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Evolution of a low-relief landscape in the Eastern Alps constrained by low-temperature thermochronology and cosmogenic nuclides

Andreas Wölfler[1], **Sebastian Reimers**[1], Andrea Hampel[1], Christoph Glotzbach[2], and István Dunkl[3]
[1]Leibniz University Hannover, Institute for Geology, Hannover, Germany (woelfler@geowi.uni-hannover.de)
[2]Eberhard Karls University Tübingen, Institute for Mineralogy and Geodynamics, Tübingen, Germany
[3]Sedimentology & Environmental Geology, Geoscience Center, University of Göttingen, Goldschmidtstrasse 3, D-37077 Göttingen, Germany,

The relief history of mountain belts is strongly influenced by the interplay of tectonics and surface processes, which both shape Earth´s landscapes. In this context, the quantification of the rates of long-term and short-term processes is key for understanding landscape evolution and requires the application of methods that integrate over different timescales. In this study, we apply low-temperature thermochronology and cosmogenic nuclides to quantify the geological and geomorphic evolution of an elevated low-relief landscape in the Eastern Alps, the so-called Nock Mountains, which are situated to the east of the Tauern Window. The low-temperature thermochronological data yield zircon fission track and zircon (U-Th)/He cooling ages of 93.4±12.9 and 77.8±7.8 Ma, respectively, which we interpret to reflect late Cretaceous cooling after Eo-Alpine metamorphism. Apatite fission track and (U-Th)/He ages are significant younger and range from 36.8 to 31.3 Ma. Time-temperature history modelling of the cooling ages suggests enhanced cooling in the Eocene followed by thermal stagnation. Thus, the rocks of the study area have been in near surface position (2-3 km) since the Late Eocene. Enhanced cooling in the Eocene is probably related to an increasing relief due to shortening, folding and thrusting in the Eastern Alps triggered by the onset of collision between the European margin and the Adriatic microplate. Under the assumption that rock exhumation occurred solely by erosion, the long-term average erosion rate derived from the thermochronological data is ~50-90 mm/kyr. Catchment-wide erosion rates derived from cosmogenic ^{10}Be in river sediments range from 83±7 to 205±18 mm/kyr and hence are lower than in other parts of the Alps. As the ^{10}Be-derived erosion rates and the long-term rates derived from thermochronology agree despite the different timescales over which the two methods integrate, our new data suggest that erosion rates did not change significantly over the last ~40 Ma. This is remarkable because within this time span numerous tectonic processes and glacial-interglacial cycles affected the study area. To investigate the deglaciation history after the Last Glacial Maximum in the Nock Mountains, we sampled glacially polished quartz veins for ^{10}Be exposure dating. The first four exposure ages obtained so far cluster between 14.5±1.4 and 16.8±1.6 ka. We interpret these ages as the record the retreat of the ice cover in the study area shortly after the Oldest Dryas stadial.