



Late exhumation of the Bergell pluton (Italian Alps): tectonics, climate change or Messinian base level drop? Insights from apatite (U-Th)/He ages determination and modeling.

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The Bergell pluton, is an elongated-shape granodioritic to tonalitic body emplaced during Oligocene time at 30-32 Ma along the Insubric Line in the south-central Alps. This intrusion is located immediately north of the Insubric fault, within a bloc delimited by a major strike slip and normal faults related to the eastward extrusion of the central and eastern Alps. The range lies north of the Italian great lakes, an area where the erosion related to the Messinian base-level drop is supposedly strong. In order to reconstruct the Miocene exhumation history of this pluton and to place constraints on the effect of Messinian base-level drop on erosion and uplift, we performed (U-Th)/He dating of 10 apatite samples from the Bergell area. Data from horizontal (constant elevation) profiles indicate that no significant E-W tilting occurred after ~9 Ma and that the present day relief, especially in the valley where the Insubric/Tonale line is located, is at least 9 Ma old. Apatite (U-Th)/He age versus elevation data from a vertical transect in the core of the pluton suggests a three phases exhumation/cooling history: (1) fast exhumation/cooling until 16-12 Ma, (2) slow exhumation/cooling and (3) fast exhumation/cooling after ~6 Ma. Simulations of the apatite He ages versus elevation relationship, using a trial and error method, confirm these three exhumation/cooling phases. It furthermore suggests that the final exhumation stage initiated between 4 and 6 Ma ago, and continued at a relatively high rate until present time. By comparing this timing with the onset of major climatic, tectonic and base level drop events recognized in the Southern Alps, we propose that the Messinian base-level drop has initiated the late exhumation of the Bergell. However, as this event is relatively short (less than 1 Myr) it cannot explain the post 4 Ma-high exhumation rate. It is thus suggested that the transition to a more variable climate initiating at 3-4 Ma might have maintained high erosion rates and driven the post 4 Ma exhumation of the Bergell area.