History of ideas on the Silurian-Devonian tectonic evolution of the northern Appalachian orogen: 1980–2014

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By the end of the 1970s, first order geological analysis had identified the major building blocks of the northern Appalachian mountain belt. At this stage reasonable consensus existed that the orogen comprised at least 5 major zones or terranes: Humber, Dunnage, Gander, Avalon and Meguma. The major differences in geological evolution between these terranes hinted at a complex tectonic evolution, yet the standard tectonic model at that time was very simple and conservative. It generally involved an east- dipping subduction zone, because this was the simplest way to explain Taconic obduction of ophiolites onto the Humber margin of Laurentia. However, little was known what happened tectonically after the middle Ordovician and how and when the various terranes were assembled into one mountain belt. The Silurian was considered a period of tectonic quiescence, whereas the tectonic processes responsible for the Devonian Acadian orogeny were highly contentious, if not a mystery to most. Yet the Acadian orogeny affected almost the whole width of the mountain belt. A major hindrance to orogenic analysis was an apparent lack of what were considered critical tectonic indicators (e.g., ophiolites and high pressure-low temperature (HP-LT) metamorphic rocks) east of the Early to Middle Ordovician Taconide belt. Theoretical considerations as well detailed studies of recent orogens such as the Taiwan mountain belt, has subsequently shown that the presence or preservation of such indicators are not necessarily a common phenomenon.

Multidisciplinary studies initiated during the 1980s and 1990s, mainly involving thematic mapping combined with geochemistry and modern U-Pb zircon geochronology, changed our views on the tectonic evolution of this mountain belt considerably. Evidence indicated orogenesis during the Silurian (Salinic), which was causally related to closure of the Tetagouche-Exploits backarc basin and accretion of the trailing Gander margin to composite Laurentia. Development of a Silurian arc on the latter while the Salinic affected other parts of Ganderia indicated that Avalonia at this time was still separated from composite Laurentia. Several lines of evidence indicated that its accretion had started at ca. 420 Ma, during the waning stages of the Salinic orogeny. At this stage, Ganderia occupied a relatively unique tectonic setting. Its leading edge was underthrust beneath composite Laurentia, while subduction and extension was taking place beneath its trailing edge. Dating of foreland basin deposits associated with both the Salinic and Acadian orogenies showed they are time transgressive, with the deformation fronts progressively becoming younger to the southeast and northwest, respectively.

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