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Monazite ages in the Chesham Pond Nappe, SW New Hampshire, U.S.A.: Implications for assembly of central New England thrust sheets

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ABSTRACT

Four distinct generations of monazite growth have been identified in samples from the Chesham Pond Nappe, and three (monazite compositional domains 2, 3, and 4) have been correlated with both temperature and mineral assemblage. Domain 1 cores were interpreted previously to be detrital relics or vestiges of an earlier Acadian metamorphism. The four monazite domains have been dated by in situ isotope and chemical methods; the following are chemical ages of each domain (weighted average ±2 standard errors of the mean): 400 ± 10 Ma (domain 1); 381 ± 8 Ma (domain 2); 372 ± 6 Ma (domain 3); 352 ± 14 Ma (domain 4). Heating and cooling rates derived from combining monazite ages, monazite thermometry, and $^{40}Ar/^{39}Ar$ closure temperatures are approximately 10–15 °C/m.y. for heating from 470 to 740 °C, approximately 8 °C/m.y. for cooling from 740 to 375 °C, and approximately 1–2 °C/m.y for cooling from 375 to 150 °C. Temperature-time paths calculated with monazite ages and monazite thermometry indicate that (1) plutonism at ca. 400 Ma was the likely heat source for the formation of monazite domain 1 and (2) monazite domains 2–4 were produced during a regional low-pressure, high-temperature metamorphism active between 380–350 Ma. The regional metamorphism is ascribed to lithospheric mantle delamination, followed by asthenospheric mantle upwelling, which heated a wide area of the Merrimack basin (southwestern New Hampshire, central Massachusetts, central Connecticut) to temperatures in excess of 725 °C. Monazite ages in the Chesham Pond Nappe and adjacent structural units to the west constrain the commencement of nappe overthrusting to roughly 355 Ma.