Geophysical Research Abstracts
Vol. 17, EGU2015-14657, 2015
EGU General Assembly 2015

Unraveling tectonics and climate forcing in the late-Neogene exhumation history of South Alaska

Pierre Valla (1), Jean-Daniel Champagnac (2), David Shuster (3,4), Frédéric Herman (1), and Maria Giuditta Fellin (2)

(1) Institute of Earth Surface Dynamics, University of Lausanne, Lausanne, Switzerland (pierre.valla@unil.ch), (2) Department of Earth Sciences, ETH Zurich, Zurich, Switzerland , (3) Department of Earth and Planetary Science, UC Berkeley, Berkeley, USA, (4) Berkeley Geochronology Center, Berkeley, USA

The southern Alaska range presents an ideal setting to study the complex interactions between tectonics, climate and surface processes in landscape evolution. It exhibits active tectonics with the ongoing subduction/collision between Pacific and North America, and major active seismogenic reverse and strike-slip faults. The alpine landscape, rugged topography and the important ice-coverage at present reveal a strong glacial imprint associated with high erosion and sediment transport rates. Therefore, the relative importance of climatically-driven glacial erosion and tectonics for the observed late-exhumation history appears to be quite complex to decipher.

Here, we first perform a formal inversion of an extensive bedrock thermochronological dataset from the literature to quantify the large-scale 20-Myr exhumation history over the entire southern Alaska. We show that almost half of the variability within the thermochronological record can be explained by modern annual precipitations spatial distribution, the residuals clearly evidencing localized exhumation along major tectonic structures of the frontal fold and thrust belt. Our results confirm high exhumation rates in the St Elias "syntaxis" and frontal zones for the last 0-2 Myr, where major ice fields and high precipitation rates likely sustained high exhumation rates; however the impact of late Cenozoic glaciations is difficult to constrain because of the low resolution on the exhumation history older than $\sim$2 Myr. On the contrary, our inversion outcomes highlight that north of the Bagley Icefield the long-term exhumation has remained quite slow and continuous over the last $\sim$20 Myr, with no late-stage signal of exhumation change since the onset of glaciations despite a clear glacial imprint on the landscape.

We thus focus on the Granite Range (Wrangell-St Elias National Park, Alaska), an area presenting a strong glacial imprint but minor tectonic activity with only localized brittle deformation. We sampled four elevation profiles over an East-West transect for low-temperature thermochrometry. Apatite (U-Th-Sm)/He dating provides ages between $\sim$10 and 30 Ma, in agreement with published data, and shows apparent low long-term exhumation rates ($\sim$0.1 km/Myr). 4He/3He thermochronometry on a subset of samples reveals a more complex exhumation history, with a significant increase in exhumation since $\sim$6-4 Ma that we relate to the early onset of glaciations and associated glacial erosion processes. Our results, in agreement with offshore sediment records, thus confirm an early glacial activity and associated erosion response in Alaska, well before the onset of Pliocene-Pleistocene Northern Hemisphere glaciations.