EGU2020-21552, updated on 14 Oct 2020
https://doi.org/10.5194/egusphere-egu2020-21552
EGU General Assembly 2020

Detailed timescale of magma-chamber assembly and eruption revealed by ultra-high precision zircon U-Pb geochronology on a Permian caldera plumbing system, Sesia Magmatic System (southern Alps, Italy)

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In recent years, technical developments in isotope dilution thermal ionization mass spectrometry technique (ID-TIMS) have pushed the precision of single zircon U-Pb geochronology to new limits. The use of interlaboratory calibrated U-Pb tracer solutions for isotopic dilution [1] paired with using newly developed high ohmic resistors (10^{13}Ohm) in Faraday cup amplifiers, allow the determination of single zircon dates with precision and accuracy at the 0.02 % level [2].This level of analytical precision makes the ID-TIMS technique a geochronological tool able to unravel the detailed temporal evolution of magmatic plumbing systems older than the Mesozoic Era.

In the southern Alps, a thick sliver of continental crust, tilted and exhumed during the Alpine orogeny, is exposed as a complete crustal cross-section (Ivrea crustal section). This section preserves a transcrustal magmatic system, developed in an extensional environment in *ca.* 4 My during the Early Permian [3]. Its upper crustal portion consists of a zoned granitic intrusion (Valle Mosso pluton) overlaid by a dominantly rhyolitic caldera-related volcanic field (Sesia Caldera).

To obtain a time-integrated view of the petrological evolution of this plumbing system, we combine a new ultra high precision ID-TIMS zircon U-Pb dataset with zircon geochemistry from samples collected in compositionally and texturally different units of the Valle Mosso pluton and Sesia Caldera. All the analyzed units are coeval within 700 ky and the overall trends in zircon trace elements (Eu*/Eu, Zr/Hf, Sm/Yb) suggest an evolution of the reservoir dominated by fractional crystallization. The data show a ca. 200 ky gap in zircon crystallization, following the injection of recharge magma that triggered the eruption of the crystal-rich rhyolite followed by caldera collapse [3]. This suggests mass addition and rejuvenation of a partly crystallized mush, which temporarily hindered zircon crystallization. On the other hand, crystal-poor rhyolites, characterized by a younger eruption age and evolved zircon composition, likely represent late stage evacuation of evolved melt lenses extracted from a mostly crystalline framework.

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