Rise and fall of the Acadian altiplano: Evidence for a Paleozoic orogenic plateau in the northern Appalachian Orogen

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High elevation orogenic plateaus are formed by a complex interplay of deep and surficial processes yet understanding of the deeper processes is limited by few recognized exposures of the lower levels of plateaus. We present evidence for the existence of an orogenic plateau during and after the Devonian Acadian orogeny (sensu lato), the mid-crustal roots of which are exposed in the New England Appalachians. The four-dimensional crustal evolution of this paleo-plateau is constrained by the integration of petrochronology, petrologic and geochronologic databases, and geophysical imaging. Doubly thickened crust, widespread amphibolite to granulite-facies metamorphic conditions, a paleo-isobaric surface, and protracted mid-crustal anatexis all indicate the presence of a high elevation (~5 km), low relief plateau by 380 Ma. $^{40}\text{Ar}/^{39}\text{Ar}$ thermochronology shows a distinct signature with very slow cooling rates of 2-4°C/m.y. following peak metamorphic conditions. Thermochronologic data, trace element and Nd isotope geochemistry, and monazite and xenotime petrochronology suggest a 50 m.y. lifespan of the plateau (380-330 Ma). Orogen parallel ductile flow and extrusion of gneiss domes resulted in plateau collapse, crustal thinning, and block-like exhumation at ca. 330-300 Ma. Thinning of the plateau crust may have led to the sharp 12-15 km step in Moho depth in western New England, possibly by reactivating the suture between Laurentia and accreted Gondwanan-derived terranes. The formation of the Acadian altiplano may have influenced Li-pegmatite genesis and Paleozoic paleoclimate, while its recognition may provide a window into the deeper processes of orogenic plateaus including partial melting, plutonism, and collapse by ductile extension.