STRATIGRAPHY STRUCTURE AND MINERALIZATION

WESTERN WHITE BAY

ROAD LOG AND FIELD GUIDE

for the

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NEWFOUNDLAND BRANCH

John Tuach

Mineral Deposits Section

Mineral Development Division

Department of Mines

St. John's, Newfoundland

STRATIGRAPHY, STRUCTURE AND MINERALIZATION IN WESTERN WHITE BAY

INTRODUCTION

The geology of western White Bay is extremely diversified (Figs. 1 and 2) and has been summarized by Lock (1969, 1972), Smyth and Schillereff (1981, 1982), and Tuach (1987). The stratigraphic succession encompasses a basement complex of Grenvillian gneiss, mafic intrusives and granitoids, Eocambrian to Ordovician platformal clastic and carbonate sequences (Coney Arm Group), Early Paleozoic mafic volcanic and volcaniclastic sequences of oceanic affinity and associated granitoids (Coney Head Complex), Silurian silicic volcanic and clastic sequences related to a major intracontinental caldera complex (Sops Arm Group), Devonian gabbroic-granitic intrusive rocks (also possibly related to a caldera complex), and Carboniferous, continental, sedimentary rocks. The Grenvillian rocks are cut by the Late Hadrynian Long Range mafic dike swarm (ca. 605 Ma; Stukas and Reynolds, 1974) and both the Grenvillian and the Paleozoic rocks are cut by Middle to Late Paleozoic mafic dike swarms.

Grenvillian, Taconic, Acadian and Hercynian orogenic events are recorded and the contrasting structural and metamorphic regimes are well displayed. A major NNE trending topographic, geological, and geophysical lineament transects the area; brittle faults are described as the Doucers Valley fault complex, however the lineament is also a locus for older structural and hydrothermal events (Lock, 1969; Williams, 1977; Tuach, 1987).

In the basement rocks, gneissic banding and complex fold patterns were developed in association with granulite facies metamorphism during the Grenvillian Orogen (ca. 1250 Ma), and a penetrative foliation accompanied by amphibolite facies metamorphism was developed after Late Grenvillian plutonism (ca. 1040 Ma; Erdmer, 1986, Erdmer and Owen, 1986). West-directed thrusting (obduction of ophiolite; Williams, 1977) is thought to have occurred in the Middle Ordovician during the Taconic orogenic event. This was accompanied by 1) tight folding with associated schistosities, 2) lower greenschist facies metamorphism of the Cambro-Ordovician platformal sequences, and 3) lower greenschist facies retrogressive metamorphism of rocks in the Grenvillian Inlier. A variable schistosity, recumbent folds, local mylonite zones, and subgreenschist facies metamorphism are evident in Silurian and older rocks and formed during the Late Silurian (Acadian) west-directed thrusting. Carboniferous rocks are relatively unmetamorphosed, older rocks were brecciated during Carboniferous deformations.

Gold mineralization of potential economic importance has been identified in Late Grenvillian granitoids and in the Silurian volcanic and sedimentary rocks. Significant lead deposits are present in Silurian carbonates. Late Carboniferous rocks host uranium and copper prospects. In addition, numerous gold, silver, copper, lead, molybdenum and fluorite occurrences are present (Fig. 2).

The localities described below illustrate many of the important lithologies, structures, metamorphic signatures, structural and stratigraphic relationships, and styles of mineralization. They are described from north to south, an arrangement that partially mimics stratigraphy. It will be impossible to visit all of these localities during the 1987 G.A.C. field trip nor will stops be made in strict order. However, it is hoped that the descriptions will serve as a guide to more leisurely and prolonged trips to western White Bay.

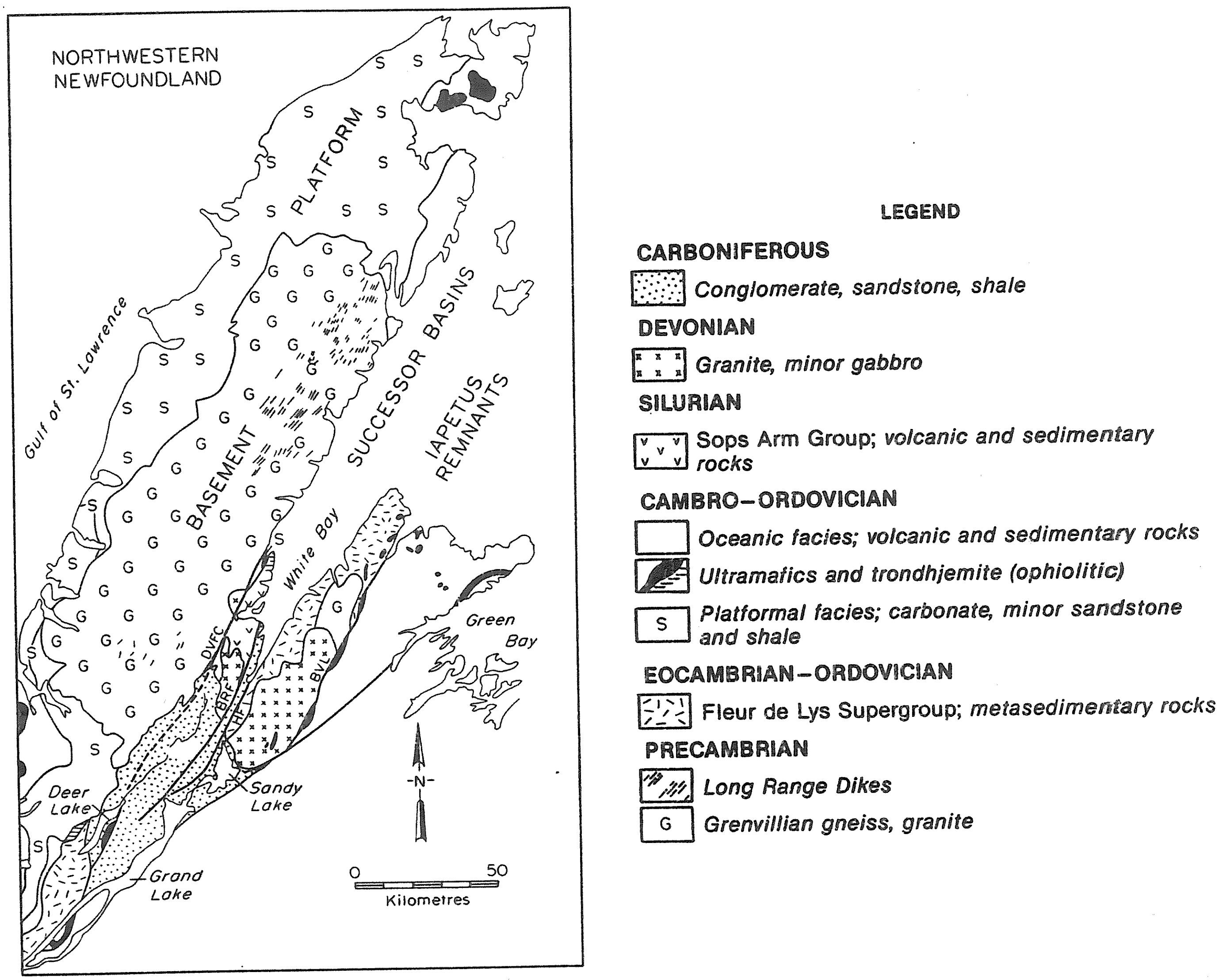

Figure 1: *General geology and tectonic elements of northwestern Newfoundland.*

DUFC - Doucers Valley Fault complex, BRF - Birchy Ridge Fault, HF - Hampden Fault, BVL - Baie Verte lineament

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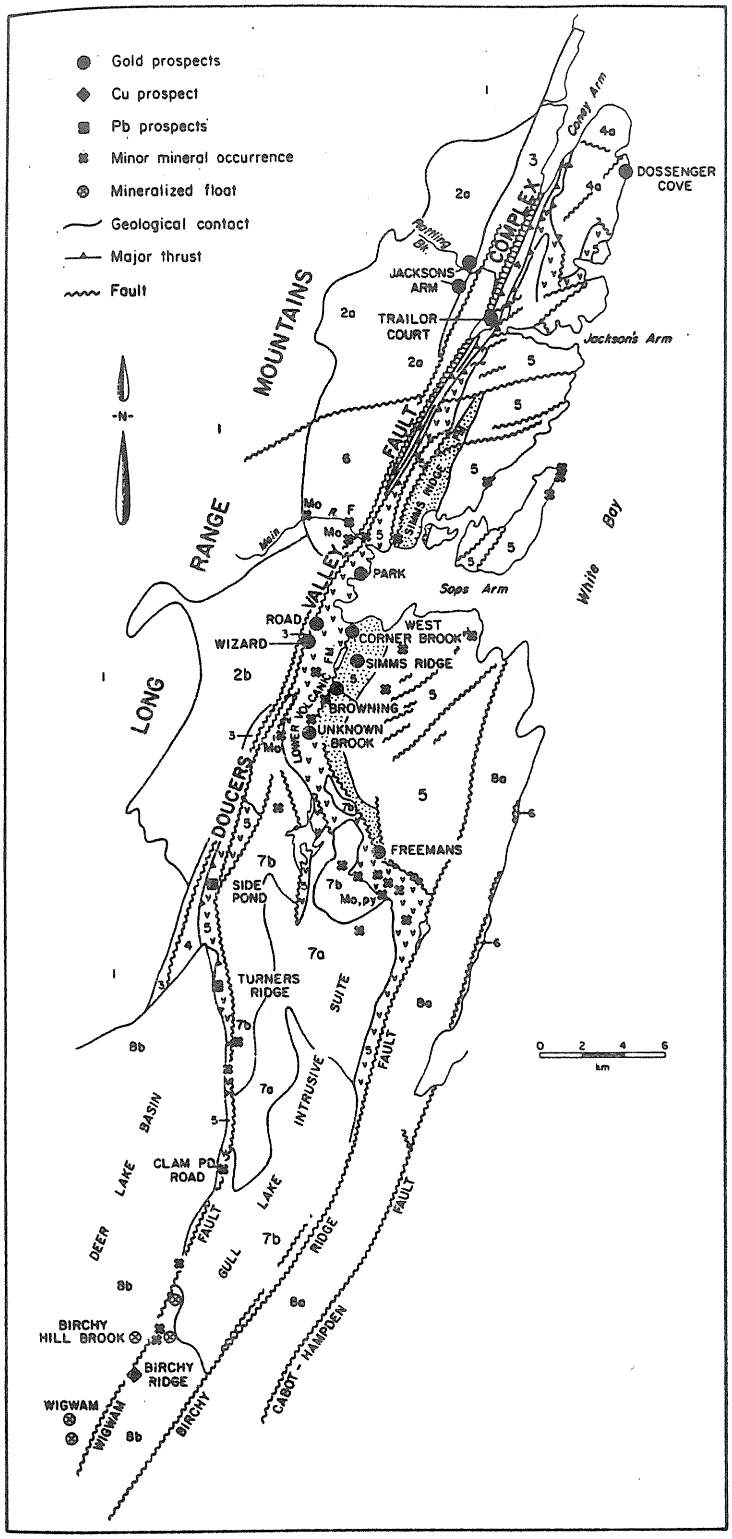


LEGEND

UPPER PALEOZOIC (Basin-fill sequences and intrusions)

CARBONIFEROUS

8 8b, Deer Lake Group (Visean): *conglomerate, sandstone, siltstone;* 8a, Anguille Group (Tournaisian): *graywacke, shale, minor sandstone and conglomerate*

DEVONIAN (approximately 398 Ma)

7 Gull Lake intrusive suite; 7a, *granites;* 7b, *intermediate and mafic intrusive rocks*

6 Devils Room granite

SILURIAN

5 Sops Arm Group

LOWER PALEOZOIC ALLOCHTHON

CAMBRIAN–MIDDLE ORDOVICIAN

4 Southern White Bay Allochthon: *partially ophiolitic (mélange containing ultramafic blocks is cross-hatched)* 4a, Coney Head Complex

LOWER PALEOZOIC AUTOCHTHON (Platform)

3 Coney Arm Group: *carbonate, shale, quartzite*

PRECAMBRIAN (Grenvillian basement)

MIDDLE PROTEROZOIC AND EARLIER

2 *Massive to foliated, feldspar-megacrystic, granitoid plutons;* 2a, French–Childs granodiorite; 2b, Main River granite

1 *Leucocratic gneiss, amphibolite, and gabbro*

Figure 2: *General geology and mineral occurrences in western White Bay; from Smyth and Schillereff (1981, 1982), Erdmer (1986a,b) and Hyde (1982). The Lower Volcanic formation and the Simms Ridge Formation of the Sops Arm Group are patterned.*

The starting point for the trip (0.00 km, Fig. 3) is on the Cat Arm road 15.6 km north of its junction with the Jackson's Arm road (approximately 1.1 km north of Little Coney Arm Brook). This road was constructed to provide access to the Cat Arm hydro development, and is a major contribution to the high cost of electricity in Newfoundland. Visitors with more time on their hands should continue north on the Cat Arm Road to the Cat Arm power station(approximately 6.5 km), to view the rugged coastline of the Long Range Peninsula.

Stops 1, 2, 3, 6, 7, 8, 9, 10, 11, 15, 16, and possibly 18 will be visited on day 1 of the field trip and will emphasize stratigraphy and structure. Stops 4, 5, 12, 13, 14 and 17 will be visited on day 2 and will emphasize styles of mineralization.

BEWARE OF ROADCUTS - OVERHANGING BLOCKS ARE EXTREMELY UNSTABLE.

ROAD LOG AND STOP DESCRIPTION
REFER TO FIGURE 3 FOR STOP LOCATION

Km 0: - **STOP 1:** (15.6 km north of Cat Arm road/Jacksons Arm road junction)

Little Coney Arm North. Grenvillian gneiss, Long Range mafic dike, Eocambrian unconformity, and lower part of the Coney Arm Group.

A 250 -300 meter long roadcut at the top of the hill at the north side of Little Coney Arm. Start at the north end of the road cut (0 km) and walk south towards Little Coney Arm.

Grey to green, leucocratic, Grenvillian gneiss is the dominant lithology at the north and south ends of the road cut. Tight folding and transposition of gneissic banding is present locally. Granulite facies metamorphic conditions were attained during the Grenvillian Orogen (ca. 1250 Ma; Erdmer, 1986; Owen and Erdmer, 1986), and a subsequent Paleozoic regressive greenschist facies metamorphic event, possibly related to overthrusting of the Paleozoic sequences, led to the pervasive development of epidote and chlorite.

At the north end of the exposure, a large, (20 m wide), steeply dipping, mafic, amphibole-bearing dike cuts the gneiss and a chilled contact is well developed. The dike is probably one of the Long Range swarm that have provided 40Ar/39Ar ages around 605 Ma (Stukas and Reynolds, 1974). Chlorite was developed in the dike presumably during the Paleozoic regressive event.

In the central and south-central part of road cut, quartzite and locally quartz-pebble conglomerate of the Eocambrian Beaver Brook Formation unconformably overlies the gneiss. These rocks form the base of the Eocambrian to Ordovician, Coney Arm Group in western White Bay and are equivalent to the Bradore Formation of the Labrabor Group in western Newfoundland. The Beaver Brook Formation is approximately 10 m thick at this locality, and consists of bedded sandstones (average bed 0.7 m), locally cross bedded, dipping at approximately 45 degrees to the ESE. Blue quartz grains, derived from Grenvillian gneiss and granite, are ubiquitous. Magnetite-rich layers and lamellae are locally well developed in the sandstones, and the formations is normally graded.

Quartzite overlies the gneiss at the north part of the exposed unconformity and a basal, 0.5 to 1.0 m thick bed of quartz-pebble conglomerate overlies the gneiss at the south end, suggesting minor relief on the unconformity surface. The unconformity surface is cut by a small fault that causes approximately 1 m

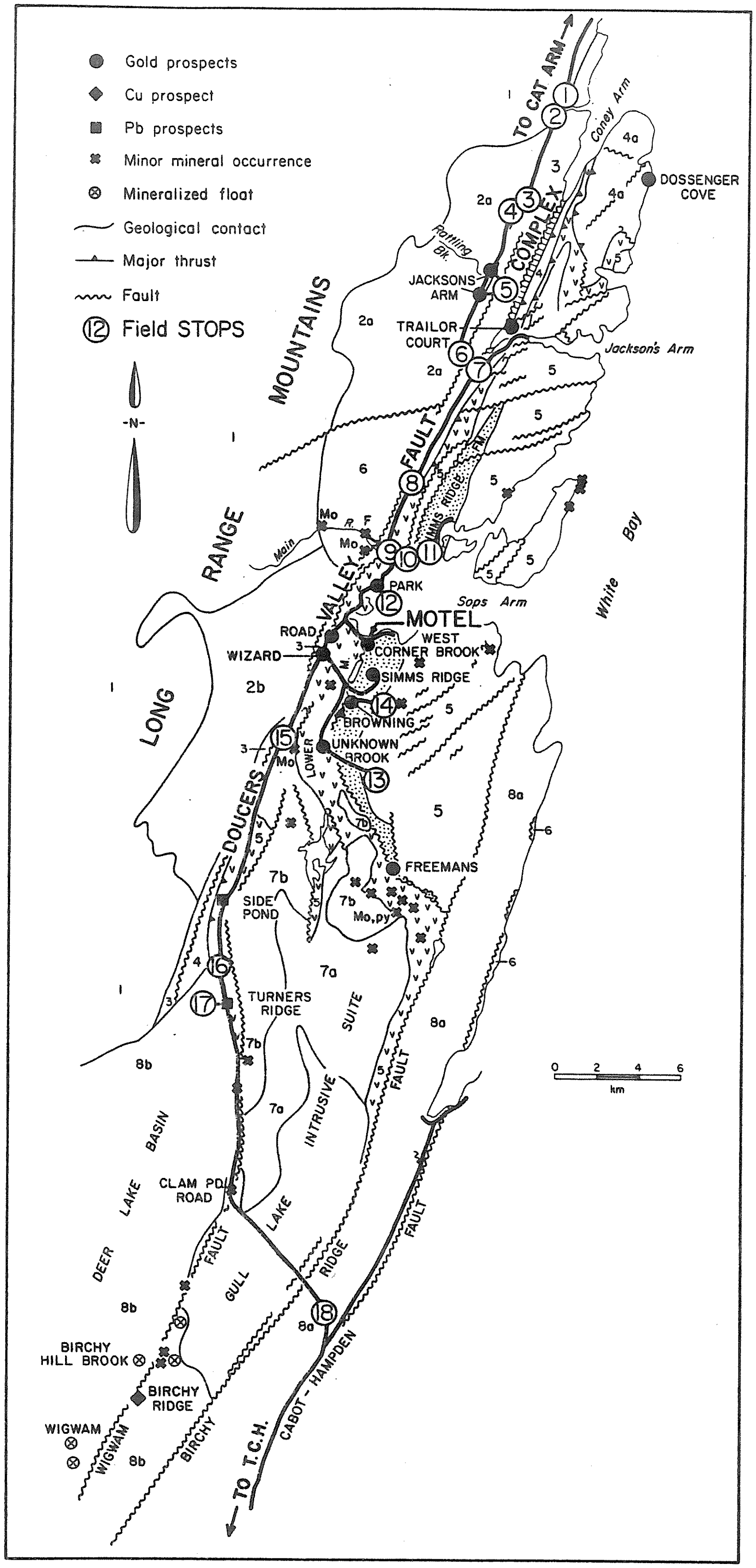


Figure 3: Stop Location and Geology (see Figure 2 for legend).

vertical displacement of the unconformity, and minor folding in the adjacent rocks.

Sandstones of the Bradore Formation pass upwards to a 1 to 2 m thick marble bed (equivalent to the Devils Cove limestone at the base of the Forteau Formation of the Labrador Group). This is overlain by phyllite and thin-bedded phyllitic limestone (equivalent to the Forteau Formation).

The Cambro-Ordovician carbonate sequences of the Petit Jardin and Watts Bight Formation are well exposed on the north and south sides of Little Coney Arm and are accessible by foot at low tide. These rocks will not be visited during the field trip.

Km 1.1:

Scenery, Grenvillian Gneiss, deformed Eocambrian unconformity, silicification of quartzite.

A scenic view eastwards of Little Coney Arm. Grenvillian gneiss is exposed on the west side of the road. The Eocambrian unconformity is exposed immediately west of the bridge over Little Coney Arm Brook at the bottom of the hill. However, the contact has been mylonitized in a crosscutting structure, and the quartzite is silicified and locally contains coarse-grained pyrite.

The roadcuts to the south of Little Coney Arm Brook are Forteau Formation equivalents and consist of bedded and laminated phyllite (also termed pelitic schist by Smyth and Schillereff, 1982), phyllitic limestone and limey quartz sands.

Km 1.6: - **STOP 2**

Little Coney Arm South Coney Arm Group phyllite and phyllitic limestone, folding, mafic dike, late thrust.

This stop is near (50 m) the southern edge of the large roadcut at the south side of Little Coney Arm. Moderately ESE-dipping, thinly bedded limestones and burrowed calcareous sandstones with abundant phyllitic partings pass eastwards into phyllite (also called pelitic schist by Smyth and Schillereff) with limestone laminae, and are probable equivalents to the upper Forteau Formation. Tight recumbent folds with moderately ESE dipping axial planes are present and abundant quartz veins are tightly folded and boudinaged. Small scale chevron folds are locally superimposed on the main schistosity. Fine-grained disseminated pyrite occurs locally.

The deformed limestones and phyllite are cut by a jointed, 060 trending vertical diabase dike (approximately 3 m thick) with well developed chilled margins. The dike has a comparable trend to mafic dikes that cut Ordovician marbles in Great Coney Arm and to mafic dikes that cut the gold-bearing stockworks at Rattling Brook, and they are presumably part of a single intrusive event. On the east side of the roadcut, the upper surface of the dike is truncated by a shallow ESE dipping thrust. This thrust may be related to either west directed thrusting in the Late Silurian or Carboniferous. The outcrop illustrates the potential complexity of structural interpretation in the area.

Km 2.2:

Eocambriam unconformity on granodiorite and pegmatite dikes.

Opposite a large grassy area, a road extends westwards for approximately 150 m to Little Coney Arm Brook. In the outcrop at the end of the road, Eocambrian quartzite unconformably overlies Late Grenvillian, foliated, megacrystic granodiorite.

Subvertical pegmatite dikes occur in the granodiorite and are truncated by the unconformity.

K 4.5: - **STOP 3**

Coney Arm Group limestone and dolostone; Petit Jardin Formation equivalents.

This stop is at a quarry on the east side of the Cat Arm Road. The rocks dip steeply to the ESE. The outcrop on the west side of the road opposite the quarry is Eocambrian quartzite of the Beaver Brook Formation. On the east side of the road at the south end of the quarry, a ribbon limestone with shale is probably equivalent to the Devils Cove Limestone at the base of the Forteau Formation. The rocks in the quarry immediately east of the limestone are light grey, thick-bedded, recrystallized dolostone and marble, and are probably equivalent to the Petit Jardin Formation. The proximity to the carbonate units implies that most of the Forteau Formation has been faulted out at this locality.

Km 5.4: - **STOP 4**

Eocambrian quartzite and polymictic conglomerate unconformably overlying Late Grenvillian granitoid.

At 5 m long outcrop on the west side of the road consists of basal conglomerate of the Beaver Brook Formation. Immediately south, on the upper surface of the exposure, quartzite overlies foliated Grenvillian granodiorite.

The unconformity surface is irregular, indicating some topographic relief in this area during the Eocambrian, a conclusion supported by the coarse boulders (to 40 cm diameter) in conglomerate. The foliation in the Grenvillian rocks is truncated by the unconformity. Boulders in the conglomerate are predominantly the underlying foliated granodiorite, and individual megacrysts weathered from the granodiorite are also common. Other boulders in the conglomerate consist of foliated diorite, granitic gneiss and quartz vein material.

The outcrop of quartzite approximately 100 m north contains abundant magnetite laminae.

Km 9.9:

Phases of Late Grenvillian granitoids, quartz veins, mafic dikes.

The outcrop is on the west side of the road. Foliated megacrystic Grenvillian granodiorite contains local biotite-rich schlieren (restite origin ?). Dikes and areas of pink feldspar-rich granite probably represent relatively differentiated phases of the Grenvillian magma. Quartz veins with minor pyrite cut the granitoids. The granitoids and the quartz veins are cut by thin diabase dikes that are probably related to the dike observed at stop 2.

Km 10.3 to Km 12.0: - **STOP 5**

Jackson's Arm alteration zone - foliated granitoids, K-feldspar alteration, fracture-stockworks, veins and shears, auriferous pyrite and arsenopyrite, quartz veins, quartzite, late mafic dikes.

The Jacksons Arm alteration zone is exposed for 1.7 Km along the Cat Arm Road to the north and south of Rattling Brook and numerous outcrops with anomalous gold content are exposed. The zone has been described briefly by Tuach and French (1986), and some of the significant features are indicated on Figure 4 (modified from Bruneau, 1984).

STOP 5: GEOLOGICAL SKETCH - JACKSONS ARM ALTERATION SYSTEM
CAT ARM ROAD

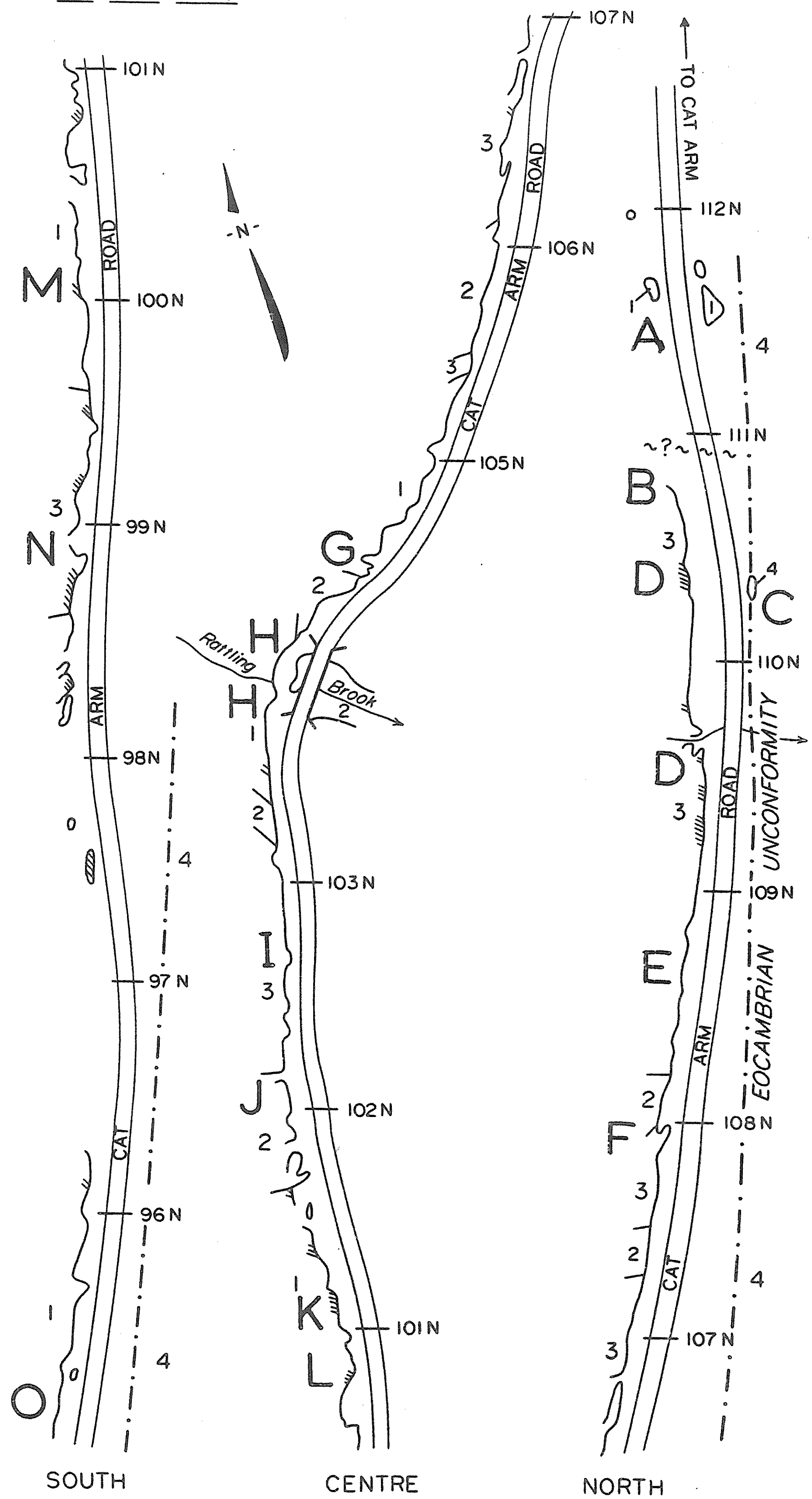


Figure 4: Rattling Brook area (modified from Bruneau 1984)

Jacksons Arm Alteration System (Figure 4)

LEGEND

Coney Arm Group

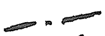
4 Quartzite overlain by phyllite, limestone

Late Grenvillian (Dominant Lithology)

3 Granite - K-Felspathized. Abundant fracture stockworks

2 Granodiorite/Granite - insipient alteration

1 Granodiorite - relatively unaltered

 Unconformity

 Outcrop ridge, individual outcrop

 Area of anomalous gold content (Bruneau, 1984). Most values are in excess of 1.0 g/t Au

A Relatively unaltered, foliated megacrystic granodiorite
B Altered and stockwork-mineralized granite
C Quartzite - some pyrite-sericite mineralization
D Altered, py ± Au mineralized granite - good fracture stockworks
E Cross cutting diabase dike (1m wide) at 60 degrees
F Amphibolite/carbonate pod and quartz viens. Grenvillian ?.
G Cross-cutting quartz veins - gas breccias
H Carbonatized amphibolite. A long range dike
I Gas breccia textures in granite. Abundant stockworks
J Auriferous silicified veins with K-feldspar margins. Also silicified shear zone
K Fracture/shear zone with silica alteration and K-feldspar
L Fracture sheets with alteration halos round fractures
M Xenolith of Grenvillian gneiss - shear zones
N Shear zones, fractures, 060 cross cutting dike
O Relatively flat lying carbonate-silica veinlets. Local K-feldspar margins.

The altered and mineralized zone as exposed on the Cat Arm road overprints foliated Grenvillian megacrystic granodiorite. Alteration consists predominantly of K-feldspathization, which is pervasively developed in the northern exposures and is developed marginal to veins in the southern exposures. Fe-rich carbonate is a common accessory in fracture stockworks and in fractures and veins. Auriferous, silicified and sericitized shear zones are developed in the southern part of the system, and veinlet stockworks containing auriferous pyrite and arsenopyrite are developed in the north. Quartzites of the Beaver Brook Formation overly the altered and mineralized granitoids at the north end of the area and contain minor pyrite.

Km 14.1: - **STOP 6**

Coney Arm Group limestone and dolostone, deformation, subterranean Carboniferous deposits.

The rockcut on the east side of the road consists of buff to white limestone and marble, possibly equivalent to the Petit Jardin Formation. A small recumbent fold structure indicates east-directed thrusting. Several minor faults contain red, hematite - stained silt and sand. A boulder of limestone breccia in front of the outcrop is cemented in a matrix of red silt and sandstone, and a small area of outcrop on the east side of the road consists of similar breccia. These breccias are probably Late Carboniferous subterranean 'speleothem' deposits; the hematite stain and silt deposits in fractures resulted from Carboniferous groundwater movement. Similar Late Carboniferous speleothem deposits occur around the Deer Lake basin in the Early Paleozoic carbonates, and collectively they indicate that little change has occurred in the topography of western Newfoundland since the Carboniferous.

Km 14.2 to Km 15.4:

Recrystallized dolostone and marble.

The large rockcuts on the west side of the road consist of recrystallized limestone and dolostone, Primary textures have mostly been destroyed and the stratigraphic setting cannot be determined. Folding and brecciation is common, and several late calcite veins with crustiform textures are well developed. A similar eastwards increase in intensity of recrystallization and late brecciation is observed in the carbonate sequence in Great Coney Arm. The recrystallization is thought to result from Taconic (or possibly Late Silurian) west directed overthrusting; the late brecciation and fracturing may relate to Carboniferous movements on the Doucers Valley fault complex.

On the east side of the Cat Arm Road, immediately north of its intersection with the Jacksons Arm Road, outcrops of micaceous sandstone have been correlated with the Maiden Point Formation and are thought to be allochthonous with respect to the underlying Early Paleozoic sequence.

Km 15.6: - **STOP 7** (Intersection of the Cat Arm road with the Jacksons Arm road)

Graphitic melange. Doucers Valley fault complex.

The Second Pond melange is exposed on the east side of Jacksons Arm Road, opposite the intersection of the Cat Arm Road. It is also well exposed in west facing outcrops to the north and south of the intersection. Strongly foliated graphitic mafic schists with minor sericite schist and sandstone are present and locally exhibit a ghost stratigraphy. Quartz-carbonate veins up 1 m thick are tightly folded and commonly boudinaged. This unit is interpreted to represent a melange developed at the base of the Taconic thrust sheets (Williams, 1977). Ultramafic blocks occur elsewhere in the melange, although none were observed at this locality. Part of the deformation of the melange may also be Carboniferous.

The NNE-trending topographic lineament represents the trace of the Carboniferous Doucers Valley fault complex.

2.3 Km north of **Stop 7:**

Carbonate-fuchsite-sericite alteration and quartz veining.

Three brown weathering zones of pervasive carbonate alteration with minor sericite and fuchsite, occur at the west side of the trailer court located at the north end of Jacksons Arm Pond. The zones are up to 15 m wide, are sub-conformable to stratigraphy, and are hosted by mafic rocks of the Murrays Cove Schists. Similarly altered rock is present along strike in the roadcut opposite the south exit from the trailer court. Comparable carbonate-rich lithologies are common hosts to gold mineralization in many settings, particularly in Archean gold districts, and in association with more recent ophiolitic ultramafic rocks.

Km 24.0: - **STOP 8** (2.7 km north of bridge over Main River).

Murrays Cove Schist, serpentinite and virginite boulders.

Massive to schistose greenstone is exposed over 50 m in a west facing outcrop. These rocks are part of the allochthonous Murrays Cove Schist.

In the center of the roadcut, a 3 m boulder of serpentinite is present in the till and probably originated from an area of serpentinite that outcrops on the powerline 200 m east. At the north end of the roadcut, a gully in till contains several brown weathering, sub-rounded to angular boulders of bright green virginite (a magnesite-quartz-fuchsite alteration product of ultramafic rocks otherwise known as mariposite). These altered ultramafic rocks are interpreted as ophiolitic in origin and are allochthonous remnants of oceanic lower crust or mantle (Williams, 1977).

Km 25.9: (800 m west of bridge over Main River)

Intersection of the Main River Road with the Jacksons Arm Road, Silurian brecciated rhyolite, Ordovician marble, Devonian brecciated Devils Room granite. Doucers Valley Fault.

Brecciated Silurian rhyolite outcrops opposite the intersection of the Main River timber access road will the Jacksons Arm road. The first outcrop on the Main River Road is pink marble of the Ordovician Coney Arm Group. This marble is in presumed fault contact with brecciated Devils Room granite to the west and with the Silurian rhyolite to the east. These faults represent the Doucers Valley fault complex at this locality.

550 m west of Km 25.9:

Devils Room granite and associated fluorite mineralization.

Equigranular to feldspar megacrystic, pink to red granite (sensu stricto), together with local pegmatite and aplite dikes, of the Devils Room granite are well exposed in the south facing roadcut on the Main River Road. Erdmer (1986) reported a Late Silurian-Early Devonian zircon date on granite of 398 Ma. Chlorite and manganese coatings are common on the numerous joint surfaces in the granite, and slickensides are ubiquitous. Jointing and tectonic brecciation increase eastwards to the Doucers Valley fault and are presumably Carboniferous phenomena.

Purple fluorite is common as coatings on joint surfaces, and occurs, together with fine grained silica, as a matrix in a 1 m wide vertical tuffisite vein in the granite. Locally, traces of chalcopyrite and malachite occur on joint surfaces.

Km 26.3: - **STOP 9**

Main River. Polymictic conglomerate of the Silurian Sops Arm Group, deformation.

An outcrop of Silurian polymictic conglomerate that occurs on the Jacksons Arm Road, approximately 350 m west of the bridge over Main Sops Arm River is a part of the Lower Volcanic formation of the Sops Arm Group (Smyth and Schillereff, 1982). The best exposure occurs in bedrock and in boulders beside the river that have been cleaned by the river flow.

The conglomerate is generally clast supported. The dominant clast lithologies are a variety of silicic volcanic and volcaniclastic rocks, sandstone, siltstone, and fine grained subvolcanic intrusive rocks analogous to lithologies in the Sops Arm Group. Clasts of phyllite, vein quartz, and serpentinite are also present, and clasts of high grade metamorphic lithologies (presumably Grenvillian) have been reported from other localities (Lock, 1969; Smyth and Schillereff 1982). Many clasts are subangular and relatively undeformed. Irregular domains of flattened clasts and schistosity indicate inhomogenous strain.

Km 26.6: - **STOP 10**

Main River Bridge. Ash flow tuff of the Lower Volcanic formation, faults, veining, hydrothermal alteration.

At the junction of the Sops Arm and Jacksons Arm roads, the south-facing outcrop consists of dark red tuff and welded tuff with minor breccia. These rocks are also part of the Lower Volcanic formation of the Sops Arm Group. Flow banding, and flattened eutaxitic textures are present locally. The outcrop is generally massive, with moderate to steep, east-dipping schistose zones developed in tuffs and breccias. These schistose zones may represent minor thrusts. In the more massive tuff, steep west dipping quartz veins are present and could represent tensional fractures developed during westward thrusting of the Silurian rocks.

Buff zones of sericite and minor epidote are developed adjacent to some of the quartz veins; these are areas of hydrothermal alteration formed contemporaneously with vein development. Similar alteration is associated with auriferous quartz veins at Stop 12.

2.4 Km east of Stop 10: - **STOP 11**

Eli Deckers Stage, Sops Arm. Clastic sediment and minor carbonate beds, deformation style, metamorphism, quartz veins, siderite spots in the Silurian Simms Ridge Formation.

This stop is on the coastline. A short trail (approximately 50 m) from the bottom of a dip in the road opposite a small grassy field (behind a single story brown house) leads down to the shore. Walk west across Eli Deckers stage) which is relatively large and new for the area, and examine the section exposed under the stage and for the next 100 m to the southwest.

The section is representative of the Simms Ridge Formation of the Silurian Sops Arm Group. It consists of interbedded siltstones, sandstones, argillite, minor thin limestone beds, and thin silicic tuff beds. Brown weathering, 1 - 2 mm, cubes of siderite occur locally and are a characteristic feature of the Simms Ridge Formation. Bedding and schistosity dip moderately to the ESE, minor open recumbent folds are present locally, and bedding-cleavage intersections indicate the presence of a tight recumbent anticlinal structure with a WNW vergence. Bedding-cleavage intersection angles vary due to differences in the competency of beds. However, the relative position of bedding and cleavage at the east end of the section indicate that it is the upper limb of the anticline, and the relative position at the west end of the exposure indicate the lower limb.

Numerous lenticular quartz veins up to 70 cm wide are present in the central part of the section (i.e. in the core of the anticline) and are subparallel to schistosity. These are locally boudinaged and tightly folded, and probably formed during deformation. Traces of pyrite are present, and analyses of a chip sample of vein material with pyrite returned anomalous values of 170 ppb Au and 1.1 ppm Ag. This provides some evidence for vein formation and minor gold mineralization during deformation and thrusting of the Silurian rocks. It is probable that the axial planes of the folds developed into thrust planes, and this conjecture leads to currently popular models for gold mineralization (involving detachment thrusts) such as those proposed for parts of the Western USA.

Km 28.0: - **STOP 12** (1.1 km south of bridge over Main River)

Park Showings. Auriferous quartz-pyrite-galena veins in the Lower Volcanic formation.

A vertical quartz vein up to 30 cm wide and several smaller veinlets outcrops over 20 m in an east facing roadcut. These are hosted by tuff of the Lower Volcanic formation. Minor pyrite is present in the veins, and the host tuff is locally sericitized. A second parallel vein, with a strike length of 3 m, outcrops about 25 m west of the road and contains minor pyrite and galena. Chips from the vein on the road analyzed 203 and 541 ppb Au and chips from the galena-bearing vein analyzed 2730 ppb Au.

A small showing in a north-facing quarry wall approximately 200 m north of Stop 11 consists of variably sericitized, locally malachite stained, tuff with narrow quartz veins and veinlets containing minor pyrite, chalcocite and chalcopyrite.

Km 28.3:

Carbonate alteration of Silurian mafic volcanics.

A brown-weathering, east-facing roadcut, exposes 15 m of massive, grey siderite faulted against silicic tuffs of the Lower Volcanic formation to the north. Less pervasive carbonate alteration occurs as deformed veins in schistose to massive, vesicular basalts of the Lower Volcanic formation on the shoreline to the south at Giles Cove. Outcrops near the massive carbonate consist of massive to schistose vesicular basalt. It is thought that the carbonate is a replacement of basalt, and that the flattened chloritic spots on the rocks may be remnants of chlorite-filled vesicles. An analysis of 541 ppb Au from chips of carbonate was reported by the author, but this was not verified by subsequent resampling.

Km 28.7:

Mafic volcanics of the Lower Volcanic formation.

Outcrops on both sides of the road, to the east of the Community Development Center, consist of vesicular basalt of the Lower Volcanic formation.

Km 29.3:

Intersection of the Pollards Point Road with the Sops Arm Road. The Riversea Motel (Fig. 3) is in Pollards Point.

Corner Brook discharges to the salt water beside the motel. The West Corner Brook prospect is located approximately 200 m up Corner Brook on the west bank and consists of anastomosing quartz veins and veinlets in a rhyolite porphyry and tuff. The veins carry minor pyrite, chalcopyrite and galena, and the host rock is weakly and variably sericitized. Grab samples of vein material assayed up to 1 ppm Au.

SET ODOMETER AT 0 FOR ROAD SECTION TO THE SOUTH OF THE POLLARDS POINT ROAD - SOPS ARM ROAD JUNCTION

Km 2.4:

Road showings. Auriferous chloritic shears and quartz veins.

A west-facing roadcut consists of sheared, brecciated, and sericitized tuff of the Lower Volcanic formation. This outcrop, and others along the Sops Arm road to the south of Pollards Point, are on or near faults of the Doucers Valley fault complex, and are severely deformed and schistose. Much of the brecciation and development of 'gouge' in these exposures is probably due to Carboniferous fault movements, and these features have been superimposed on earlier more ductile deformation features.

Km 3.9:

Intersection of Pinkstons Road with the Sops Arm Road.

STOP 13

Unknown Brook. Alteration features on the Lower Volcanic Formation. Auriferous veins.

East (2.4 km) of the intersection noted above, a subsidiary woods access road trends south and parallels Corner Brook. The intersection is approximately 100 m west of Corner Brook. Drive up the subsidiary road to the end (approximately 2 km) and walk down the trail to Corner Brook, follow Corner Brook upstream for approximately 200 m to the intersection of Unknown Brook (the first stream on the west bank) with Corner Brook.

The Unknown Brook prospect consists of pyritic quartz-feldspar-carbonate veins with minor galena, that occur locally within a conglomerate bed at the top of Lower Volcanic formation. Drilling in this area resulted in the following intersections from 4 holes: 8.4 ppm Au over 1.75 m, 7.75 ppm Au over 2.6 m, 32.3 ppm Au over 0.33 m, and 71.5 ppm Au over 0.12 m.

At the junction of Unknown Brook with Corner Brook, massive and shaly limestone at the base of the Simms Ridge Formation overlie a conglomerate unit at the top of the Lower Volcanic formation; tuffs and tufaceous sandstone of the Lower Volcanic formation occur upstream on Unknown Brook. Several lenticular, weakly deformed, auriferous, quartz-carbonate-pyrite-feldspar veins up to 25 cm wide occur in the conglomerate. This outcrop is part of the gold-bearing zone, and a grab sample of vein material assayed 4138 ppb Au. The veins are probably syndeformational.

A zone of pervasive sericite alteration aproximately 70 m long and 15 m thick is exposed in a cliff face above a small waterfall located approximately 400 m upstream on

Unknown Brook. This was described as 'sheared, carbonatized and pyrophyllitized' by Snelgrove (1935), however, recent XRD work indicates only the presence of sericite. Minor pyrite occurs in the alteration zone, and narrow quartz-carbonate veins are present. Siliceous, cigar-shaped rods are ubiquitous in the alteration zone, and may represent relict lithophysae in an original rheoignimbrite flow (D.F. Strong, personal communication, 1986). Sericitic tuff and tuffaceous sandstone can be recognized adjacent to the alteration zone. Carbonate and chlorite alteration also occur in the vicinity of the pervasively sericitized area. The alteration is either predeformational or syndeformational, and its relationship to the gold mineralization in the quartz veins at the Unknown Brook junction is unknown.

STOP 14

Browning Mine. Alteration features in the Simms Ridge Formation.

Walk upstream on Corner Brook from the bridge on Pinkstons Road. (Approximately 2.5 km east of Pinkstons Road - Sops Arm Road intersection.)

The Browning Mine consists of 2 vertical shafts and a tunnel, from which approximately 149 ounces of Au were produced from 1000 tons of ore (Snelgrove, 1935). The gold was presumably obtained from quartz veins in sericitized shales and altered carbonate beds of the Simms Ridge Formation. The shafts occur on the east bank above the river, and material from the waste tips can be examined nearby. An adit was driven in shales containing quartz-carbonate veins approximately 250 m upstream from the bridge on the east bank of the river, and several cuts in the rockface and waste material from one of the dumps occurs 100 to 120 m further upstream.

The section exposed in the stream is essentially on strike. Bedded and laminated shales of the Simms Ridge Formation are profusely spotted with siderite crystals that become more abundant towards the area of the shafts. In the section upstream from the adit, the shales are pervasively sericitized, indicating extensive hydrothermal alteration. Smaller areas of alteration affect the shales and minor silicic tuff beds further upstream. It is probable that the carbonate spotting of the shales is an outer 'propylitic' alteration facies related to the hydrothermal alteration, and therefore the Simms Ridge Formation (characterized by siderite crystals), outlines the areal extent of hydrothermal systems related to gold mineralization in the Lower Volcanic and Simms Ridge formations.

A schistose, chloritic band, up to 1 m wide, outcrops beneath the adit and probably represents an east-dipping shallow fault. Further upstream, beneath the fault and the altered shales, grey, massive, brown weathering, Fe-dolomite beds in the stream bed are spotted with a green mica that may be fuchsite. These Fe-rich carbonate beds may be the altered equivalent to fossiliferous limestone beds at the base of the Simms Ridge Formation (these contain minor disseminated galena) that outcrop approximatey 500 m upstream.

Quartz-carbonate veins are common in all the outcrops and locally contain pyrite. They vary from boudinaged and tightly folded in the plane of the schistosity to crosscutting, post deformational veins. Traces of base metal mineralization are present in veins, for example, cross-cutting, chalcopyrite-bearing quartz vein occurs in the stream bed opposite and slightly downstream from the adit, and minor pyrite, galena, chalcopyrite and sphalerite occur in deformed quartz veins in the blasted cut at the north end of the alteration zone. These latter mineralized veins may represent the ore horizon.

The foliations, augen of siderite crystals, and deformation of at least some of the quartz veins indicate that the alteration and mineralization is at least syndeformational, and possibly predeformational (a feature in agreement with observations at Unknown Brook and at Eli Deckers stage in Sops Arm.) It is possible that the systems originated at an early stage during or slightly after deposition of the rocks, and that deformation related to thrusting, together with ductility contrasts, caused vein formation and local concentration of gold.

Km 4.0:

Wizard Prospect. Gold-bearing, folded quartz veins in sericitic tuff.

At the south end of the roadcut south of the Pinkstons Road - Sops Arm Road intersection, a strongly foliated, 3 m wide, sericite tuff unit is exposed within more mafic tuffs on both sides of the road. The sericitic unit contains minor disrupted and tightly folded quartz veins that contain minor pyrite and traces of galena; a grab sample of vein material assayed 6150 ppb Au. The rocks probably belong to the Lower Volcanic formation. However, the outcrop is near the Doucers Valley fault complex, and the intense deformation and disruption of the quartz veins may relate to late fault movements.

Km 7.3: **STOP 15**

Gull Lake Granite, Coney Arm Group marbles, and a Doucers Valley fault.

At this stop, and in roadcuts for several hundred meters to the north, brecciated Gull Lake Granite of the Devonian Gull Lake Intrusive Suite is faulted against dark grey marble of the Ordovician Coney Arm Group. Brecciation of the granite is best developed close to the fault and dies out approximately 500 m to the east. Striated surfaces occur in the granite, a shaly graphitic gouge occurs along the fault zone, and the upper marble beds are complexly folded.

The brecciation and gouge development is presumably Carboniferous since it affects the granitic rocks, and probably relates to strike slip movements. These brittle structures contrast with more ductile structures developed in earlier orogenic events.

Km 19.1: **STOP 16**

Carboniferous North Brook Formation - Silurian unconformity.

A spectacular Visean unconformity is exposed on both sides of the road towards the north end of the 200 m long roadcut. Start at the north end of the exposure and walk south. **DO NOT PULL ON BLASTING WIRE SINCE IT MAY BE ATTACHED TO POWDER STICKS - BEWARE OF FALLING BOULDERS.**

Buff to red-brown, open to tightly folded phyllitic argillite and thin-bedded limestone at the north end of the outcrop probably belong to the upper part of the Lower Volcanic formation of the Silurian Sops Arm Group. Minor pyrite is present locally, and a few small quartz-carbonate veins cut the schistosity. Moderate to steep dipping, red to brown, coarse conglomerate and breccia (clasts up to 1 m in diameter) with minor red sandstone lenses and beds unconformably overlie the argillite to the south. These red beds belong to the Visean North Brook Formation. This is the lowest unit of the Late Carboniferous Deer Lake Group that outcrops in the Deer Lake

Basin to the south and west. The unconformity surface and crude bedding dips steeply to the southwest.

The conglomerate/breccia is generally clast supported and extremely poorly sorted; clasts vary from subrounded (particularly the larger clasts) to angular. Granite, and locally gabbro and diabase of the Gull Lake Intrusive Suite are the most abundant clasts in the North Brook Formation at this locality. Elsewhere, however, the most adundant clasts in comparable deposits are of underlying lithologies (i.e. gneiss clasts if the underlying rock is gneiss, and limestone if the underlying rock is limestone). Clasts of rhyolite and of argillite similar to Silurian lithologies are also present. Numerous clasts of green, epidote-clay fault gouge, that locally may be altered gabbro, indicate an extremely active tectonic environment with exposure and erosion of a fault surface along a scarp during deposition.

The deposits at this locality are debris flows (I. Knight, personal communication, 1987).

The presence of sericite in the Silurian rocks suggests that they have been hydrothermally altered. This alteration may relate to the large gold-bearing alteration systems described above, or to formation of galena deposits described below. The red coloration (hematite stain) of the Silurian rocks is pervasive at and near the unconformity surface. However, further from the unconformity surface, the red color is confined to narrow fractures and adjacent zones. This indicates that the hematite stain of the Silurian rocks is due to oxidizing Carboniferous groundwaters that were circulating during deposition of the North Brook Formation and which penetrated the substrate for a short distance. Hematite stain related to Carboniferous groundwaters was also noted at Stop 6.

The North Brook Formation was deposited as debris fans on the margins of the Deer Lake Basin, with lacustrine deposits formed in the basin center (Hyde, 1979). Caliche horizons at other localities, and red beds, indicate arid conditions. The Deer Lake Basin is a semi-graben characterized by active faulting along its the east margin during the Late Carboniferous, as indicated by the boulders of gouge, and the steep dip of the beds at this locality.

Km 20.7: **STOP 17**

Turners Ridge lead prospect

The 150 m long, east-facing rock face, approximately 30 m west of the Sops Arm Road, cuts through the Turners Ridge lead prospect. This deposit was drilled by Noranda Exploration prior to road construction and approximately 200,000 tonnes of 3 to 4 percent lead were indicated (Dimmell, 1969).

The grey-green rock is predominantly dolomite with local pevasive calcite alteration, and is a unit in the Lower Volcanic formation of the Sops Arm Group. The dolomite is severely brecciated: and coarse to fine grained galena accompanied by calcite and minor barite occurs in fractures and fracture stockworks. Rusty-weathering, buff to pink, brecciated rhyolite occurs on top of the dolomite, and faults or thrusts are present between the two lithologies. Minor galena mineralization in the rhyolite was intersected in drill holes.

Drilling has shown that the Silurian dolomite and rhyolite have been thrust westwards over coarse, relatively undeformed conglomerate of the Carboniferous North Brook Formation, and additional low angle thrusts may occur in the Silurian volcanic rocks. These may represent localized, late movements on the adjacent fault (the Wigwam Fault, Hyde, 1972), comparable structural events were also responsible for the steep dip of the bedding and unconformity at the previous stop.

Km 21.7:

Brecciated Silurian rhyolite, brittle deformation.

A 100 m long quarry is present approximately 50 m west of the Sops Arm Road. Severely Brecciated, fractured and faulted rhyolite and tuff of the Lower Volcanic formation is exposed, and zones of gouge or rockflour are abundant. This outcrop again demonstrates the brittle deformation style of Carboniferous fault movement.

Km 24.2:

North Brook Formation conglomerate.

A 100 m diameter quarry is present approximately 100 m west of the Sops Arm road and exposes extremely coarse Carboniferous Conglomerate of the North Brook Formation.

Km 26.7:

Peralkaline granite of the Devonian Gull Lake Intrusive Suite is faulted against brecciated Silurian felsic tuff in a small outcrop on the east side of the road.

Km 28.4:

A 100 m roadcut exposes severely brecciated gabbro and diabase of the Gull Lake Intrusive Suite.

Km 37.6: **STOP 18** (11.3 km north of the Trans Canada Highway)

Early Carboniferous fluvial deposits, deformation.

Subvertical, relatively unmetamorphosed, grey to black beds of the Early Carboniferous (Tournaisian) Anguille Group are exposed in a 200 m long roadcut on both sides of the road. This is the first large outcrop exposed on the road north towards Sops Arm from the Trans Canada Highway.

The sequence alternates between units (to 4 m) dominated by scoured medium to coarse micaceous sands, and units (to 5 m) of interbedded, sheeted, fine-grained sands and black, locally organic-rich, shale. Rip-up clasts, scoured bases, and load casts are present in the coarse sands, and these are probably fluvial channel deposits. The sheeted sands and argillite contain parallel laminations, local cross-laminations, mud cracks, and plant debris, suggesting fluvial overbank deposits. A flood plain environment is indicated with a meandering channel system and associated crevasse splay or overbank deposits.

HAPPY FIELD TRIPPING

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