


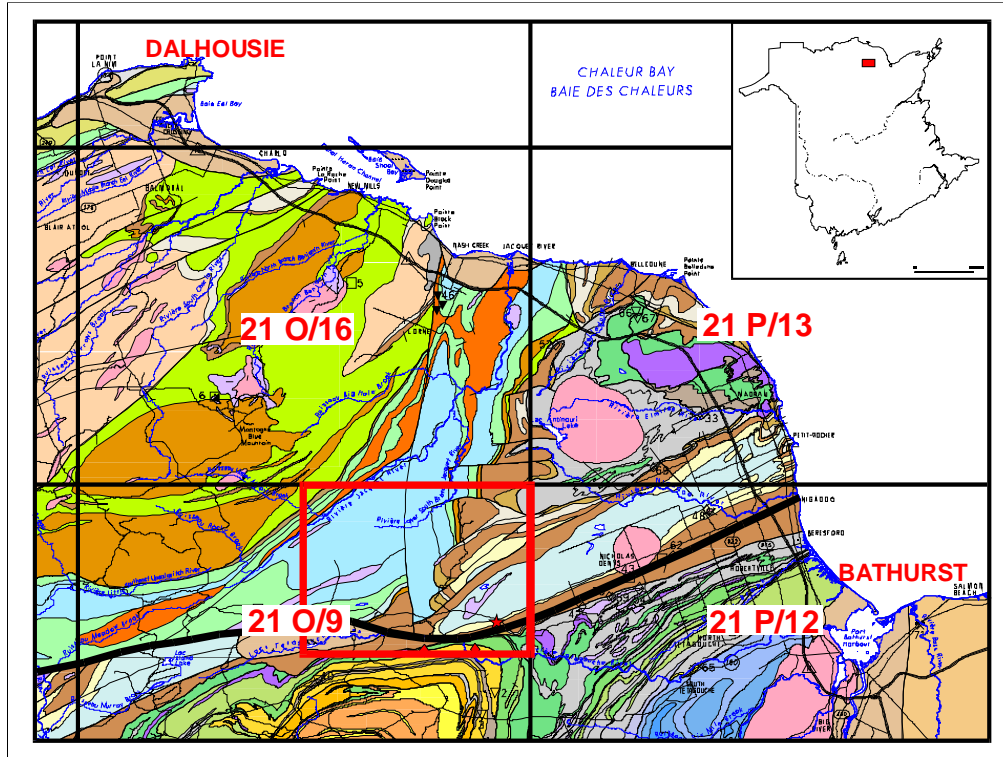
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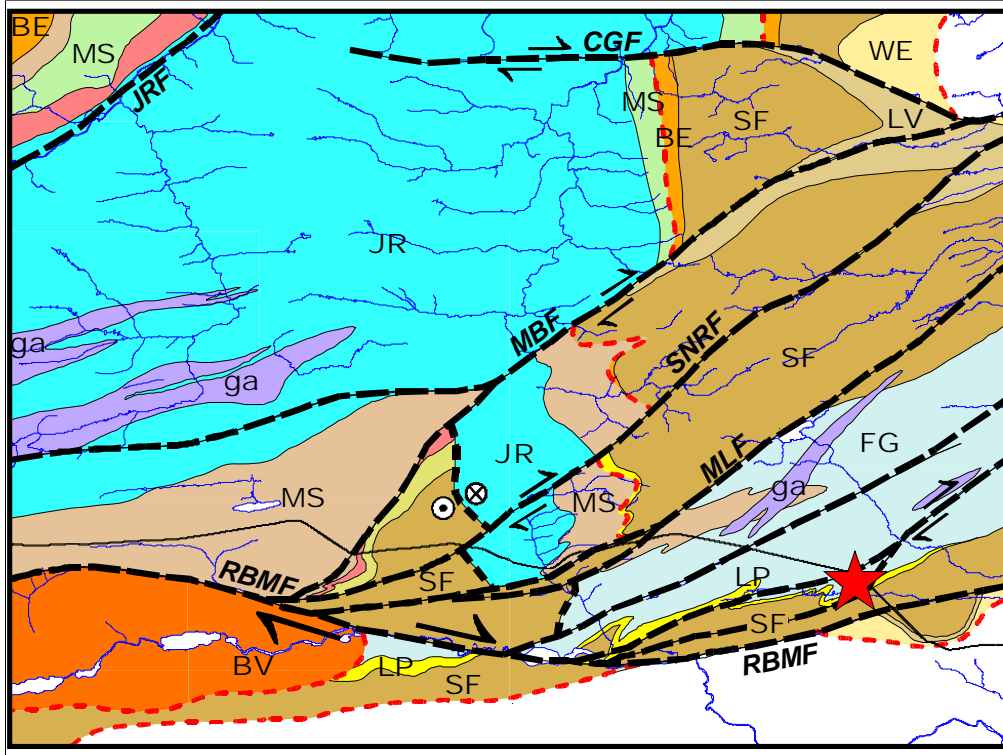
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**Silurian-Devonian Stratigraphy and
Structure in the Arleau Brook Area,
Northern Margin of the Miramichi Highlands**

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This slide shows the general geology of the Chaleur Bay region. The location of the study area is outlined in red. It is situated between polydeformed Ordovician rocks of the Miramichi Highlands (Bathurst Mining Camp) to the south and the Elmtree Inlier to the northeast, and overlaps the Nigadoo River Syncline, the Jacquet River Syncline and a medial anticline termed the Melanson Brook Anticline by the author of this presentation. A major fault system, the Rocky Brook-Millstream Fault (RBMF, shown by the heavy black line) transects the southern part of the study area.



This slide shows the geology of the Arleau Brook area in more detail. Ordovician rocks on the south and northeast are uncoloured, and are unconformably overlain by Silurian rocks of the Chaleurs Group. From oldest to youngest, the Chaleurs Group consists of the Weir (WE), La Vieille (LV), Simpsons Field (SF), LaPlante (LP) and Free Grant formations (FG). In the southwest, west of Tetagouche River, the Weir and La Vieille formations are absent and the Simpsons Field Formation unconformably overlies the Ordovician rocks.

The Dalhousie Group conformably overlies the Chaleurs Group and consists of the Mitchell Settlement (MS) and overlying Jacquet River (JR) formations. Shown in orange at Middle and Upper Tetagouche lakes, is a small outlier of flat-lying Carboniferous rocks of the Bonaventure Formation.

The area is transected by numerous faults, most of which are dextral strike-slip faults, but a NNW-trending fault just west of Arleau Brook is interpreted as a normal fault that dissects the Melanson Brook Anticline. This will be explained more fully later on. Red dashed lines are unconformities; in addition to the Ordovician and post-Acadian unconformities, there is a Late Silurian disconformity just east of center that is inferred because the top of the Chaleurs Group is missing here. The following summary of rock units begins with the Simpsons Field Formation.

The red star is the location of the Elmtree Resources limestone quarry, which is hosted by the LaPlante Formation.



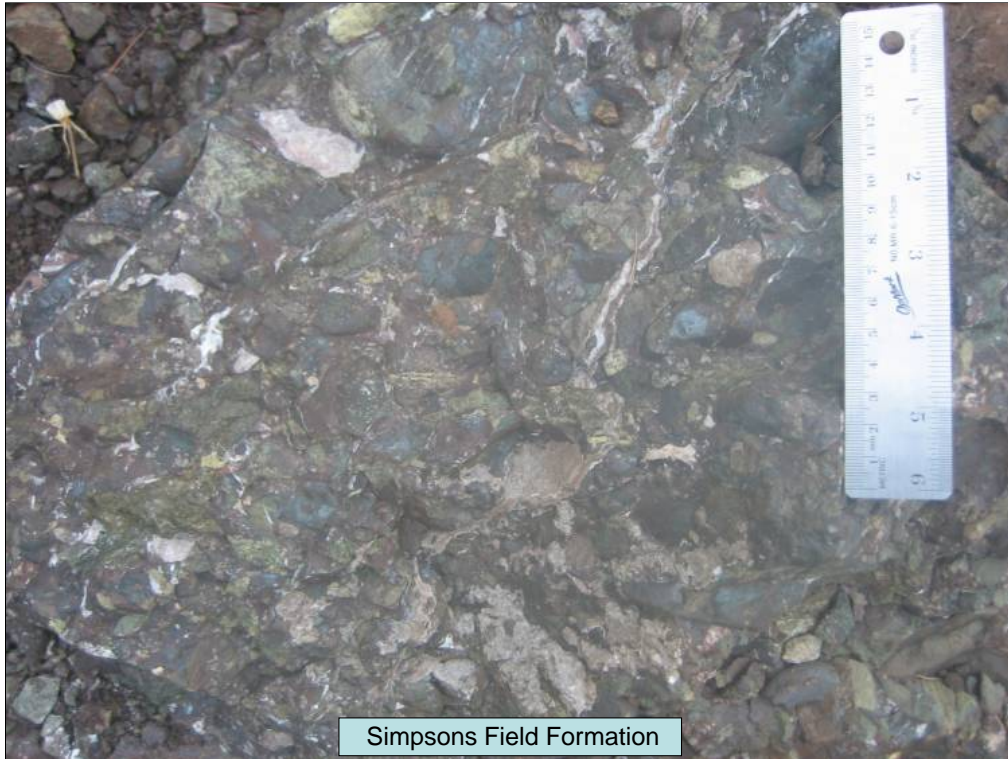
This is an example of volcaniclastic conglomerate from the Simpsons Field Formation, which underlies much of the eastern part of the study area. The conglomerate contains well-rounded felsic and mafic volcanic clasts that are presumably derived from the roughly coeval volcanic rocks of the Bryant Point and Benjamin formations. These rocks are extremely hard, very thick-bedded, and show no cleavage.



North of the RBMF the Simpsons Field Formation fines upward. This is an example of some greyish maroon, cross-laminated sandstone, deposited in a shallow-water environment.



The uppermost exposed parts of the Simpsons Field Formation north of the RBMF comprise thin-bedded, pink to maroon or light purple fine-grained sandstone and siltstone, in places with intercalated pebbly or cobbly beds.



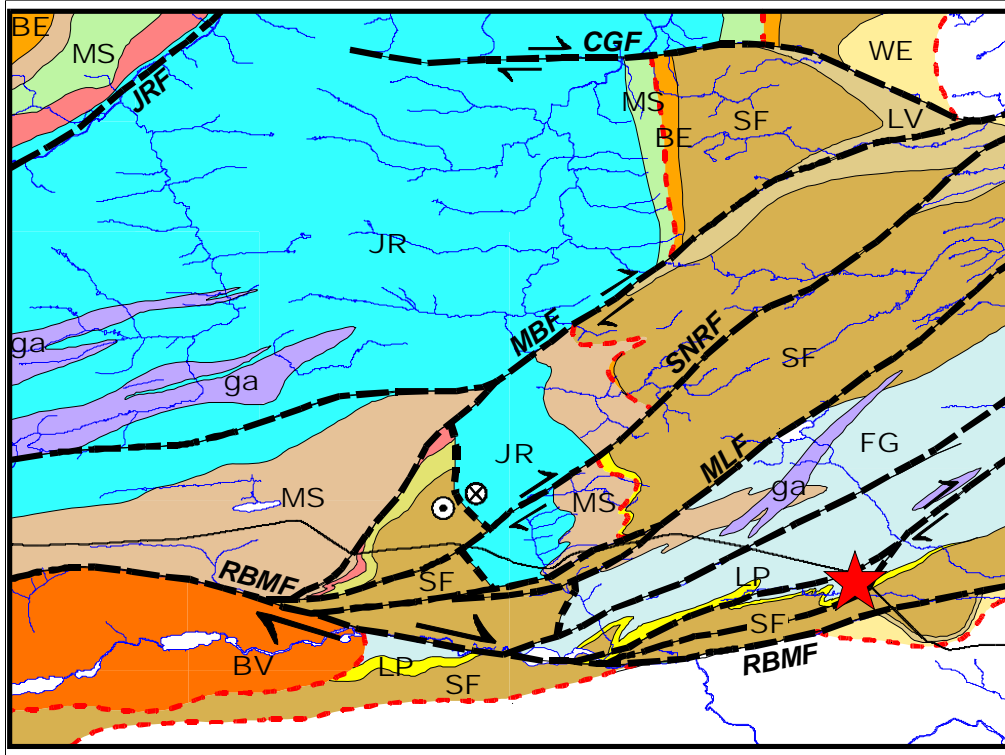
South of the RBMF, Simpsons Field conglomerates are commonly green in colour because of abundant mafic volcanic detritus derived from the unconformably underlying Ordovician Fournier Group.



The Simpsons Field Formation is overlain by the Pridolian LaPlante Formation, consisting mainly of high-calcium reefal limestone exposed in various parts of the Nigadoo River Syncline (NRS), including the western extension of the NRS in the Ramsay Brook area. This limestone is quarried by Elmtree Resources at their Sormany Road site and was quarried at their former site just west of Petit Rocher.



This is a view looking west at the Elmtree Resources quarry.



High-grade limestone (yellow band) can be traced along a belt that extends west from the quarry (red star) to Arleau Brook, and coincides with a zone of intense stretching and shearing.



South of the RBMF, the LaPlante Formation is exposed on the south bank of Tetagouche River between Lower and Middle Tetagouche lakes, but the limestone here is not strongly deformed and is generally very fossiliferous. At the quarry, primary features are generally obliterated by deformation but some proximal reefal facies have been recognized by Ivan Dimitrov.



The LaPlante Formation is overlain by the Free Grant Formation, the uppermost unit of the Chaleurs Group. This is a very weathered outcrop of Free Grant, which consists of thin-bedded to laminated grey quartzose sandstone and siltstone, generally non-calcareous and locally fossiliferous.



Slatey siltstone of the Free Grant Formation overlies and is infolded with the LaPlante Formation at the Elmtree quarry.



The Free Grant Formation is overlain by the Mitchell Settlement Formation, the lowest part of the Dalhousie Group. In the survey area, this unit is dominated by maroon laminated and locally cross-bedded shallow-water siltstones and sandstones, although the type area of the Mitchell Settlement farther northeast comprises more basalt and lesser interbedded grey and maroon sedimentary rocks.

This unit makes it possible to correlate Lower Devonian rocks on opposite sides of the RBMF (Dalhousie Group to the north and Tobique Group to the south), because it is lithologically identical to the Greys Gulch Formation in the Tobique Group. This will be discussed in more detail later on.



The Mitchell Settlement locally includes a significant component of distinctive green sandstone and siltstone interbedded with the dominant maroon sedimentary rocks - this is exactly what is seen in the Greys Gulch Formation to the southwest. In this slide, maroon sediments are seen in the background and green sediments in the foreground.



A comparison of typical examples of the Mitchell Settlement Formation on the left and the Greys Gulch Formation on the right illustrates how similar the bedforms (and therefore depositional environments) are in the two units. And both units locally contain mafic and minor felsic volcanic rocks.

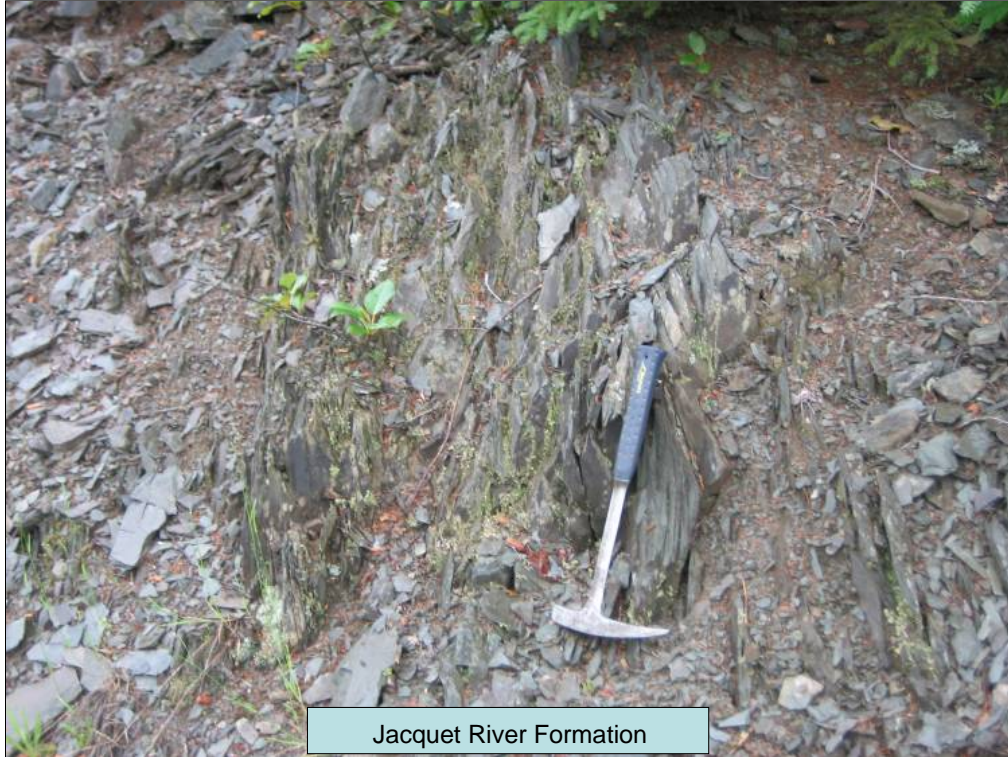


Mitchell Settlement Formation

The Mitchell Settlement also includes minor grey parallel- or cross-laminated sandstone and siltstone in the lower part of the unit, particularly in the vicinity of the Clarinda gold occurrence.



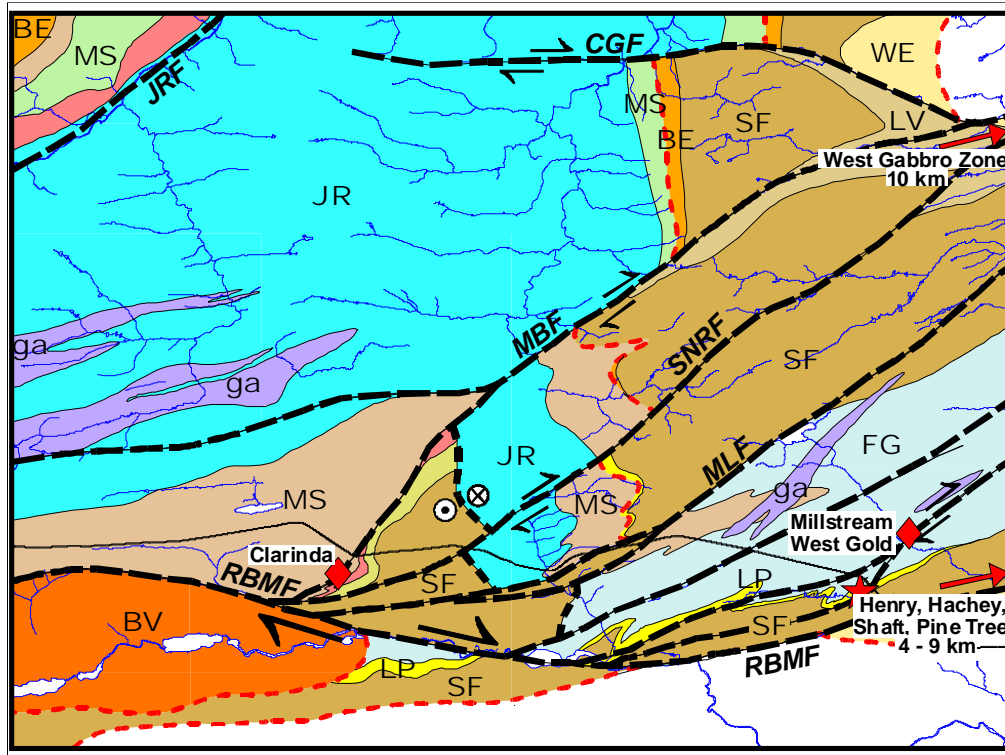
This pink aphyric rhyolite that crops out near the Clarinda gold occurrence is assigned to the Mitchell Settlement Formation because it immediately underlies Mitchell Settlement sedimentary rocks and appears to be too young to belong to the Silurian Benjamin Formation. These rhyolites are also seen along strike from Clarinda at the Arleau Brook occurrence, but their connection with the actual mineralizing event is unclear.



The Mitchell Settlement Formation is gradationally overlain by the Jacquet River Formation, which underlies a large area in the Jacquet River drainage basin. In the Arleau Brook area, it consists of grey quartzose siltstone and fine-grained sandstone, although farther west there are substantial volumes of interbedded felsic and mafic volcanic rocks.



The Jacquet River Formation is lithologically homogenous and not very photogenic as a rule. Bedding is commonly defined by thin, irregular bands and lenses of light brown-weathered, slightly more calcareous sediment interpreted as thin turbidites deposited in a slope environment, so the Jacquet River Formation records much deeper water conditions than the underlying Mitchell Settlement.



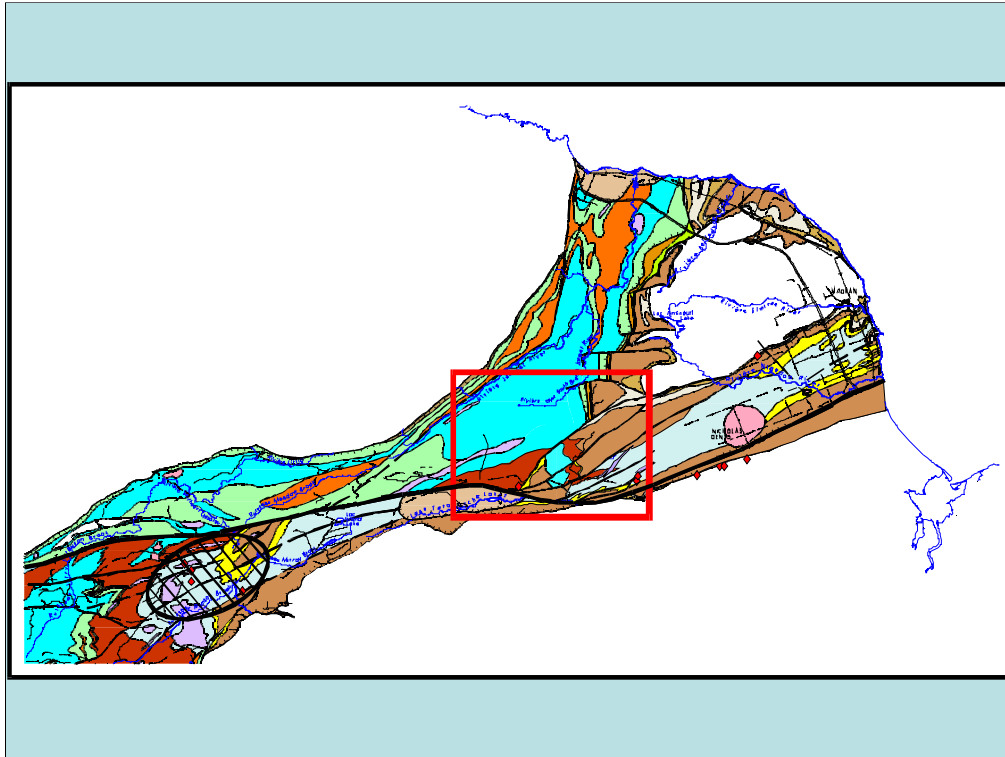
The most important mineral occurrences in the study area are the Clarinda and Millstream West Gold occurrences, both of which occur near one of the many faults in the area. These occurrences typically display iron carbonate alteration and are spatially related to fine-grained gabbro dykes. All in all, they are very reminiscent of gold occurrences in the SE Upsalquitch-Ramsay Brook area to the southwest.

Gold mineralization occurs at the West Gabbro Zone 10 km along strike to the ENE. Base metals and silver occur at the Shaft, Hachey and other deposits 4-9 km to the east. These areas are being very actively explored and drilled by Stratabound Minerals and Puma Exploration, respectively. These deposits are also associated with major faults though the style of mineralization is different from the occurrences in the Arleau Brook area and they are probably genetically related to proximal Late Devonian felsic plutons.

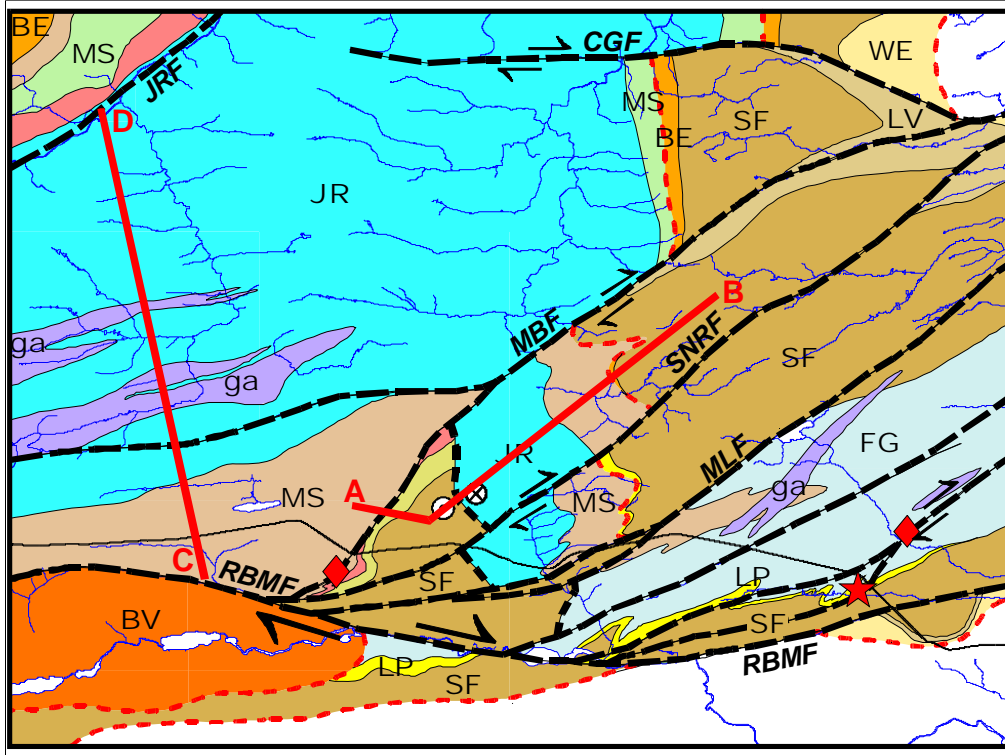


This slide shows some altered, brecciated, loose material from a former trench at Clarinda. Fifteen holes were drilled here and the best assays were 0.7 g/t Au over 17 m and 3.1 g/t Au over 2 m.

At Millstream West Gold just NE of the Elmtree quarry, about 25 holes were drilled, with the best assays being 9.1 g/t Au over 1.5 m and 3.2 g/t Au over 6.3 m.

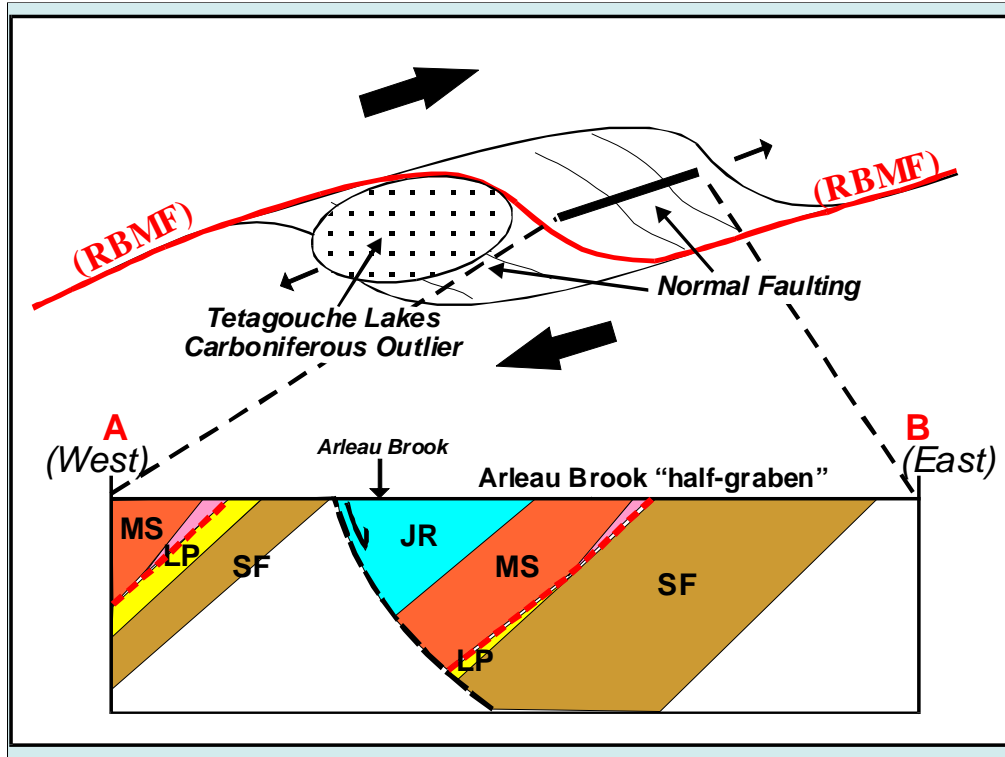


Zooming out for a regional view, we see the location of the Arleau Brook occurrences relative to those in the SE Upsalquitch area to the southwest. The Simpsons Field, Jonpol, McCormack Brook, Dalhousie Road, etc. occurrences are spatially related to faults and fine-grained gabbro dykes, and most are hosted by the Free Grant Formation, same as the Millstream West Gold occurrences.

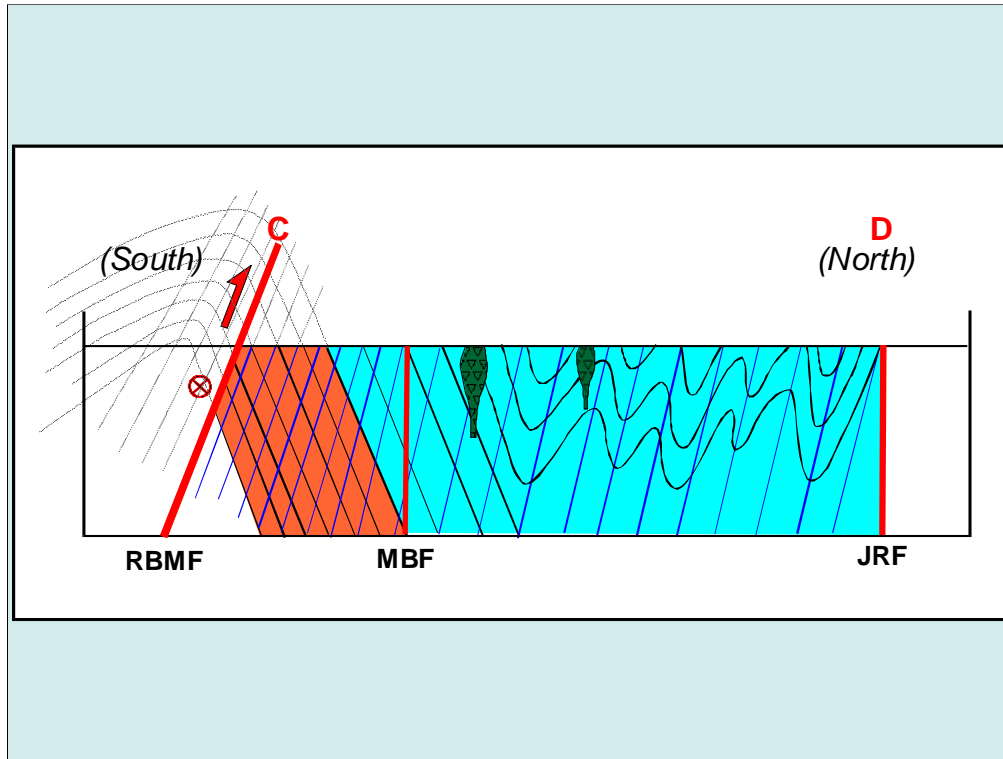


The remainder of this presentation concerns the structural history of the Arleau Brook area. Most faults are dextral strike-slip, the most significant being the RBMF. However, a normal fault just west of Arleau Brook is proposed to explain missing stratigraphy between the Simpsons Field and Jacquet River formations. A normal rather than a reverse fault is the preferred interpretation because of evidence for local crustal extension. For example, the presence here of the Tetagouche Lakes Carboniferous outlier is unlikely to be a coincidence and indicates that this section of the RBMF was probably a zone of transtension. The next slide will illustrate this a little more clearly.

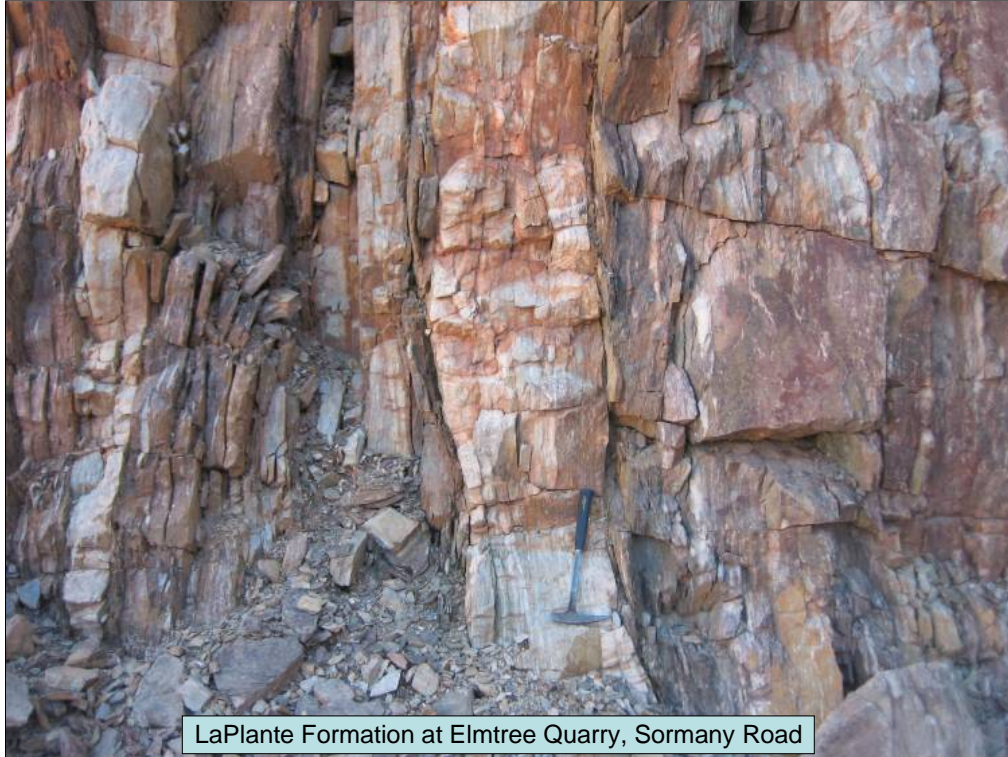
The heavy red lines show the location of cross-sections A-B across the Arleau Brook half-graben, and C-D across strike through the Jacquet River Syncline, which will be shown on the next two slides.



The top figure shows a transtensional pull-apart basin developed along an inflection in the RBMF. On the SW side, extension and subsidence is recorded by the Tetagouche Lakes Carboniferous outlier, whereas on the NE side Carboniferous rocks that probably existed there have since been eroded, but evidence of extension is preserved as a normal fault. Downthrow on the east side of this fault places the Simpsons Field Formation in tectonic contact with the Jacquet River Formation and creates a half-graben structure.



Cross-section C-D is constructed across the Jacquet River Syncline from the RBMF to the Jacquet River Fault. On the north side of the RBMF, bedding-cleavage relationships in the Mitchell Settlement Formation imply truncation of the nose and south-dipping limb of a mega-scale fold that is somewhat inclined to the north. In the Jacquet River Formation, bedding reversals indicate numerous large-scale folds. Axial planar cleavage continues to dip consistently south, again demonstrating slight north-directed overturning.



LaPlante Formation at Elmtree Quarry, Sormany Road

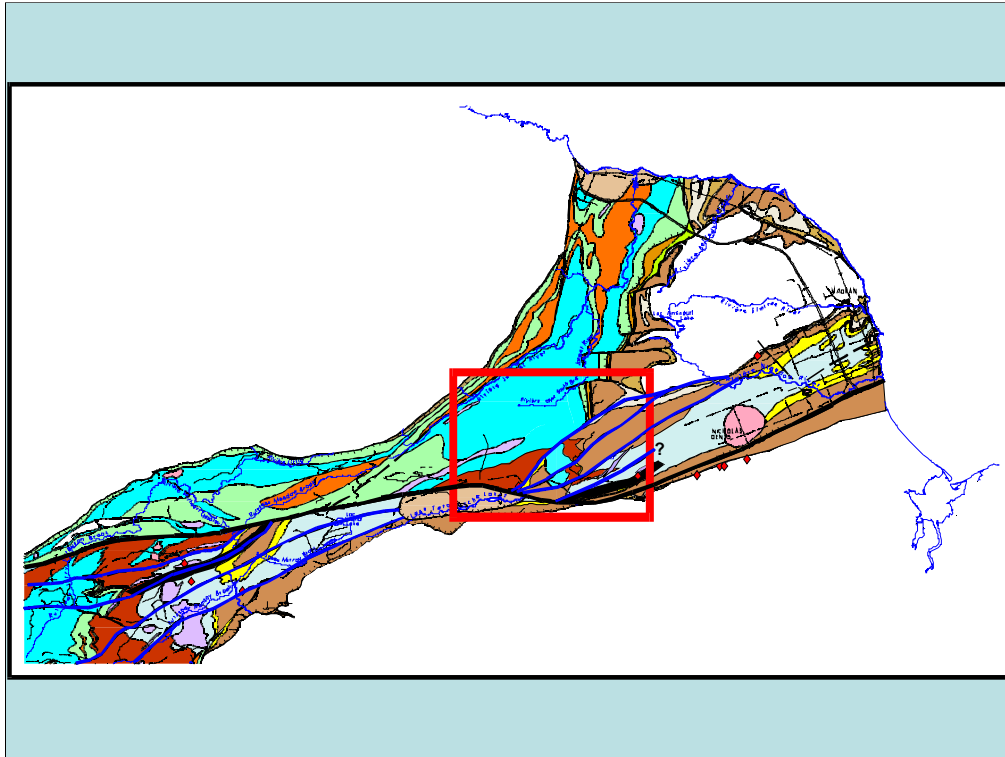
Faults are not accompanied by significant ductile deformation except within a broad shear zone on the north side of the RBMF between Arleau Brook and the Elmtree quarry and beyond. This is an example of intensely deformed limestone at the quarry, where Ivan Dimitrov has recognized tight folds plunging 10-20° to the NE.



Just east of Arleau Brook, pebbles in Simpsons Field conglomerate near the contact with the LaPlante Formation are stretched and flattened, a dramatic contrast from the unclevated conglomerates containing well-rounded pebble and cobbles normally seen in this unit.

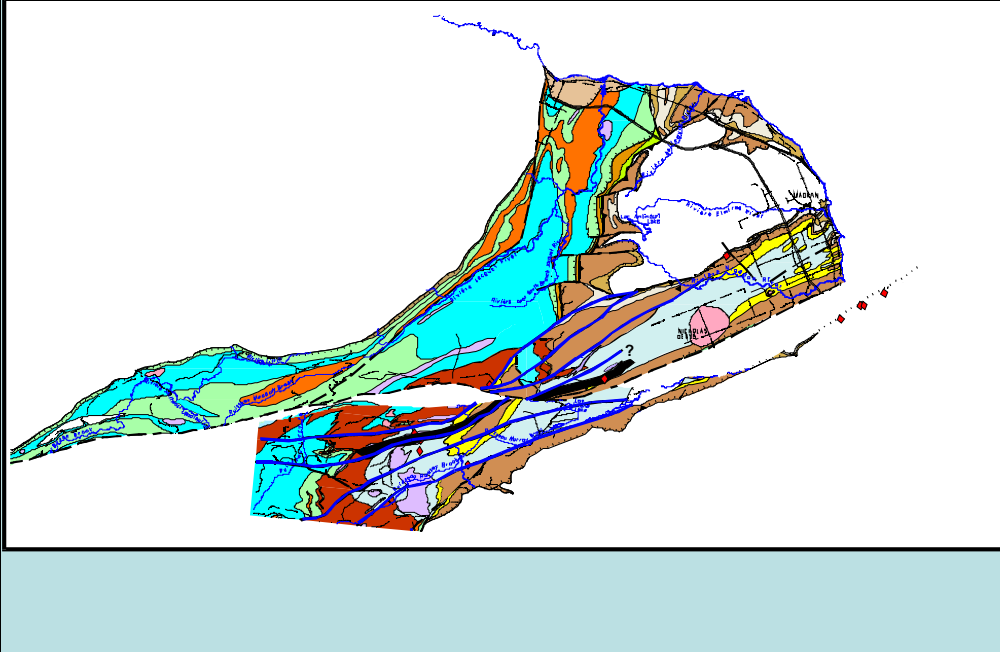


The only other place a comparable degree of deformation in non-Ordovician rocks has been observed is in the McCormack Brook area farther west on the south side of the RBMF. This is a mylonitic limestone from the LaPlante Formation near McCormack Brook, about 30 km SW of the Elmtree quarry.

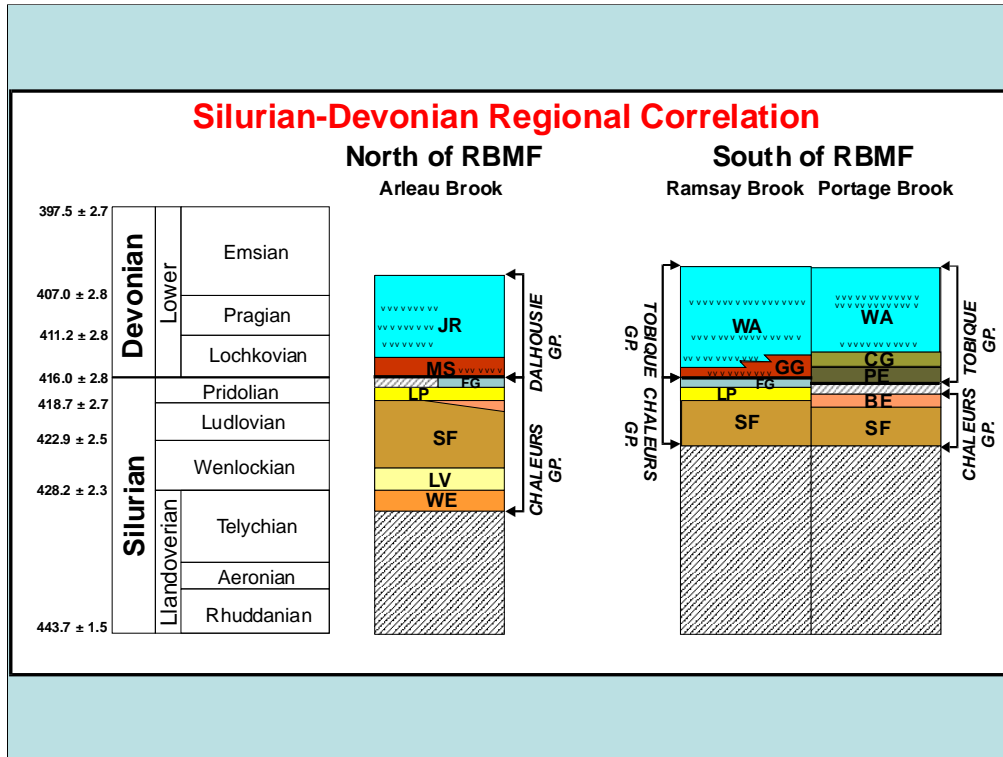


Looking at the big picture again, the heavy black lines show the location of these high strain zones, and the heavy blue lines are the major faults in the respective areas. The Late Silurian-Early Devonian stratigraphy is also virtually identical.

Restoration of movement on the RBMF



The shear zones, faults and stratigraphic contacts line up by restoring about 25 km of movement on the RBMF. If the shear zone is offset along the RBMF, it obviously precedes the main period of movement on the RBMF, so this has implications for the structural history of the area.



To summarize, these stratigraphic columns show the correlation of Silurian and Devonian strata on opposite sides of the RBMF. In the Chaleurs Group, units older than the Simpsons Field Formation are absent south of the fault, but the Simpsons Field and LaPlante formations are lithologically the same. A brief Late Silurian hiatus above the Benjamin Formation in the Portage Brook region south of the fault is also recognized north of the fault where the LaPlante and Free Grant formations are missing NE of Arleau Brook.

In the Lower Devonian section, Dalhousie Group and Tobique Group nomenclature differs, but the Mitchell Settlement Formation is easily correlated with the Greys Gulch Formation as mentioned earlier, and the Wapske Formation is lithologically similar to the Jacquet River Formation. As yet, there are no precise fossil or radiometric dates to put absolute values on the age range of these units, but the correlation appears to be solid.