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Neogene Relief Development in the Western European Alps Revealed by Apatite (U-Th-Sm)/He and 4He/3He Thermochronometry.

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Neogene European Alps increase in both in-situ denudation rates and sediment fluxes to surrounding basins are suggested to have been caused by climatically-induced erosion pulse (Cederbom et al., 2004) and relief amplification due to Quaternary glaciations. However, these potential climatic controls, as well as the timing on denudation rates increase and/or relief development, are still debated as there are only few quantitative studies on topographic change during Pliocene-Quaternary times (Haeuselmann et al., 2007).

Here we present apatite (U-Th-Sm)/He data from vertical transects in the External Crystalline Massifs of the European Alps (Swiss Valais, Mont-Blanc area and Ecrins-Pelvoux massif). Previous thermochronology studies, employing apatite fission-track and (U-Th)/He data, have reported an increase pulse in denudation rates before $\sim$5 Ma ago in these areas; however the very recent (i.e. last 2-3 Ma) topographic evolution and potential valley incision remain unconstrained by these data. We selected a subset of key samples from these profiles (Swiss Valais and Mont-Blanc) for which we applied a novel method based on 4He/3He thermochronometry and performed a random search algorithm to identify permissible thermal histories below $\sim$80 °C. These thermal histories are compared to denudation and relief scenarios obtained from numerical inversion of our (U-Th-Sm)/He ages and previously published data using the 3D thermo-kinematic model Pecube.

For the samples near the top of the profile, 4He/3He results (Swiss Valais and Mont-Blanc) show rapid cooling before $\sim$5 Ma followed by a quiescent phase with little cooling. This early cooling may be due to tectonically-controlled exhumation of the External Crystalline Massifs. Mid-profile and bottom samples only show very recent but significant cooling ($\sim$1 Ma). We suggest this late-stage cooling to be due to an episode of valley deepening related to the transition in climate variability (change in glacial/interglacial cycles amplitude and/or periodicity) in the European Alps. Further investigations in mountain belts using the 4He/3He thermochronometry is under way to more precisely constrain climatically- and/or tectonically-driven topography evolution. This presentation was supported by the EUROCORES programme TOPO-EUROPE of the European Science Foundation.