Examining a channel flow hypothesis along the Nashoba- Avalon Terrane Boundary, Eastern Massachusetts.

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Abstract

The Acadian orogeny resulted from the accretion of the southeastern New England Avalon Terrane (AT) to the Nashoba Terrane (NT) - the trailing edge of Ganderia - to its northwest, in eastern Massachusetts. Ganderia and the AT are mostly Gondwana-derived. Previously, rocks of the NT were interpreted to have been extruded to the southeast over the AT as part of a channel flow zone. Only the top and center of this zone are exposed in the NT.

Bedrock and structural mapping were carried out in the AT adjacent to the NT to locate the bottom of the channel flow zone. The main rock types are migmatitic biotite gneiss and mafic rock, quartzite, and igneous rocks, exposed in 10s of m to km scale blocks and lenses. Some of these rocks have been sheared and show evidence of mylonitization. Furthermore, they occur near, and in two areas are crosscut by, igneous plutons of unknown age.

The foliations of migmatitic rocks, quartzites, and mylonites predominately dip NW, but the orientations of the mylonites vary, especially away from the terrane boundary. Lineations plunge NE and SW in migmatites, NE in quartzites, and NW in mylonites. Migmatitic rocks show abundant isoclinal folds. Predominantly NW to SW dipping normal faults with various slickenline orientations were observed in all rock types.

The migmatitic biotite gneiss and its structures resemble those of the NT. However, U-Pb zircon data yielded a detrital zircon signature typical for Avalonia, with predominantly Mesoproterozoic and minor Paleoproterozoic and Tonian populations. Furthermore, zircon overgrowths are ~585 Ma, which suggests that the high-grade metamorphism and partial melting were Ediacaran and did not result from the Acadian orogeny and channel flow at that time. Based on the (1) blocky/lensoid outcrop pattern of rock types, (2) varied orientations of structures, and (3) abundance of faults, the area may represent a brittle fault zone that cut off the interpreted channel flow zone of the Nashoba terrane. Our structural analysis is complemented by and provides context for high-resolution seismic imaging of the crust enabled by the ongoing GENESIS deployment of broadband seismometers across the NT. Preliminary results from GENESIS suggest a transition in crustal structure across the boundary between NT and AT, consistent with geological observations.