Geophysical Research Abstracts
Vol. 13, EGU2011-10101, 2011
EGU General Assembly 2011

Neogene denudation rates in the Eastern Alps as determined by low temperature thermochronology

Andreas Wölfler, Kurt Stüwe, Nicolas Legrain, and Harald Fritz
Graz, Earth Sciences, Graz, Austria (andreas.woelfler@uni-graz.at)

Erosion affects the topographic form and kinematics of orogens, and it may provide dynamic feedbacks between climate and tectonics. Thermochronology measures the timing and rates at which rocks approach the surface and cool as a result of exhumation.
Our study aims to better understand the Miocene to recent exhumation and erosion periods in the Eastern Alps. For this, we use a combination of zircon and apatite (U-Th)/He analysis, applied to rocks from both sides of the Penninic/Austroalpine boundary and by the evaluation of recently published low temperature thermochronological data. This approach allows monitoring the thermal history of exposed rocks in the temperature range between 300 to 40 °C, thus documenting exhumation from about 10 km crustal depth to near-surface levels.
The Austroalpine units yield systematically older ages (zircon: 57.3 – 37.3 Ma; apatite: 14.7 – 9.1 Ma) than those from the penninic Tauern Window (zircon: 18.6-13.5; apatite: 7.6 – 5.1 Ma) and both datasets display positive correlation with elevation. According to the age-elevation relationship gain 0.2 mm/yr for the Austroalpine- and 0.7 for the Penninic units in middle to late Miocene times. The apatite (U-Th)/He data also provide indirect constraints on the average denudation rate for the time of closure of the cooling ages to present and yield 0.5 mm/yr for the Pliocene to recent. These values are comparable to those from the Central Alps where recent studies demonstrated that rock uplift is a response to climate-driven denudation. In the Eastern Alps however, a different geodynamic evolution must be considered. By evaluation of already published thermochronolgical data we can demonstrate that denudation in the eastern part of the Eastern Alps occurred at relatively low rates (in average: 0.1 – 0.2 mm/yr) during Miocene times. The difference in denudation rates in the Tauern Window and the adjacent eastern crystalline units are considered to be related to distinct tectonic evolution and/or different lithospheric conditions beneath the eastern part of the Eastern Alps.
The available geochronological data of the Tauern Window reveal episodes of accelerated cooling that coincide with the denudation budget of the Eastern Alps. An increase in the sediment budget between 24 and 21 Ma is less pronounced by low temperature thermochronology. However this event is related to the buildup of topography and relief especially in the Swiss- and Western Alps as well as the western Eastern Alps, whereas surface erosion and relief in the eastern Eastern Alps declined. Between 18 and 17 Ma a drastic increase of sediment discharge rates coincides with the zircon fission track data from the eastern Tauern Window. According to the lack of age-elevation relationships of the published zircon fission track data no estimation of exhumation rates is possible. However the zircon fission track data are consistent with a period or reorganization in the Eastern Alps. The new zircon helium data of our study fall exact in the time of decreasing sediment discharge between 16 and 14 Ma. Again a period of accelerated exhumation between 12 to 7 Ma is well documented by apatite fission track and partly by apatite (U-Th)/He ages and may be correlated with the termination of E-W extension in the Eastern Alps.