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Analysing spatial variation of Late Cenozoic exhumation over the European Alps: diverse approaches to a fission-track database

A. J. Vernon (1,2), P. A. van der Beek (2), M. K. Rahn (3) and H. D. Sinclair (1)

(1) Grant Institute of Geosciences, University of Edinburgh, Edinburgh EH9-3JW, United Kingdom, (2) Laboratoire de Geodynamique des Chaines Alpines, 38400 Grenoble, France, (3) Swiss Federal Nuclear Safety Inspectorate, 5232 Villigen-HSK, Switzerland (antoine.vernon@ed.ac.uk)

The quantification of the temporal and spatial distribution of erosion over a mountain chain is key to understanding the dynamics of both surface and deep processes. Studying the intricate relationship between erosion, tectonics and climate can be done by comparing the past outflux of a chain (the pile of sediments in the foreland basins) and the thermochronological record (cooling history of the rock at the surface today). In this respect, the multitude of existing apatite and zircon fission-track ages over the Western and Central European Alps constitute a uniquely large database. We propose different approaches to exploit these data. (i) A one-dimensional study retains the locations with fission-track ages on both zircon and apatite. The difference in closure temperature for these two ages allows us to calculate a local two-step mean cooling rate, indicating the distribution of areas of accelerating or decelerating cooling with time. (ii) A two-dimensional study collects ages along cross-sections targeted at major faults and lineaments. This is aimed at gathering information on the timing and depth of fault activity. (iii) A three-dimensional study investigates the significance of interpolated surfaces of uniform age. First, an interpolation of all data permits the extraction of iso-age lines which represent the intersection of iso-age surfaces with the topography. Second, local elevation/age correlations are estimated at each data point according to its nearest neighbours. The local elevation/age trends are extrapolated to estimate the depth of iso-age surfaces underneath each data point. We then draw the iso-age surfaces under the relief by extrapolating between iso-age lines and points. The differences in altitude of the successive iso-age surfaces give estimates for de-

nudation rates through time on each point of the map. Finally, the latter information combined with the mean cooling rates calculated in (i) may enable to estimate on these locations the geothermal gradient averaged during certain stretches of time.