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Exhumed mantle along an Ocean Continent Transition : the exemple of the Totalp ophiolite in SE Switzerland.

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Mantle exhumation processes have been intensely investigated in slow and ultraslow spreading Mid-Ocean Ridges while a few petrological and structural descriptions exist from exhumed mantle rocks in the Ocean Continent Transitions (OCTs). At the present it is still not understood when, where and how serpentinisation occurs and ophicalcites form in OCTs and how these processes are linked to the deformation and hydrothermal and magmatic evolution within an embryonic oceanic domain. In order to learn more about these processes, we studied the exhumed mantle rocks in the Totalp ophiolite near Davos in SE Switzerland. The Totalp ophiolite is mainly formed by exhumed serpentinised mantle rocks that are associated with ophicalcites and deep-water pelagic sediments from Upper Jurassic to Lower Cretaceous age. Here we present the results of detailed mapping and of a structural and petrological investigation of the Totalp ophiolite.

Former interpretations of the Totalp ophiolite suggested that a single massive body of serpentinized mantle that is in an upside-down position forms this ophiolite. Our study show, however, that the Totalp ophiolite consists of two major bodies that are thrust one on top of the other. The lower body preserves remnants of a paleo-seafloor. This is indicated by radiolarian cherts overlying exhumed serpentinized mantle rocks and ophicalcites. In contrast to most other Alpine ophiolites, the Totalp ophiolite preserves excellent outcrops of high temperature peridotite mylonites and foliated serpentinite as well as of serpentine cataclasites and gouges and ophicalcites that are only little affected by Alpine metamorphism, which does not exceed pumpellite to prenite facies. In many places Alpine structures overprint and transpose previous pre-Alpine exhumation structures. The Alpine overprint is, however, not penetrative, which is well shown by the locale occurrence of undeformed Upper Jurassic sediments that still preserve their depositional geometries. Remnants of an intact paleo-seafloor can be followed over several hundreds of square meters. Based on mapping and detailed petrological and structural investigations we try to establish the genetic and kinematic relation between high- to low-temperature structures. Peridotite mylonites (>800°C) representing the oldest structures, are overprinted by successive events of hydration reactions, initiating with high temperature hydrothermal alteration manifested by the formation of amphibole layers that predate serpentinization and the formation of ophicalcites. Serpentinisation, which is volumetrically the most important process, overprints the mylonites and seems to pre- and post-dates the formation of cataclasites as indicated by the brittle deformation of already serpentinized mantle. The carbonatisation, manifested either by the formation of veins or the replacement of serpentine, occurs during as well as after cataclastic deformation, gouge formation and exhumation at the seafloor. Serpentinization as well as the formation of ophicalcites clearly predates Alpine deformation, which is indicated by the reworking of these rocks in the overlying post-rift sediments. Comparing to exhumed mantle rocks from the Totalp ophiolite with those sampled at Mid-Atlantic Ridge at 13-15°N (e.g. Picazo et al, in prep) show some major differences. The crystallisation of magmatic minerals (amphibole, plagioclase) within the serpentinized mantle rocks have not been observed, which suggests that the rocks from the OCT may have formed in a colder and yet less magmatic environment comparing to those dredged from the Mid-Atlantic Ridge at 13-15°N. This may suggest that the thermal conditions and hydrothermal systems in OCT and MOR may be different. Further work is, however, necessary to test this idea.