MANTLE XENOLITHS FROM THE NORTH HARTLAND DIKE AND THE ORIGIN OF MESOZOIC LAMPROPHYRES IN VERMONT

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A Cretaceous (133 ±6 Ma) camptonite dike in the spillway of the North Hartland flood control dam displays abundant inclusions of spinel lherzolites and lesser amounts of dunite, harzburgite, and clinopyroxenite, as well as quartz plagioclase granulites and other xenoliths. The inclusions range up to fist-sized and are concentrated in bands through the middle part of the intrusion. Other Mesozoic dikes in the Northeast contain high-grade metamorphic crustal inclusions, but dikes with ultramafic (mantle) xenoliths are rare. Electron microprobe analyses of mantle minerals from North Hartland include enstatite, diopside, low-Ti augite, Mg-rich olivine, brown chromian spinel, and rare phlogopite, with compositions that are generally comparable to mantle minerals from four other New England and Quebec lamprophyres. Geothermometer calculations using the North Hartland analyses indicate equilibrium temperatures that are somewhat lower than those from other sites.

Xenolith occurrences are important to studies of tectonic features and the origin of igneous rocks in the region. Geochemical data from the North Hartland and other xenolith sites show that the Cretaceous mantle had little variation across terrain boundaries in the region, with vertical heterogeneity but relatively good lateral homogeneity of mantle rock types. Volatile-rich compositions are rare in the xenoliths, with little evidence for chemical enrichment with mobile elements in their source areas. Such enrichment may be required for the generation of alkaline basalt melts that ascended as lamprophyre dikes, and which also puddled into chambers that became plutons such as Ascutney Mountain. Vermont lamprophyre rare earths show a possible equilibrium with deeper, garnet-bearing and enriched source rocks, and so the xenoliths may represent incidental mantle material not related to lamprophyre genesis and mantle enrichment processes.