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Migmatite formation in a crustal-scale shear zone during continental subduction: an example from a high-pressure granitic orthogneiss from the Orlica–Śnieżnik Dome (NE Bohemian Massif)

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Petrological study and pseudosection modelling have been carried out in high-grade orthogneisses of the southern domain of the Orlica–Śnieżnik Dome (NE Bohemian Massif). The studied samples are from an outcrop dominated by two deformation fabrics, a sub-horizontal S1 foliation defined by bands of recrystallized K-feldspar, quartz and plagioclase folded by centimetre- to several metre-scale close to isoclinal folds associated with development of a new subvertical N-S trending foliation S2. Based on field features and textural observations, a gradual transition from banded mylonitic orthogneiss (Type I) to stromatitic (Type II), schlieren (type III) and nebulitic (type IV) textures typical of migmatities can be distinguished. The banded orthogneiss is composed of almost monomineral recrystallized K-feldspar layers (2 to 10 mm thick) alternating with layers of plagioclase and quartz (1 to 4mm thick), parallel to the S1 limb and the axial planar S2 foliation. The stromatitic migmatite shows 1 to 4 mm thick layers with macroscopically diffuse boundaries between plagioclase, quartz and K-feldspar rich domains. Boundaries between quartz and feldspar layers are poorly defined and interlobed with adjacent minerals. The schlieren migmatite is almost isotropic preserving small K-feldspar-rich domains within a matrix characterized by random distribution of phases, whereas in the nebulitic migmatite the microstructure is completely isotropic characterized by random distribution of phases. The transition from the Type I to IV is characterized by increasing nucleation of interstitial phases along like-like grain boundaries, by a decrease of grain size of all phases and by progressive disintegration of recrystallized K-feldspar grains by embayments of fine-grained myrmekite.
The mineral assemblage of all types consists of biotite, white micas, garnet, quartz, K-feldspar and plagioclase, and accessory apatite, ilmenite, zircon and monazite. In the mineral equilibria modelling, the core of garnet (alm0.58, py0.02-0.03, grs0.34, sps0.05) and phengite (Si = 3.38–3.20 p.f.u) is consistent with a P–T peak at $10^{-1}3$ kbar and 720−750°C in the dominant grt-bt-ph-rt-qtz-pl-kfs mineral assemblage. The garnet rim (alm0.68, py0.02-0.03, grs0.11, sps0.21), white mica rim (Si = 3.10 p.f.u) together with unzoned biotite (XFe = 0.76–0.78) match the modelled isopleths in the middle-P part of the grt-bt-ph-ilm-qtz-pl-kfs field to reach the solidus at 7−8 kbar and 630−650°C. In addition, the absence of prograde garnet zoning in the Type I to III suggests that the garnet was completely re-equilibrated during the retrograde history, whereas in the Type IV the HP garnet chemistry was preserved. This is discussed in frame of melt presence in different migmatite types along their P–T path. Based on mineral equilibria modelling it is argued for fluid/melt-fluxed melting at HP conditions and on exhumation. The migmatite textural types are a result of grain-scale melt migration process and not of a localized melt transport in dykes as known from metasediments.