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The dynamics of serpentinite dehydration reactions in subduction zones: Constrains from the Cerro del Almirez ultramafic massif (Betic Cordillera, SE Spain)

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Arc volcanism, earthquakes and subduction dynamics are controlled by fluids from downgoing slabs and their effect on the melting and rheology of the overlying mantle wedge. High pressure dehydration of serpentinite in the slab and the subduction channel is considered as one of the main sources of fluids in subduction zones. Even though this metamorphic reaction is essential in subduction activities, the behavior of the fluids, the kinetics and thermodynamics during the breakdown reaction are still poorly understood. The Cerro del Almirez (Nevado-Filábride Complex, Betic Cordillera, SE Spain) uniquely preserves the dehydration front from antigorite serpentinite to chlorite-harzburgite and constitutes a unique natural laboratory to investigate high-pressure dehydration of serpentinite. This reaction occurred in a subduction setting releasing up to 13 wt% of water, contributing significantly to the supply of fluids to the overlying mantle wedge. A key to the understanding of the metamorphic conditions prevailing during serpentinite dehydration is to study the two prominent textures –granofels and spinifex-like chlorite harzburgite– occurring in this reaction product. The detailed texture differences in the Chl-harzburgite can provide insights into diverse kinetic and thermodynamic conditions of this dehydration reaction due to variations in effective pressure and drainage conditions. It has been proposed that difference in overpressure (P') and deviation from growth equilibrium, i.e. overstepping, is responsible for these two types of textures [Padrón-Navarta et al., 2011]. The magnitude and duration of P' is highly dependent on dehydration kinetics [Connolly, 1997]. The fast pressure drop, with spinifex-texture as a product, can be linked to draining events expected after hydrofracturing, which are recorded in grain size reduction zones in this massif. According to this hypothesis, mapping of textural variation in Chl-harzburgite might be used as a proxy to investigate the hydrodynamics of serpentinite dehydration reaction. During an intensive detailed field mapping of a well-exposed area of ca. 0.87 km2 in the W-SW part of the massif, we mapped textural variations of Chl-harzburgite every three to ten meters. Granofels and spinifex lenses occur within scales of decimetres to decametres. These spatial scale constrains can be linked to temporal scales of the reactions and to the spatial and temporal variation of fluid release during dehydration of serpentinite.

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