Evolution of Proto-Avalonia: a 1.0 Ga tectonothermal event and geodynamic linkage to the breakup of Rodinia?

J.B. Murphy[1], R.A. Strachan[2], R.D. Nance[3], D.K. Parker[2], and M.B. Fowler[2]
[1]*Department of Geology, St. Francis Xavier University, Antigonish, Nova Scotia B2G 2W5, Canada, <bmurphy@stfx.ca>*
[2]*School of Earth and Construction Sciences, Oxford Brookes University, Oxford OX3 OBP, United Kingdom*
[3]*Department of Geology, Ohio University, Athens, Ohio 45701, USA <dnance1@ohiou.edu>*

Avalonia, the largest suspect terrane in the Canadian Appalachians, originated along the Neoproterozoic margin of Gondwana and was accreted to Laurentia by the late Ordovician. The age and character of Avalonian basement is key to identifying the portion of the Gondwanan margin from which the terrane was derived and provides important constraints for Neoproterozoic paleocontinental reconstructions. Since this basement is not exposed, it must be characterized indirectly by isotopic analyses. Nd-Sm data from ca. crustally derived, 630-430 Ma felsic rocks typically record initial e_{Nd} values between 0 and +5.0 and model ages (T_{DM}) between 0.8 to 1.1 Ga, but the origin of this isotopic signature is unclear. Two early Avalonian igneous complexes that were emplaced prior to the main (630-570 Ma) cycle of Neoproterozoic magmatism; the ca. 734 Ma Economy River Gneiss of mainland Nova Scotia and the ca. 675 Ma Malverns Plutonic Complex of the British Isles show non-overlapping e_{Nd^t} values of +1.29 to +4.09, and -0.11 to -2.03, respectively. Yet their T_{DM} (998 -1194 Ma and 1043- 1147 Ma) are almost identical and are similar to those of the main 630-570 Ma arc phase and subsequent Paleozoic tectonothermal events. This indicates that the isotopic signature is a characteristic feature of Avalonian basement and that felsic magmatism produced by peak arc activity was predominantly generated by recycling pre-existing crust.

The T_{DM} ages are interpreted to record a ca. 1.0 to 1.2 Ga tectonothermal event that formed much of the basement upon which subsequent Neoproterozoic and Paleozoic tectonothermal activity developed. This interpretation is supported by U-Pb detrital zircon ages of 977-1223 Ma obtained from Avalonian sedimentary rocks in Nova Scotia that are coeval with the main arc phase. This tectonothermal event is interpreted to reflect western-Pacific-type arc-back arc complexes formed coevally with the Tocantins province of central Brazil. The transition to eastern Pacific-type arc activity may be related to the ca. 760 breakup of Rodinia in a manner analogous to effect of the breakup of Pangea on the tectonothermal evolution of western North America.