spinel harzburgites of 900 °C and 19.5 kbar. A pressure of about 32 kbar and temperature of 1070 °C has been obtained for the spinel-free garnet peridotites. This is consistent with those estimated using other formulations by CARSWELL (1990). Orthopyroxene rims in contact with garnet for both peridotite types yield a pressure of 13.5 kbar and a temperature of 810 °C consistent with the equilibrium P-T conditions of the surrounding granulites as estimated by PETRAKAKIS (1993). REE and trace elements in the less serpentinized garnet spinel peridotites from Meidling im Tal (L.O.I. less than 2.0 wt %) are consistent with an origin as a residue in the upper mantle after variable degrees of partial melting and melt extraction. The La/Yb values between 1.8 and 2.2 indicate a LREE enrichment. The Tb/Yb ratio of 0.17 implies that the melt extraction took place in the garnet and not in the spinel lherzolite field (BODINIER et al., 1988).

Ultental: The peridotitic rocks consisting mainly of fine and coarse grained garnet-bearing and garnet-free spinel lherzolites and harzburgites which occur as lenses embedded within metasediments and metabasites of the Ultental basement (OBATA & MORTEN, 1987; NTAFLOS et al., 1993). Protogranular and porphyroclastic textures are typical for the coarse grained type and porphyroclastic and equigranular textures for the fine grained type. Peridotites are occasionally cut by veins, up to 1m thick, consisting of garnet clinopyroxenites and very rare garnetites up to 10 cm thick. Garnet is pyrope-rich with Py_{65} and Cr_2O_3 up to 1.10 wt % showing variable degree of kelyphitization. Cr-rich spinel (Cr/Cr+Al up to 0.45) is always enclosed by garnet. Equilibrium T-P conditions of 780 °C and 18 kbar were calculated using formulations for geobarothermometers as discussed by BREY & KÖHLER (1990). Major, trace and REE elements confirm the existence of a wide range of compositions from depleted spinel harzburgites to fertile garnet spinel lherzolites. The linear correlation between Ni-MgO, Yb-Al_2O_3, and CaO-Al_2O_3 (MORTEN & OBATA, 1991; NTAFLOS et al. 1993) is consistent with an origin in a homogeneous upper mantle source after variable degrees of partial melting and melt extraction (FREY at al., 1985). Model melt calculations using bulk FeO, MgO concentrations and Fo in Olivine (HANSON & LANGMUIR, 1978) indicate that the inferred melts appear to be picritic and originated in the garnet peridotite field. The Tb/Yb ratios which are much less than unity imply that major melting processes took place in the garnet and not in the spinel lherzolite field. Whole rock $^{143}Nd/^{144}Nd$ isotopic ratios for fine grained type yield ϵ^{O}_{Nd} values between 0.04 and 1.33 whereas the coarse grained type yield ϵ^{O}_{Nd} values between 5.56 and 16.37. In contrast to the $^{143}Nd/^{144}Nd$ ratios, the $^{187}Os/^{186}Os$ ratios are relatively homogeneous for all type of rocks with ratios between 0.98000 and 1.0985. Further isotopic analyses on minerals will be needed for interpretation of the scattering of the Nd isotope signatures. An age of 339 ± 3 Ma has been obtained in one sample using the Sm-Nd garnet-whole rock method.

Conclusions: Bohemian and Ultental peridotites are different in many respects:

1. The Bohemian peridotites with same exceptions are heavily serpentinized. The Ultental peridotites are not very serpentinized.
2. Bohemian peridotites have experienced higher equilibrium temperatures and pressures than the Ultental peridotites.
3. Bohemian peridotites are derived primarily from the garnet peridotite field with the exception of the garnet spinel peridotites from Meidling im Tal which probably come from the transition zone between garnet and spinel peridotite field. The Ultental peridotites come from the transition zone between garnet and spinel peridotite field.
4. Tb/Yb ratios from both units indicate that partial melting took place in the garnet and not in the spinel peridotite field.
5. The peridotites from Bohemian Massif yield Sm-Nd garnet-whole rock ages of 370 Ma (BECKER, 1993) whereas from Ultental an age of 339 Ma is obtained.

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METAMORPHIC EVOLUTION OF MOLDANUBIAN ROCKS

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Despite differences in lithology between the Bunte Series and the Gföhl Unit, common rock types within both units show paragenetic similarities that suggest comparable conditions of metamorphism. The assemblage Grt + Bi + Sill + Kfs + Plg + Q + Ilm + Ru (A), is common in migmatic gneisses within the "Bunte Serie", in blastomylonic rocks comprising the tectonic boundary ("Granulite-lamella") between the "Monotone Serie" and "Bunte Serie", as well as in the Gföhl gneiss and the acid granulites (PETRAKAKIS & RICHTER, 1990). These types of rocks share further paragenetic and textural features such as (a) homogenised garnets showing cooling-and-resorption affected rims, (b) inclusions of kyanite, white mica, potash feldspar, quartz, plagioclase, rutile and biotite within garnet, (c) polymorphic transformation of kyanite into sillimanite and, (d) ilmenite overgrowing rutile. Nevertheless, textural differences among these rock types are also apparent and probably related to their tectonic position within the granulite terrain. Acid granulites and the rocks of the "Granulite-lamella" exhibit typical blastomylonitic fabrics characterised by sharp compositional banding (dark-coloured, Bi + Grt Sill-bands alternating with light-coloured, Fsp + Q-bands) and the occurrence of (a) porphyroclastic garnet and, occasionally, kyanite, (b) coarse-grained augen-perthite and, (c) ribbon-quartz, within a fine-grained matrix composed of quartz, feldspars, biotite, sillimanite, ilmenite and rutile. On the other hand, the gneisses of the "Bunte Serie" and the Gföhl-gneiss commonly show syn-tectonic migmatic features and are generally medium-grained. Textural transitions to intensively deformed fabrics with ribbon-quartz are occasionally developed at some margins of the latter rock type. This observation and the geochemical similarity between Gföhl-gneiss and acid granulites (VELLMER, 1992) suggest that the blastomylonitic granulites, which generally occur at the highest tectonic position within Moldanubia, represent a "tectonic facies" of the widespread Gföhl-gneiss.