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Space-time Inversion of Thermochronologic Data for Exhumation Rates within the Alps

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A major constraint on exhumation rates, and thus topography, across an orogenic belt comes from low-temperature thermochronometry data. In well-studied mountain belts like the Alps, the number of thermochronometric data has reached many hundreds, which presents challenges in data analysis and interpretation. We have developed a method of statistical inversion, similar to seismic tomography, to extract exhumation rates that are variable in both space and time. The method is based on a parameterization that has discrete timesteps, but imposes only a statistical correlation structure in space. Results are in the form of spatial maps of exhumation rate, valid over a specific time range, along with a statistical measure of resolution and variance reduction.
Using a suite of $\sim$1000 fission-track and (U-Th)/He ages from zircon and apatite collected from across the Alps, we investigate the ability of these data to resolve exhumation rates. High pulses of exhumation seen over long wavelengths provide evidence for either erosionally controlled exhumation, or changes within the underlying mantle. We also observe a shift in high-exhumation from the southern Alps towards the north with time. In addition, the data seem to support an increase in average erosion rate towards the present day, though this signal is only present in the west.