(U-Th)/He Thermochronology of Mont-Tremblant, Quebec: Insight into an Ancient Landscape

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Abstract

Mont-Tremblant is one of the tallest and steepest peaks (875 m) within the southwestern Grenville Province. It is composed of 1.2 Ga Mesoproterozoic granulite facies orthogneiss and host to a 1.15 Ga AMCG suite. The region is situated at the transition from a thick to thin mantle root and is located off-axis to the Mesozoic Great Meteor hotspot track within the Western Quebec Seismic Zone. Advancements in thermochronology have made it possible to study the cooling and uplift history of the Mont-Tremblant region through crustal depths of <10 km with the application of zircon and apatite (U-Th/He) thermochronometry. Samples were collected along a ~650 m vertical traverse on Mont-Tremblant and from the adjacent distal regions. Zircon (U-Th/He) ages are notably scattered, exhibiting a positive correlation of younger ages with higher effective uranium concentrations (eU). Samples with eU values <300 ppm yield preliminary (U-Th/He) ages of ca. 650 Ma at the highest elevation (875 m) to ca. 560 Ma at the base (235 m). Apatite ages yield ca. 290 Ma at the highest elevation, and ca. 190 Ma from structurally low levels. By incorporating the (U-Th/He) data with regional geology into the thermal modeling program HeFTy, viable time-temperature paths can be determined. Resolvable thermal episodes defined by our data correspond with post-Grenville cooling (Neoproterozoic) or cooling and exhumation of the orogen during rifting and passive margin formation associated with the Iapetus Ocean (Early Cambrian). Moreover, this indicates that the rocks from the area have not experienced sufficient heating (>200°C) to reset the zircon He systematics since the Proterozoic-Cambrian transition. Apatite (U-Th/He) ages of ca. 290-190 Ma suggest no significant post-Carboniferous burial and may reflect far-field tectonism related to the Alleghanian collision. By combining apatite and zircon (U-Th/He) thermochronometery, we provide a unique look at the low-temperature history of the Mont-Tremblant region.