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Internal Microstructure and Breakdown of Garnet from Moldanubian Granulites (Gföhl Unit, Dunkelsteinerwald, Lower Austria)

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Symplectites in some conspicuous granulite facies rocks from the Moldanubian Gföhl Unit in Lower Austria show an unusual bulk composition with very high Mg, Ca contents and 14 mole% normative corundum. It contains garnet (XPyr>0,5), clinopyroxene (XMg: 14 mole%; XCaTs: 0,3), pargasitic hornblende (XMg: 17 mole%), and plagioclase (XAn>0,8). The primary microstructure is granular, medium-grained and well equilibrated. Clinopyroxene often shows exsolution lamellae and inclusions of amphibole and plagioclase.

Garnets of about 2-3cm size are common. Often they are resorbed and therefore significantly smaller. The large garnets display numerous inclusions, e.g. of kyanite. The garnets show internal deformation domains. The lattice orientations of the different domains show displacements around a common rotation axis approximately parallel to [211]. This points to incipient polygonalization of garnet during crystal plastic deformation at obviously high strain rates under high grade metamorphic conditions.

Along garnet margins and within cracks, various replacement symplectites were formed comprising distinct assemblages among orthopyroxen, spinel, anorthite, Al-rich amphibole, tschermakitic diopside, sapphirine and corundum. Symplectite formation was induced by decompression feature. The last peak metamorphic conditions of the Gföhl Unit has been estimated in previous studies with pressures and temperatures around resp. 8-11 kbar and 700-800°C. The rocks then experienced isothermal decompression followed by isobaric cooling around 5-6 kbar (e.g. Petrakakis 1997). The temperature during the formation of the symplectites has been estimated by garnet-orthopyroxene thermometry and resulted in values of approx. 700°C for the pressure-range of 5-6 kbar, indicating essentially isothermal decompression.

The rims of breaking down garnets adjacent to Opx+Spl+Pl-symplectite show diffusional zoning patterns allowing geospeedometry modelling. This zoning is continuous displaying increasing Fe and decreasing Mg towards the rim. Diffusion modelling gives a time interval for symplectite formation of about 1000 years, dating thus an instantaneous decompression event within the geological time frame. Preservation of the delicate symplectite microstructures and the lack of penetrative deformation are consistent with isobaric cooling at 5-6 kbar suggested earlier.