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Albite vein formation during exhumation of high-pressure terranes: a case study from alpine Corsica

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ABSTRACT The formation of late-stage veins can yield valuable information about the movement and composition of fluids during uplift and exhumation of high-pressure terranes. Albite veins are especially suited to this purpose because they are ubiquitously associated with the greenschist facies overprint in high-pressure rocks. Albite veins in retrogressed metabasic rocks from high-pressure ophiolitic units of Alpine Corsica (France) are nearly monomineralic, and have distinct alteration haloes composed of actinolite + epidote + chlorite + albite. Estimated *P–T* conditions of albite vein formation are 478 ± 31 °C and 0.37 ± 0.14 GPa. The *P–T* estimates and petrographic constraints indicate that the albite veins formed after the regional greenschist facies retrogression, in response to continued decompression and exhumation of the terrane. Stable isotope geochemistry of the albite veins, their associated alteration haloes and unaltered hostrocks indicates that the vein-forming fluid was derived from the ophiolite units and probably from the metabasalts within each ophiolite slice. That the vein-forming fluid was locally derived means that a viable source of fluid to form the veins was retained in the rocks during high-pressure metamorphism, indicating that the rocks did not completely dehydrate. This conclusion is supported by the observation of abundant lawsonite at the highest metamorphic grades. Fluids were liberated during retrogression via decompression dehydration reactions such as those that break down hydrous high-pressure minerals like lawsonite. Albite precipitation into veins is sensitive to the solubility and speciation of Al, which is more pressure sensitive than other factors which might influence albite vein formation such as silica saturation or Na:K fluid ratios. Hydraulic fracturing in response to fluid generation during decompression was probably the main mechanism of vein formation. The associated pressure decrease with fracturing and fluid decompression may also have been sufficient to change the solubility of Al and drive albite precipitation in fracture systems.

Key words: albite veins; Corsica; exhumation; fluids; ophiolite; retrogression.

INTRODUCTION

Veins are one of the most visible manifestations of fluid flow. A large number of studies have focussed on utilizing the chemical, thermal and structural information that can be obtained from the study of veins to assess the degree of coupling between deformation, metamorphism and fluid flow (e.g. Yardley, 1983; Selverstone *et al.*, 1991, 1992; Bebout & Barton, 1993; Oliver, 1996; van der Klauw *et al.*, 1997; Agard *et al.*, 2000; Cartwright & Buick, 2000; Bons, 2001). This type of information can potentially help to constrain larger crustal-scale processes such as the initiation and propagation of faults and shear zones, partial melting processes at different levels in the crust and density changes in rocks during compaction and burial.

In general, veins represent complex geochemical systems whose character is dependent on a wide range of variables including: (1) the pressure and temperature of vein formation; (2) the chemistry of the vein-forming fluid; (3) the volume of fluid; (4) the scale of chemical transport; and (5) the mechanism of vein formation. In recent years two broad models of vein formation have been proposed. The first model, based largely on theoretical modelling has suggested that veins are the products of large-scale fluid flow systems (e.g. Wood & Walther, 1986; Ferry & Dipple, 1991; Bebout & Barton, 1993). The second model, based more on field and analytical data has suggested that veins are the products of small-scale fluid transport (Yardley & Bottrell, 1992; Slater *et al.*, 1994; Henry *et al.*, 1996; Cartwright & Barnicoat, 1999). In terms of the presence of veins in high-pressure metamorphic rocks, the later model has generally been favoured (e.g. Philippot & Selverstone, 1991; Getty & Selverstone, 1994). However, in general, the retrogression of high-pressure rocks is commonly associated with extensive veining that reflects the mobility of fluids during exhumation (Barnicoat, 1988; Bebout & Barton, 1989; Thomas, 1990, 1991; Barrientos, 1991; Philippot & Selverstone, 1991; Selverstone *et al.*, 1992; van der

