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Large-scale fluid flow patterns within the Corsican Ophiolite

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Abstract

Veins are a ubiquitous feature within the Corsican Ophiolite and attest to the production and movement of fluids at all metamorphic grades. However oxygen isotope data for the ophiolite indicates that there has been little fluid flow between different units of the ophiolite. In contrast, oxygen and carbon isotope data for matrix and vein calcite in the ophiolite suggest that the calcite is probably derived from CO_2-bearing fluids from the surrounding Schistes Lustrés. There does not appear to be any fluid flow in the opposite direction, from the ophiolite to the Schistes Lustres. Thus, whilst large-scale fluid flow from the Schistes Lustrés to the ophiolite probably occurred, this fluid flow was not pervasive. The disequilibration between the calcite and the whole rock suggests that fluid flow may have been rapid or confined to fracture systems.

Keywords: Ophiolite; stable isotopes; subduction; fluid flow

1. Introduction

It is widely acknowledged that fluids play a critical role in subduction zone processes. At high crustal levels, large amounts of fluid are released through compaction and dewatering, and the dehydration of low-temperature clays and micas. These fluids probably migrate back up the subduction zone to be expelled within the accretionary wedge, where they may cause large-scale metasomatism. At deeper crustal levels, fluids are released through devolatilisation reactions. These fluids are thought to play an integral role in mantle metasomatism and the generation of arc magmas. However, despite the increasing number of studies investigating fluid processes in subduction zones, the scale and direction of fluid flow and the size of fluid pathways in subduction zones is still a subject of debate. Numerous studies on the Franciscan terrane, USA, have advocated large-scale fluid flow at depth during subduction on the basis of trace elements, metasomatism and stable isotope systematics (Bebout and Barton, 1993). Other studies have provided compelling evidence for the absence of any significant fluid flow in high-pressure rocks from the European Alpine chain (Barnicoat and Cartwright, 1997). Whilst not necessarily mutually exclusive, it is difficult to use these studies, which have tended to investigate either one depth-level or one rock-type within the subduction zone, to develop a broader picture of regional fluid flow patterns in subduction zones. The recent study of Cartwright and Barnicoat (1999), which looked at the overall oxygen isotope systematics of the Zermatt–Saas ophiolite, addresses this problem by comparing its overall isotopic character with that of unmetamorphosed ophiolites. Gregory and Taylor (1981) showed that the oxygen isotope character of unmetamorphosed ophiolites varies in a systematic and predictable manner with depth. Elevated $\delta^{18}O$ values (>5.7‰) characterise the upper sections of the

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