Rapid Miocene Exhumation to the East of the Tauern Window

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The Eastern Alps were substantially shaped by northward movement of the Dolomites Indenter and eastward extrusion of the orogenic wedge in front of the indenter. A resulting sinistral wrench zone runs through the western Tauern Window (TW) and continues along the Salzach-Ennstal-Mariazell-Puchberg Fault (SEMP) eastward. Low-T thermochronological studies demonstrate rapid Miocene cooling of the TW units from ≥ 350 °C to below ~ 80 °C due to folding and coeval erosion. Thermochronologic ages in the Eastern Tauern Window range between 12 Ma to 22 Ma for the zircon fission track chronometer (partial annealing zone (PAZ) ~ 200 – 350°C, e.g., Tagami et al., 1996) and 5 Ma to 13 Ma for the apatite (U-Th)/He chronometer (partial retention zone (PRZ) ~ 40 – 80°C, Stockli et al., 2000). Ages for the zircon (U-Th)/He and apatite fission track chronometers fall in between.

Along the eastern margin of the TW, the extensional Katschberg Fault-System (KFS) decoupled the Gurktal Block (GB) in its hanging wall from folding. The KFS was active between 20 and 17 Ma, in the early Miocene (Scharf et al., 2016). A late reactivation phase is demonstrated by reset or partially reset zircon and apatite fission track ages within the footwall towards the fault, yielding Late Miocene to Pliocene ages (Bertrand et al., 2017). A similar younging trend is observed within the TW towards the Brenner Fault in the western TW. The GB in the hanging wall of the KFS preserves a rapid Cretaceous and Eocene cooling through the zircon fission track PAZ and rapid Oligocene to Miocene cooling through the apatite fission track PAZ (Wölfler et al., 2023).

The Niedere Tauern (NT), north of the GB and south of the SEMP line, seem to be structurally closely linked to the TW. They show a similar rapid Miocene cooling history and an intervening Cenozoic structure between the TW and the NT is missing. Published apatite fission track ages range between 14 Ma and 24 Ma (apatite PAZ ~ 60 – 100°C, Wagner et al., 1989). Published apatite (U-Th)/He ages from the southern boundary of the NT range between 6 Ma and 7 Ma, indicating a Late Miocene cooling below ~ 80 °C (Wölfler et al., 2016).

Our (U-Th)/He analysis from the interiour of the NT revealed ages of around 20 Ma to 23 Ma (zircon (U-Th)/He), and 11 Ma to 22 Ma (apatite (U-Th)/He). Published apatite fission track ages fall in between and partly overlap with our results. This demonstrates a rapid cooling pulse in the Miocene, exhuming at least the western part of the NT from ≥ 200 °C to below ~ 80 °C. Published AHe ages of ~ 6 Ma along the southern margin of the NT might relate to late Miocene normal faulting along the complex Murtal Fault-System (MFS). A pronounced jump towards older thermochronologic ages in the Seckauer Tauern, east of the Pöls fault and extensional structures along this fault indicate a structural decoupling of the western NT from the Seckauer Tauern.

In this contribution, we discuss the linkage between TW and N T and characterize in greater detail the exhumation history along the eastern wrench zone.

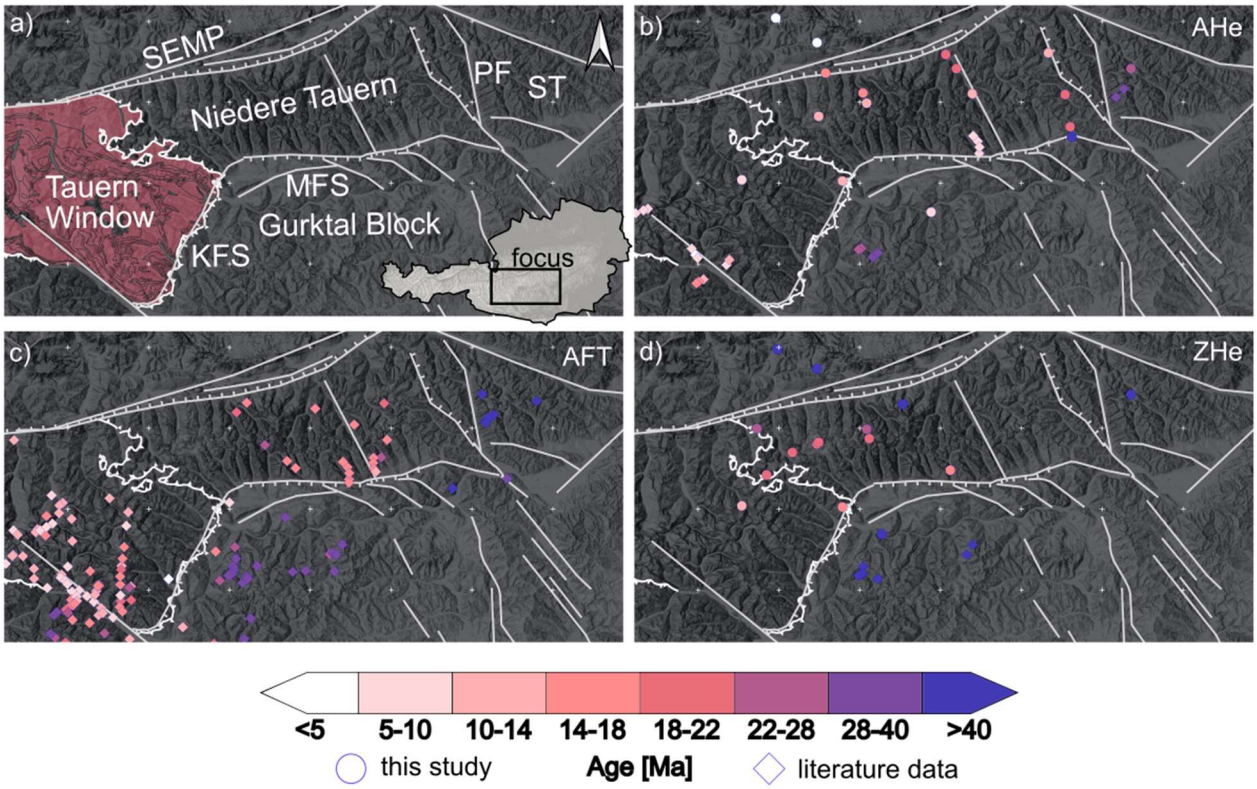

Figure 1: a) This map shows the location of major structural entities named in the text. The inlet shows the location of the maps of a)-d) within Austria. Abbreviations are: SEMP…Salzach-Ennztal-Mariazell-Puchberg Fault, PF…Pöls Fault, ST…Seckauer Tauern, MFS…Mur Fault-System, KFS…Katschberg Fault-System. Cross-grid distance is 20 km. b) Distribution of new and published apatite (U-Th)/He ages (AHe) in the study area. c) Distribution of published apatite fission track ages (AFT) in the study area. d) Distribution of new and published zircon (U-Th)/He ages (AHe) in the study area.

Bertrand A, Rosenberg C, Rabaute A, Herman F, and Fügenschuh B, 2017 Tectonics 36 207–28

Scharf A, Handy M R, Schmid S M, Favaro S, Sudo M, Schuster R, and Hammerschmidt K, 2016 Tectonophysics 674 210–26

Stockli D F, Farley K A, and Dumitru T A, 2000 Geology 28 983–6

Tagami T, Carter A, and Hurford A J, 1996 Chemical Geology 130 147–57

Wagner G A, Gleadow A, and Fitzgerald P G, 1989 Chemical Geology: Isotope Geoscience section 79 295–305

Wölfler A, Kurz W, Fritz H, Glotzbach C, and Danišík M, 2016 Terra Nova 28 297–305

Wölfler A, Wolff R, Hampel A, Hetzel R, and Dunkl I, 2023 Tectonics 42 1–29