U-Pb Ages From Detrital Zircon in Avalonian Sedimentary Rocks: Temporal Changes in Provenance Tied to Terrane Migration?[1]

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The Avalon microcontinent in the northern Appalachian orogen originated near the margin of the supercontinent Gondwana, but its position along that extensive margin, and its timing of separation, remain disputed. Avalonia is characterized by Neoproterozoic - Cambrian clastic sedimentary sequences. Detrital zircon ages from these sedimentary units may provide constraints on the locations of the terrane prior to its accretion to Laurentia. U-Pb ages have been obtained for detrital zircon from units with depositional ages ranging from c. 630 Ma to c. 505 Ma. The oldest sample, from the Hammondvale Metamorphic Suite (HMS) in southern New Brunswick, contains zircon as young as 630 Ma, providing a maximum depositional age. The dominant Neoproterozoic zircon population has an age of 682 Ma, which likely represents the age of the main sediment source, but the sample also contains a few older Neoproterozoic grains (approaching 800 Ma). Importantly, the HMS sample also contains relatively abundant 1.9 - 1.0 Ga zircon, but no zircon with ages between 2.9 and 1.9 Ga. In contrast, published data from quartzite clasts from a conglomerate thought to be deposited at c. 550 Ma in New Brunswick and Nova Scotia show different detrital zircon age patterns: the percentage of Mesoproterozoic grains is lower than in the HMS, and a population of 2.0 - 1.9 Ga grains is present. Thus the latest Precambrian appears to mark the beginning of an important change in sediment sources to Avalonia. A younger (c. 540 Ma) quartzite (Ratcliffe Brook Formation) reinforces this apparent change in provenance in that Mesoproterozoic zircons are even lower in abundance and the abundance of 2.1 - 1.9 Ga zircon is higher. Additionally, a new c. 800 Ma zircon population is noted. This new age peak may also reflect a fundamental shift in provenance, perhaps as a consequence of migration of the terrane along the Gondwanan margin. Two additional (c. 520 Ma) Cambrian samples also have also been investigated; the vast majority of zircon in the c. 520 Ma Glens Falls Formation is c. 600 Ma, suggesting derivation primarily from local sources. In contrast, the Sgadan Lake Formation, also 520 Ma, also shows a predominant peak at about 600 Ma but also has a secondary age peak at 2.1 - 1.9 Ga, in addition to minor Mesoproterozoic and **Archean** peaks. The age distribution most closely resembles that found in the quartzite clasts from the 540 Ma conglomerate. The youngest Avalonian sandstone analyzed is sandstone from the c. 505 Ma King Square Formation. The age pattern of detrital zircon for this unit is most similar to the quartzite from the Ratcliffe Brook Formation, except that the 2.1 - 1.9 Ga peak is less, and the 850-800 Ma more, pronounced. A clear temporal shift is seen from Mesoproterozoic dominant and 2.1 - 1.9 absent, towards a minimal Mesoproterozoic record, with a considerably more important 2.1 - 1.9 Ga peak and an increasing importance of 850 - 800 Ma zircon. Various scenarios can be envisioned to explain these results; however, we suggest that the changing ages of detrital zircon are tracking the movement of Avalonia from a South American Gondwanan location towards a West African location prior to its cross-ocean migration towards Laurentia. A similar migration pattern has been suggested for the Carolina terrane of the southern Appalachians, also based on changing age populations of detrital zircon.

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