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Miocene to Pleistocene Exhumation of the Southern European Alps

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We apply apatite fission-track, (U-Th-Sm)/He dating, 4He/3He diffusion profiles, and OSL thermochronometry to construct a complete thermal history and constrain the exhumation and topographic evolution of the Adamello complex in the Southern European Alps. The Adamello complex is an Eocene-Oligocene pluton emplaced at a depth of 7 km, now exposed at the intersection of two major fault systems and dissected by deep valleys, which drain into larger fluvial systems overdeepened during the Messinian Salinity Crisis.
All our ages span the Miocene and display a normal age-elevation relationship, where age increases with elevation, until 2300m, below which all AHe ages are within error of each other. We interpret this break in slope as the onset of a period of rapid cooling initiating at 8.5 Ma and continuing till at least 6 Ma, our youngest age. Further insight is provided by helium diffusion profiles, which constrains the cooling history of the grain from 80°C-20°C. Our results confirm that rapid cooling began at ∼8.5 Ma and continued until 4 Ma. We estimate exhumation rates using age-elevation relationships and cooling histories.
We compare these estimates with those predicted from a 3-D heat conduction model including topographic relief and erosion (Pecube; Braun, 2002) paired with the Neighborhood Algorithm, which is a two stage mathematical procedure that finds models, or parameters, which minimize the misfit to the data (Sambridge, 1999a,b). The predicted tectono-geomorphic history is tested for feasibility through comparison with known timing of tectonic and erosional events and the thermal history determined by helium diffusion profiles. We also discuss how our results compare to results from elsewhere in the Alps and the implications for the exhumational/erosional history of the Alps.