Geophysical Research Abstracts
Vol. 13, EGU2011-10884, 2011
EGU General Assembly 2011

Extracting erosional denudation rates from low-temperature thermochronology in hot magmatic arcs.

Thibaud Simon-Labric (1,2), Peter van der Beek (1), Gilles Brocard (3), Christian Teyssier (4), and Pete Reiners (5)

(1) University of Grenoble, ISTerre, Grenoble, France (thibaud.simon-labric@ujf-grenoble.fr), (2) Institute of Geology and Paleontology, Lausanne University, Lausanne, Switzerland., (3) Department of Earth and Environmental Science, University of Pennsylvania, Philadelphia, United States., (4) Department of Geology and Geophysics, University of Minnesota, minneapolis, MN, United States., (5) Geosciences, University of Arizona, Tucson, AZ, United States.

Active continental magmatic arcs are characterized by a dynamic thermal structure that is controlled by magmatic and surface processes, and which renders the interpretation of low-temperature thermochronology data problematic. Here, we integrate apatite and zircon (U-Th)/He data with numerical thermo-kinematic models to study the relative effects of magmatic, tectonic, and surface processes on the thermal evolution of the crust and cooling patterns in the Cenozoic North Cascades arc (WA State, USA). A modified version of the 3D thermo-kinematic code Pecube is used to evaluate reasonable exhumation scenarios based on the regional context and thermochronometric data. Apatite and zircon (U-Th)/He data from two age-elevation profiles that are located 7 km south of the well-studied Chilliwack composite intrusion show that spatial and temporal variability in the geothermal gradient linked to magma emplacement can be contrained and separated from exhumation processes. During Chilliwack batholith emplacement at $\sim$35-20 Ma, the geothermal gradient of the country rocks increased to a very high steady-state value (70-100°C/km), which is likely a function of magma flux and the distance from the magma source area. Including a temporally varying geothermal gradient in the analysis allows quantification of the thermal perturbation around magmatic intrusions and the retrieval of the simplest denudation history from the data, which is consistent with independent evidence for the uplift and erosional history of the North Cascades. More generally, this study highlights that a combined approach including thermo-kinematic modelling and age-elevation sampling of low-temperature thermochronometers opens new opportunities to study the thermal structure and its evolution in magmatic arc systems.