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Quartz vein formation in the Agly massif, French Pyrenees: $^{40}Ar/^{39}Ar$ dating, mineral chemistry, and fluid inclusion study.

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Quartz veins in metamorphic basement rocks document periods of hydrous fluid mobility. Here, we present a study of vein formation in the Agly Massif, eastern French Pyrenees, which was subjected to metamorphism during the Hercynian and Alpine orogenies and during Mesozoic extension between the two (Siron et al., 2020).

In this study, fourteen quartz samples have been selected for $^{40}Ar/^{39}Ar$ dating of the fluids inside fluid inclusions (FIs) by stepwise crushing. The results are characteristic for this method: all samples show anomalously high ages in the first part of the experiments decreasing to essentially flat plateaus in the final steps. The plateau ages are interpreted as the time of quartz vein formation, ranging from 117 to 62 Ma, i.e., mid-Cretaceous to early Paleocene. The initial values indicate the presence of another trapped argon component, with $^{40}Ar/^{36}Ar$ intercepts >6000. An additional nine K-feldspar samples from the same veins are dated by incremental heating.

The quartz veins show considerable variation in mineral content, including feldspars, biotite, muscovite, chlorite, and minor amounts of epidote, almandine, apatite, ilmenite, titanite, and scapolite. Mineral assemblages including quartz, chlorites, epidote, muscovite point to crystallization in the greenschist facies around *ca* 300°C (Palin, 2020).

Preliminary FI data are collected from primary FIs occurring in vein quartz from the Souanyes and Bélesta areas. FIs from Souanyes are two-phase (liquid + vapor with constant ratio) aqueous inclusions with high salinity (26.0 $NaCl_{eq}$). FIs from Bélesta are aqueo-carbonic multi-phase inclusions (liquid water + gaseous phase, usually supercritical at room temperature ± a cubic salt ± a carbonate, measured using Raman spectroscopy). During microthermometric measurements, these FIs show metastable behavior (e.g., lacking salt re-nucleation after melting) or experienced post-trapping modifications (salt precipitation after cooling) that prevent to obtain an accurate salinity. However, a salinity of ca. 26.3 wt% $NaCl_{eq}$ can be deduced. The lack of freezing of the gaseous phase during cooling reveals the presence of contaminant gas (N_2, measured using Raman spectroscopy) within CO_2.

In summary, most quartz veins in the Agly massif formed during the Cretaceous, which is consistent with recent thermochronology (Odlum & Stockli 2019). The vein mineralogy points to emplacement in the greenschist facies of high-salinity aqueous fluids, locally with CO_2 and N_2.

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