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Evidence for fluid-melt immiscibility during partial melting in the Oberpfalz migmatites, Moldanubian Zone (Bohemian Massif)

Iris Wannhoff (1), Silvio Ferrero (1,2), Patrick J. O' Brien (1), Martin A. Ziemann (1), and Lutz Hecht (2)

(1) Universität Potsdam, Institut für Erd- und Umweltwissenschaften, Potsdam, Germany (sferrero@geo.uni-potsdam.de), (2) Museum für Naturkunde (MfN), Leibniz-Institut für Evolutions-und Biodiversitätsforschung, 10115 Berlin, Germany

The formation of a separate COH fluid is expected during crustal anatexis of graphite-bearing metasediments, and due to its low solubility in granitic melts, this may result in melt-fluid immiscibility conditions. The coexistence of primary melt and fluid inclusions in peritectic phases is the most secure evidence for primary immiscibility during anatexis. In this study primary fluid and melt inclusions in garnet have been characterized to investigate in detail this phenomenon during partial melting of metapelitic rocks from the Oberpfalz, Moldanubian Zone (Bohemian Massif). Partial melting of the Oberpfalz migmatites occurred via dehydration melting of biotite at 800-850˚C and 0.5-0.7 GPa. The Oberpfalz migmatites contain garnet, cordierite, biotite, plagioclase, K-feldspar, quartz, green spinel and accessory minerals such as ilmenite, rutile, graphite, apatite, monazite and zircon. At the microscale the presence of melt pseudomorphs, i.e. cuspate lobate grains of microcline, plagioclase, quartz and cordierite, is direct evidence for partial melting. Microstructural and microchemical investigation confirmed garnet as a peritectic phase, which formed simultaneously with the melt and trapped both fluid and melt as primary inclusions. The garnet shows a significant zoning in Ca with an M-shaped profile, interpreted to be due to various stages of growths at different PT conditions. The inclusions are concentrated in clusters in the Ca-poor core and rim of the garnet, and show anhedral to negative crystal shape, with size 5-25 μm. The fluid consists of mainly CH_4, $N_2$and minor CO_2 and H_2(COHN fluid), while the melt shows a granitic character as it crystallizes micas (biotite and muscovite), K-feldspar, albite/kumdykolite and quartz/cristobalite. The presence of CH_4 in fluid inclusions in garnet is rarely reported. The variable amount of CH_4 in these inclusions is interpreted to be the result of selective water-loss or post entrapment modifications. Siderite and calcite may be present in fluid inclusions and are interpreted to have formed during post-entrapment carbonation/hydration reactions between the fluid and the host garnet.