Discovery of a Neo-Acadian ultrahigh temperature metamorphic event in central Massachusetts via Sm-Nd garnet geochronology and Zr-in-rutile thermometry

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Work in Connecticut, USA has linked crystallographically oriented rutile needles included in garnet to ultrahigh temperature (UHT) metamorphism [1, 2]. This textural feature is also seen in garnets from the Littleton Formation in Phillipston, Massachusetts, USA, prompting investigation into the time-temperature history of these rocks in order to better understand the metamorphic history of central Massachusetts. In this study, a single 2.4 cm diameter garnet porphyroblast was drilled into six concentric growth zones [3] and each zone was prepared for Sm-Nd analysis. Additionally, zirconium concentrations in rutile needles were measured using an electron microprobe and Zr-in-rutile temperatures [4] of >900°C were calculated. Because the rutile needles were only present in the outer two zones of the garnet we calculated a garnet-matrix isochron age (using the outer two zones only) of 363.91 ± 0.80 Ma (n=7; MSWD = 4.7) and interpret this to be the age of the UHT event. Interior zones of the garnet show flat major element chemistry likely reflecting full diffusional resetting of earlier garnet during the UHT event. This UHT age is significantly younger than 390-380 Ma Acadian orogeny ages recorded in New Hampshire [5], but agrees with some younger, Neo-Acadian ages reported in Massachusetts [6].

[1] Ague and Eckert (2012) *American Mineralogist* **97**, 840-855 [2] Ague *et al* (2013) *Geology* **41**, 271-274 [3] Pollington & Baxter (2011) *Chemical Geology* **281**, 270-282 [4] Tomkins *et al* (2007) *Journal of Metamorphic Geology* **25**, 703-713 [5] Pyle *et al* (2005) *American Mineralogist* **90**, 592-606 [6] Robinson *et al* (1998) *GFF* **120**, 119-148