Lu-Hf and U-Pb geochronology, and thermometry link slab break-off to regional heating in the Pamir

MATTHIJS A. SMIT[1], LOTHAR RATSCHBACHER[2], ELLEN KOOIJMAN[3] AND MICHAEL A. STEARNS[4]

[1]Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia, 2020-2207 Main Mall, Vancouver, Canada V6T 1Z4; msmit@eos.ubc.ca
[2]Institut für Geologie, TU Bergakademie Freiberg, Bernhard-von-Cottastrasse 2, D-09599, Freiberg, Germany
[3]Department of Geosciences, Swedish Museum of Natural History, Frescativägen 40, SE-114 18 Stockholm, Sweden
[4]Department of Earth Science, University of California–Santa Barbara, 1006 Webb Hall, Santa Barbara, CA 93106-9630, USA

Constraining the thermal evolution of the deep crust in the Pamir-Tibet orogen is a critical step towards linking Cenozoic plate dynamics, magmatism, and mountain building in the region. Extensive research accomplishments during the past 3 decades now allow detailed reconstruction of Miocene exhumation, uplift and magmatism across the orogen. Nevertheless, earlier processes related to heating and compression along the Eurasian margin are still largely obscured. This is due to the scarcity of well-preserved assemblages across the plateau region and the general difficulty in resolving early petrological records. In contrast to Tibet, the Pamir provides extensive exposure of Cenozoic deep-crustal rocks [1]. In this study, we explore the early thermal history of these rocks using garnet Lu-Hf geochronology and thermometry, and rutile U-Pb dating and Zr-in-rutile thermometry.

Garnet growth first occurred in the South Pamir at ca. 37.0 Ma – shortly after the 44-40 Ma break-off of the Indian Plate to the south [2]– and spread to the Central Pamir during the following 10.4 Myr [3]. At 26.6 Ma, the deep crust was heated beyond 750 °C regionally, and was ductile and partially molten, aiding the switch to ductile thinning at 22-20 Ma. Rutile U-Pb thermochronology records cooling of the deep crust to c. 500 °C at 9.0 Ma at an average rate of 30 K Myr^{-1}. The history uncovered here confirms a long-lived thermal history of the Pamir deep crust [4], and advocates a causal link between slab break-off and the heating and ductile thinning of the subduction hanging wall.

[1] Schmidt et al. (2013) *EPSL* **312**, 411-421; [2] Negredo et al. (2007) *EPSL* **259**, 212-225; [3] Smit et al. (2014) *Geology* **42**, 1047-1050; [4] Ducea et al. (2003) *Geology* **31**, 849-852.