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Fluid circulations and quartz ductile deformation in the depths of accretionary prisms: An integrated cathodoluminescence and infrared study

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To study the processes of deformation in the depths of accretionary prism, we have carried out a study in the Shimanto Belt, in Japan, considered as a fossil accretionary prism. There, the deep metamorphic terranes of the Hyuga and Morotsuka Group were pervasively deformed for conditions of $\sim$300 $^{\circ}$C and 3-5 Kbars. Quartz precipitated at depth was intensely deformed by ductile shearing, enabling to unravel the micro processes of deformation in presence of abundant fluid. Cathodoluminescence (CL) analysis revealed the presence of two distinct kinds of quartz, which we interpret as associated with two distinct fluids. One kind of quartz, blue in CL, precipitates in macro veins. The other kind of quartz, brown in CL, is found in micro veins as well as plastically deformed quartz domains. The distribution and speciation of water studied with FT-IR analysis is correlated to structures. Inherited grains, free from plastic deformation, contain a larger amount of water than strongly elongated grains. In addition, small and equant recrystallized grains contain an even smaller amount of water than elongated grains. In parallel, recrystallized grains are free from optically visible fluid inclusions, which are in contrast densely distributed in inherited and elongated grains. We also observed water speciation with the presence of characteristic picks at 3380 cm and 3480 cm^{-1}attributed to OH associated relatively with Al^{+3} and Li^{+1}. All samples always show the broad band centered at 3400 cm^{-1} related to "liquid-like" molecular water (H2O) in quartz but only the quartz blue in CL, present in veins, registered the signal in secondary picks. FT-IR and cathodoluminescence signals, in good agreement with each other, constitute consistent signatures of the two distinct kinds of fluids circulating at depth. Further study is required to determine the origin of these fluids. In addition, recrystallization plays a large role in redistributing water and impurities during plastic deformation. The effect on quartz rheology is unclear, as recrystallized grains are drier, hence potentially stronger, than inherited grains.