Pectolite in calc-silicates from NE Sardinia, Italy: Evidence of metasomatism during Variscan metamorphism

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Pectolite has been found in two adjacent calc-silicate lenses (about 3 m in length and 11–15 m in width) enclosed in a sequence of multideformed migmatites from the Variscan metamorphic basement of NE Sardinia, near Tamarispa.

The migmatites are made up of plagioclase, biotite, quartz, ± fibrolite, ± garnet, and retrograde muscovite. The biotite content of migmatite greatly increases upon contact with calc-silicates, so that the latter rocks appear enveloped by a dark-grey shell of migmatite 20–50 cm thick.

Calc-silicates are characterised by weak schistose matrix and poikiloblastic garnet grains up to 15 cm in diameter.

Wollastonite, calcite (up to 20 %), small garnet crystals, diopside, pectolite, quartz, and minor plagioclase, epidote, apatite, and sphene have been identified in the matrix.

Poikiloblastic garnet contains small clinopyroxene and wollastonite inclusions, forming a millipede-like structure. Garnet is a poorly zoned grossularite (Grs=88–96%; Alm =4–9%) with low spessartine content. Clinopyroxene is salitic, with X_{Mg} = 0.60–0.71 and an Al_2O_3 content up to 1.20 %.

Wollastonite is essentially $CaSiO_3$ with minor FeO (<0.30 %) and Al_2O_3 (<0.10%) content. It is often partially replaced by calcite ± quartz, or more rarely, forms spectacular fine-scale intergrowth with calcite.

Pectolite occurs as fine-grained crystals growing in the microfractures of wollastonite and poikiloblastic garnet or as a thin, discontinuous rim, developed around wollastonite grains.

Calc-silicates share a common metamorphic and deformational history with the surrounding migmatite. Temperatures from 650 to 700 °C and pressures between 4 and 7 kbar have been determined using conventional thermobarometry on the migmatites of NE Sardinia (Franceschelli et al., 1989). Temperatures from 650 to 850 °C and X_{CO2} between 0.006 and 0.13 have been estimated by Elter and Palmeri (1992) in the calc-silicates.

Calc-silicates are crosscut by two types of veins (I and II):

i) type I veins, up to 8–10 cm thick and 4–5 m long, originating from the surrounding biotite-rich migmatite.

ii) type II veins, a few millimetres in thickness, often originating from type I veins.

Quartz, calcite, epidote, K-feldspar, Fe-rich- clinopyroxene, apatite, titanite, albite, and muscovite were found in the type I veins.

Calcite, pectolite, and quartz are the principal minerals in type II veins.

Pectolite has quite a homogeneous chemical composition, which on average, is: SiO_2 =54–55%, CaO =34–35%, Na_2O=7–8%.

The widespread growth of pectolite on wollastonite suggests a pectolite-forming reaction similar to that proposed by Heinrich (1993), wollastonite + HCl + $NaCl_{aq}$ = pectolite + $CaCl_{2aq}$, for the metacherts at the contact aureola of the Bufa del Diente intrusion (Mexico).

According to Heinrich (1993), this reaction is favoured by the infiltration of Na-K-rich metasomatic fluids.

In the calc-silicates from NE Sardinia the formation of pectolite occurs after metamorphic peak conditions and may be related to the circulation of fluid released during the final stage of melt crystallization in the surrounding migmatites.

References

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