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Pre-Variscan evolution and high temperature metamorphism of the Oetztal-Stübai Complex (Eastern Alps)

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The Oetztal-Stübai Complex (OSC) of the Eastern Austroalpine domain is a polymetamorphic unit extending between western Austria (Tyrol) and northern Italy (Autonomous Province of Bozen/Bolzano). The OSC is made of crystalline basement consisting of metasedimentary rocks (paragneisses and micaschists) hosting numerous bodies of metagranitoids and metabasic rocks, along with subordinate metacarbonates and ultramafics of igneous origin. The Alpine metamorphism in the OSC increases from the north-west to the south-east (Purtscheller & Rammlmair, 1982).

Pre-Alpine evolution of the OSC is testified by the crystallization of Cambrian mafic-to-ultramafic cumulates with MORB-like signatures preserved in pods and layers within the Central Metabasite Zone (CMZ) (Miller & Thöni, 1995; Konzett et al., 2005); an Ordovician high temperature event resulting in intrusions of granitoids and metapelites anatexis (e.g. Winnebach migmatites); occurrence of Variscan eclogites within the CMZ and subsequent pervasive re-equilibration under amphibolite facies conditions. However, structural relationships in the field do not rule out the possibility of a pre-Variscan HP event.

Extensive field work, microstructural and petrological analyses, and radiometric dating are being carried out in two key areas, Längenfeld and Reschenpass/Passo Resia. The two areas are similar in the occurrence of two Ordovician intrusions, the Sulztal type-S granite (Längenfeld) and the Klopaiert Tonalite (Reschenpass), for which we obtained by U-Pb LA-ICP-MS dating of zircons ages of 482.4 ± 1.5 Ma and 460 ± 0.83 Ma, respectively.

In the Längenfeld area, rocks belonging to the CMZ show various degrees of metamorphic reactions progress often resulting in symplectitic relationships. Mafic-to-ultramafic rocks, with exceptionally well preserved cumulitic textures, display the destabilization at high pressure conditions of anorthite-rich plagioclase to omphacite+corundum intergrowths bordered by garnet, replacing plagioclase as confirmed by REE patterns determined by in-situ LA-ICP-MS. Within these cumulates, newly discovered troctolitic layers show corundum-bearing coronas around olivine and granoblastic textures with increased anorthite content in plagioclase rims, implying a static phase of high temperature recrystallization. Associated metacarbonates are characterized by olivine ($\text{Mg}/(\text{Mg}+\text{Fe})=0.95$) and Fe-spinel.

Additionally, we found evidence of partial melting involving metapelites and eclogites of the CMZ, resulting in corundum-bearing migmatitic gneisses and eclogite-derived melts. The Variscan age of CMZ eclogites has been assessed by Sm-Nd mineral and WR isochrons in Miller & Thöni (1995), but unpublished U-Pb zircon data (Sollner & Gebauer in Hoinkes & Thöni, 1993) points to an age of 497 Ma for this high pressure event. This hypothesis deserves further investigations on account of our field work and newly discovered field relationships, suggesting the existence of a pre-Variscan high temperature event post-dating an older eclogite facies metamorphism.

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