Geophysical Research Abstracts
Vol. 20, EGU2018-14580-1, 2018
EGU General Assembly 2018

Lawsonite formation and fluid redistribution along the seismogenic portion of the fossil Alpine subduction zone (Schistes Lustrés, W. Alps)

Benjamin Lefeuvre, Philippe Agard, Anne Verlaguet, and Benoit Dubacq

Sorbonne Université, CNRS-INSU, Institut des Science de la Terre, ISTeP UMR 7193, F-75005 Paris, France (benjamin.lefeuvre@upmc.fr)

Seismicity in subduction zones is increasingly linked to dehydration reactions occurring along the prograde metamorphic path during rock burial. Fluid-driven, kilometer-scale mass transfer (e.g., silica deposition) has also recently been hypothesized to modulate seismicity. How metamorphic reactions at the microscopic scale may trigger earthquakes, episodic or aseismic slip at the kilometric scale is however poorly elucidated.

This study reports on blueschist facies metasedimentary rocks buried to depths ($\sim$ 20-40 km) corresponding to the seismogenic zone of the paleo-Tethyan subduction (Alpine Schistes Lustrés, Western Alps). As these calcschists host huge amounts (up to 30 vol%) of hydrous minerals such as lawsonite or carpholite (re)crystallized over different generations, in veins as well as in the rock matrix, they are a good proxy to track fluid migration and mass transfer in this critical part of the subduction system. With 12 wt.% H_2O and only minor amounts of Ca in the pelitic part of the protolith, the formation of abundant lawsonite (CaAl2Si2O7(OH)2•[H_2O]) also questions the possibility of Ca mobilization from the carbonate fraction of the protolith and hence massive CO_2 release.

This contribution presents preliminary results on the sequence of crystallization with respect to deformation events and on fluid redistribution and geochemical variations, from the outcrop scale to the mineral/reaction scale. Based on detailed fieldwork and mineral textures, four types of lawsonite have been identified, with non-systematic cross-cutting relationships between them. The more abundant type of lawsonite is found within the schistose matrix surrounded by carbonates-rich layers. This lawsonite presents many rutile and organic matter inclusions and can be observed as black prisms within the schistosity. The veins contain generally two types of elongated, creamy colored lawsonite. The first type is observed within quartz-rich veins along growth planes, parallel to the selvage, whereas the second type is systematically associated with pseudomorphed ankerite (i.e. the Fe-Mg-(Mn)-rich carbonate). A fourth subordinate type is observed in places in the schistose matrix as white millimetric prims. Together with textural constraints, systematic sharp zoning observed in the various lawsonite types, with Ti-rich cores and Sr-rich rims, helps tracking reactions forming lawsonite. The main one appears to be of the type: chlorite + calcite/aragonite + O_2 = lawsonite + ankerite + quartz + hematite +2H_2O. This reaction, observed at both the mineral and outcrop scale (i.e. ankerite-rich domains are found on surfaces of carbonate horizons), suggests that major decarbonation of the system is not required to account for the formation of voluminous lawsonite.

These different lawsonite generations witness intense fluid circulation and redistribution of elements between hydrous phases, including between carbonate and pelitic layers. Our preliminary results point to the local redistribution and buffering of these fluids. Although this conclusion does not preclude the transfer of fluids passing through the rocks, large-scale mass transfer is not required to account for the various crystallization features observed.