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ECLOGITES WITHIN THE MONOTONOUS SERIES OF THE BOHEMIAN MASSIF: EXAMPLES FROM SOUTH BOHEMIA AND LOWER AUSTRIA

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In the southern Bohemian Massif high pressure mafic and ultramafic rocks (eclogites, garnet peridotites and garnet pyroxenites) are generally found within the acid granulite massifs. However, small bodies of overprinted eclogites, garnet pyroxenites and spinel peridotites are also known from the outcrop area of the Monotonous Series migmatitic cordierite-sillimanite-K-feldspar gneisses.

In Lower Austria blocks of overprinted eclogite are recorded from the Ostrong Unit in the area between Nussendorf and Prinzendorf, NNW of Ottenschlag and around Sallingberg (all map sheet 36, Ottenschlag) and close to the Rastenberger Granodiorite at Gutenbrunn (sheet 19, Zwettl). The majority of sampled metaeclogites once contained the high pressure assemblage garnet + omphacite + quartz + rutile + kyanite ± (clino)zoisite. All have suffered a major static recrystallisation at lower pressure conditions with the most prominent having occurred at granulite facies conditions. Garnet was replaced by very fine-grained intergrowths of orthopyroxene + spinel + calcic plagioclase; omphacite broke down to produce a symplectitic intergrowth of diopside + sodic plagioclase + orthopyroxene ± amphibole; former kyanite domains consist of almost opaque aggregates of tiny grains or needles of spinel ± corundum ± extremely Al-rich sapphirine set in anorthite; (clino)zoisite is pseudomorphed by aggregates of anorthite dusted by tiny Fe oxides; quartz has thick coronas of orthopyroxene (especially close to garnet) and rutile has been mostly replaced by ilmenite. In some metaeclogites all the primary phases (except quartz) have been totally replaced but with the original texture of the rock completely preserved thus confirming the static nature of the overprint. In less aluminous (kyanite ± zoisite-free) samples symplectites after omphacite are very fine-grained and contain small rounded aggregates (spots) comprising a core of orthopyroxene and a rim of clinopyroxene of a third composition.

The rocks found close to the Rastenberger Granodiorite show a late-stage development of Fe-rich olivine (Fo_{45}) $\pm$ spinel ($X_{\text{Mg}} = 0.35$) + calcic plagioclase within and around garnet. Such a low pressure pyroxene hornfels facies overprint is also known in Moldanubian Zone metaeclogites from South Bohemia (Klec), NE Bavaria (Winklarn) and the Black Forest.

Unusual metapelites associated with the metaeclogites near Sallingberg contain relics of kyanite and large pyrope-rich garnets that pre-date the widespread low pressure event. Kyanite shows a variable degree of transformation to sillimanite but also has reaction rims of spinel $\pm$ corundum + plagioclase with closely associated staurolite (post spinel?): the whole domain is surrounded by cordierite. A thick rim of cordierite ($\pm$ vermicular quartz) is also found consuming garnet.

Lenticular and tabular mafic and ultramafic bodies up to a few hundred metres in extent have recently been discovered within the structurally uppermost part of the Monotonous Series, close to the border of the Český Krumlov Varied Series, around the village of Světlík in southern Bohemia. Petrographic observations combined with mineral and whole rock analyses allow a subdivision of the mafic members into: common quartz-free eclogites; quartz $\pm$ kyanite $\pm$ (clino)zoisite eclogites; garnet-hornblende-clinopyroxenites and metagabbros. Quartz-free eclogites generally retain more primary-textured clinopyroxene than quartz-bearing samples but still a considerable proportion of the jadeite content has been lost during lower pressure overprint as blebs and laths of plagioclase and amphibole + plagioclase always intervenes between garnet and pyroxene. The garnet-hornblende-clinopyroxenites consist of more magnesian garnet (50 - 60 mol% pyrope) sitting in a matrix of diopside and pale yellow-green magnesio-hornblende. This amphibole clearly replaced pyroxene but this represents an early hydration reaction, probably still at relatively high pressure, and predates more darkly-coloured, significantly more aluminous, amphibole, derived from later garnet breakdown. The kyanite-bearing samples show virtually the same breakdown textures as described above from Austrian samples including considerable growth of orthopyroxene as well as the presence of exceedingly Al-rich sapphirine in the kyanite breakdown domain.

The term metagabbro describes coronitic mafic rocks with igneous relics but of various grain sizes including olivine-porphyritic basalt. Coronas are of orthopyroxene, amphibole $\pm$ spinel and garnet between olivine and plagioclase. A small ultramafic body is a serpentinised spinel lherzolite.

Surprisingly, even though the rocks suffered a major overprint at granulite facies conditions, some of the garnets still preserve overgrowth textures and growth zoning (e.g. core $\text{Alm}_{59} \text{Prp}_{13} \text{Grs}_{20} \text{Sps}_8$, near rim $\text{Alm}_{45} \text{Prp}_{28} \text{Grs}_{28} \text{Sps}_1$). Diffusion modeling of zoning at the rim of garnet and the degree of homogenisation of growth zoning suggest that the high temperature event was only of short duration. This is inconsistent with the sort of temperature-time paths expected for regional metamorphic events that reached the same peak temperatures.

The thermal and baric history recorded by these two series of eclogites is incompatible with that of their most common metapelitic host gneisses. Not only the high

pressure stage but also the granulite facies breakdown is absent in the gneisses. Only very rare metapelites contain evidence for an earlier medium to high pressure stage (kyanite relics, Mg-rich garnet) but these rocks are closely associated with the metaeclogites (a comparable situation exists in the Winklarn Series of NE Bavaria). An allochthonous position in the Monotonous Series is strongly suggested but it must be strongly emphasised that the eclogites described here are different in many respects to those found in the acid granulite-bearing Gföhl Unit which is widely accepted as being allochthonous. For example kyanite-, zoisite- and quartz-bearing eclogites are exceedingly rare in the Gföhl Unit and the preservation of parts of the prograde evolution, as described here, is also absent. The evidence thus strongly implies the presence of at least two allochthonous units with high pressure relics in the Bohemian Massif.

ENTWICKLUNG MOLDANUBISCHER GESTEINE IN ÖSTERREICH: EINE PERSPEKTIVE AUS DER SICHT DER METAMORPHOSE

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Ähnliche Mineralparagenesen in Gesteinen der Bunten Serie und Gföhler Einheit als auch geothermobarometrische Abschätzungen weisen auf ähnliche Metamorphosebedingungen während der letzten, herzynischen, hoch-metamorphen Überprägung. Die geringe Streuung der abgeschätzten Temperaturen (700 - 800° C) im Gegensatz zu der weiten Streuung des Druckes (7 - 11 Kbar) ebenso wie manche der auftretenden Texturen weisen auf annähernd isothermale Dekompression der Gesteine während dieser metamorphen Prägung hin. Frühe Stadien der retrograden Entwicklung werden durch annähernd isobare Abkühlung bei 550 - 600° C und 4 - 6 Kbar charakterisiert. Diese Entwicklung kann bis zu tieferen Temperaturen von ~400° C verfolgt werden. Der abgeleitete P,T-Weg entspricht P,T-Wegen wohlbekannter Granulitgebiete, die durch tektonische Verdickung von kontinentaler Kruste entstanden sind. Ein Kontinent-Kontinent-Kollisionsenvironment könnte für die Einstellung von granulitfaziellen Bedingungen im Falle der moldanubischen Granulite in Österreich verantwortlich gemacht werden. Deswegen werden die abgeschätzten Metamorphosebedingungen als Schliessungsbedingungen einzelner Proben bei $T_{\max}$ -Bedingungen interpretiert. Der hohe Grad der Metamorphose und die isobare Abkühlung der moldanubischen Gesteine weisen darauf hin, daß sie der unteren Platte angehören. Die Hebung der Gesteine aus ihrer beträchtlichen Metamorphosetiefe erfolgte durch langandauernde, regional übergreifende Extension der Kruste. Deswegen wird die letzte tektonische Aktivität, die für die vorliegende Prägung des Moldanubikums verantwortlich ist, als episodisch betrachtet. Vorliegende Metamorphosedaten über die Monotone Serie und das Moravikum werden zur Erstellung des P,T-Weges herangezogen. Die Auswirkungen dieses Entwicklungsmodells auf Systeme, die von Diffusion kontrolliert werden (Geothermobarometrie und Altersbestimmung), werden diskutiert.