# The geological history of the Brunswick subduction complex in Bathurst, northern New Brunswick – an important clue to understanding the tectonic evolution of the Northern Appalachian Orogen

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Critical to understanding the tectonic history of the Gondwanan Gander margin of the Northern Appalachians are the geological relationships preserved in the polyphase deformed rocks of the Brunswick complex near Bathurst in north-central New Brunswick.

A combination of stratigraphic, structural, geochemical, radiometric and isotopic data of the Lower Paleozoic rocks shows development of a magmatic arc (Popelogan arc) during the Arenig (479-473 Ma) on the Gander margin. Subsequently the Popelogan arc rifted and migrated towards the west due to slab-rollback, which opened a wide, Japan-Sea style back-arc basin (Tetagouche basin) during the Middle Ordovician (c. 473-460 Ma). Rifting appears to have taken place in stages, which led to development of several oceanic subbasins, separated by small semi-continental fragments.

The Popelogan arc collided with the Laurentian margin during the Caradoc (c. 455 Ma) and was subsequently unconformably overlain by Ashgill rocks of the Matapedia overstep sequence; hence the Popelogan arc is the obvious equivalent of the Bronson Hill arc in New England, with which it also lies on strike. Stratigraphic and radiometric evidence constrain closure of the Tetagouche basin between 450 and 420 Ma; thus during deposition of the adjacent Matapedia sequence above the now accreted and shut-off Popelogan arc. Closure of the Tetagouche basin led to underplating and incorporation into the Brunswick complex. Underplating was achieved mainly by imbrication ($D_1$) into numerous thrust-bounded nappes. D1 took place at conditions of c. 8-6 kb, 330-400°C (epidote-blueschist to greenschist facies). Removal of the effects of the deformation ($D_2$-$D_4$) that postdated underplating shows that the stratigraphy in each nappe has an overall northward younging, while the sedimentary cover of the volcanic rocks becomes progressively younger towards the south. This suggests that underplating progressed from north to south, and formed a series of southward propagating duplexes.

The major thrusts that separate nappes with different volcanic stratigraphies also coincide with minor, but consistent jumps in metamorphic grade such that it created a partially inverted sequence with higher pressure rocks overlying lower pressure rocks. Hence, the major thrust faults must have continued moving after peak metamorphism, which is consistent with the observation that the thrust-related deformation ($D_1$) comprises at least two generations of shear zones. $D_1$ also included steeply inclined, s-shaped isoclinal folds that folded the earliest thrusts and rotated them into steeper attitudes. The overall geometry and kinematics of the nappe sequence with ophiolite at the highest structural level, underlain by progressively less oceanic rocks, combined with the presence of large ophiolitic melanges and blueschists is difficult, if not impossible, to explain in any other way than by northwest-directed subduction. Deformation in the subduction complex is coeval with deposition of the Late Ordovician-Early Silurian Fredericton trough foredeep, which is linked to the Ordovician rocks of the subduction complex by detritus and age of deformation. The excellent preservation of the HP-assemblages indicates that refrigeration of the Brunswick Complex, and hence subduction of cold lithosphere, continued while the rocks were exhumed during the Silurian. The Brunswick Complex is the best preserved Silurian subduction complex in the Northern Appalachians and can be traced along strike into other parts of the orogen. Its preservation is the best evidence that the Laurentian margin was active during this time.

The subduction related structures ($D_1$) were overprinted into complex fold structures during the Devonian. These structures are related to extensional collapse and transpression and are coeval with bimodal magmatism. Terminal collision, slab-breakoff and oblique accretion of Meguma were probably responsible for this deformation.