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Subduction channel and accretionary processes highlighted by medium- and high-P serpentinites from South Central Chile

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Ultramafic bodies exhumed in metamorphic terrains offer the opportunity to shed light on deep processes occurring in the subduction channel and at the base of accretionary prisms. Here, we performed detailed petrological and multi-scale structural investigations combined with thermodynamic modelling on serpentinites from the ultramafic massif of La Cabaña (South-Central Chile), which belongs to a Late Paleozoic accretionary prism. We distinguish five main types of ultramafic rocks: 1) massive partially serpentinized peridotites, (2) schistose serpentinites, (3) mylonitic antigoritic serpentinites, (4) olivine-bearing mylonitic serpentinites and (5) Ti-clinohumite and Ti-chondrodite olivine-bearing serpentinites. A first event of hydration of the mantle peridotites is recorded by Fe2+ porous rim in Cr-spinels (∼625-440ºC) followed by static partial retrogradation of olivine into lizardite (< ∼300ºC) with probable formation of Fe3+-rich and magnetite rims around spinels. Later, focused deformation and fluid passage through domains with high strain produced formation of schistose serpentinites within the stability field of antigorite (∼320-400ºC), while preserving some undeformed domains of meta-peridotites. This deformation stage (D1(LT)) prevailed near the base of the accretionary prism and was characterized by strong rheological contrasts and the formation of tubular folds and lenses of meta-peridotites embedded in schistose serpentinites. On the other hand, mylonitic antigoritic serpentinites recorded deeper conditions encountered in the subduction channel at 380-400ºC. They host olivine-bearing mylonitic serpentinites that likely registered hotter conditions at medium pressures (∼600ºC, 11.5 kbar) testifying for immature thermal architecture of the subduction system. Moreover, a sample containing Ti-clinohumite and Ti-chondrodite in equilibrium with antigorite and metamorphic olivine suggests pressure conditions above 15 kbar (> 50 km depth) for ∼500ºC, thus when the subduction system had already cooled. These medium- and high-P serpentinites preserved evidences of simple shear and burial kinematics (D1(MT) and D1(HT)), before to be exhumed likely by discrete shear zones up to the mantle corner near the base of the accretionary prism, possibly aided by sheath folds. All ultramafic rocks of La Cabaña were then incorporated inside the prism (∼285 Ma), following the deformation style of D1(LT). From that time, they shared the same evolution as the enclosing meta-sediments, affected by the subvertical D2 shortening during exhumation processes within the accretionary system and, later, by the subhorizontal E-W D3 shortening in more superficial conditions.