Geological Relationships at the Western Margin of the Miramichi Highlands: Portage Lakes to Serpentine Lake Area

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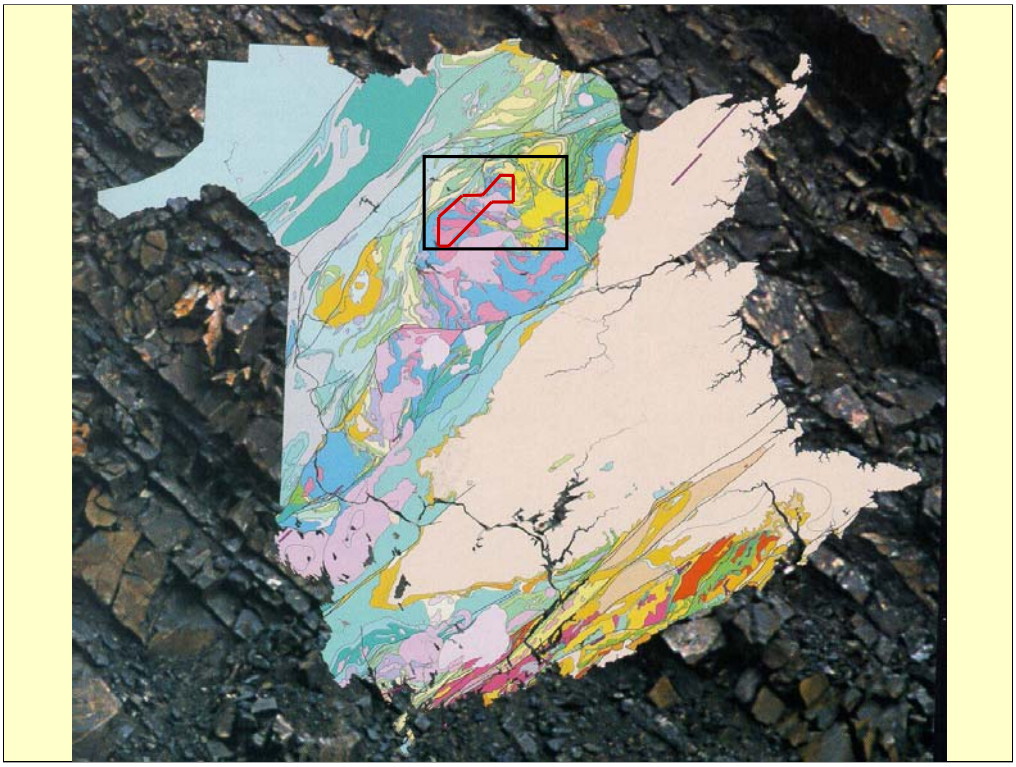
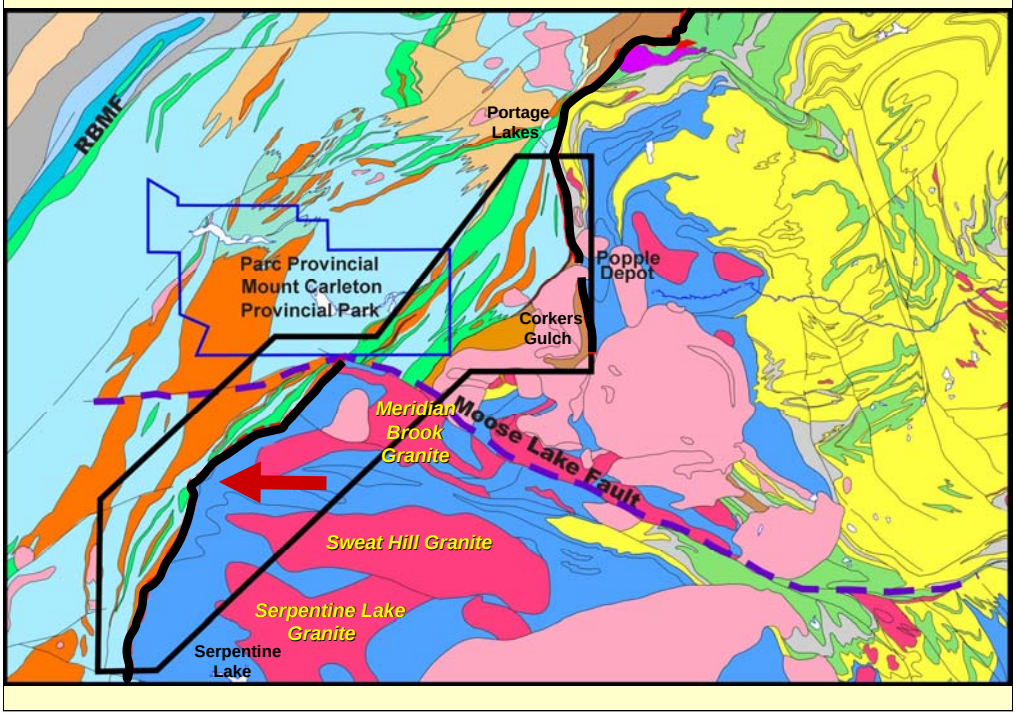


Location map of the study area in northern New Brunswick. The following slide shows the area outlined by the black rectangle in more detail; the heavy red line shows the location of field work.

Location of Study Area



The heavy black line is the boundary between the Miramichi Highlands to the east (right) and the Tobique Belt to the west (left).

The Miramichi Highlands are underlain by Cambrian to Ordovician rocks of the Miramichi Group (dark blue) and the Bathurst Supergroup (yellow and light green), whereas the Tobique Belt comprises interbedded sedimentary (light blue, light brown) and mafic (darker green) and felsic (orange) volcanic rocks.

The Miramichi-Tobique boundary is dextrally offset along the Moose Lake Fault, forming an “embayment” at Corkers Gulch. In this area, various phases of the Early Devonian South Nepisiguit River Plutonic Suite intrude rocks of both the Miramichi and Tobique zones, obscuring the contact in many places. Foliated Ordovician granites are more common south of the Moose Lake Fault (e.g., Meridian Brook, Serpentine River and Sweat Hill granites), implying relative uplift of this block.

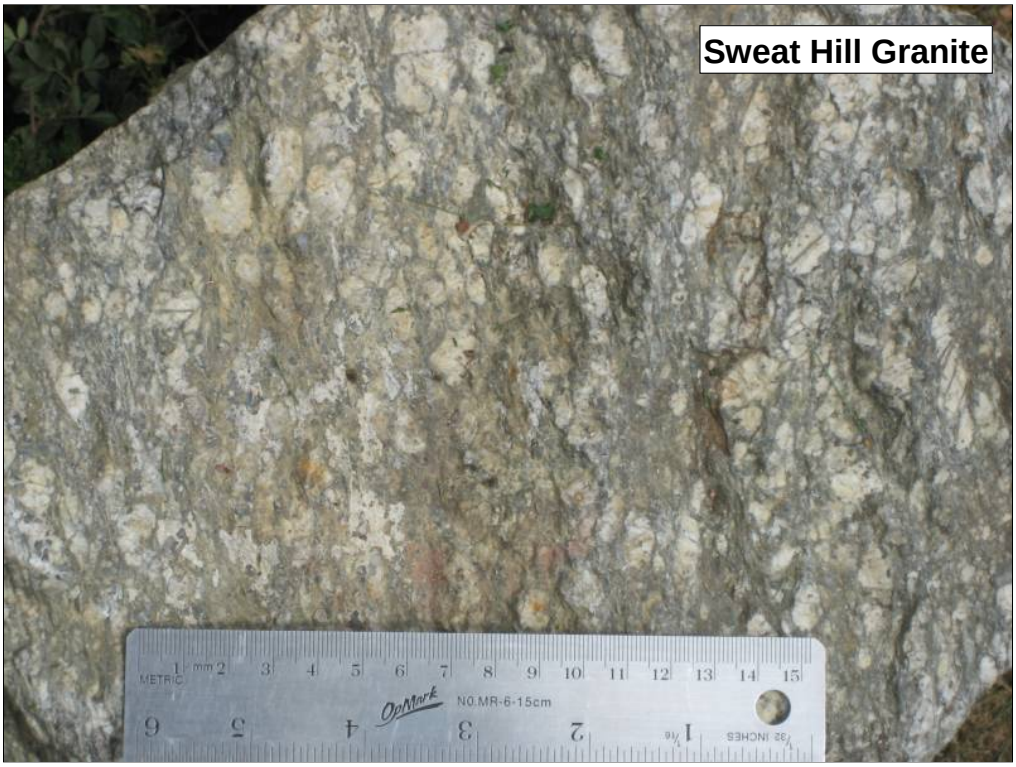
The red arrow points to the location of a showing found by prospector Wayne Carroll. Previous mapping indicates the area is underlain by sedimentary rocks of the Miramichi Group, but igneous rock samples collected by Wayne resemble Nepisiguit Falls quartz-feldspar crystal tuff of the Tetagouche Group, which crops out much farther east. Field work was planned to investigate and map out any volcanic rocks in the area.

Feldspar-quartz porphyry, south side of Serpentine River

This is a hand specimen of feldspar-quartz porphyry on the south side of Serpentine River, south of the Carroll showing. It is similar to the Nepisiguit Falls Formation but feldspar phenocrysts are larger than normally seen in that unit.

Feldspar-quartz porphyry, south side of Serpentine River

This is the outcrop of porphyry; two other exposures of similar but finer-grained porphyry were observed in this area.



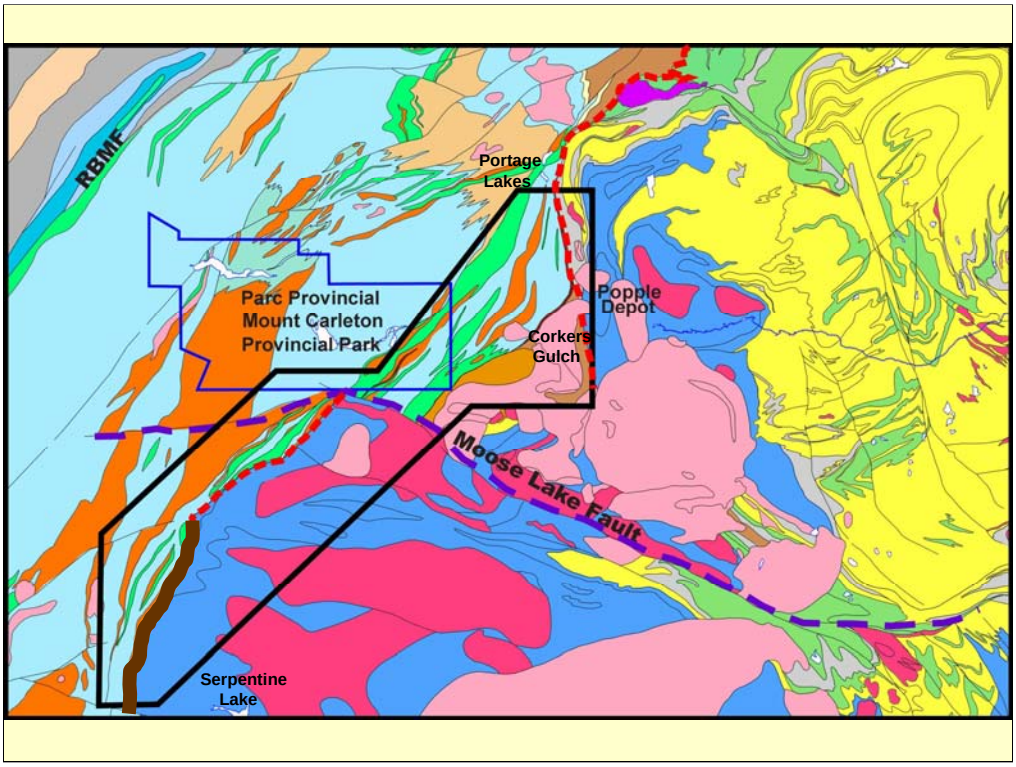
Mapping to the north of Serpentine River led to discovery of an outcrop of Sweat Hill Granite (feldspar-quartz augen granite) forming a small body some distance from the main pluton. This outcrop contained an associated late phase of finer-grained feldspar-quartz porphyry, very similar to the outcrop south of the showing. It is concluded that the porphyritic igneous rocks near Serpentine River are dykes (or sills) and not volcanic rocks.

Knights Brook Formation, Wayne Carroll showing

The host rocks at the showing are grey quartzose wackes, fine-grained sandstones and siltstones of the Knights Brook Formation (Miramichi Group). The source and nature of mineralization (~ 1% combined Pb+Zn) remains unclear.

F_2 folds in quartzite and wacke, Knights Brook Formation

The Knights Brook Formation displays two well-developed foliations, including abundant F2 minor folds of composite S0-S1, with S2 axial planar cleavage. This view is looking down on the outcrop surface.



The Carroll showing and the porphyry are found just east of the Miramichi-Tobique contact. Mapping at and near the contact revealed that it is an unconformity and not a fault as shown on existing maps. The contact was closely approached but not actually observed; nevertheless, evidence for an unconformity includes complete absence of fault-related deformation even a few metres from the inferred location of the contact, and a locally thick unit of conglomerate at the base of the Tobique Group south of Serpentine River (brown band in southwestern part of this map).

Basal conglomerate, Costigan Mountain Formation
Jummet Brook-Clyde Brook area

The basal conglomerate consists dominantly of rounded to subangular pebbles and cobbles of Miramichi Group lithotypes (quartzite, meta-quartz wacke, etc).

Basal boulder conglomerate, Costigan Mountain Formation
Jummet Brook-Clyde Brook area

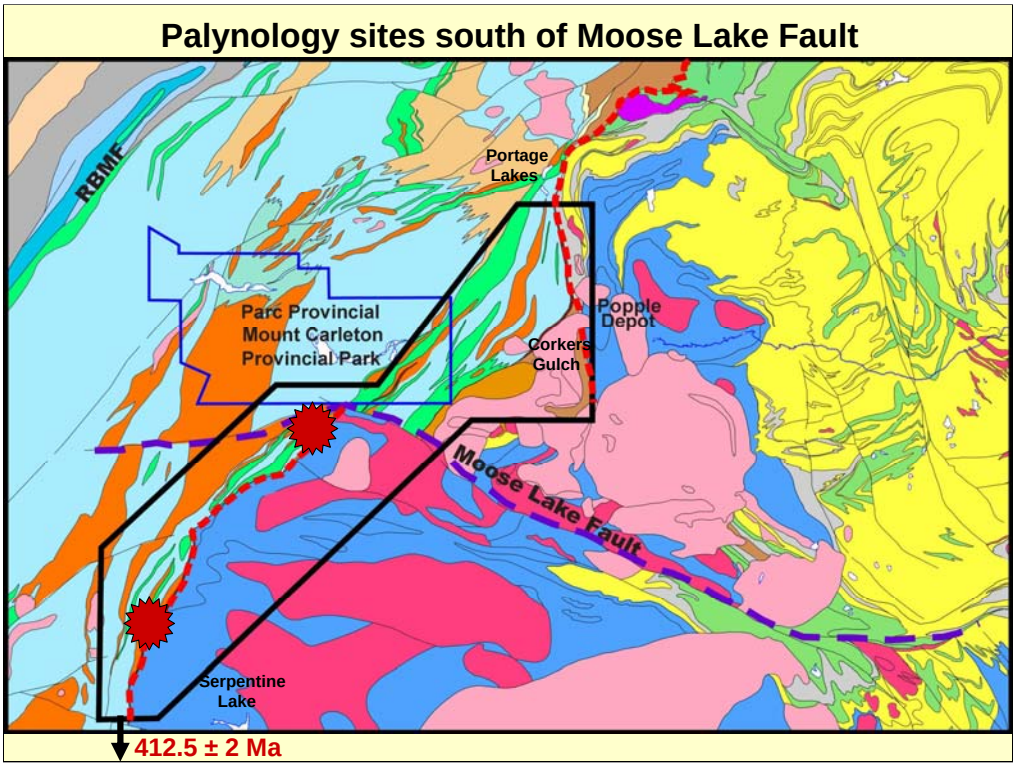
At one location the conglomerate consists of large rounded boulders of quartzite. This must be very close to the contact, but unfortunately this was the extent of exposure, after digging and peeling off vegetation.

Chain of Rocks Formation, Serpentine River

On Serpentine River, medium-bedded quartzites of the Chain of Rocks Formation are exposed below the unconformity.

Devonian siltstone/fine-grained sandstone, Serpentine River

Basal conglomerate is not present everywhere in the Tobique Group; on Serpentine River, above the quartzites shown on the previous slide, the basal Tobique Group (Costigan Mountain Formation) comprises thin-bedded siltstones and fine-grained sandstones. These rocks crop out very close to the quartzites but again, it was not possible top put a finger on the contact without excavation. No deformation, brecciation, etc. was observed.

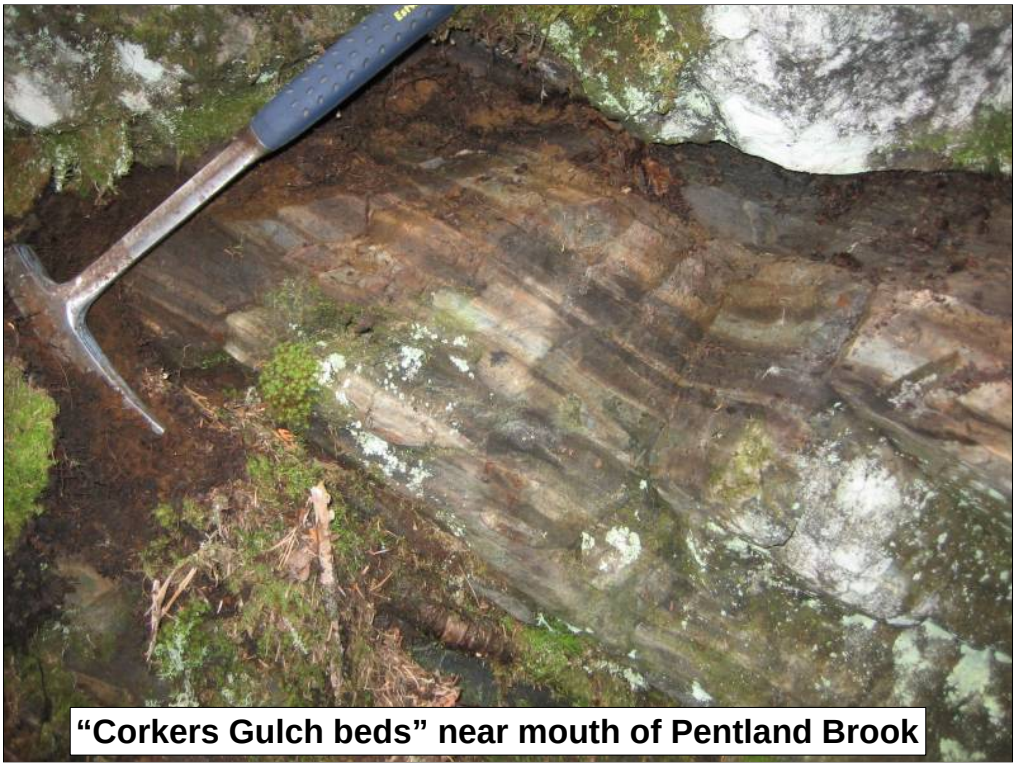


To better define the age of the oldest part of the Tobique Group (Costigan Mountain Formation) south of the Moose Lake Fault, two samples of Costigan Mountain shaly siltstone were collected as close as possible to the unconformable contact (red dots) and processed for spores. One sample contained spores of late Lochkovian-early Pragian age, which agrees very well with the 412.5 Ma age obtained some years ago from Costigan Mountain rhyolite south of the study area (arrow) and west of Trousers Lake (Wilson et al. 2004).

Next, the rocks in the Corkers Gulch area north of the Moose Lake Fault were examined. This is a scene of some of the rugged topography at Corkers Gulch near Popple Depot, just south of the Nepisiguit River. A radiometric date obtained in 2005 from rhyolite just west of Corkers Gulch, had already shown that at least some of the Tobique Belt rocks north of the Fault are older than those to the south.

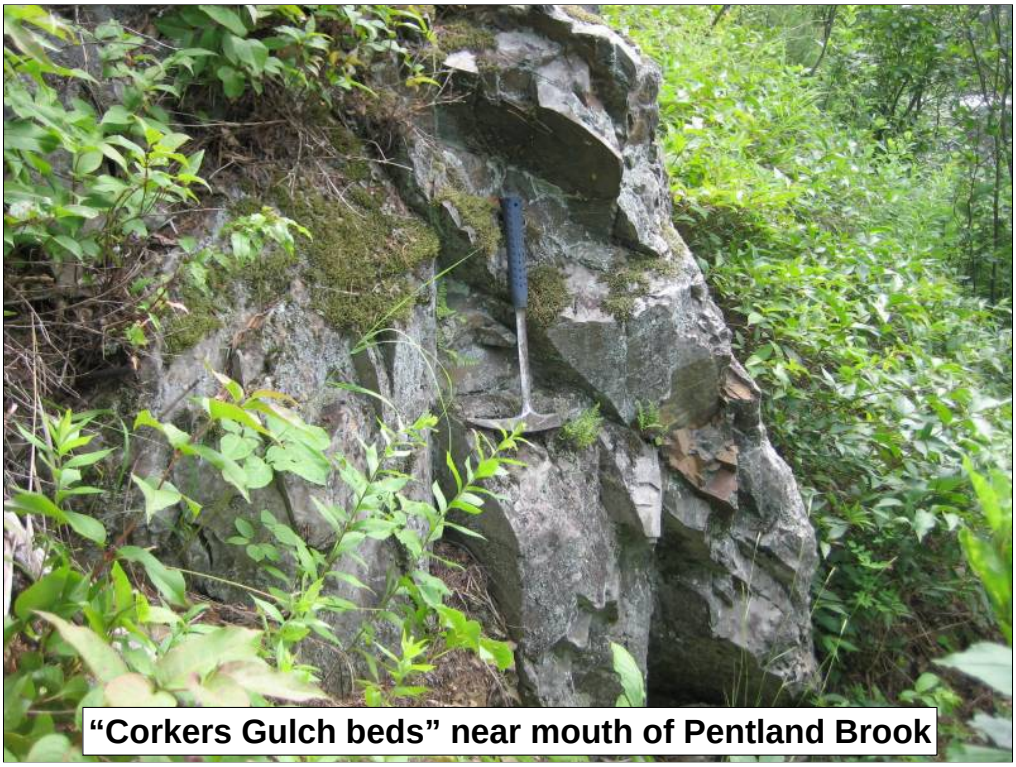
“Corkers Gulch sandstone”

In the Corker’s Gulch area, the oldest rocks of the Tobique Belt are parallel and/or cross-laminated quartzose sandstones. These rocks are invariably intensely hornfelsed due to the nearby, and presumably subjacent, intrusions of the South Nepisiguit River Plutonic Suite.



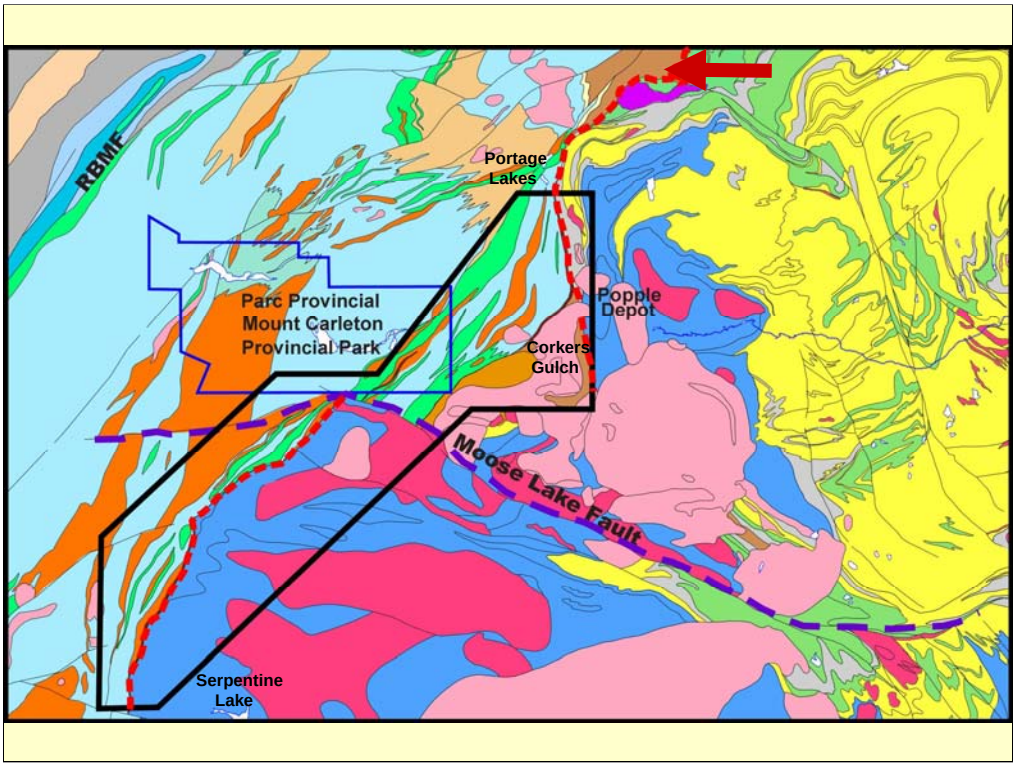
“Corkers Gulch beds” near mouth of Pentland Brook

In places the sandstones are thin-bedded; beds display parallel or cross-lamination, and local grading. Calc-silicate contact metamorphic alteration (whitish patches) is not uncommon in the area.



“Corkers Gulch beds” near mouth of Pentland Brook

Elsewhere, the sandstones are very massive (thick-bedded?) with little or no evidence of primary bedforms.



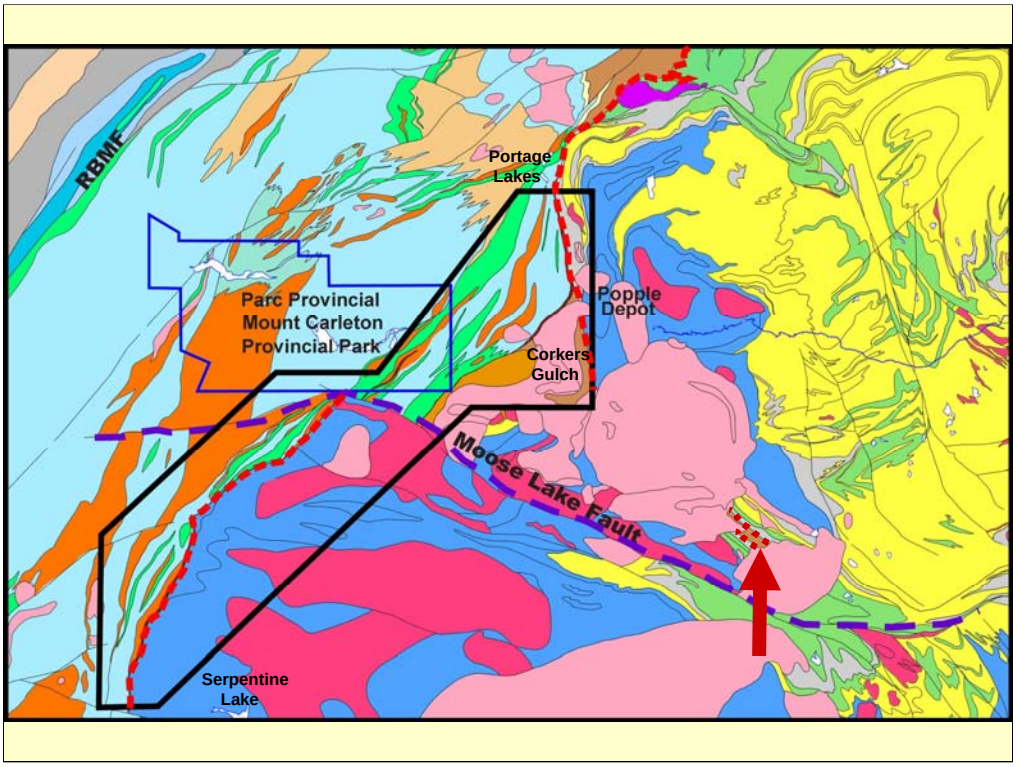
These quartzose sandstones are portrayed in the light brown colour at Corkers Gulch. Comparison with rocks exposed farther north, on Route 180 just east of the SE Upsalquitch bridge (red arrow), allows the Corkers Gulch beds to be assigned to the (Ludlovian) Simpsons Field Formation.

Simpsons Field Formation, Rte. 180 (type area)

The outcrop on Route 180 is in the type area of the Simpsons Field Formation, and consists of medium- to thick-bedded quartzose sandstone.

Simpsons Field Formation, Rte. 180 (type area)

A close-up shows that these quartzose rocks feature similar bedforms such as ripple cross-bedding, parallel lamination, etc., as the Corkers Gulch beds.



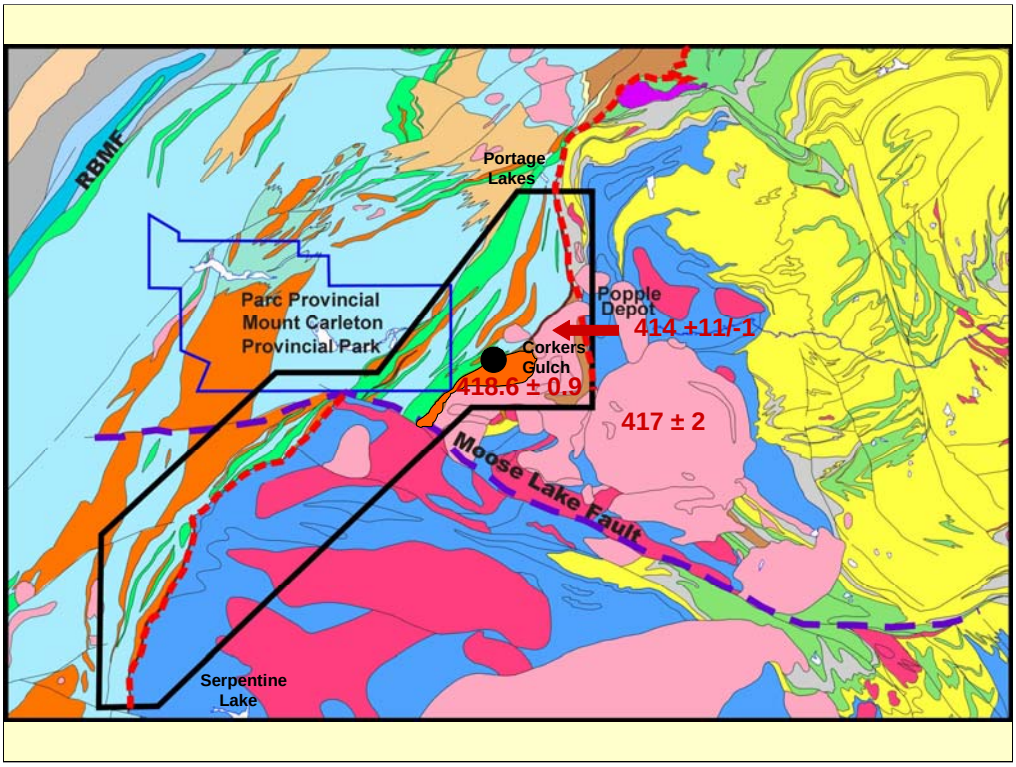
Farther southeast, near Goodwin Lake (red arrow), a small inlier of sandstone and conglomerate within the (Ordovician) California Lake Group, had previously been assigned to the Simpsons Field Formation (Wilson and Kamo 1997).

Simpsons Field Formation, Maliseet Mountain area

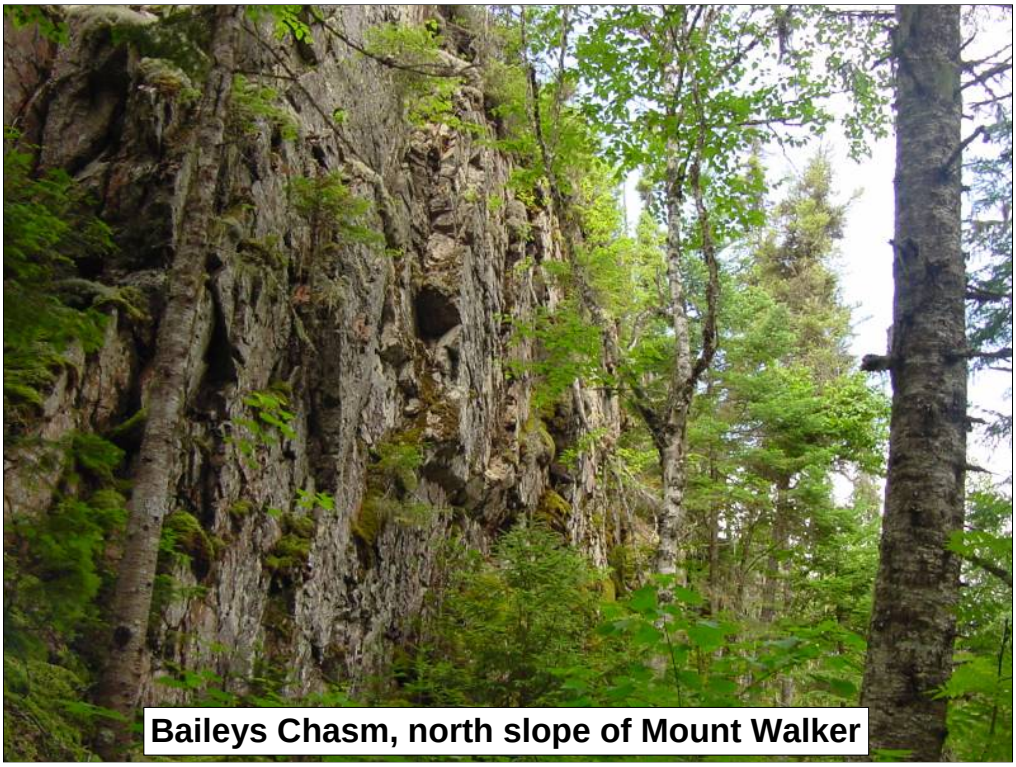
These sandstones are very similar to those on Route 180 and at Corkers Gulch: massive to ripple-laminated, beige-brown quartzose sandstone with local patches of calc-silicate alteration.

Simpsons Field conglomerate, Maliseet Mountain area

A coarse polymictic conglomerate in this (i.e., Goodwin Lake) area is interpreted as marking the unconformity with the underlying California Lake Group. Since an unconformable relationship between the Simpsons Field Formation and Ordovician rocks exists here and in the type area (boulder-cobble conglomerate overlies the Fournier Group along Route 180), an unconformity is inferred in the intervening Corkers Gulch area, not a fault as shown on existing maps.

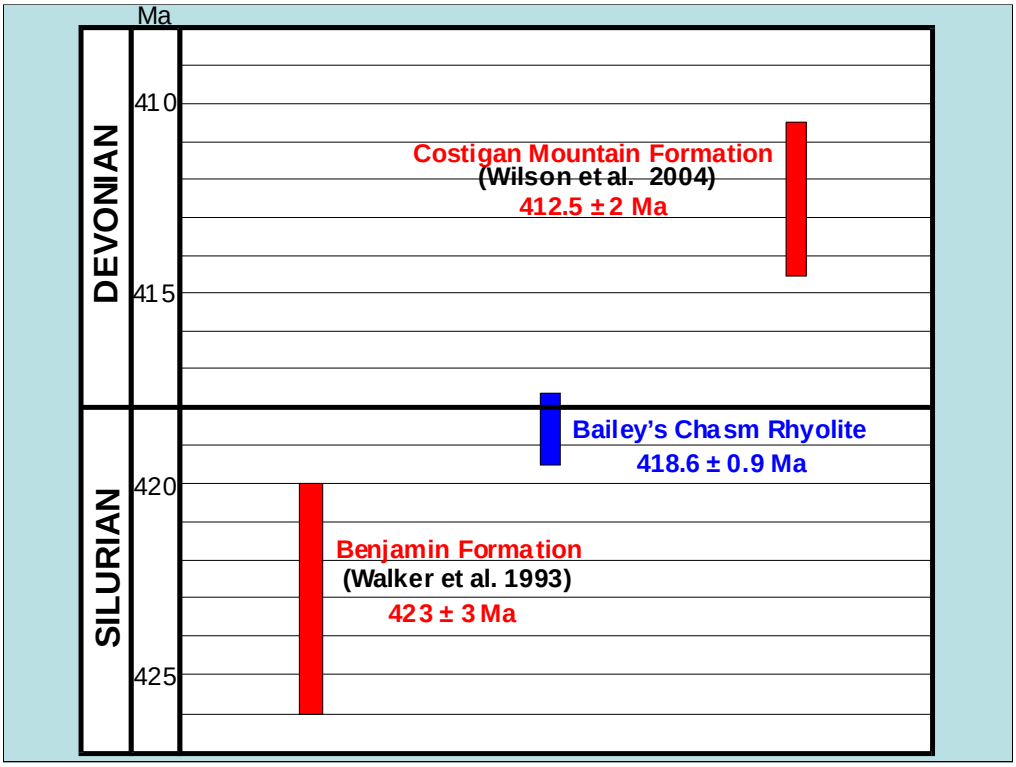


The Simpsons Field Formation is overlain by rhyolite (orange colour) that has recently yielded a Late Silurian age of 418.6 ± 0.9 Ma (black spot shows location of sample). Both the rhyolite and the Simpsons Field Formation are intruded by the Mount Latour Granite (red arrow), a late, alkalic phase of the South Nepisiguit River Plutonic Suite that has been dated at 414 +14/-1 Ma. However, the rhyolite may be comagmatic with the Mount Elizabeth Granite (417 ± 2 Ma).

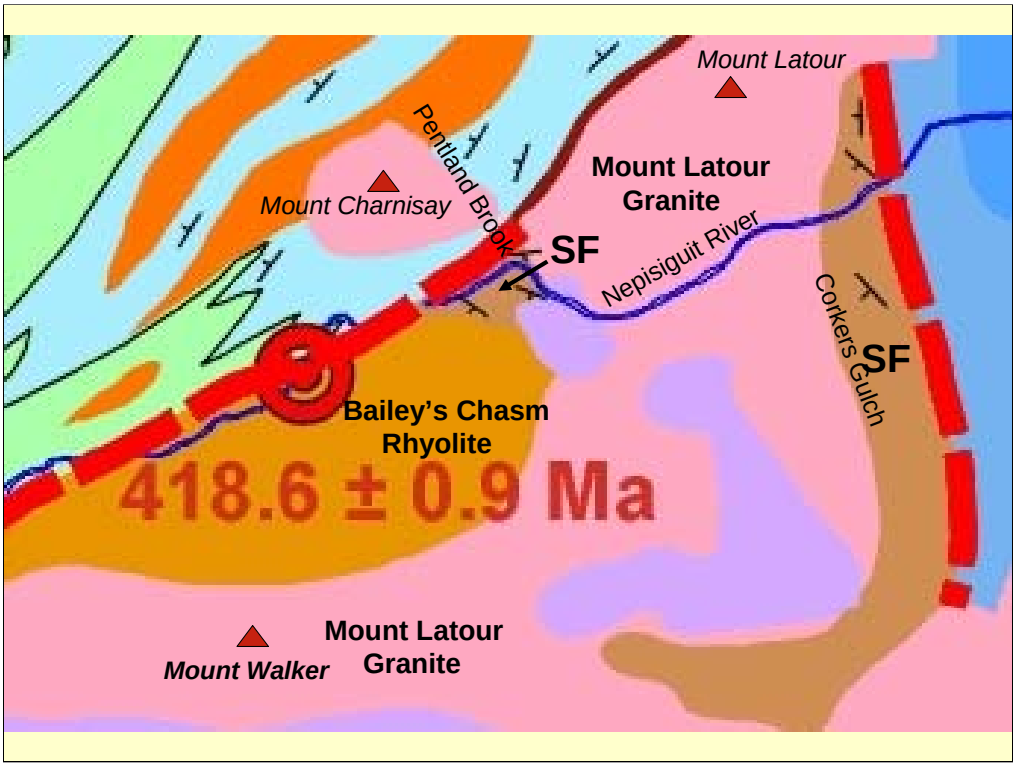


Baileys Chasm, north slope of Mount Walker

The rhyolite is best exposed at Bailey's Chasm, a striking geomorphic feature on the north slope of Mount Walker, south of Nepisiguit River. The Bailey's Chasm Rhyolite is typically pink, locally grey, and generally flow-layered.



The age of the Bailey's Chasm rhyolite is somewhat anomalous, as it is younger than the Benjamin Formation (Chaleurs Group), and older than the Costigan Mountain Formation. However, it is included in the Chaleurs Group because of its apparent conformable relationship with the Simpsons Field Formation, and evident unconformable relationship with overlying rocks of the Tobique Group.



A close-up shows more clearly the geological relationships at the Chaleurs Group-Tobique Group contact, especially on either side of the Nepisiguit River at Pentland Brook, southeast of Mount Charnisay.

The Simpsons Field Formation (SF -- light brown) dips to the south and southwest under the Bailey's Chasm Rhyolite (dark yellow), in marked contrast to the consistent northwesterly dips in Tobique Group rocks to the west (sedimentary, felsic and mafic volcanic rocks in light blue, orange and light green, respectively).

Furthermore, a quartz-pebble-rich conglomerate is exposed along the lower part of Pentland Brook, at the base of the Tobique Group (dark brown band between Mount Latour and Mount Charnisay).

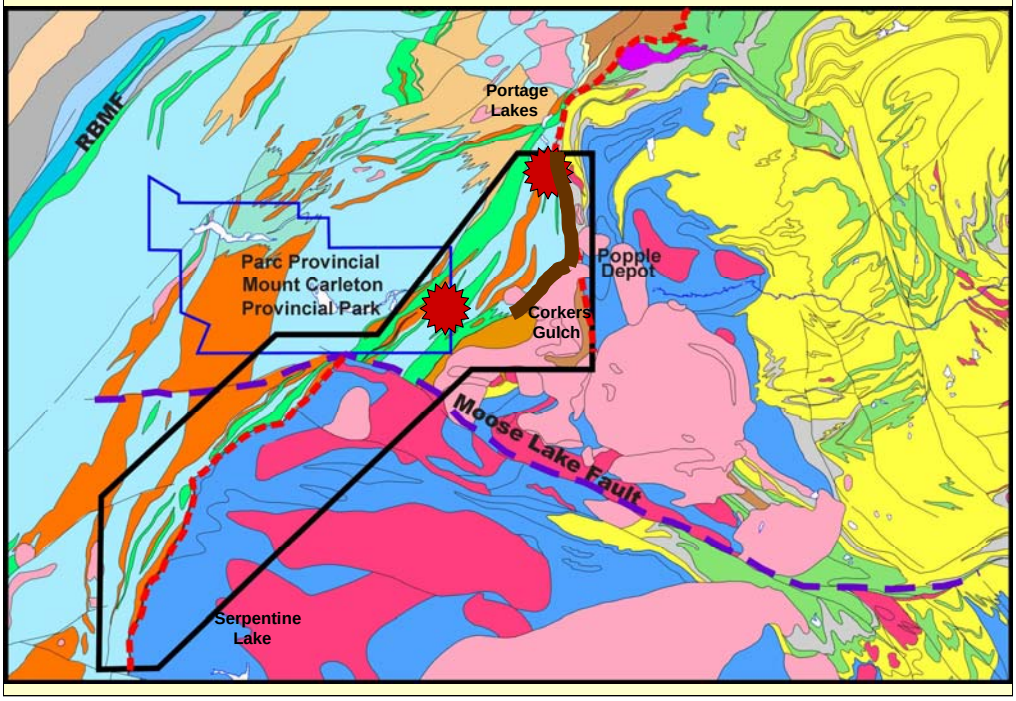
A latest Silurian-earliest Devonian unconformity (thick red dashed line) is therefore indicated between the Chaleurs Group and the Tobique Group.

Pink - Mount Latour Granite; light purple - gabbro; red bulls-eye - location of rhyolite sample for radiometric dating.

Basal conglomerate, Pentland Brook Formation, Pentland Brook

This is a photograph of the conglomerate on Pentland Brook, which forms the base of the Pentland Brook Formation (new name) of the Tobique Group.

Palynology sites, Pentland Brook Formation



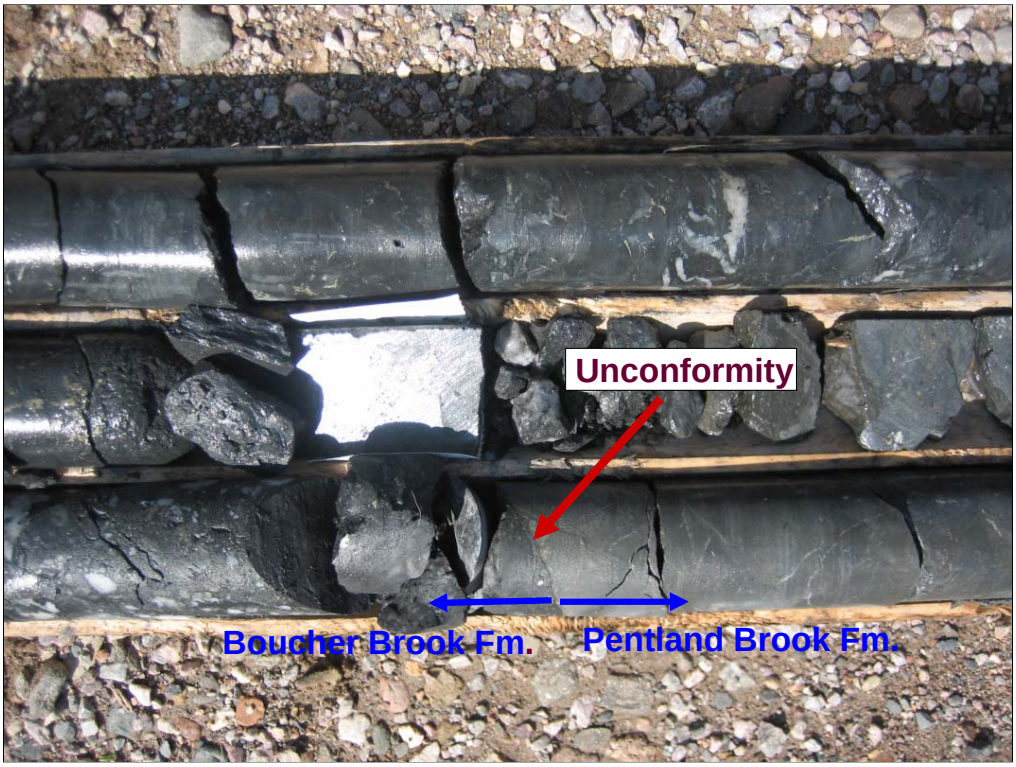
The Pentland Brook Formation was introduced because palynological work on sedimentary rocks above the sub-Tobique Group unconformity north of the Moose Lake Fault (sample locations in red dots) shows that the rocks here are early (perhaps earliest) Lochkovian in age, i.e., older than those south of the fault, where rocks of this age are absent. The basal conglomerate (dark brown band) can be traced to the north almost as far as Portage Lakes.

Basal conglomerate, Pentland Brook Formation, West Branch Portage Brook

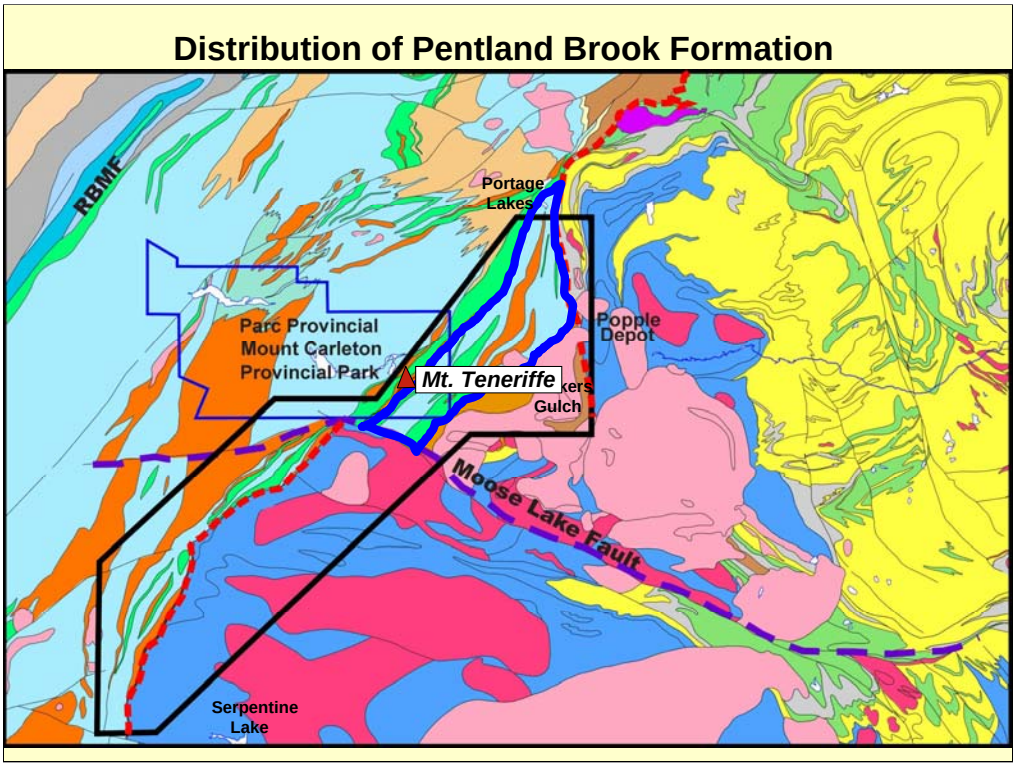
Along West Branch Portage River, the Pentland Brook conglomerate is more polymictic in nature, with many angular pebbles and cobbles derived from the Miramichi Highlands (probably California Lake Group).

Boucher Brook chert, West Branch Portage Brook

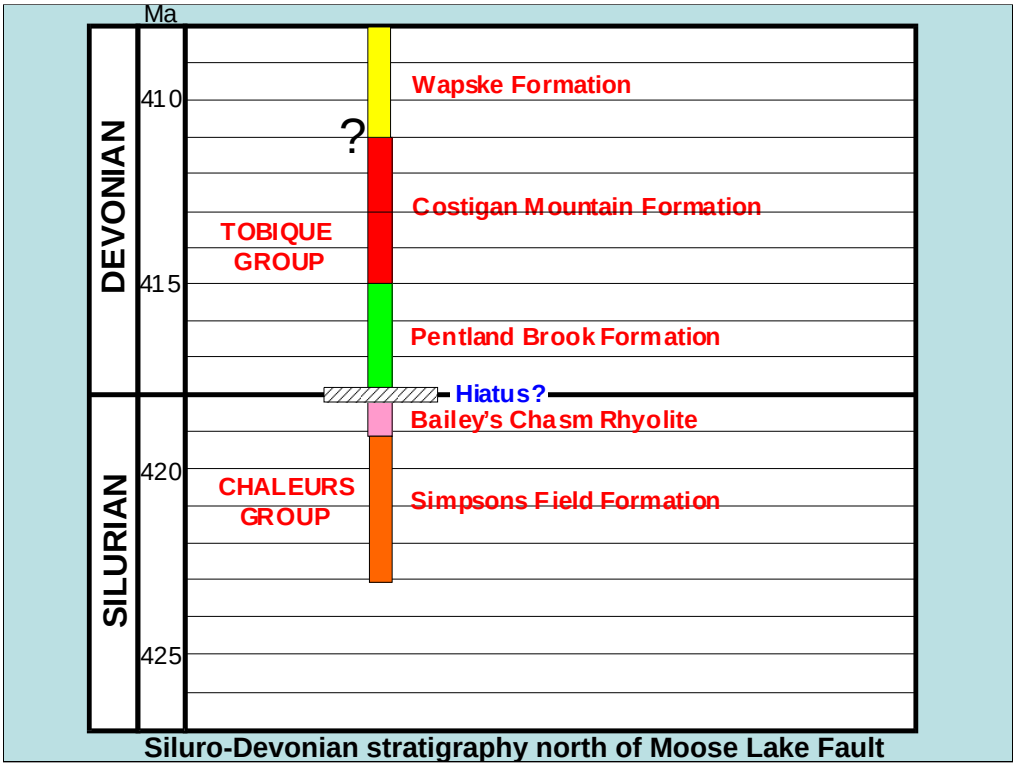
In the Portage Brook area, the Pentland Brook Formation overlies dark grey to black banded chert of the Boucher Brook Formation (California Lake Group). Silurian rocks of the Simpsons Field Formation and Bailey's Chasm Rhyolite are not present here, having pinched out west of Popple Depot (possibly more evidence of an unconformity, or else overstepping of Silurian rocks by the Tobique Group).



The contact between the Pentland Brook and Boucher Brook formations is exposed in drill core from the Portage Brook base metal prospect. Clearly, this contact is also an unconformity, and not a fault as shown on current geological maps of the area.



The thick blue line outlines the extent or distribution of the Pentland Brook Formation as presently understood. The contact with the overlying Costigan Mountain Formation is based on the location of a quartz-pebble conglomerate on Mount Teneriffe that is very similar to a belt of conglomerate in the lower part of the Costigan Mountain Formation south of the Moose Lake Fault.

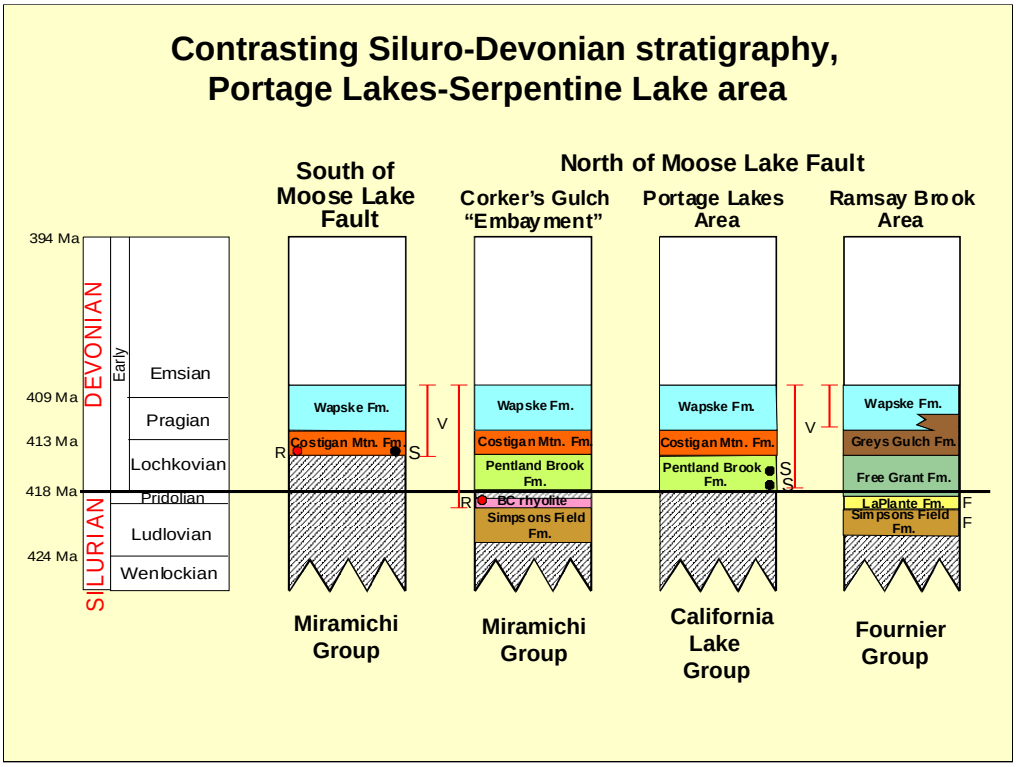


Siluro-Devonian stratigraphy north of Moose Lake Fault

This slide presents a summary of Siluro-Devonian stratigraphy north of the Moose Lake Fault.

A brief hiatus is posited at the Silurian-Devonian boundary to account for the Chaleurs Group-Tobique Group unconformity. The Late Silurian Salinic Orogeny accounts for unconformities seen in various parts of northern New Brunswick, but in at least one case (at Limestone Point) it clearly predates the Simpsons Field Formation, whereas this unconformity postdates that unit.

The age of the Costigan Mountain-Wapske contact is uncertain, and is probably diachronous.



This slide presents a correlation chart for Siluro-Devonian strata in and near the study area. Below the cross-hatching at the bottom of each column is the name of the corresponding unconformably underlying (Cambro-) Ordovician unit in the Miramichi Highlands. Radiometric age control is shown with a red dot, and spore localities with a black dot. The duration of volcanic activity is portrayed by the vertical red lines with a "v".

It can be seen that very significant contrasts exist within this relatively small area (it is only ~30 km from the Ramsay Brook area to the Moose lake Fault):

a) The Simpsons Field Formation is succeeded by the Bailey's Chasm Rhyolite and by an unconformity at Corker's Gulch, whereas at Ramsay Brook the Simpsons Field is overlain by the LaPlante Formation (limestone) and an unbroken Siluro-Devonian sequence is present.

b) At Ramsay Brook, the Free Grant Formation (Chaleurs Group) is coeval with the Pentland Brook Formation (Tobique Group) at Corkers Gulch; however, the Free Grant contains no volcanic rocks.

c) The Chaleurs Group is absent at Portage Lakes and south of the Moose Lake Fault (overstepped?).

d) The base of the Tobique Group (and onset of magmatic activity) north of the Moose Lake Fault is significantly older than to the south of the fault.

e) Volcanic activity in the Ramsay Brook area is delayed compared to any of the other areas.

SUMMARY

- **North of the Moose Lake Fault:**
  - **Miramichi Highlands-Tobique Belt contact is an unconformity**
  - **The Chaleurs Group is unconformably overlain by the Tobique Group : Salinic Orogeny?**
  - **The base of the Tobique Group is ca. earliest Devonian**
  - **The Bailey's Chasm Rhyolite has an "anomalous" Pridolian age**

SUMMARY

- **South of the Moose Lake Fault:**
  - **Miramichi-Tobique contact is an unconformity**
  - **Base of Tobique Group is ca. late Lochkovian**
  - **Rocks of the Chaleurs Group and the Pentland Brook Formation, if deposited, have been overstepped by the Costigan Mountain Formation**

SELECTED REFERENCES

WILSON, R.A. and KAMO, S.L. 1997. Geology of the Micmac Mountain-Mount Bill Gray area (NTS 21 O/08d), southwestern Bathurst Mining Camp, New Brunswick. In Current Research 1996. Edited by B.M.W. Carroll. New Brunswick Department of Natural Resources and Energy, Minerals and Energy Division, Mineral Resource Report 97-4, pp. 273-298.

WILSON, R.A., BURDEN, E.T., BERTRAND, R., ASSELIN, E. and MCCRACKEN, A.D. 2004. Stratigraphy and tectono-sedimentary evolution of the late Ordovician to Middle Devonian Gaspé Belt in northern New Brunswick: evidence from the Restigouche area. Canadian Journal of Earth Sciences 41: pp. 527-551.

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