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Late-stage cooling history of the Eastern and Southern Alps and its linkage to Adria indentation

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Late-orogenic indentation by rigid lithospheric plates and microplates into softer orogenic wedges leads to post-collisional shortening, lithospheric thickening and vertical and lateral extrusion. The European Eastern and Southern Alps represent a prime example of indenter tectonics. Their Late Neogene geodynamic framework is influenced primarily by the ca. NW-ward motion and counterclockwise rotation of the Adriatic microplate with respect to Europe, which resulted in an oblique, dextral transpressional setting.
In this study we refine the late-stage exhumation pattern related to indentation of the eastern Adriatic indenter, i.e. the still northward pushing triangular northeastern part of the Southalpine block that indented the Eastern Alps. New apatite (U-Th)/He and apatite fission track thermochronometry data come from (1) the Karawanken Mountains adjacent to the eastern Periadriatic fault along the northeastern edge of the indenter and from (2) the central-eastern Southern Alps from within the indenter and from its western edge.
We find apatite (U-Th)/He ages from the Karawanken Mountains ranging between 11 and 6 Ma, which indicate an episode of fault-related exhumation leading to the formation of a positive flower structure and an associated peripheral foreland basin as well as lateral activity along the Periadriatic fault system. Apatite (U/Th)/He and fission-track data combined with previous data from the Southern Alps indicate that exhumation largely occurred during the Late Miocene, too, and was maximized along thrust systems, with highly differential amounts of vertical displacement along individual structures.
Our new data contribute to mounting evidence for widespread Late Miocene tectonic activity in the Eastern and Southern Alps. They demonstrate a shift from deformation and exhumation concentrated within the Tauern Window at the beginning of the indentation process, to less pronounced, but more widespread exhumation along the edges as well as the interior of the indenter. We discuss this shift in light of Adria indentation and propose a major change in boundary conditions operating on the orogen, i.e. variable coupling between the orogenic wedge and the adjacent plate and/or a shift in Adria-Europe convergence direction, as the underlying process.