Climatic signature of some Ordovician, Silurian and Devonian paleosols in the Avalon Terrane of northern Nova Scotia; implications for paleogeographic reconstructions

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The relative position of the Avalon Terrane in Neoproterozoic to Paleozoic reconstructions has been a constant source of controversy. Some of the reconstructions are mainly based on paleomagnetics, isotopic signatures and zircon ages, without due consideration being given to the climatic signatures provided by sedimentary rocks. Paleosols are especially reliable paleoclimatic indicators, but those in the Avalon Terrane have received little attention in this regard.

Red paleosols developed between basalt flows of the Middle Ordovician Dunn Point Formation show evidence for a hot and humid equatorial climate, but one with strongly alkaline characteristics. The absence of significant land plants in Middle Ordovician times is thought to explain this apparent dichotomy between high humidity and high alkalinity. The Dunn Point paleosols may have formed at the eve of a major change in near-surface groundwater conditions that took place near the end of the Ordovician as the radiation of land plants terminated the trend of increasing alkalinity (related to a gradual reduction in atmospheric CO_2 levels) that characterized Precambrian and lower Paleozoic times.

The development of calcrete hardpan in the Red Member of the Silurian Moydart Formation indicates that the climate in that part of the Avalon Terrane, though still warm, had become substantially more arid, possibly due to the migration of Avalon to subtropical areas. Calcrete development and inefficient chemical weathering of basalt flows in the Upper Devonian McAras Brook Formation also indicate tropical arid conditions, but equatorial conditions cannot be ruled out due to the context of supercontinentality in which these paleosols evolved. Hence, according to paleoclimatic signatures from paleosols, the Avalon Terrane of northern Nova Scotia apparently remained between the tropics throughout most of the Paleozoic.