*American Mineralogist, Volume 101, pages 1792–1806, 2016*

SPECIAL COLLECTION: ADVANCES IN ULTRAHIGH-PRESSURE METAMORPHISM

# Dissolution-reprecipitation metasomatism and growth of zircon within phosphatic garnet in metapelites from western Massachusetts

**Emily M. Peterman[1,*], David R. Snoeyenbos[2], Michael J. Jercinovic[2], and Andrew Kylander-Clark[3]**

[1]Earth and Oceanographic Science, Bowdoin College, 6800 College Station, Brunswick, Maine 04011, U.S.A.
[2]Department of Geosciences, University of Massachusetts-Amherst, 611 N. Pleasant Street, Amherst, Massachusetts 01003, U.S.A.
[3]Department of Earth Science, University of California-Santa Barbara, Webb Hall, Santa Barbara, California 93106-9630, U.S.A.

## Abstract

Highly restitic garnet-kyanite-phlogopite metapelitic schists from the Goshen Dome of western Massachusetts contain: a population of prograde monocrystalline, megacrystic garnet, some with significant P in substitution for Si; precipitates of hydroxylapatite and rutile; and <1 μm zircon crystals of undetermined origin and abundance on the order of $10^5$/mm$^3$. The unusual P content and the abundant internal precipitate suite are similar to features reported in garnet from ultrahigh-pressure (UHP) and mantle settings, suggesting a potential (U)HP origin for the garnet megacrysts. Zircon included in megacrysts is surrounded by radial fractures, indicating in situ volumetric expansion or new growth. Cores display rare earth element (REE) profiles and cathodoluminescence (CL) zoning consistent with magmatic growth, and yield only Paleozoic dates (447–404 Ma). The embayed core-rim boundary is marked by a several micrometers wide band of CL-dark zircon enriched in Y, P, U, and Th that is interpreted as the accumulation of redistributed xenotime component from the original zircon rim during metamorphism. Outside of this band, the rim has elevated Hf, Th/U << 1, and steep heavy REE profiles. The metamorphic rims yield concordant dates from 400 to 381 Ma. Matrix zircon grains have magmatic cores (1726–415 Ma) with similar core–rim boundaries enriched in Y, P, U, and Th. Metamorphic rims on matrix zircon yield slightly younger dates (393–365 Ma) and are compositionally heterogeneous.

The difference between the youngest core and oldest rim indicates a short interval (ca. 4 Ma) between deposition of detrital zircon and the onset of metamorphism in the earliest Acadian. The oldest zircon rim dates are found within phosphatic garnet megacrysts of possible very high-pressure origin. The compositional uniformity of these rims indicates equilibrium with a single source; the anomalous composition suggests a combination of dissolution-reprecipitation and new growth of zircon that is derived from garnet. The range in both composition and dates indicates that matrix zircon rims formed in response to local changes in mineralogy and fluid/melt composition and/or availability. New growth of zircon on these grains cannot be confirmed, suggesting that dissolution-reprecipitation reactions during continued metamorphism may be the dominant mechanism that formed these rims. The data collectively suggest that dissolution-reprecipitation may be a common mechanism for producing metamorphic rims on zircon that does not require additional Zr and Hf, which are limited within most metamorphic settings.

**Keywords:** Zircon, garnet, LASS, dissolution-reprecipitation, metasomatism, metamorphism, Invited Centennial article