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PUMPELLYITE WITHIN THE SCHNEEBERG COMPLEX (EASTERN ALPS): A RELICT OF PROGRADE METAMORPHISM ?

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Introduction

Indicators for alpine thrust tectonics are rarely preserved within metapelites of the Eastern Alps. Our study area, the Schneeberg Complex (SC), shows fine grained serizitic garnet mica schists, which are intense deformed in three dimensional scale. They occur adjacent to paragonite-hornblende metabasites metamorphosed at HP-LT conditions [1].
Textural observations of pumpellyite within recrystallized quartz grains suggest early prograde formation. These minerals are investigated by optical and scanning electron microscopy (SEM) and Raman spectroscopy and compared to a pumpellyite hornfels sample of California and data from literature. Exhumation history of the study area is determined by fluid inclusion data and quartz rheology.

Geological and structural setting

The Schneeberg Complex (SC) and its adjacent Ötztal Basement Complex (ÖC) are part of the Austroalpine tectonic unit and consist of medium to high-grade metamorphic rocks of varying tectonometamorphic history. Peak conditions of the eo-alpine overprint were reached in the Texel group with minimum pressures of ca. 1.2 GPa and 500–550°C, forming staurolite and kyanite up to eclogitic parageneses [2]. There, exclusively eo-Alpine Rb-Sr and K-Ar cooling ages are revealed around 100–80 Ma [3], whereas in central and north-western parts of the ÖC mixed ages and Variscan ages dominate (for overview see [4]).
The incorporated Schneeberg Complex includes Alpine staurolite growth and eo-Alpine pressure dominated metamorphism. At the NW margin of the SC, high pressure low temperature mineral assemblages, presented by paragonite-hornblende schists [4], reflect peak metamorphic conditions for the metabasic units within the central SC around 8–10 kbar and 550–600°C and yield Ar/Ar ages of 84.5 ± 1 Ma [5] for Eoalpine amphibolite facies conditions.
The study area within the Seewertal Valley defines the hanging wall limb of the Schneeberger main syncline that includes various lithologies with garnet-mica schists, amphibolites, quartzites and hornblende-garben schists and gneisses. Lithologies are intense prograde mylonitized followed by intense tight folding that occurs predominantly perpendicular to the main direction of stretch. Rims of garnet porphyroblasts, up to cm in scale, overgrow these mylonitic and folded layers that are embedded within a fine grained serizitic matrix. Garnets show rotated quartz inclusion patterns with straight grain boundaries, suggesting low differential stress during growth [6].

Petrography and microstructures of the studied metapelites

Structures are evaluated parallel and perpendicular to foliation (x-z and y-z sections). Within ductile deformed quartz layers (y-z-sections) pumpellyite, always included in biotite, occurs at fold hinge areas. Pumpellyite forms aggregates and lenses up to 0.4 mm in size. Optical properties are very similar to epidote with high relief and anomalous grey-brown birefringence.

By Raman Spectroscopy the pumpellyite is clearly distinguished from epidote and clinozoisite. Pumpellyite within hornfels from California is comparable to the studied crystals but reflects a distinct shift in wavenumber (Figure 1). This may be attributed to chemical differences between pumpellyites in hornfels rocks and metapelites [7].

Chemical analyses with the SEM show higher Mg contents in pumpellyite compared to epidote (around 3 wt.% MgO).

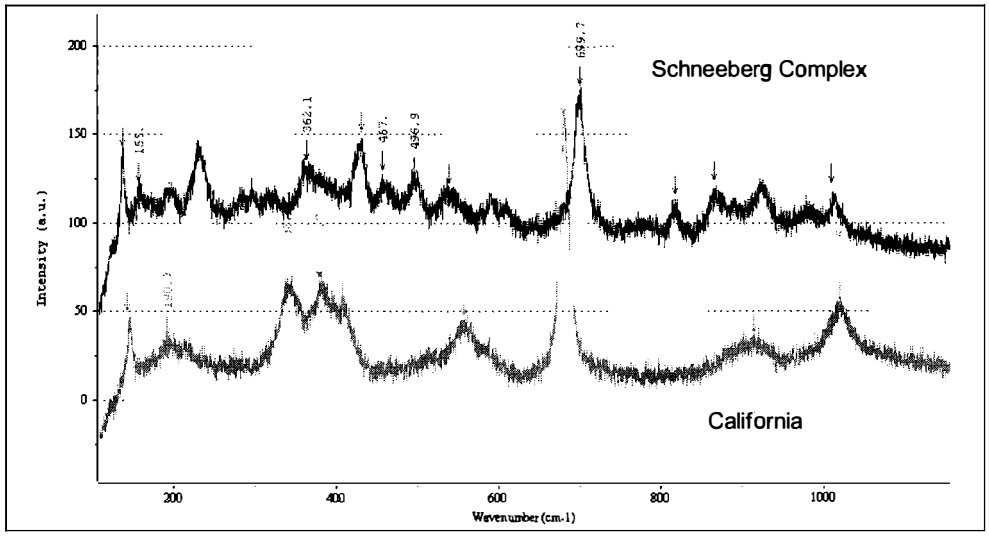

Figure 1

Raman spectra of pumpellyite within metapelite from the SC (black) and metabasite from California (grey).

Interpretation and conclusion

Prograde growth of pumpellyite within fold hinge areas of ductile deformed quartz aggregates is established. Host mineral quartz is recrystallized by grain boundary migration after peak metamorphism. Retrograde isothermal decompression down to low pressure and high temperature conditions, derived from combined fluid inclusions and quartz deformation textures, [8] contradict growth of pumpellyite during uplift within fold hinge areas of tightly deformed quartz layers. Therefore, the timing of formation is related to the crustal thickening of the Ötztal-Stubai Complex during onset of alpine thrust tectonics at ca. 120–100 Ma. [4].

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