Hughes-Owens 313 1102

REF. OR DRAWING NO. 79-125

DETAILS Buchans

12 A/15 (882)

Hughes-Owens 313 1102

LEGEND

CARBONIFEROUS(?)

19 — Poorly indurated, red conglomerate and sandstone.

SILURIAN AND DEVONIAN

Topsails Intrusive Suite

15 — **15a**, Brick red and gray, subaerial quartz-feldspar crystal tuff and unwelded ignimbrite; **15b**, red and gray, subvolcanic quartz-feldspar porphyry; **15c**, pink, buff and black flow-banded rhyolite, rhyolitic breccia and tuff.

18 — Medium to coarse grained, pink to white, peralkaline granite; minor peralkaline quartz-feldspar porphyry.

17 — Medium to coarse grained, pink, biotite and hastingsite granite.

16 — **16a**, Fine grained, minor biotite and rare hornblende, red alaskitic granite, granite, syenite and quartz syenite; minor unseparated fine grained, peralkaline quartz-feldspar porphyry; **16b**, fine grained, equigranular, gray diorite; **16c**, fine grained, pinkish gray, hybrid diorite.

SILURIAN (?)

14 — Red, cross-bedded, ripple-marked sandstone.

LATE ORDOVICIAN AND SILURIAN (?)

13 — Fine to coarse grained gabbro and diabase (may in part be equivalent to basic phases of Topsails Granite Complex)

12 — **12a**, Medium to coarse grained, pink granodiorite (Feeder Granodiorite); **12b**, altered gray-green granodiorite.

11 — Fine grained, altered, green felsic intrusive.

Buchans Group (units 3-10)

Upper Buchans Subgroup

10/9 — Interfingered and intercalated mafic and felsic volcanic rocks: **9**, Basaltic and andesitic pillow lava, breccia, pyroclastic flows, and tuff; minor unseparated felsic volcanics; **10a**, green, intermediate to dacitic breccia and quartz-feldspar crystal tuff; **10b**, black rhyolitic quartz-feldspar crystal tuff and flows; **10c**, buff, pink and gray rhyolitic breccia, tuff, flow-banded rhyolite and pyroclastic flows.

8 — Arkose and polymictic conglomerate.

7 — **Lake Seven Basalt:** Fine grained, dark green, vesicular and calcite amygdaloidal flows, breccia and tuff.

Lower Buchans Subgroup

6A — **Lucky Strike Ore Horizon Sequence** (may include unseparated unit 5 in lower parts): **6Aa**, Dacitic crystal-vitric, crystal, and lithic tuff and breccia; pyroclastic and debris flows; minor siltstone and rhyolite; **6Ab**, mafic flows and tuffs; **6Ac**, rhyolite.

5A — **Intermediate Footwall:** Gray to green, mafic to intermediate tuff, breccia and minor flows.

4C — **Footwall Arkose** (lateral facies equivalent to 4A,B): **4Ca**, Massive, pink, lithic arkose; minor conglomeratic lenses; **4Cb**, tuffaceous graywacke and litharenite, minor siltstone and chert; **4Cc**, fine grained litharenite, siltstone and chert; **4Cd**, graded, green, quartzose sandstone.

4A — **Prominent Quartz Sequence** equivalents: **4Aa**, Dacitic quartz-feldspar crystal tuff and breccia; **4Ab**, feldsparphyric basaltic lava, pillow lava, pillow breccia, minor pyroclastics and bedded chert. **4Ac**, pink to buff rhyolite flows and tuff.

3 — **Basal Basalt: 3a**, Basaltic pillow lava, pillow breccia, tuff and breccia; minor red chert and sedimentary rocks; **3b**, green and buff felsic flows, breccia and tuff; **3c**, pink and purplish gray spheroidal rhyolite.

Allochthonous sequence (units 4B, 5B, 6B; equivalent to 4A, 5A, 6A respectively)

6B — **Oriental Ore Horizon Sequence: 6Ba**, Dacitic crystal-tuff and breccia; pyroclastic and debris flows; quartz and feldsparphyric rhyolite, minor mafic volcanics; **6Bb**, mafic breccia and pillow lava.

5B — **Ski Hill Formation:** Andesitic pyroclastic breccia; minor flows and tuff.

4B — **Prominent Quartz Sequence: 4Ba**, Dacitic breccia and crystal tuff; **4Bb**, basaltic pillow lava.

ORDOVICIAN AND (?) LATER

2 — Gray to black, minor red, interbedded slate, argillite and graywacke (equivalent to Victoria Lake Group in part).

ORDOVICIAN OR EARLIER (?)

Hungry Mountain Complex

1A — **Western Belt: 1Aa**, Fine to medium grained foliated diorite, gabbro and amphibolite; **1Ab**, medium grained white to minor pink, foliated granite, adamellite, granodiorite and tonalite; includes minor feldspar porphyritic phases; cataclastic rocks in thrust zone.

1B — **Eastern Belt: 1Ba**, Medium to coarse grained equigranular gabbro, diorite, and olivine gabbro; **1Bb**, medium grained equigranular tonalite and granodiorite.

SYMBOLS

- Geological boundary (defined, approximate, assumed, gradational)
- Unconformity
- Bedding, tops known (inclined, vertical)
- Bedding, tops unknown (inclined, vertical)
- Pillow bedding, tops known (inclined, vertical)
- Pillow bedding, tops unknown (inclined, vertical)
- Flow banding (inclined, vertical)
- Fracture cleavage and schistosity (inclined, vertical)
- Schistosity, foliation (inclined, vertical)
- Foliation due to thrusting (inclined, vertical)
- Anticline (approximate)
- Syncline (approximate)
- Minor fold (showing plunge and dip of axial plane)
- Thrust fault (defined, approximate or assumed)
- Fault (defined, approximate, assumed)
- Mine, in situ ore (lead, zinc, copper, gold) — 1 Pb, Zn, Cu, Au
- Mine, transported ore (lead, zinc, copper, gold) — 2 Pb, Zn, Cu, Au
- Mineral occurrence (pyrite, chalcopyrite) — py, cp
- Glacial striae (with direction and relative age)
- Drumlinoid ridge (direction of ice movement unknown)

1 Oriental No. 1
2 Oriental No. 2
3 Old Buchans (Buchans River)
4 Lucky Strike
5 Rothermere
6 MacLean

Geology compiled by B.F. Kean from detailed mapping carried out by Asarco and The Price Co. (Minerals Division), and regional mapping by B.F. Kean, 1977.

This preliminary map may be subject to revision and corrections.

Geological cartography by Mineral Development Division, Department of Mines and Energy, Government of Newfoundland and Labrador.

Copies of this map may be obtained from the Mineral Development Division, Department of Mines and Energy, P.O. Box 4750, St. John's, Newfoundland A1C 5T7.

Base maps at same scale published by the Surveys and Mapping Branch, Department of Energy, Mines and Resources, Ottawa.

Approximate magnetic declinations, 1969, for center of map, 28°39′W, decreasing 3.0′ annually.

Elevations in feet above mean sea level.

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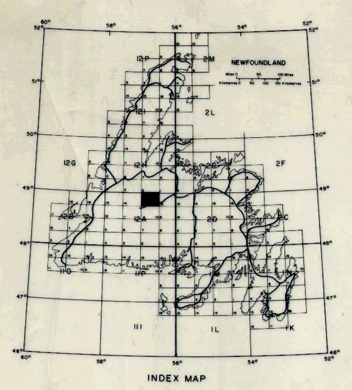
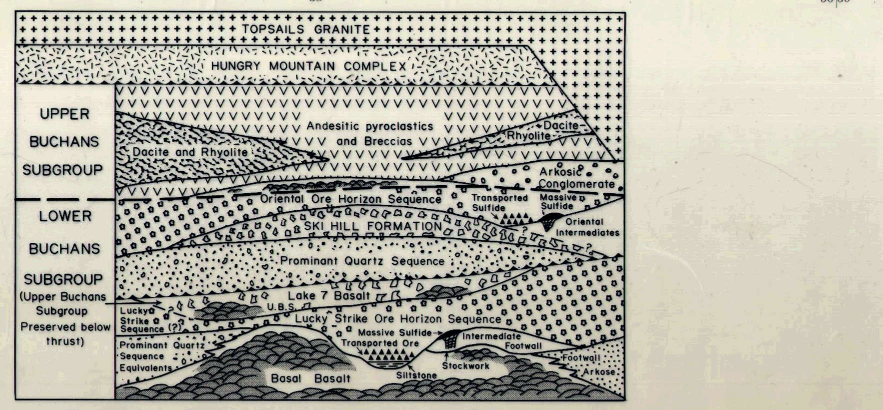


INDEX MAP

MINERAL DEVELOPMENT DIVISION
DEPARTMENT OF MINES AND ENERGY
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

MAP 79-125
BUCHANS
NEWFOUNDLAND

Scale 1:50,000 Échelle



Simplified Schematic Post-Thrusting Stratigraphy of the Buchans Area

MARGINAL NOTES

The Buchans map-area (12A/15), in south-central Newfoundland, is accessible in its southern part by Route 50 from the Trans Canada Highway at Badger. Privately owned logging roads provide local accessibility to the map-area south of Red Indian Lake. Red Indian Lake and the Exploits River provide additional but restricted accessibility. The northern part of the map-area is accessible only by helicopter.

The map-area is characterized by gently rolling, boggy lowlands and low rounded peaks and ridges of the 300 m or less surface of the Hinds Lake Flats or Lawrence Peneplain of the High Central Plateau; monadnocks of granite rising to more than 450 m represent the High Valley Peneplain of the High Central Plateau (Twenhofel and MacClintock, 1940). All parts of the map-area have been glaciated with an early, dominantly southward, ice movement and a later southwestward movement. Vegetation varies from heath and marsh, with dense tuckamore growth in protected areas, to heavy spruce and fir cover in the Red Indian Lake basin. Outcrop is generally sparse and is restricted to local topographic highs and to river channels. The main drainage is into the Red Indian Lake - Exploits River system.

The map-area was previously mapped at 1:250,000 scale by Williams (1970). It has also been mapped in detail and compiled on unpublished 1:40,000 scale maps by ASARCO. The immediate mine vicinity is the subject of a number of detailed studies and university theses (e.g. Relly, 1960; Thurlow, 1973).

The map-area lies in the Paleozoic Central Mobile Belt of the Newfoundland Appalachians (Williams, 1964) and is underlain by three contrasting geological terranes; namely, (1) the Hungry Mountain Complex, (2) the Buchans Group and underlying sedimentary rocks, and (3) the Topsails Granite and its extrusive equivalents.

The Hungry Mountain Complex (Thurlow, 1975) (unit 1) can be subdivided into Western and Eastern Belts separated by the Topsails Granite. The Western Belt (1A) consists of granitoid rocks which are intrusive into fine to medium grained, equigranular amphibolite and hornblende gabbro. The granitoid rocks contain xenoliths of fine grained mafic rocks in places, some of which are predeformed. The rocks of unit 1A, except the gabbro locally, have a well-developed penetrative fabric. The Eastern Belt (1B) consists of medium grained, equigranular, hornblende-bearing tonalite and granodiorite, and medium to coarse grained gabbro, olivine gabbro, and diorite. Plagioclase-rich veins pervade the rocks. Intrusion breccias and xenoliths indicate an igneous intrusive sequence starting with the most mafic rocks through to the most felsic rocks. Rare xenoliths of amphibolite and deformed gabbro occur in the Mary March Brook area. Tonalitic dikes similar to unit 1B intrude amphibolite of unit 1A posttectonically on the southwest side of Hinds Lake. The strong foliation characteristic of the Western Belt is weak to absent in the Eastern Belt. Posttectonic diabase dikes intrude all of the rocks of unit 1.

The rocks of unit 1 become progressively more deformed and acquire a protomylonitic texture and fabric as the contact with the Buchans Group is approached. Mylonites are developed in the thrust zone east of Sandy Lake. A tectonic fabric and related metamorphic aureole showing prograde metamorphism from subgreenschist to upper greenschist-lower amphibolite is developed in the underlying Buchans Group below the thrust fault west of Sandy Lake. Thurlow (personal communication) reports the development of small scale recumbent folds in the aureole that suggest thrusting of the complex from the north-northwest to the south-southeast. Undeformed aplite dikes and feldspar porphyry dikes of the Topsails Granite cut both the thrust zone and the penetrative fabric of unit 1A. The relationship between the penetrative fabric in the Hungry Mountain Complex and the cataclastic fabric in the thrust zone is not observed; however, the regional trace of the thrust plane transects the orientation of the penetrative fabric. This penetrative fabric is not developed in the Buchans Group. Therefore, the regional penetrative deformation of unit 1A is interpreted to predate the Buchans Group and the thrusting. The rocks of unit 1A are dated by two Rb/Sr whole rock isochrons from two localities as 660 ± 70 Ma and 400 ± 60 Ma (Bell and Blenkinsop, in press).

Rocks of unit 2 are inseparable, but, in part, are lateral equivalents of the Victoria Lake Group (Mercer, 1978) and may contain Caradocian and younger rocks in its upper parts. The Victoria Lake Group to the northeast and southwest of the map-area contains limestones which yield conodonts of late Llavirnian-early Llandeilo age (Stouge, unpublished report). In the Badger map-area (12A/16), about 15 km to the northeast, the stratigraphic top of the Victoria Lake Group is marked by distinctive Caradocian black shales and slates (Kean, 1977b); these rocks are not separable from unit 2 in the map-area. Rocks of unit 2 are overprinted by an inhomogeneously developed penetrative fabric with associated lower greenschist facies metamorphism.

The contact between the Buchans Group (units 3-10) and the rocks of unit 2 is not exposed in the map-area. In the Badger map-area, the Buchans Group structurally overlies Siluro-Ordovician (?) graywackes and conglomerates (Anderson, 1972) that conformably overlie Caradocian black shales (Kean, 1977b). The contact of the Buchans Group with this graywacke-conglomerate sequence has been inferred to be both a fault (Williams, 1970) and a conformable contact (Anderson, 1972). In the Lake Ambrose map area (12A/10) to the southwest, lithologies similar to the Buchans Group conformably overlie siltstones of the Harbour Round Formation, which in turn conformably overlies the Middle Ordovician Victoria Lake Group (Kean, 1977a). The Buchans Group is thus considered to be post-Middle Ordovician in age. A Rb/Sr whole rock isochron of 447 ± 18 Ma has been obtained on the Buchans Group (Bell and Blenkinsop, in press).

The Buchans Group is divided into a Lower (units 3-6) and an Upper (units 7-10) Subgroup; informal stratigraphic names are taken from PRICE and ASARCO maps and reports. Parts of the stratigraphy are repeated by thrust and reverse faults, and this coupled with rapid lateral facies variations make a stratigraphic synthesis difficult and open to interpretation.

Vesicular and calcite amygdaloidal flows of the Basal Basalt (unit 3) contain plagioclase and less abundant augite phenocrysts in a fine grained matrix of plagioclase laths and chlorite. This unit is sheared, brecciated and hematitized along faults in the vicinity of Red Indian Lake. Unit 3 is conformably overlain by the Prominent Quartz Sequence equivalents (unit 4A) in the west and by the Footwall Arkose (unit 4C) in the east. Units 3 and 4C are interfingered in the mine area.

Units 4A and 4B are stratigraphic equivalents that have been repeated by thrust faults. Unit 4 consists of coarse clastic breccia, quartz-feldspar crystal tuff, mafic volcanics and rhyolite. It is interpreted to be a proximal facies equivalent and source area to unit 4C. Unit 4C consists of coarse and unsorted, and in places unstratified, tuffaceous sedimentary rocks rich in pink rhyolite, quartz, feldspar, chert, and minor mafic rock clast interbedded with thin beds of graded litharenite, siltstone and chert. These fine beds predominate in the upper part of the unit (unit 4Cc). Rip-up clasts are common in the basal parts of the coarse beds. The unit is interpreted to be a mass-flow deposit, derived from unit 4A, that infilled depressions within the Basal Basalt.

Units 5A and 5B are considered stratigraphic equivalents that are structurally repeated by thrust faults. Intermediate to mafic pyroclastic rocks of the Intermediate Footwall (unit 5A) disconformably overlie the Basal Basalt (unit 3) and locally conformably overlie the Footwall Arkose (unit 4C). It hosts the stockwork mineralization of the Lucky Strike orebody. Rocks of the Ski Hill Formation (unit 5B) conformably overlie the Prominent Quartz Sequence (unit 4B). Rocks similar to 5B occur near the top of unit 4A north of Clementine Lake. They are tentatively included with the mafic volcanics of unit 4A. Units 5A and B are only separated from other units in the vicinity of the mines.

Unit 6 consists of the Lucky Strike Ore Horizon Sequence (unit 6A) and the Oriental Ore Horizon Sequence (unit 6B). They are considered stratigraphic equivalents that are structurally repeated by thrusting. The Lucky Strike Ore Horizon Sequence (unit 6A) and the Oriental Ore Horizon Sequence (unit 6B) conformably overlie the Intermediate Footwall (unit 5A) and the Ski Hill Formation (unit 5B), respectively, and they locally disconformably overlie lower stratigraphic units. The base of unit 6 is marked by the local deposition of pyritic siltstones in depression. The siltstone is medium gray, siliceous, well sorted and laminated, with common cross-beds and slump structures (Thurlow, 1973). Intercalated, light to dark green, dacitic, crystal-vitric and lithic tuffs, pyroclastic flows and minor mafic and rhyolitic rocks conformably overlie the siltstones in the depressions but elsewhere may disconformably overlie older units (Thurlow, 1975). Deposition of fine grained, banded, stratiform and stratabound sulphides such as the Lucky Strike and Oriental 1 orebodies, and associated stockwork or stringer mineralization in the underlying rocks occurred after the deposition of these pyroclastic rocks. Coarse, unsorted, generally unstratified breccias consisting of angular to subrounded clast of dacite, siltstone, rhyolite, and subordinate mafic volcanic and granite-granodiorite, overlie the pyroclastics and sulphides. Massive sulphide and barite clasts are common locally and in places are concentrated to form economic deposits (e.g. Rothermere, MacLean and Oriental 2). These breccias are interpreted to be laharic and pyroclastic flow deposits that represent a slump facies equivalent of the *in situ* pyroclastics and sulphides. Dacitic pyroclastics and red-maroon, hematitized, aphyric to quartz and feldspar porphyritic rhyolite locally form the stratigraphic top of unit 6.

The Lake Seven Basalt (unit 7) overlies the ore horizon sequences and forms the base of the Upper Buchans Subgroup south of Buchans. The base of the Upper Buchans Subgroup is marked by arkose and granite bearing polymictic conglomerates (unit 8) in the Oriental Mines area and by rocks of units 9 and 10 in the east.

Mafic rocks of unit 9 are predominant in the central and eastern areas of the map-area and are interfingered with felsic rocks of unit 10. In the Buchans River area, coarse pyroclastic breccias and pyroclastic flows constitute most of unit 9. Thin argillite and mudstone beds are interbedded with these rocks in the East Branch of the Buchans River.

Unit 10 varies from andesitic to rhyolitic, with rhyolite predominating in the upper parts of the sequence.

Intrusive rocks of unit 11 are fine grained, altered, felsic granitoid rocks that are similar to granitic rocks intrusive into the Victoria Lake Group (Mercer, 1978).

Unit 12 consists of pink, hematitized, and gray-green, altered granodiorite. Unit 12 is characterized by rounded or slightly resorbed, generally equant, quartz phenocrysts up to 1.5 cm across, and by strongly zoned plagioclase. Unit 12a, the Feeder Granodiorite (Thurlow, 1975), is texturally and chemically similar to silicic volcanic rocks in parts of the Buchans Group and clasts of unit 13a occur in the Buchans Group. They are thus thought to be coeval. A Rb/Sr whole rock isochron of 410 ± 80 Ma has been obtained on the Feeder Granodiorite (Bell and Blenkinsop, in press).

Elongate bodies of gabbro and diabase (unit 13) intrude the Buchans Group pretectonically. Columnar jointed diabase occurs at Bluff Hills northwest of Buchans. Numerous, narrow, fine grained diabase dikes cut the Buchans Group.

Red sandstone (unit 14) similar to the Silurian Botwood and Springdale Groups (Williams, 1970) occurs in fault contact with unit 3 northeast of Millertown on Red Indian Lake. The sandstone consist predominantly of subangular to subrounded quartz with less common lithic clasts, feldspar and muscovite; rare lithic clasts with a sericite-defined foliation, developed prior to incorporation, are also present. Calcite and hematite form the cement.

Units 15 to 18 constitute the Topsails Granite. Extrusive rocks and subvolcanic porphyries (unit 15) are considered volcanic equivalents of the intrusive rocks. The relationship between unit 16 and units 17 and 18 is not known. In places the contact between unit 16 and peralkaline porphyries (unit 18) seems to be gradational. Peralkaline microgranite dikes of unit 18 intrude unit 17. Dikes of unit 16 and peralkaline quartz-feldspar porphyry (unit 18) cut the Buchans Group, the Hungry Mountain Complex and the thrust zone.

Unit 15a and b is peralkaline and consist of phenocrysts of quartz and alkali-feldspar and microphenocrysts of riebeckitic-arfvedsonite and aegirine. Unit 15c is non-peralkaline and consists essentially of holocrystalline, aphanitic, interwoven quartz and feldspar, often with a spherulitic texture.

Unit 16 is peraluminous and is granitic to granophyric in texture. It was called the alkali feldsapr granite by Thurlow (1975). The typical mineralogy is hematitized orthoclase and microcline-perthite, quartz, plagioclase, minor biotite and rare hornblende. It varies imperceptibly from syenite through quartz syenite to granite; alaskitic phases are common. Unit 16 has been dated by a Rb/Sr whole rock isochron as 386 ± 17 Ma (Bell and Blenkinsop, in press). Diabase and gabbro with mildly alkaline affinities, diorite and hybrid phases are associated with this unit. Unit 16 intrudes and is cut by diabase dikes.

Unit 17 is characterized by the presence of hastingsitic amphibole. It consists dominantly of orthoclase and microcline-perthite, quartz, minor plagioclase, biotite and hastingsite.

Unit 18 consists of equigranular peralkaline granite characterized by the presence of riebeckitic arfvedsonite, aegerine and possible aenigmatite. Orthoclase, microcline-perthite, and quartz make up the bulk of the rock. Unit 18 has been dated by a Rb/Sr whole rock isochron as 421 ± 7 Ma (Bell and Blenkinsop, in press).

Poorly indurated strata of presumed Carboniferous age (unit 19) occur in isolated outcrops in the Red Indian Lake area. The unit consists mainly of red sharpstone conglomerate with interbedded, thin, red sandstone beds. Imbrication in the conglomerates indicates deposition from southwesterly currents.

Southeasterly directed thrust faults (Thurlow, 1975) resulted in structural repetitions of stratigraphy within the Buchans Group and overthrusting of the predeformed Hungry Mountain Complex upon the Buchans Group. Faults along the shores of Red Indian Lake may also be thrusts modified by later movements. The Topsails Granite was then emplaced and the area was folded into a large, open, northeasterly trending syncline. The development of a weak, subvertical, widely spaced fracture cleavage accompanied this deformation.

Metamorphism is of the subgreenschist facies in the Topsails Granite and most of the Buchans Group. Lower greenschist facies metamorphism is developed along faults in the Buchans Group in the southwest, and in the Hungry Mountain Complex. Upper greenschist-lower amphibolite facies metamorphism is developed in the thrust zone.

All of the economic deposits in the map-area occur within the Lower Buchans Subgroup. They are all "volcanogenic sulphides" and belong to three distinct but genetically related types; namely, (1) stockwork ore, (2) *in situ* syngenetic massive sulphide ore, and (3) mechanically transported breccia ore. Practically all ore production has come from the syngenetic massive sulphide and mechanically transported breccia ore (Thurlow, 1975).

Stockwork ore consists of a network of sulphide veins in a strongly altered volcanic host. They veins are interpreted to feed, and in places are associated directly with, the syngenetic massive sulphide ore. The stockwork ore consists of a sphalerite, galena and chalcopyrite mineral assemblage but, except for copper, the grade is lower than the syngenetic massive sulphide ore. The Engine House and Two Level Footwall and part of the West orebodies belong to this type (Thurlow, 1975).

The *in situ* syngenetic massive sulphide ore consists of bedded or banded, fine grained, high-grade assemblage of galena, sphalerite, lesser chalcopyrite, pyrite and trace silver and gold (Thurlow, 1973). This type includes such deposits and prospects as Lucky Strike, Oriental 1, part of West orebody, Rothermere Footwall orebody and Mudhole prospect.

The mechanically transported breccia ore was derived by slumping of semiconsolidated massive sulphide ore and essentially represents subaqeous debris flows. The MacLean, Rothermere, Oriental 2, Two Level orebody, Old Buchans orebodies and Clementine prospect are of this type.

The Upper Buchans Subgroup contains no known economic mineralization. Pyrite and, in places, chalcopyrite mineralization occur in some of the felsic volcanics of this unit. A small tonnage, low grade, stratiform pyritic copper prospect (Little Sandy) occurs in intermediate to felsic breccias of unit 10.

Alkali feldspar and peralkaline granite suites commonly host epigenetic fluorite, tin, tungsten and uranium mineralization. The Topsails Granite, being of this type, may be a favorable environment for these elements. Fluorite occurs as miarolitic cavity fillings in the alkali feldspar granite (unit 16) and as an accessory interstitial mineral in the peralkaline granite (unit 18).

The Carboniferous rocks along Red Indian Lake contain disseminated carbonaceous material and granitic detritus from the Topsails Granite. Despite their red oxidation color, the presence of favorable source rocks and depositional environment indicates a possible area for uranium mineralization. However, no anomalous readings were found by hand-held scintillometer.

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