Geophysical Research Abstracts
Vol. 17, EGU2015-1504, 2015
EGU General Assembly 2015

Grain size effects on the closure temperature of white mica in a crustal-scale extensional shear zone – implications for dating shearing and cooling from in-situ 40Ar/39Ar laser-ablation of white mica (Tauern Window, Eastern Alps)

Andreas Scharf (1,2), Mark Handy (2), Stefan Schmid (3,2), Silvia Favaro (2), Masafumi Sudo (4), Ralf Schuster (5), and Konrad Hammerschmidt (2)

(1) Sultan Qaboos University, College of Science, Department of Earth Science, Muscat, Oman (scharfa@zedat.fu-berlin.de), (2) Department of Earth Sciences, Freie Universität Berlin, Malteserstrasse 74-100, 12249 Berlin, Germany, (3) Institute of Geophysics, Eidgenössische Technische Hochschule (ETH), Sonneggstrasse 5, 8092 Zürich, Switzerland, (4) Institute of Earth and Environmental Science, Universität Potsdam, Karl-Liebknecht-Strasse 24-25, 14476 Potsdam-Golm, Germany, (5) Geologische Bundesanstalt, Neulinggasse 38, 1030 Wien, Austria

We conducted in-situ 40Ar/39Ar laser ablation dating of white-mica grains on specimens from the footwall of a crustal-scale extensional fault (Katschberg Normal Fault; KNF) that accommodated eastward orogen-parallel displacement of Alpine orogenic crust in the eastern part of the Tauern Window (Austria). We obtained cooling ages ranging from 31 to 13 Ma, with most ages clustering between 21 and 17 Ma. Folded white micas that predate the main Katschberg foliation yield, within error, the same ages as white-mica grains that overgrow this foliation. Moreover, the new 40Ar/39Ar white-mica ages indicate that cooling of large white-mica grains (300-500 μm) at the base of the KNF reached 445°C at 20 Ma, and subsequently migrated upwards within the KNF towards the cool Austroalpine units in the hangingwall. Near the hangingwall, where the grain size of white mica within the KNF is smaller (< 100-300 μm), temperatures reached the 400°C closure temperature of the 40Ar/39Ar white-mica system at 17 Ma. This younging upward trend of white-mica with decreasing grain size in the KNF attributed to a reduction of the closure temperature from the base (445°C) to the top (< 400°C) and explains the counter-intuitive trend of downward-increasing age of cooling in the footwall of a low-angle normal fault. When combined with new Rb/Sr white-mica cooling ages and existing thermochronological ages in the area, the 40Ar/39Ar laser ablation ages constrain rapid cooling in the Eastern Tauern Dome (ETD) to have started in latest Oligocene – earliest Miocene time, i.e., sometime between 25 and 21 Ma, and to have ended no later than 17 Ma.
The almost identical ages provided by Rb/Sr on biotite, zircon fission track and 40Ar/39Ar white-mica systems in samples from the top of the KNF indicate that this part of the shear zone cooled very rapidly from 400 to 270°C. The 40Ar/39Ar white-mica thermochronomter is well-suited to date the early-stage rapid cooling history of the KNF because the interval of grain size-dependent closure temperatures (445-400°C) overlaps with the range of temperatures (510 to 440 $\pm$ 30°C) derived from the dynamically recrystallized quartz microstructures.