

## **Metamorphosed Ordovician Fe- and Mn-rich rocks in south-central Maine: From peri-Gondwanan deposition through Acadian metamorphism**

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### **ABSTRACT**

The Wilson Cove Member of the Cushing Formation is a thin (up to 120 m thick) metamorphosed Fe- and Mn-rich unit exposed discontinuously over a distance of >75 km in southern Maine. Cathodoluminescence imaging of zircon grains from the unit reveal texturally isolated detrital cores surrounded by distinct metamorphic overgrowths. U-Pb SHRIMP core ages range from 463 to 2058 Ma with a strong peak in the Neoproterozoic-Early Cambrian. This distribution of ages is consistent with a peri-Gondwanan source region and a Middle to Late Ordovician depositional age. Zircon rims have an age of  $373 \pm 4$  Ma, consistent with growth during late Acadian metamorphism. Whole-rock geochemistry reveals considerable major- and trace-element variability with generally elevated abundances of Fe<sub>2</sub>O<sub>3</sub>(t) (15–43 wt%), MnO (0.1–12.1 wt%), Ba (4–2503 ppm), and As (7–1161 ppm). Geochemical discrimination diagrams suggest the protoliths were mixtures of hydrothermal exhalatives and terrigenous clastic sediment, with these materials most likely having been deposited in a marine back-arc basin proximal to a peri-Gondwanan continental source region. Late Devonian low-pressure, amphibolite-facies metamorphism of these bulk compositions produced assemblages dominated by grunerite + garnet + biotite + quartz. These and other mineral assemblages found in the Wilson Cove unit in south-central Maine are consistent with peak metamorphic conditions of 550 to 600 °C and 3–4 kbar previously determined from nearby metapelites. Mineral assemblages, mineral modes, and mineral compositions in these Fe- and Mn-rich rocks are strongly influenced by whole-rock bulk compositional variability. In particular, the compositions of co-existing garnet and grunerite vary systematically as a function of whole-rock MnO concentration.

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