Chemical variation and deformation of the upper mantle across an OCT

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A remnant of an ocean continent transition (OCT) in the Alps (Totalp-Platta, Switzerland) offers an exceptional exposition of the upper mantle across the section. We characterized the chemical and microstructural variations induced by melt/fluid percolation and localization of deformation across the entire section. The OCT is made of spinel peridotite (Totalp) and changes toward the ocean to pyroxenite-poor peridotites that equilibrated in the plagioclase stability field (Platta). Platta contains clinopyroxenes (cpx) with a L-REE strongly depleted trace elements signature similar to cpx from the abyssal peridotites. However, flat and generally enriched REE patterns of other cpx from both Platta and Totalp suggest fertilization of the peridotite by melt. Moreover, the peridotite contains amphibole (kaersutite) testifying the presence of fluid at high temperature. A second generation of amphibole (pargasite) undeformed and replacing cpx probably crystallized during a late fluid percolation in the peridotite.

Mylonitic peridotite is observed both in Platta and Totalp and the peridotite contains μm ultramylonitic bands forming a high temperature foliation. The μm ultramylonitic bands are made by olivine (ol) + orthopyroxene (opx) or ol + cpx. The ductile deformation recorded by olivine in the host peridotite indicates a (001)[100] slip system, whereas in each μm ultramylonites a different olivine slip system is activated (A-type, D-type and C-type) probably dependent of cpx or opx proportion and the presence of liquid/fluid in the system. Close to the continent (Totalp) centimetric ultramylonitic shear-zones are slightly discordant to the foliation. They are well mixed 5 phases made by ol, cpx, opx, spinel and a high proportion of kaersutite (14%). The kaersutite is enriched in K_2O and clinopyroxene is enriched in Al_2O_3 and TiO_2 compared to the host peridotite and μm ultramylonitic bands, suggesting that shear zones are the final deformation localizing an evolved melt at a temperature of 750-775°C. Moreover, in the ultramylonitic shear zones, olivine and amphibole are probably the major phases influencing the localization of deformation with an axial [010] fabric for the olivine and a [001](100) for the amphibole.

During mantle exhumation in an OCT, the presence of fluid/melt will not only changes the chemical composition and the mineralogical proportion of the peridotite but will also influence the localization of the deformation.