Effects of a partial reset on zircon (U-Th)/He data: the case of the Drau Range, Eastern Alps and adjacent Southern Alps

Bianca Heberer[1], István Dunkl[2], Franz Neubauer[1], Sina Schulz[2], Hilmar von Eynatten[2]

[1] *University of Salzburg, Dept. Geography and Geology, Salzburg, Austria; e-mail: bianca.heberer@sbg.ac.at*
[2] *University of Göttingen, Geoscience Center, Göttingen, Germany*

(U-Th)/He dating has become a widely-used tool among the rapidly advancing low-temperature thermochronology methods. Beside apatite, zircon is now a common phase for this application. Radiation damage due to self-irradiation, substantially influences the diffusivity of He in zircon. Thus, a more complex kinetics causes a wide range of closure temperatures from ca. 210 to <50 °C. In a typical zircon suite, the internal damage stored within the crystals will usually vary to a significant degree and range somewhere between fully crystalline (or undamaged) to metamict. Such difference in radiation damage from crystal to crystal in the same rock severely influences the geochronological systematics of that sample and thus needs to be considered carefully. This is particularly the case for samples which spent prolonged residence time in the He partial retention zone and/or were exposed to temperatures sufficiently cool for radiation damage to accumulate.

In this study, we address the question whether ZHe data from very low-grade metamorphic units may be transformed into geologically meaningful age information and as such may enhance thermal history reconstructions. We applied ZHe dating to blocks, adjacent to the eastern part of the Periadriatic fault in the Eastern European Alps and the Southern Alps, which underwent deep diagenetic to very low-grade metamorphic transformations. In that area, folded and faulted Austroalpine units (with the Permomesozoic Drau Range in its center) are juxtaposed to southward tilted Southalpine units across the Periadriatic fault. The Periadriatic fault exposes deformed Oligocene tonalites, which intruded at ~30 Ma at depths of ca. 12–16 km.

We found a large variability in ZHe data: 28 from these samples allowed an averaging the single-grain ages and yielded mean sample ages from 283 to 29 Ma, while 8 samples shown a scatter in excess of analytical uncertainties. These overdispersed data all show negative date-eU correlations. However, the detected age groups fit well to thermal effects known from the geological history of the study area. Samples from the Austroalpine Drauzug block and adjacent basement units yielded several geologically significant age groups, which are: ZHe ages around 260 to 250 Ma are associated with a Permian rift-related thermal pulse, whereas ages of 190 to 180 Ma monitored a subsequent cooling, consistent with published data. An age group with a wider range between ca. 130 to 90 Ma reflect the Cretaceous peak of collisional metamorphism, whereas data ranging from 60 to 50 Ma monitor regional cooling after metamorphism. Finally, samples with ZHe data around 30 Ma are related to the thermal effects of Oligocene intrusions, which obviously affected wider Austroalpine areas as previously thought.

We conclude that ZHe data acquired for a complex, in parts partially reset sample suite, may enhance thermal history reconstruction.