

Pre-Variscan evolution of the Oetztal-Stubai Complex (Eastern Alps)

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The Oetztal-Stubai Complex (OSC, Eastern Austroalpine) is one of the largest tectonic units of the Alps extending between western Austria (Tyrol) and northern Italy (Autonomous Province of Bozen/Bolzano). The OSC is a polymetamorphic unit made of crystalline basement consisting of metasedimentary rocks hosting numerous bodies of metagranitoids and metabasic rocks, along with subordinate metacarbonates and ultramafics. The Alpine metamorphism increases in temperature from 300°C in the north-west up to 500°C in the south-east (Raso et al., 2025).

Pre-Alpine evolution is testified by Cambrian mafic to ultramafic cumulates preserved within the Central Metabasite Zone (CMZ) (Miller & Thöni, 1995; Konzett et al., 2005); an Ordovician high temperature event resulting in widespread intrusions of granitoids and partial melting of metapelites (*e.g.* Winnebach migmatites); occurrence of Variscan eclogites in the CMZ and pervasive re-equilibration under amphibolite facies conditions. Extensive field work, microstructural and petrological analyses, and radiometric dating are being carried out in the Central Metabasite Zone, specifically around the locality of Längenfeld (Milchenkar and Luibiskogel areas). Here, the Sulztal type S granite, for which we obtained U-Pb zircon ages of 463.7 ± 1.1 Ma, flanks the metabasic complex consisting in abundant mafic eclogites enveloping ultramafic protoliths locally showing well preserved cumulitic textures. The Milchenkar area hosts the majority of these preserved protoliths, mainly cumulitic olivine gabbros and subordinated troctolites and gabbros, while the Luibiskogel area is characterized by higher degrees of deformation and metamorphism, resulting in the complete eclogitization of the mafic and ultramafic cumulates, and by the widespread occurrence of eclogite-derived leucosomes. Whole rock and mineral chemistry of magmatic minerals, along with trace element composition of Ti-rich amphibole (up to 5% TiO₂) suggest a mildly alkaline parental melt. Different degrees of metamorphism affect the cumulitic protoliths: olivine gabbro occasionally display the destabilization at high pressure conditions of anorthite-rich plagioclase to omphacite + corundum intergrowths bordered by garnet; corundum-bearing coronas made of sodic amphibole also occur in troctolites around orthopyroxene rims growing on olivine. Plagioclase is also often characterized by granoblastic textures with increased anorthite content in the rims, implying a static phase of recrystallization at high temperature. Mafic eclogites show complex textures with the presence of at least two generations of garnet and omphacite or Na-amphibole. Notably, previously unreported inclusions of corundum and Mg-staurolite in eclogitic garnet have been found.

The occurrence of closely associated markers of pre-Variscan processes, reflecting a wide range of P-T conditions, offers a remarkable opportunity to investigate and reconstruct the late stages of Gondwana’s evolution.

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