Role of Igneous Rocks in Terrane Analysis: Application to Geological Evolution of the New England Avalon

O.D. Hermes, Department of Geology, University of Rhode Island Kingston, Rhode Island 02881 USA

In southeastern New England, the Avalon Zone contains the following terranes (from east to west): the (1) Fall River-Dedham terrane, (2) Esmond-Milford terrane, and (3) Hope Valley gneiss terrane. Within this composite zone, the study of igneous rocks provides insight into: (1) constraints on timing of terrane linkages, (2) mechanics of linkage and tectonics (i.e., subduction, strike-slip, flake tectonics, pull-apart regimes, (3) evolution of crustal sources through time, and (4) processes that may disturb such "normal" evolutionary trends.

The presence of widespread Paleozoic alkalic igneous rocks within the Fall River-Dedham and Esmond-Milford terranes indicates assembly prior to the mid-paleozoic, and possibly as early as the late Proterozoic. Juxtapositioning of the Hope Valley and Esmond-Milford terranes occurred between 370-275Ma as indicated by deformation of Devonian granite along the Hope Valley Shear Zone, and subsequent intrusion of Permian granite which locks together the two terranes. Arrival of the Hope Valley terrane to ancestral North America is poorly constrained, but most likely occurred during the Taconic or Acadian orogenies, although an Alleghanian arrival is not precluded.

In all three terranes, late Proterozoic magmatism is mainly calcalkaline, and consistent with processes of crustal thickening and accretion. The residual, relatively anhydrous crustal source material underwent periodic partial melting throughout the Paleozoic to produce episodic alkalic magmas that formed shallow A-type plutons accompanied by local bimodal volcanism. Such magmatism occurred within attenuated crust, probably accompanied by strike-slip faulting which ultimately caused late Paleozoic rift or pull-apart basins. A dramatic change in magmatic character occurred in the Permian, and is characterized by peraluminous, water-rich magmatism involving source material that contains a substantial component of Archean age. Apparently, anhydrous source material was mixed with old, hydrous material derived from the African craton by underplating during impingment of Gondwana with the North American continent during the closing of the Rheic Ocean.