

LATE-DEVONIAN COOLING AND MISSISSIPPIAN UPLIFT OF THE CHESTER DOME, SOUTHEASTERN VERMONT

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Contrasting ⁴⁰Ar/³⁹Ar ages of muscovite from the Chester dome and its cover rocks in southeastern Vermont suggest that differential uplift of the dome persisted until at least the middle Mississippian. Cooling ages obtained from a single outcrop containing Proterozoic schists and amphibolites intruded by pegmatites in the interior of the Chester dome are: ~375 Ma (amphibole correlation age), ~335 Ma (muscovite correlation age), ~320 Ma (biotite total fusion age), and ~270 and ~185 Ma (K-feldspar high and low temperature age steps, respectively). These data define a smooth, continuous late Acadian cooling history. In contrast, coarse muscovite separates from prograde quartz veins hosted by biotite-grade phyllitic cover rocks of the Silurian-Devonian Waits River Formation along the eastern flank of the dome yield cooling ages between 355 and 364 Ma – 20 to 30 million years older than muscovite from within the core of the Chester dome. Because both core and cover rocks now occur at the same level, uplift of core rocks must have been decoupled from the eastern cover rocks and persisted until at least 335 Ma.

To establish the time of crystallization of retrograde fabrics in the Waits River Formation, muscovite from overprinting cleavages was analyzed. A sample containing two biotite-free cleavages each defined by muscovite and chlorite, and both enveloping relic Acadian garnet porphyroblasts was collected ~6 km east of the core rocks near samples yielding late Devonian cooling ages. The resulting age spectrum climbed from 335 to 350 Ma and is interpreted to reflect a mixture of crystallization-age populations of these two retrograde cleavages with a possible minor relic Acadian muscovite cooling-age component. We hold that these late cleavages probably formed in the Mississippian during uplift of the Chester dome.

Numerical approximations were used to create a one-dimensional finite difference model to simulate tectonic conditions in the Chester dome. Amphibole-plagioclase and garnet-biotite thermometry, coupled with garnet-muscovite-plagioclase barometry were used to constrain P-T conditions to 600-700 °C and 10-14 kbars within the dome. Geophysical input parameters were used to determine a loading-unloading history consistent with ⁴⁰Ar/³⁹Ar cooling ages obtained within the interior of the dome. However, P-T paths predicted by this model fail to reach minimum P-T conditions estimated using geothermobarometry. Three possible explanations for this tectonic paradox include: 1) a purely conductive one-dimensional heat-flow model may not capture the full scope of geological conditions (e.g. advective (hydrothermal?) heat flow), 2) geological models may omit more complicated tectonic scenarios for the Silurian, or 3) geothermobarometric calculations are exaggerated by inherited Proterozoic garnets in an Acadian matrix..

Our results confirm that the rocks of the Chester dome and its cover reached peak metamorphic conditions during the middle Devonian, Acadian orogeny. However, contrasting muscovite cooling ages and retrograde Mississippian fabrics indicate that uplift of the dome was delayed until the Mississippian, and that the Chester dome may not be entirely an Acadian structure.

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