Geochronology meets GIS: towards a kinematic model for the Appalachian – Caledonide orogen

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Appalachian-Caledonide orogen development has been traditionally illustrated using cross-sections showing terrane accretion and collision over time. This approach is valuable but leads to implicit assumptions: subduction was initiated at passive continental margins; convergence was mainly orthogonal; terranes and zones had ribbon-like geometry parallel to continental margins; and present-day orogen geometry is a valid "end point" for reconstructions. Post-Pangea tectonic evolution provides little support for these assumptions.

To reach a more actualistic model for the closure of the Iapetus Ocean, we hope to incorporate a number of under-utilized data sets: (1) Estimates of late Paleozoic and Mesozoic plate motions, to restore a valid mid-Devonian geometry from which to build back in time; (2) Reviews of legacy biostratigraphic data using calibrated time scales to place sedimentary units accurately relative to isotopically dated igneous units; (3) A review of paleomagnetic information including both declinations and inclinations, so as to evaluate systematic vertical-axis rotations as well as latitude changes; (4) A compilation of detrital zircon data using newly developed display techniques to show proximity of terranes to major continental blocks that are the best candidates for sedimentary provenance. The last of these items has led us to compile >350 published detrital zircon data sets in a common format. The softwares GPlates and QGIS allow us to present these data in geographic space using new graphical techniques.

Preliminary results suggest that terranes attributed to Ganderia and associated Gondwana-derived arcs crossed the Iapetus in several pieces, arriving at the Laurentian margin at different times from Ordovician to Devonian. Portions of "Ganderian" and "Avalonian" continental crust may have been juxtaposed during Penobscottian convergence on the margin of Gondwana. The Taconian Orogeny is explained as the result of a diachronous arc-continent collision that involved both Laurentia-derived and Gondwana-derived units. It was followed by subduction-polarity reversal at the Laurentian margin. Salinian deformation resulted from subduction-accretion of terranes at this margin, over a period of time lasting from the Late Ordovician nearly the end of the Silurian Period. Acadian deformation resulted from sinistral and convergent motions at an Early Devonian along-margin boundary that may have varied from transpressional in New England to ideal strike slip in Britain and Ireland.