10 My of prograde metamorphism in the Monviso ophiolite: LASS depth profiling of µm-scale zircon rims

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Metamorphic reactions in subducted rocks control the material flux from the downgoing slab to the overlying mantle wedge. The Monviso meta-ophiolite – a relatively coherent slice of subducted and exhumed oceanic lithosphere – contains abundant zircon-bearing Fe-Ti gabbros, presenting an ideal case to study the timescales of subduction metamorphism. The ophiolite consists of overturned metagabbros, basalts, and sediments (Monviso Unit) structurally overlying an upright sequence from mantle peridotite through sedimentary cover (Lago Superiore Unit), with ductile shear zones within and between units. Previous SHRIMP U-Pb zircon geochronology has focused on rocks associated with these shear zones, including an eclogite-facies quartz vein (45 ± 1 Ma: Rubatto and Hermann, 2003) and a metasomatized Fe-Ti metagabbro block rind (45.8 ± 0.7 Ma: Rubatto and Angiboust, 2015). Other age data (Ar/Ar, Sm-Nd, Lu-Hf) scatter between 60 and 48 Ma, including a Lu-Hf garnet–whole-rock two-point isochron at 49.1 ± 1.2 Ma (Duchene *et al*., 1997).

To quantify the timing of prograde metamorphism at Monviso, we performed laser-ablation split-stream (LASS) continuous depth-profiling on zircons from two Fe-Ti gabbros several meters above the Lower Shear Zone (LSZ), and additionally on an eclogite mylonite from the Intermediate Shear Zone (ISZ). The two distal gabbros are banded, with grt-omph-rt±tlc±phg±chl assemblages and pseudomorphs after lawsonite. Textural relationships suggest that these rocks avoided significant strain after lawsonite growth. Coarse, euhedral to subhedral zircons from these gabbros contain partially reset igneous cores with thin metamorphic rims (~500 nm to ~10 µm); rim dates do not form a single population and instead record a continuous age spread from ~60–50 Ma. In contrast, the mylonitic eclogite contains exclusively peak phases (grt-omph-rt-chl) and significantly smaller zircons yielding a uniform U-Pb zircon date (50.2 ± 1.1 Ma, MSWD = 2.1) with no evidence of age inheritance. The distinctions in mineralogy, textures, and U-Pb zircon dates suggests that the ~10 My age range recorded in the distal gabbros faithfully records a minimum duration for prograde subduction metamorphism at Monviso. This duration is similar to that determined using multiple isotopic systems in UHP metasediments along strike at Lago di Cignana (e.g., Lapen et al., 2003). The single-population dates recorded by mylonitic and metasomatized samples likely record a final metamorphic pulse associated with recrystallization, ductile shearing, and pervasive fluid flow.