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

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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 of Paleozoic to Early Carboniferous age (305.8±6.2 Ma). These results place the end of Variscan orogenic collapse at 315 Ma (300-280°C). The thermal history from K-feldspar at the base of LS shows pulsed exhumation at rapid rates between 70-55 Ma (300-200°C) and 45-35 Ma (200-100°C). The results document the Paleozoic crustal history 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.

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