Geochronology, geochemistry, and geodynamic evolution of Tatric granites from crystallization to exhumation (Tatra Mountains, Western Carpathians)

Conference Paper · September 2022

CITATION
1

READS
19

8 authors, including:

Elizabeth J. Catlos
University of Texas at Austin
150 PUBLICATIONS **3,878** CITATIONS
SEE PROFILE

Milan Kohut
Earth Science Institute, Slovak Academy Sciences, Bratislava, Slovakia
124 PUBLICATIONS **1,532** CITATIONS
SEE PROFILE

Thomas M. Etzel
ExxonMobil
34 PUBLICATIONS **88** CITATIONS
SEE PROFILE

J. Richard Kyle
University of Texas at Austin
126 PUBLICATIONS **2,134** CITATIONS
SEE PROFILE

Geochronology, geochemistry, and geodynamic evolution of Tatric granites from crystallization to exhumation (Tatra Mountains, Western Carpathians)

Elizabeth J. Catlos[1], Igor Broska[2], Milan Kohút[2], Thomas M. Etzel[1,3], J. Richard Kyle[1], Daniel F. Stockli[1], Daniel Paul Miggins[4], & Daniel Campos[1]

[1] *Department of Geological Sciences, Jackson School of Geosciences, The University of Texas at Austin, Austin, Texas, United States of America*
[2] *Earth Science Institute of the Slovak Academy of Sciences, Dúbravská cesta 9, 840 05 Bratislava, Slovak Republic*
[3] *ExxonMobil, 22777 Springwoods Village Parkway, Spring, TX 77389, USA*
[4] *College of Earth, Ocean, and Atmospheric Sciences, Oregon State University, Corvallis, 104 CEOAS Admin Bldg. Corvallis, OR 97331-5503, USA*

The Western and High Tatra Mountains (northern Slovakia, southern Poland) contain the best-exposed rocks record within the Carpathian orogenic belt. They are a logical location to study arcuate orogenesis, exhumation rates of the deep crust, and magnitudes and rates involved in the transfer of heat and mass during mountain-building events. Understanding the timing and nature of tectonic events recorded in the Western Carpathian region is helpful for global plate reconstructions and linking the range to other locales that document the closure of Tethyan oceans throughout Europe. Petrological, geochemical, and geochronological data from granitic assemblages across the Western (n=1) and High Tatra Mountains (n=19) were used to understand how they responded to an extended tectonic and magmatic history. Geochemical data from samples from the Western and High Tatra Mountains suggest they were emplaced in a volcanic arc setting at lower P (<5 kbar). Most have been derived from a mafic source, enriched mantle, non-garnet bearing source with some clay component. Two samples from the Western Tatra and High Tatra Mountains have HREE patterns and negative Eu anomalies consistent with a within-plate signature, suggesting the presence of melts from a collisional source are present in both regions.

Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS) zircon dating shows a dominant Early Carboniferous (Tournaisian, TuffZirc age = 349.3+2.9/-1.5 Ma at 95% confidence, n=119 spots), but Paleoproterozoic/Neoarchean (2544±33 Ma, ±1σ) to Late Carboniferous (Kasimovian, 305.8±6.2 Ma) dates were also found. The age pattern is consistent with granitic assemblages within the European Variscan belt and suggests an affinity with Armorican terranes derived from a northern Gondwanan Cadomian arc. The final stages of Variscan orogenic collapse are timed at ca. 315 Ma based on the youngest zircon age population. Monazite dated in thin section are also Tournaisian, but the youngest age is Permian (Th-Pb, 270.0±9.1 Ma, ±1σ), consistent with the timing of large-scale Pangean Permian extension.

High Tatra granite K-feldspar $^{40}Ar/^{39}Ar$ ages indicate slow post-magmatic cooling after granite crystallization. The oldest $^{40}Ar/^{39}Ar$ ages from two samples near Lomnický štít (LS) suggest a thermal event in the Late Triassic (~220 Ma), but others from the sub-Tatra fault and near Gerlachovský štít (GS) are younger (Early Cretaceous, ~120 Ma). The thermal history from K-feldspar at the base of LS shows pulsed exhumation at faster rates between 70-55 Ma (300-200ºC) and 45-35 Ma (200-100ºC). The results document the Paleo-Alpine tectonic imprint of the Western and High Tatra Mountains until the onset of more Neo-Alpine exhumation. The data point to uplift earlier than suggested by models of extrusion tectonics applied to the region. Early uplift is connected with Eocene ALCAPA (ALps-CArpathians-Pannonia) escape leading later to the development of the Carpathian arc.

Acknowledgements. This work was supported by the US National Science Foundation (1460050) and Slovak Research and Development Agency (APVV-18-0107 and VEGA 2/0075/20). We appreciate field assistance and/or discussions with Marty Grove, Brent A. Elliott, Thomas Quintero, Theresa Perez, Saloni Tandon, Zoe Yin, Dušan Catlos, Miro Hreus, and Karol Ivanič. Data collected in the UT Austin Geo-Thermochronometry Lab and UCLA SIMS facility.