Testing for channel flow along the Nashoba-Avalon terrane boundary in Eastern Massachusetts.

Nikhil Arolkar, Victoria Simoneau, Yvette D. Kuiper, Frederik Link, Maureen D. Long

Abstract

The southeastern New England Avalon Terrane (AT) accreted to the southeastern margin of the Nashoba Terrane (NT) at the onset of the Acadian orogeny (latest Silurian to Devonian). The NT represents the trailing edge of Ganderia. Rocks of the NT have previously been interpreted as having been extruded to the southeast over the AT as part of a channel flow zone (CFZ).

Based on fold symmetries, it was inferred that only the top and center of this zone are located in the NT. Bedrock and structural mapping were carried out in the AT adjacent to the NT to test whether the bottom of the CFZ may be located in the AT. Data were collected from migmatitic biotite gneiss, mylonite, foliated quartzite, and gneiss. Structural data were divided into NE and SW domains. In the NE domain, foliations dip predominantly NW, and lineations plunge NE and SW. Migmatitic and gneissic rocks are absent in the SW domain, and orientations of mylonite zones and foliations in quartzite vary. Compared to the NE domain, rocks in the SW domain are strongly faulted and intruded by Ediacaran and late Silurian/Devonian granitic and gabbroic plutons. The presence of migmatite and consistency in structural orientations in the NE domain, and the general resemblance of structures to those in the NT make the NE domain a likely candidate to represent the bottom of the CFZ.

U-Pb zircon data of the migmatitic biotite gneiss 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 high-grade metamorphism and partial melting occurred in the Ediacaran, i.e., not during the Acadian orogeny. Hence, the migmatitic biotite gneiss in the AT terrane does not represent the bottom of the CFZ. We believe that the Bloody Bluff Fault along the Nashoba-Avalon terrane boundary may have cut off the bottom of the CFZ. Our 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.