

Early Paleozoic intra-plate reactivation of the Ottawa graben and links to the onset of the Taconic orogeny: insights from stratigraphy, detrital zircon provenance, and paleoflow of the Cambrian-Ordovician Potsdam Group

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The Ottawa graben is a Neoproterozoic intracratonic rift in northeastern North America that was reactivated throughout the Phanerozoic and persists as a modern seismically active zone of lithospheric weakness with extant topography. Using U-Pb geochronology of detrital zircons combined with paleoflow and stratigraphic data from the Potsdam Group provides evidence for three episodes of reactivation of the Ottawa graben on the Cambrian to Early Ordovician Laurentian craton. The earliest episode was during the late Early to Middle Cambrian and coincided with localized rifting and the opening of fault-bounded mini-basins that were filled with arkose derived from local rift shoulders consisting mainly of ca. 1176 Ma Grenville sources of the Frontenac terrane. Additionally, the local presence of ca. 1442 Ma zircons suggests more extensive opening of the Ottawa graben along the trace of the modern Ottawa River Valley, which provided a localized conduit for the transport of sediment derived from parts of the Central Gneiss Belt, ~350–400 km to the west. The second episode of reactivation occurred during the Middle to early Late Cambrian and resulted in the topographic inversion of parts of the southern Ottawa graben; notably, with the onset of uplift of the adjacent Adirondack Dome, and radial dispersal of sediment and introduction of ~1000–1060 Ma detrital zircons throughout the Ottawa graben. The third and final episode of reactivation occurred during the Earliest Ordovician and coincided with a second phase of topographic inversion, but this time marked by subsidence of the Adirondack Dome and uplift of parts of the northern Ottawa graben. This resulted in southeastward paleoflow and the re-introduction of ca. 1442 Ma zircons from reworked older Potsdam strata and/or direct sourcing from parts of the Central Gneiss Belt to the west.

Each of the three episodes of reactivation coincided with regional plate tectonic events in and around ancestral eastern North America which in turn hypothetically perturbed the Laurentian intraplate stress field, triggering reactivation of the Ottawa graben. The earliest episode of reactivation coincides with a poorly constrained period of Cambrian rifting and syn-rift sedimentation in paleo-southern Laurentia that most likely coincident with a late-stage episode of Laurentian lithospheric extension preceding the initiation of Taconic orogenesis. The latter two episodes of reactivation are linked to Peri-Laurentian Taconic orogenic events, including Late Cambrian obduction of the Iapetus Ocean over peri-Laurentian terranes and Early Ordovician initiation of Humber Seaway subduction.