Natural Resources

Mines

EASTERN LABRADOR FIELD EXCURSION FOR EXPLORATIONISTS

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Newfoundland Labrador

Natural Resources

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C.F. Gower, J. Haley, C., Moran and A. Chafe

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GEOLOGICAL SURVEY
NEWFOUNDLAND AND LABRADOR
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St. John's, Newfoundland
September, 2011

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INTRODUCTION

Eastern Labrador is currently undergoing huge changes in land use, brought about by the completion of the Trans-Labrador Highway; the creation of national and provincial parks; hydroelectric power developments; other economic activity, such as forestry, tourism and mineral exploration; and the advancing of indigenous peoples' land claim issues. For mineral exploration, which is the focus of the Eastern Labrador Field Excursion for Explorationists (ELFEE), these developments have mixed impact, greatly enhancing access to some areas, while, at the same time, denying it to others.

The objective of the excursion is to provide information to prospectors, mineral exploration company personnel, and other interested parties regarding the geology and mineral potential of the region. Rather than simply visiting sites of known economic interest, however, the excursion will also include locations that either provide key information with respect to understanding the geological make-up of eastern Labrador, or are instructive in explaining techniques used by geologists. The excursion extends over a 5-day period as follows: Day 1 – L'Anse Amour to Mary's Harbour; Day 2 – Mary's Harbour to Port Hope Simpson; Day 3 – Port Hope Simpson to Cartwright; Day 4 – Cartwright to Goose Bay; Day 5 – Pope's Hill region, southwest of Goose Bay.

There are several reasons for launching this excursion at the present time – apart from the fact that the completion of the Trans-Labrador Highway makes such a trip possible for the first time. These include, (i) the availability of new geological maps at 1:100 000-scale for the whole region (Gower, 2010a), (ii) the completion of an up-to-date review of mineral occurrences in eastern Labrador (Gower 2010b), (iii) the delivery of results of detailed lake-sediment and lake-water surveys (McConnell and Ricketts, 2010) for parts of the region (all recent releases by the Geological Survey of Newfoundland and Labrador), and (iv) significant current mineral exploration activity in the region (Search Minerals Inc., Silver Spruce Resources Inc., EagleRidge Resources Ltd.).

The field guide starts by presenting a brief overview of the geology of the region. This is followed by descriptions of the individual sites (as time, weather and other factors permit; not all locations will necessarily be made, and there could be impromptu stops not included in this guide). Apart from site descriptions, inset boxes and appendices explaining geological terms and mineral compositions have been included in an attempt to make some technical aspects clearer for non-specialists.

Finally, the extent to which this excursion is a co-operative effort cannot be overstressed. Agencies involved are the Government of Newfoundland and Labrador (Department of Natural Resources), mineral exploration companies working in the region (especially Search Minerals Inc. and Silver Spruce Resources Inc., which have both contributed to the field guide), and communities in southeast Labrador, through the Labrador Straits and Southeast Aurora Development Corporations.

REGIONAL GEOLOGICAL SETTING

The region comprises late Paleoproterozoic (1800–1600 Ma) and Mesoproterozoic (1600–900 Ma) rocks, with minor additions around 600 Ma. Rocks have been dated by isotopic methods from many places in eastern Labrador, from which data it has been interpreted that the region was affected by four major mountain-building events, technically known as orogenies. These occurred at 1800–1770 Ma (pre-Labradorian orogeny), 1710 to 1600 Ma (Labradorian orogeny), 1520 to 1460 Ma (Pinwarian orogeny) and 1085–985 Ma[1] (Grenvillian orogeny). These mountain-building events result from collisions between major segments of the earth's crust, referred to by geologists as crustal plates. The most cataclysmic of these was the Grenvillian orogeny, which involved a collision between the ancient cores of North America (Laurentia) and South America (Amazonia).The part of Laurentia affected by Grenvillian orogenesis, which, in Canada, extends from the Great Lakes in Ontario to the Labrador coast, is known as the Grenville Province.

As a result of Grenvillian orogenesis, much of the earlier geological history has been severely modified (or obliterated) by pressure and heat (deformation and metamorphism), when the rocks were deeply buried, hot and ductile. Nevertheless, it is possible, through careful field work and geochronological study, to find sites where the earlier history can be deciphered. As it is essentially impossible to discuss the geological history of eastern Labrador without reference to these four major events, it is worthwhile to fix them in one's mind at the outset (*see* Boxes 1 and 2).

In addition to time relationships, spatial relationships also need to be memorized. Although the Grenvillian orogeny affected all of the southernmost Canadian Shield, this excursion will only make reference to the eastern third of the Grenville Province (Figure 1), and, of that, only its easternmost half will be visited (Figure 2). Grenvillian orogenesis affected various parts of the region in different ways. As a conceptual means of coming to grips with these various orogenic effects, several terranes have been proposed. In eastern Labrador, five terranes have been defined. These are, from north to south, Groswater Bay terrane, Hawke River terrane, Lake Melville terrane, Mealy Mountains terrane and Pinware terrane (Figure 3). The Groswater Bay and Hawke River terranes were outside of where most (but not all) Grenvillian orogenesis took place, and were more affected by Grenvillian deformation than heat. The Lake Melville terrane took the brunt of Grenvillian orogenesis, but the nature of the deformation and metamorphism differed depending on area. North and west of Lake Melville, the rocks were thrust along shallow-dipping fault structures in a northwest direction over those at deeper levels, whereas, southeast of Lake Melville, the rocks on the southwest side moved, along vertical faults, to the northwest relative to those on the northeast side (Figure 4). In the Mealy Mountains terrane and Pinware terrane, deformation and metamorphism was not as severe as in the Lake Melville terrane, but there was much more granitic magmatism of Grenvillian age than in the Groswater and Hawke River terranes. The Mealy Mountains terrane also differs from the Pinware terrane in that it comprises Labradorian-ages rocks (1710–1600 Ma), whereas the Pinware terrane is mostly underlain by Pinwarian-aged rocks (1520–1460 Ma).

After the end of the Grenvillian orogeny, not much happened for 400 million years, until the break-up of the supercontinent (created during collision between Laurentia-Amazonia and other crustal plates). The break-up started around 615 Ma in Labrador, evidence of which is provided by numerous north-northeast-trending faults, some of which are occupied by huge basaltic dykes (Long Range dykes), development of rift basins, and their infilling by sediments.

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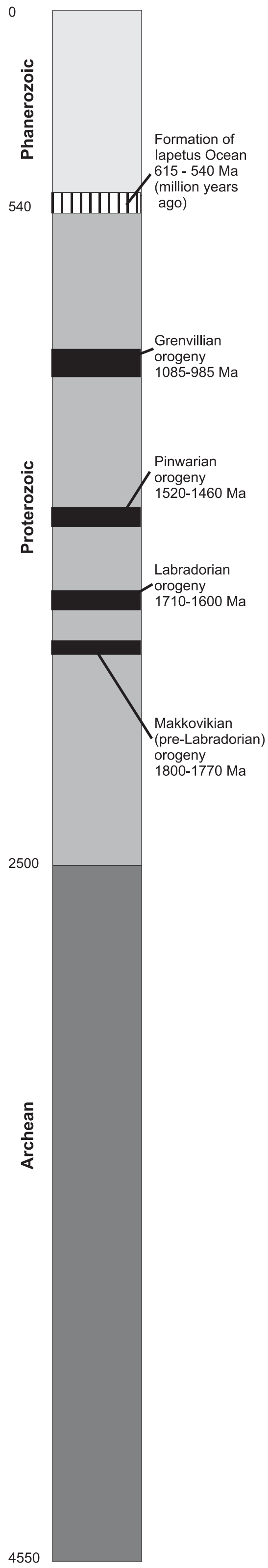
[1] Ma = 'million years ago'; i.e., 1800 Ma means 1800 million years ago.



Geological time and eastern Labrador

The Earth is believed to be about 4550 million years old.

Earth scientists have traditionally recognized three main divisions of geological time, namely **Archean**, **Proterozoic** and **Phanerozoic**.

Almost all the rocks in southeastern Labrador are Proterozoic in age. They formed during relatively short (geologically speaking), but very active, mountain-building events termed **orogenies**.

The oldest recognized rocks were formed between 1800 and 1770 million years ago. These are more common farther north, in the Makkovik region, hence the name **Makkovikian orogeny**.

The next period of activity, for which evidence is found across southern Labrador, occurred between 1710 and 1600 million years ago. It is known as the **Labradorian orogeny**.

After another (relatively short) break in geological upheavals, the region was again in turmoil, between 1520 and 1460 million years ago, during the **Pinwarian orogeny**, which takes its name from southeastern Labrador.

The final major and most cataclysmic event occurred between 1850 and 985 million years ago, and is termed the **Grenvillian orogeny**. This event is recognized throughout the southern part of the Canadian Shiel**d.** Time-equivalent orogenic events are known throughout the world, resulting in one of the biggest re-organizing of crustal plates the Earth has ever known.

The last major event in the region was a period of crustal break-up between 615 and 540 million years ago**.** This lead to the formation of an ancient, and now vanished, sea, to which the name **Iapetus Ocean** has been given.

Box 1. *Geological time and eastern Labrador.*

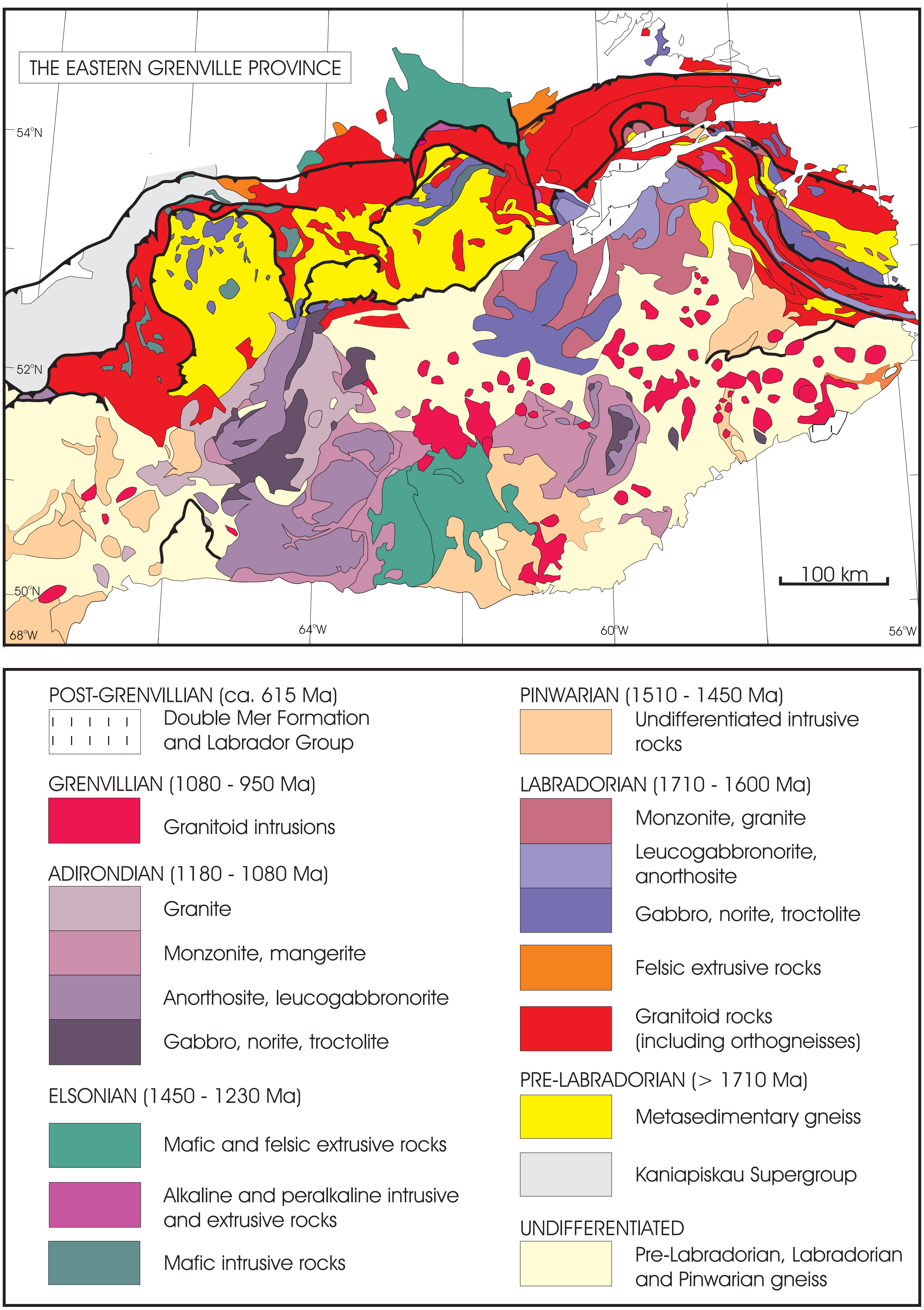


Figure 1. *Regional geological map of the eastern Grenville Province.*

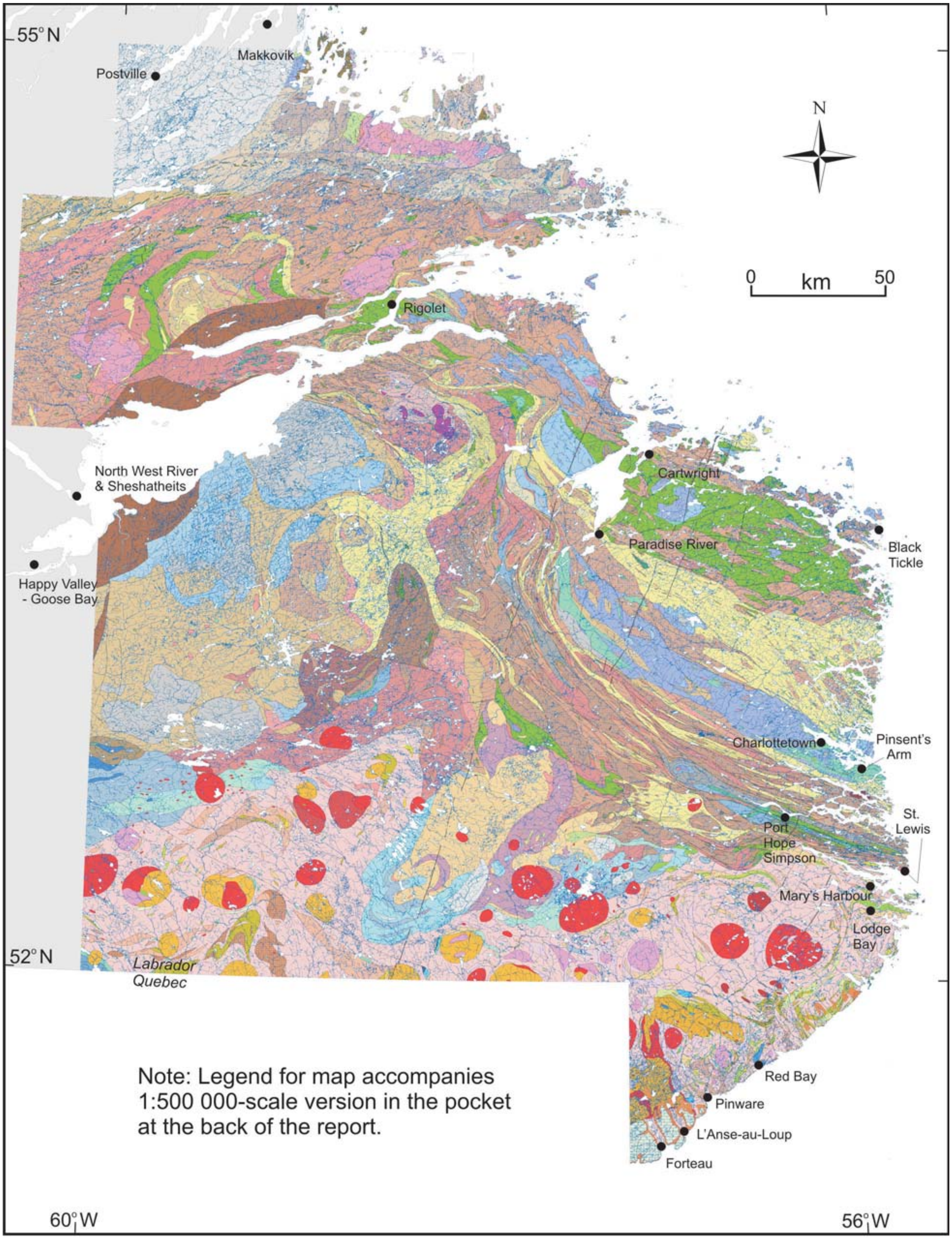


Figure 2. *Geological map of eastern Labrador.*

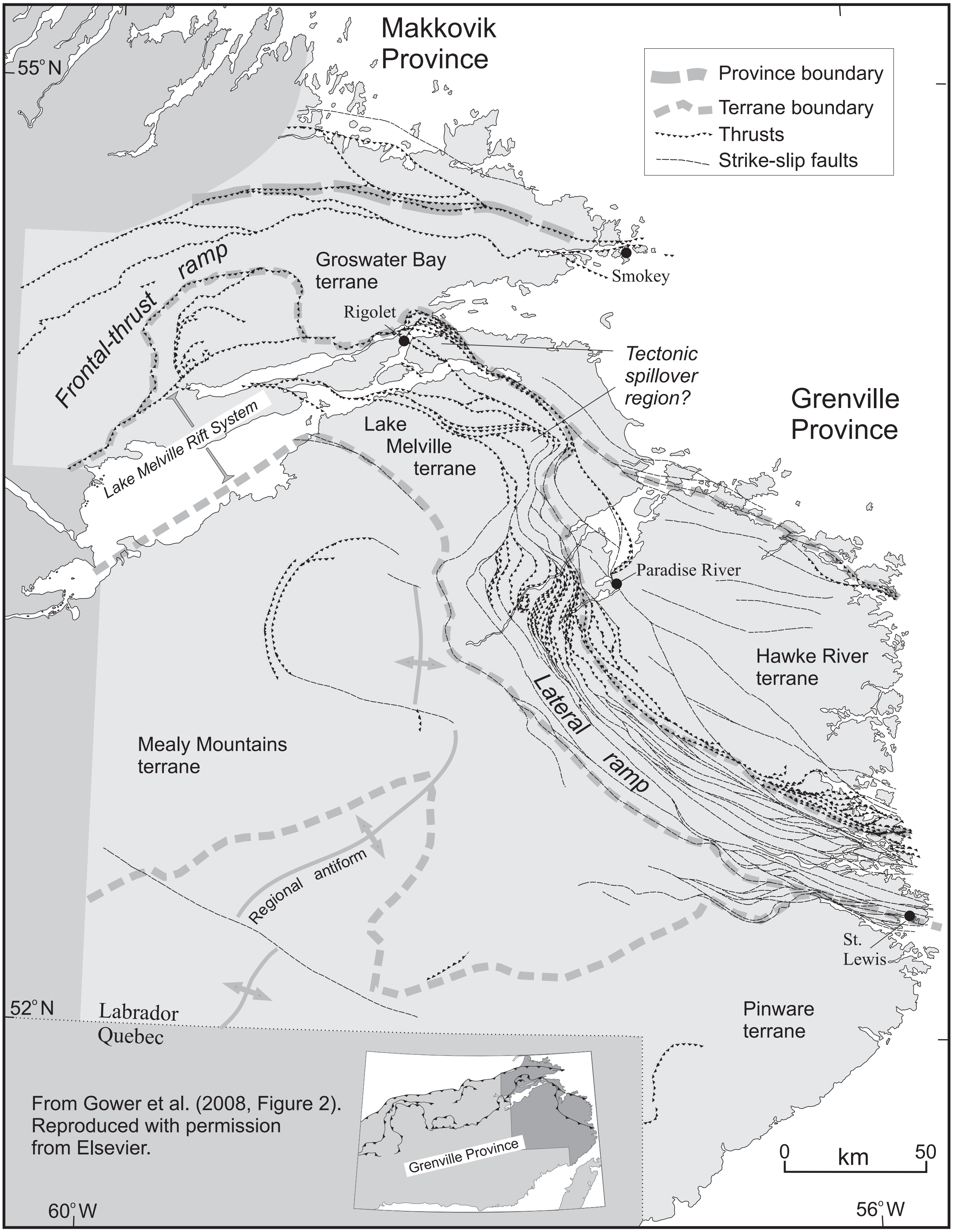


Figure 3. *Terranes and major geological structures in eastern Labrador.*

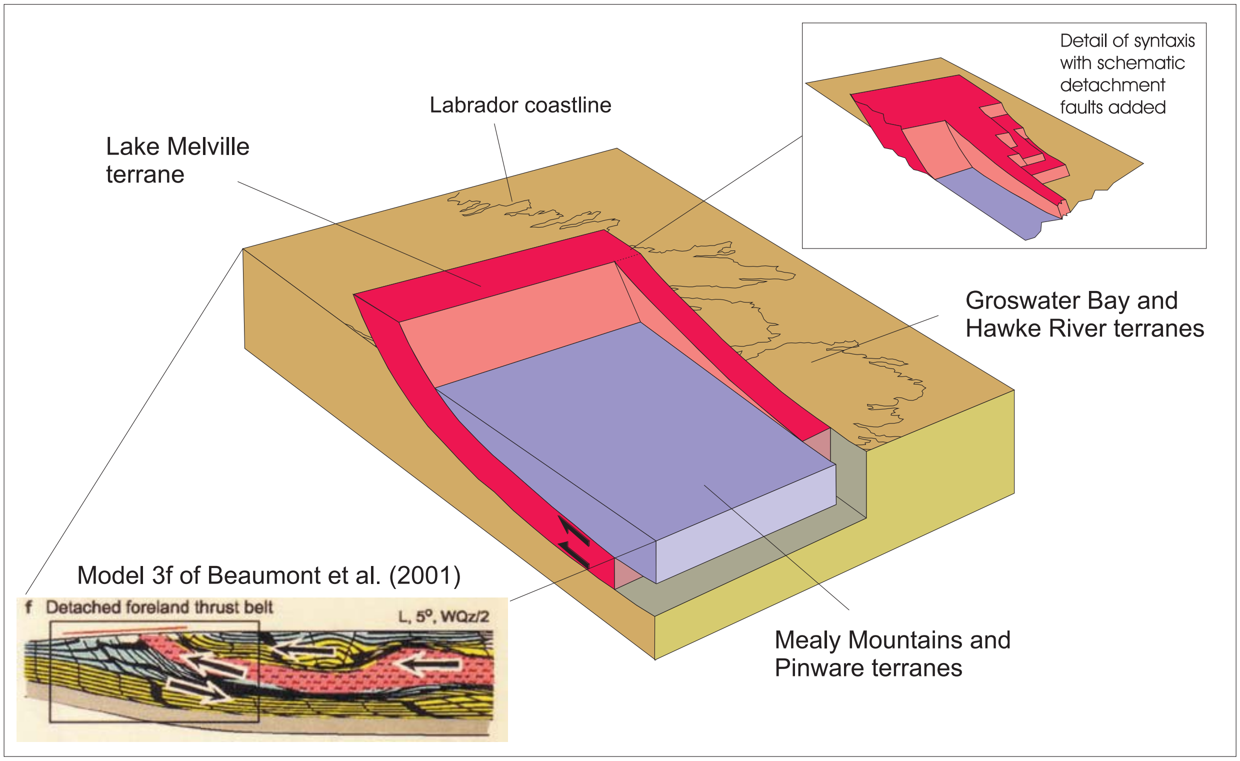


Figure 4. *Block diagram illustrating model for Grenvillian orogenesis.*

Measuring Geological Time.

Rocks are dated using isotopes of uranium (U) and lead (Pb). Over very long periods of time, uranium gradually changes to particular types of lead (radiogenic lead). These are slightly different from ordinary, stable lead (common lead). The rate of change is constant, predictable and can be measured.

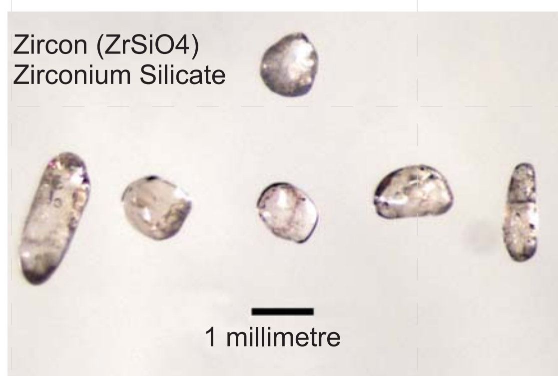
When zircons crystallize, uranium is trapped in the crystals. As radiogenic lead is created, it also gets trapped in the crystal.

To make the measurements, geochronologists extract uranium- and lead-bearing minerals from rocks (zircon, most commonly, but there are a few other suitable minerals).

Using a mass spectrometer, the amount of uranium remaining, and the radiogenic lead formed, can be measured.

^{238}Uranium (92 Protons & 146 Neutrons)
changes to
^{206}Lead (82 Protons & 124 Neutrons)
taking 4.47 billion years for half of it to do so.

^{235}Uranium (92 Protons & 143 Neutrons)
changes to
^{207}Lead (82 Protons & 125 Neutrons)
taking 704 million years for half of it to do so.



Box 2. *Measuring geological time.*

EXCURSION STOPS

Note: Co-ordinates for Days 1-4 are given as UTM NAD 27, Zone 21

DAY 1. L'ANSE AMOUR TO MARY'S HARBOUR

Day 1 will address the Pinware terrane, to gain familiarity with some of the rock types, particularly those having a supracrustal origin (*i.e.*, volcanic and/or sedimentary rocks formed at the Earth's surface). The supracrustal rocks are interpreted to have significant mineral potential. The stops described below are located on Figure 5.

Stop 1.1. Labradorian Volcanoclastic Rocks Intruded by Grenvillian Pegmatite and Alkalic Mafic Dyke; 1 km West of Capstan Island (517524 5712120)

At this locality, the host rock is of supracrustal origin, and interpreted to be a banded volcanoclastic(?) unit. This is discordantly intruded by pegmatite, which is itself intruded by an alkaline mafic dyke and crosscut by a sheared felsic veinlet (Plates 1a and 1b). The outcrop demonstrates unequivocal field relationships, which, when combined with geochronological data, provide critical information regarding the geological history of the region. This locality has no known specific economic significance, but similar rocks, 5 km to the northeast, host minor pyrite mineralization.

The dominant rock at this outcrop is a well-banded, multi-coloured, fine-grained, recrystallized quartzofeldspathic rock. The uniformity of banding (interpreted as bedding), and the 36% quartz content (too high for most igneous rocks), are good reasons to consider it to be supracrustal. The rock has an age of 1637 ± 8 Ma; in other words, Labradorian (Wasteneys *et al.*, 1997).

A pink-weathering, 1 m-wide, planar pegmatite dyke, discordantly intrudes the host rocks. It was emplaced at 1036 ± 17 Ma, *i.e.*, during Grenvillian orogenesis (Wasteneys *et al.*, 1997).

The later alkalic mafic dyke discordantly intrudes the pegmatite and its host rock The dyke is fine grained, black-weathering and homogeneous. It has an age of 985 ± 6 Ma, dating its emplacement to near the end of Grenvillian orogenesis.

The alkalic mafic dyke is discordantly intruded by a 1-cm-wide aplite dyke that has been dextrally sheared. It has not been dated, but its presence is consistent with known late- to post-Grenvillian granitoid plutonism in the region, which has an age range from 966 to 951 Ma.

Stop 1.2. Basal Cambrian Unconformity; Quarry, 1 km North of West St. Modeste (519359 5716611)

This quarry demonstrates another way geologists determine time relationships between rocks, namely an unconformity (Plate 1c). Unconformities result from the deposition of younger rocks on uplifted and eroded older 'basement', in this case between Grenvillian and earlier rocks as the basement, and unmetamorphosed red-brown pebbly sandstones of the Bradore Formation as the

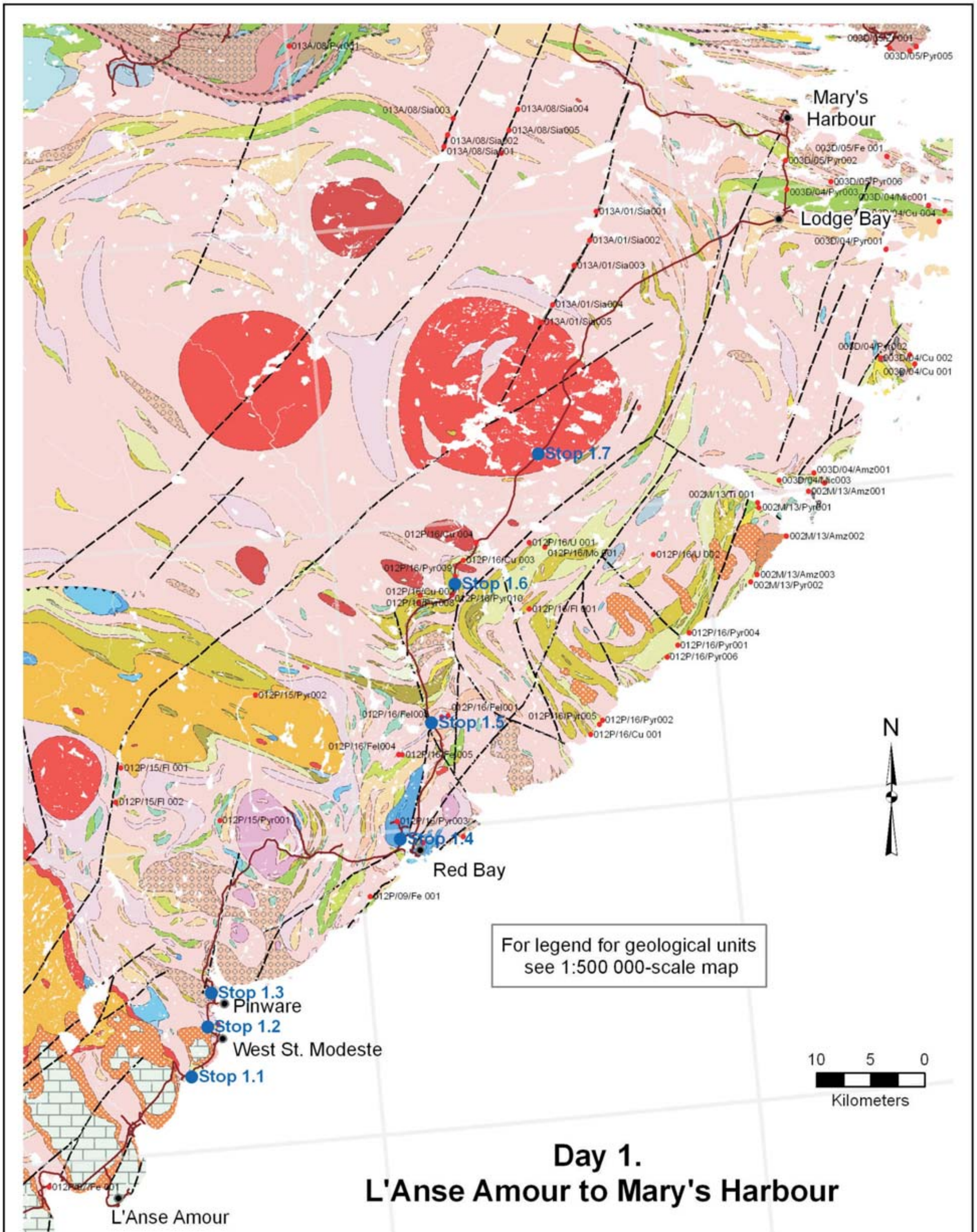
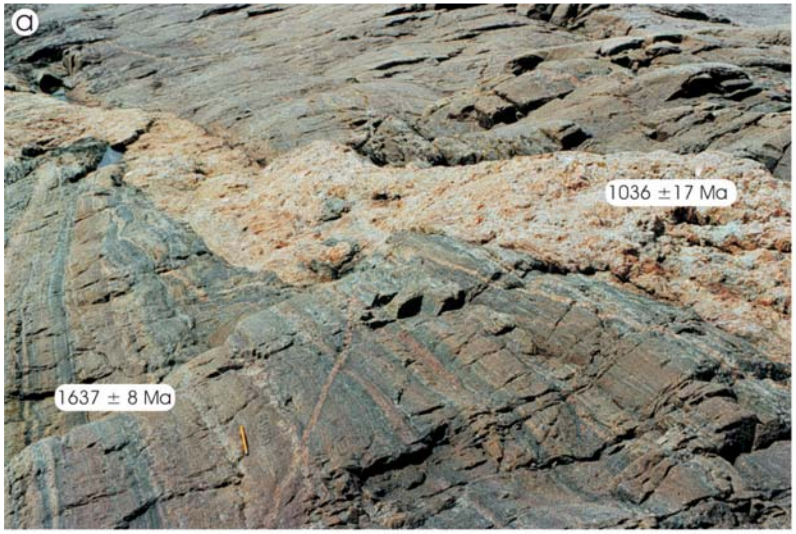


Figure 5. *Excursion route and stops for Day 1 – L'Anse Amour to Mary's Harbour.*



Stop 1.1. Banded volcaniclastic rocks intruded by pegmatite

Stop 1.1. Pegmatite intruded by alkalic mafic dyke

Stop 1.2. Unconformity between Grenvillian basement and Bradore Formation; West St. Modeste

Stop 1.3. Pinwarian K-feldspar megacrystic granite; age 1467 ± 8 Ma.

Plate 1. Outcrop photographs for localities 1.1, 1.2 and 1.3.

cover. The boundary between the Grenvillian basement and the overlying Bradore Group sediments represents a time gap of about 400 million years. Unconformity-related uranium deposits are a well-known class of mineralization associated with this geological setting elsewhere in the world, although there is no evidence, so far, that such is the case in this region.

The unconformity profoundly truncates northwest-trending, moderately northeast-dipping Grenvillian gneisses that host granitic and pegmatitic veins. The crystalline rocks below the unconformity are altered to brown-red hematitic zones associated with patches of green colouration that affects the rocks for a few metres below the surface. This alteration indicates the remnants of a once widespread ancient weathering surface, which probably formed under tropical, humid conditions (based on the types of clay and other minerals present, *e.g.*, greenalite).

The basal Bradore Formation consists of crudely stratified to crossbedded, brown-red pebbly sandstone. The sandstone ranges from poorly sorted and very coarse grained to better sorted and fine grained between undulose scours that are spaced through the section. The poorly sorted lithofacies above the unconformity are characteristic of braided streams.

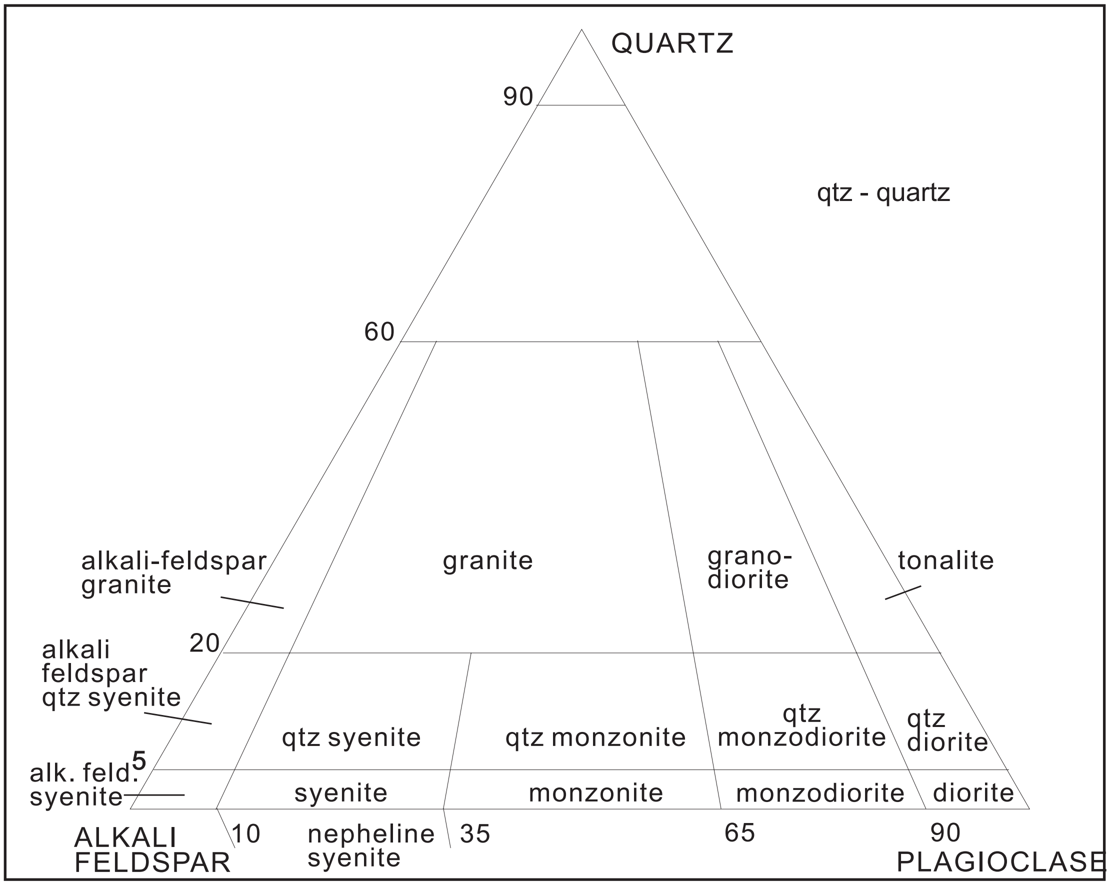
Stop 1.3. Pinware K-feldspar Megacrystic Granite; 500 m North of Pinware (520016 5719846)

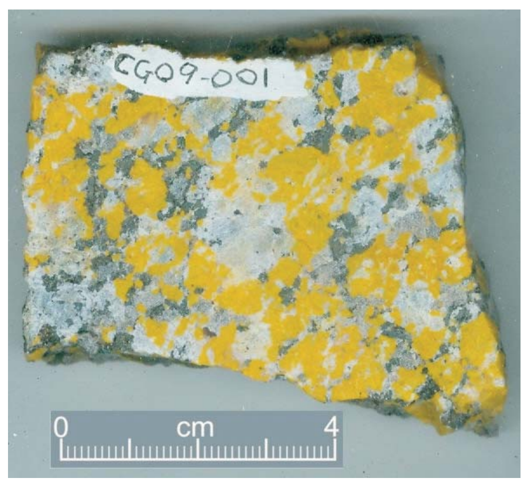
Rocks at the first two localities display geological products of Labradorian, Grenvillian and post-Grenvillian events. The other widespread event in eastern Labrador, particularly in southern regions, was the Pinwarian orogeny (1520–1460 Ma). This locality displays a Pinwarian granodiorite to granite (*see* Box 3 for granitoid rock terminology). A sample from here was dated as having an emplacement age of 1467 ± 8 Ma (Heaman *et al.*, 2004). The map pattern of the body is irregular (Figure 5), which is interpreted as the result of folding during later Grenvillian orogenesis. The rock at this locality (Plate 1d) is a fairly uniform, coarse-grained, hornblende–biotite granitoid rock containing seriate to megacrystic K-feldspar and showing a strong foliation. It contains large magnetite crystals with mafic-mineral-depleted haloes, normally considered to be caused by a chemical reaction in which biotite is oxidized and replaced by K-feldspar, magnetite and hydrous fluid.

Pinwarian granites are not known to host any mineralization in eastern Labrador. Then why show them on an excursion such as this? Partly, because it is worthwhile to have familiarity with all rocks in a region, rather than just those currently deemed to be of economic interest.

Stop 1.4 Amphibolitized Red Bay Mafic Intrusion and Allanite- and Titanite-rich Pegmatite; West Red Bay (538481 5732401)

The amphibolite (metamorphosed rock of basaltic composition) at this locality is grouped as part of the Red Bay mafic intrusion, much of which elsewhere in the body consists of pristine igneous-textured rocks. The Red Bay mafic intrusion has been dated to be 980 ± 3 Ma (Heaman *et al.*, 2004), from a locality in the downtown area. The key point of interest at this site is an unusual pegmatitic intrusion that contains abundant allanite, titanite and common magnetite. The titanite is also present in the amphibolite where it forms elongate, bladed, red–brown euhedral





Naming various types of granitoid rock depends on knowing the proportions of quartz, alkali feldspar (usually potassium feldspar) and plagioclase. Distinguishing between quartz, alkali feldspar and plagioclase is generally possible in hand samples of coarse-grained rocks (above left), but it is much easier after the rock has been treated using a sodium cobaltinitrate stain (above right). Potassium-bearing minerals stain yellow; plagioclase, quartz and dark minerals remain white, grey and black, respectively.

Box 3. *Classification of granitoid rocks.*

prisms up to 3 cm long at the centre of elliptical white pods of quartz, plagioclase and K-feldspar up to 6 cm long. Similar white pods also enclose magnetite (Plate 2a), which formed by the biotite breakdown reaction described above. The titanite probably formed in a similar way.

Minor mineralization, in the form of disseminated pyrite and pyrrhotite and traces of chalcopyrite, from the Red Bay gabbro was reported by van Nostrand and Mark (1996). In addition, Bostock (1983) mentioned that local people had shown him samples of ilmenite and chalcopyrite that were claimed to have been found in the vicinity of the Red Bay intrusion. Some pegmatites in the Red Bay district are also characterized by abnormally high magnetite content, and perhaps merit prospecting for other minerals.

Stop 1.5. Nepheline Syenite; 12 km North of Red Bay (542204 5742905)

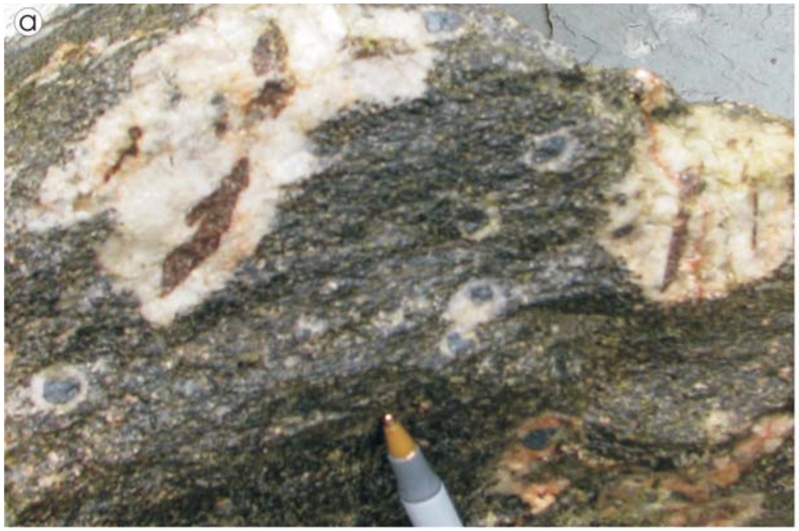
A distinctive nepheline-bearing alkali-feldspar syenite, 10 km north-northeast of Red Bay, was discovered during 1:100 000-scale mapping of the area. The syenite has a syn- to late-Grenvillian age of 1015 ± 6 Ma (Heaman *et al.*, 2004). The intrusion is probably less than 200 m wide but could be at least 4.5 km long, trending in a northeast direction.

The syenite is white-weathering, medium to coarse grained, recrystallized and weakly to moderately foliated. Nepheline is easily recognizable as chalky-white on weathered surfaces or pink grains in fresh rock (Plate 2b). From hand sample and thin section estimates, nepheline forms up to about 40% of the rock. Other minerals are well-twinned albite, microcline, and zircon (2942 ppm Zr in one occurrence). Magnetite, aegerine and garnet were provisionally identified in hand sample, but were not included in the thin sections cut.

Nepheline is a mineral of economic interest. It is utilized mainly in the glass and ceramic industries, but has a wide variety of other uses. The occurrences in this area were investigated by Triassic Properties (Laracy, 1996). A research and marketing study carried out by Quantum Consulting Inc. for Triassic Properties (Laracy, 1998) made favourable comparisons with respect to nepheline syenite deposits elsewhere. On the other hand, Clark (1997) dismissed the occurrences as having economic significance. Note that alkali-feldspar syenitic rocks are common in the southern Pinware terrane (although typically containing sodic clinopyroxene and/or amphibole, rather than nepheline), so there is good reason to suspect that other rocks favourable to mineralization, apart from nepheline syenite, may be present in eastern Labrador. For example, a sample of alkali-feldspar syenite (at 455319 5769610) has 5425 ppm Zr.

Stop 1.6. Pitts Harbour Group; 28 km North of Red Bay (545412 5755385)

Pitts Harbour Group is the name given to a package of supracrustal rocks found in the Pinware terrane, mostly between Red Bay and Henley Harbour. The supracrustal rocks mostly comprise quartzofeldspathic rocks thought to have a felsic volcanic/volcanoclastic or sedimentary protolith. Other rock types include quartzite, quartz-rich meta-arkose, psammite, pelitic rocks, calc-silicate rocks (*see* Box 4 for terminology details) and banded amphibolite (interpreted to have been derived from basaltic volcanic rocks). The high proportion of rocks potentially having a felsic volcanoclastic origin and the concomitant lack of pelitic gneiss, are two criteria that distinguish these



Stop 1.4. Titanite and magnetite in leucosome spots within amphibolitized Red Bay mafic intrusion

Stop 1.5. Coarse-grained, light pinkish brown nepheline

Stop 1.6. Pelitic gneiss of Pitts Harbour Group showing minor sulphide mineralization

Stop 1.7. Chateau Pond granite. Gradation from white (right) to red (left) is due to hematite alteration close to vertical fracture under tip of pen

Plate 2. *Outcrop photographs for localities 1.4, 1.5, 1.6 and 1.7.*

Grainsize	Material	Sedimentary rock type	Metamorphic rock type
Coarse grained	Boulders, cobbles, pebbles	Conglomerate	Psephite (rarely used)
Medium grained	Sand grains	Sandstone, quartzite	Psammite, quartzite
Fine grained	Mud particles	Siltstone, mudstone	Semipelite, Pelite
Various grainsizes	Calcium carbonate	Limestone	Marble
Various grainsizes	Calcium carbonate and mud particles	Limey mudstone	Calc-silicate rocks

Box 4. *Metamorphic equivalents of sedimentary rocks.*

rocks from pelitic gneisses farther north (to be seen on Day 3 of the excursion). In addition, two U–Pb zircon ages of 1640 ± 7 Ma and 1637 ± 8 Ma, obtained from rocks interpreted to have been derived from a felsic volcanoclastic protolith (Tucker and Gower, 1994; Wasteneys *et al.*, 1997), provide strong evidence that these rocks are much younger than the 1810–1770 Ma best-age estimate for the pelitic gneisses.

The north end of the outcrop on the west side of the road is of most interest at this locality. Here, sillimanite–garnet–biotite metasedimentary gneiss is present, displaying mauve garnet that is so characteristic of metasedimentary gneiss. The rocks are very rusty weathering in patches and host pyrite, arsenopyrite(?), and trace chalcopyrite mineralization (Plate 2c).

The Pitts Harbour Group has received attention from explorationists because of its spatial association with Cu–U–Mo–Ag–Au–As lake-sediment anomalies in the Henley Harbour area. Copper, pyrite, molybdenum, uranium, and fluorite mineral occurrences have been found in the Pitts Harbour Group.

Stop 1.7. Chateau Pond Granite; 44 km North of Red Bay (554190 5766804)

The Chateau Pond granite is an example of numerous late- to post-tectonic granitoid plutons emplaced between 970 and 950 Ma throughout the southern half of the eastern Grenville Province. The Chateau Pond granite is circular to elliptical in outline, but the northwest half of the pluton has been sinistrally displaced 1.5 km along a north-east-trending fault. The intrusion is mostly granite, but is gradational into quartz monzonite. The granite is pink to white weathering, coarse to very coarse grained, massive and homogeneous (Plate 2d). The pluton contains large rafts of foliated biotite granite and remnants of quartzofeldspathic supracrustal rocks, which are inferred to be xenoliths of the surrounding or underlying rocks. An age of 964 ± 2 Ma, interpreted to date time of emplacement, has been obtained from an outcrop at the shore of Chateau Pond (Gower *et al.*, 1991).

The granite is not known to be mineralized, although minor pyrite occurs at this particular site. Potential for mineralization in the late- to posttectonic Grenvillian granitoid plutons appears to be low. The plutons are associated with Zn and Cd lake-sediment anomalies and minor fluorite was found in one pluton.

DAY 2. MARY'S HARBOUR TO PORT HOPE SIMPSON

Day 2 will be partly spent examining two REE prospects discovered and being evaluated by Search Minerals Inc. Note that, in addition to these, Search Minerals Inc. has reported mineralization at other locations, namely its Foxtrot, Piperstock Hill, Southern Shore, Toots Cove and Pesky Hill sites. Some structural features of the southern Lake Melville terrane will be also be addressed and, if time allows, some stops presently assigned to Day 3 may be examined. Planned stops are shown on Figure 6.

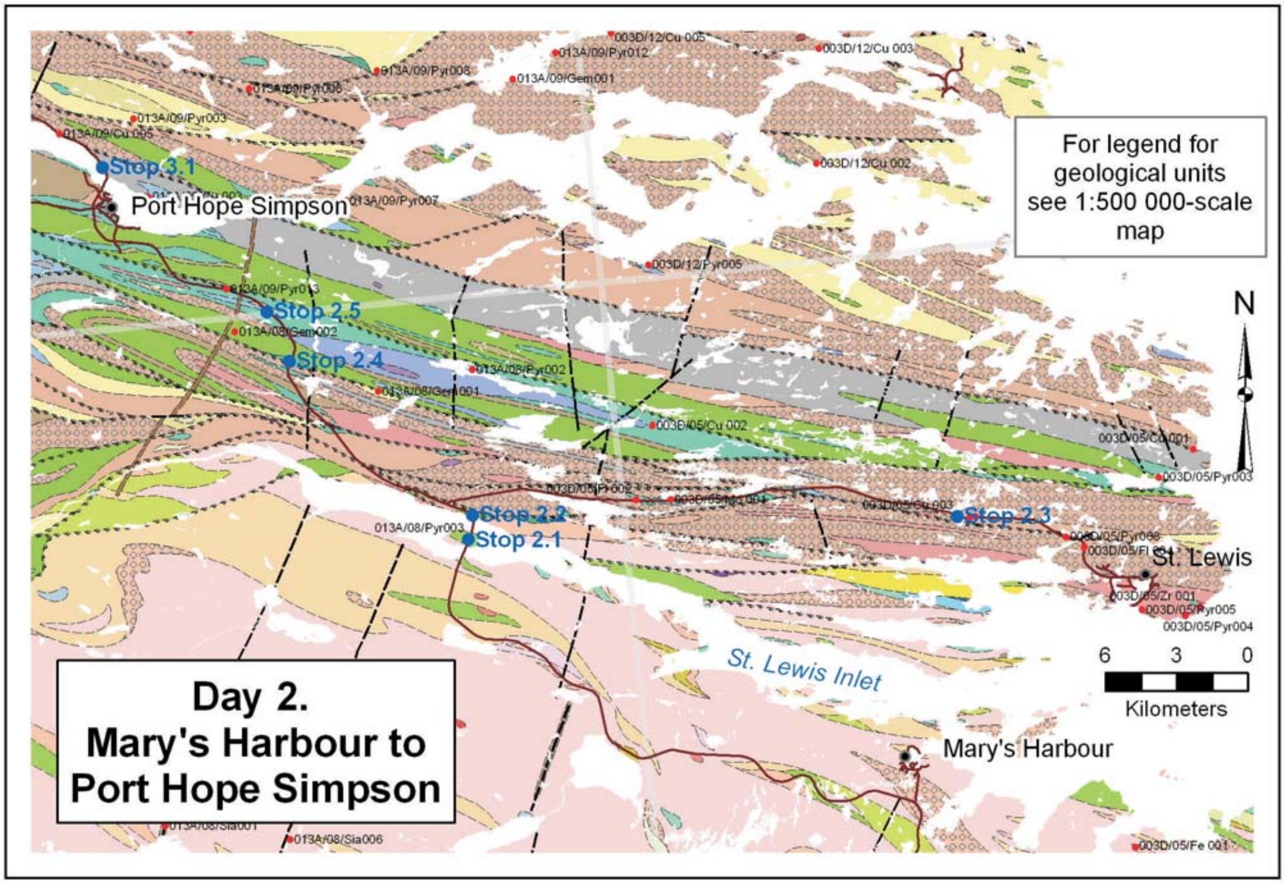


Figure 6. *Excursion route and stops for Day 2 – Mary's Harbour to Port Hope Simpson.*

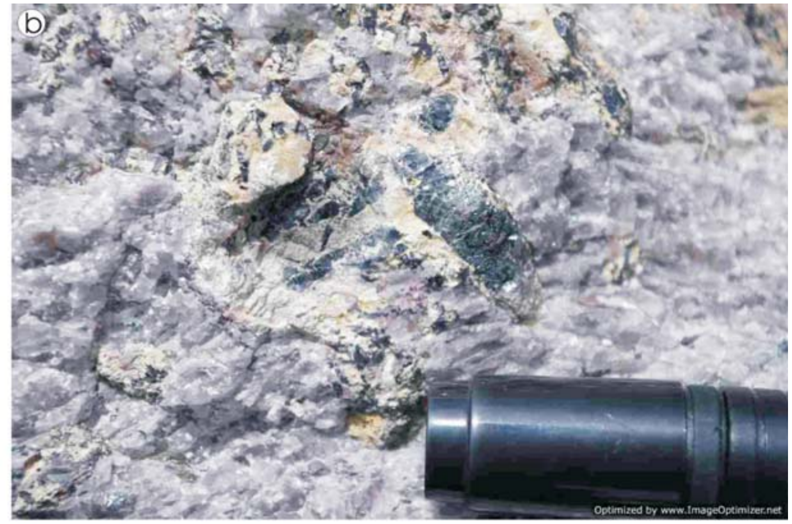
Stop 2.1. REE Mineralization at HighREE Island, St. Lewis Inlet Causeway

Contributed by Chris Moran, Search Minerals Inc.

The host rocks on HighREE Island mainly consist of strongly recrystallized foliated granitic rocks. These contain remnants of amphibolite-grade mafic dykes and/or mafic volcanics. There is also a wide range of pegmatite and aplite intrusions, of differing compositions and of varying ages, which pre- and postdate mineralization.

This prospect (Plate 3a) contains significant rare-earth element (REE) mineralization which is heavy rare-earth-element enriched. The mineralization is predominantly found in quartz-magnetite bearing pegmatitic veins. Fergusonite and allanite are the dominant rare earth bearing min-

Stop 2.1. Striped mineralized outcrop on 'HighREE' Island, St. Lewis Inlet



Stop 2.1. Detail of mineralization on HighREE Island. Pale yellow-green material is fergusonite.

Stop 2.2. Steeply lineatead mylonite intruded by pegmatite at the boundary between the Pinware/Mealy Mountains and Lake Melville terranes

Stop 2.2. Detail of mylonitic (straight) gneiss

Plate 3. *Outcrop photographs for localities 2.1 and 2.1.*

erals (Plate 3b), and abundant zircon and apatite are also present. Amazonite (Pb-bearing potassium feldspar), fluorite, molybdenite as well as other disseminated sulphides such as pyrite and chalcopyrite can also be found on the island.

Apart from visual inspection of the rocks for REE-bearing minerals, radioactivity can also be a good indication of mineralization. Spectrometers and scintillometers can be invaluable indicators for prospective areas. This technique must be used with caution as not all areas with high counts have high REE concentrations and some areas with low radioactivity may have enriched amounts of REE.

One of the main localities containing this type of mineralization is known as Brian's showing, discovered by local prospector Brian Penney in the fall of 2009 below two feet of snow!

The first phase drill program at the HighREE Island Prospect consisted of 13 holes, drilled in late 2010 (*see* Search Minerals Inc. news release, Oct. 5, 2010), that were positioned to trace outcropping HREE–Zr–Y–Nb veins to depths down to 170 m. Mineralization consists of fergusonite, allanite and zircon, which is hosted in pegmatites, quartz–magnetite veins and aplitic veins. Weighted averages from the best interval (DDH HI-10-04: 16.37–16.67 m) give values of 334 ppm Dy, 2510 ppm Y, 22 380 ppm Zr, 3850 ppm Nb and 0.74 % TREE (total rare earth elements; not including Y) or 1.00% TREE + Y over 0.3 m (true width) (Search Minerals Inc. press release, June 13, 2011; *http://www.searchminerals.ca/newsreleases/NR06-13-11.pdf*). Some results from the drilling program are given in Table 1.

Stop 2.2. Mylonite Marking Boundary between Pinware and Lake Melville Terranes; North Side of St. Lewis Inlet (561224 5806540)

Superbly displayed at this locality (Plate 3c) and for at least 2 km along strike to the west are ultramylonitic rocks (straight gneisses; Plate 3d). These are the product of extreme deformation and commonly mark major crustal interfaces. Fabric is defined by leucosome layers, biotitic veneers, narrow amphibolitic partings, and compositional heterogeneities. During deformation, the rocks were flattened across their fabric and extended parallel to it. Locally, the mylonitic fabric is folded. For the most part, these rocks are too severely deformed to retain obvious kinematic indicators[2] (*see* Box 5), but those present indicate a steep north-side-up sense of movement. Compositionally, the rocks include granite, granodiorite, amphibolite and diorite. Pegmatites occur as porphyroclastic remnants and as later, discordant intrusions, some of which are composite pegmatite–aplite. The intrusions are up to several metres wide. The deformation is interpreted to be Labradorian.

Stop 2.3. Road Belt; 8.5 km West of St Lewis (582004 5805888)

Contributed by James Haley, Search Minerals Inc.

Rock types in the Fox Harbour area include metamorphosed felsic and mafic supracrustal sequences (of which the Road Belt is one), along with variably mylonitized megacrystic granitic

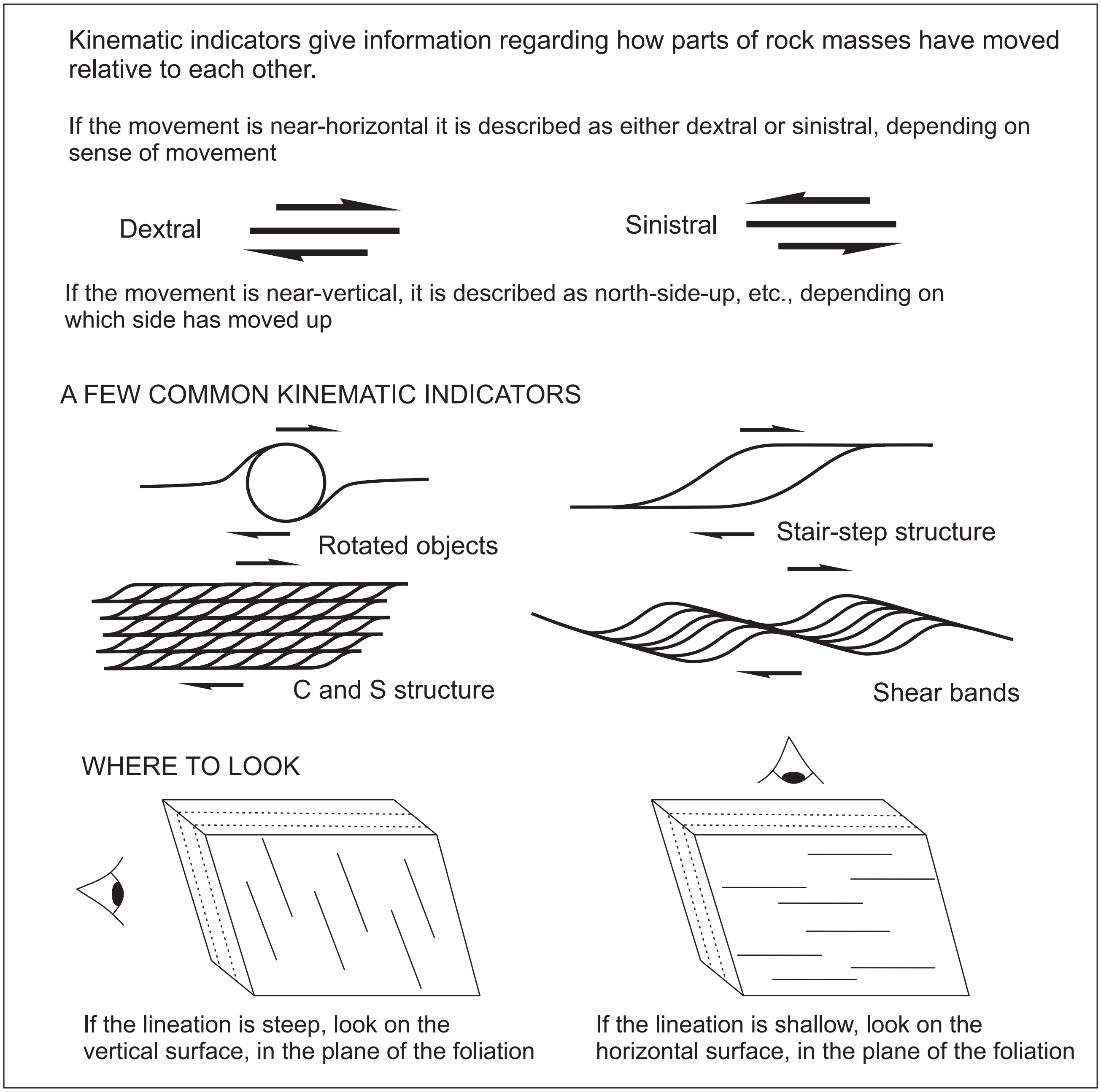
[2] Kinematic indicators provide information regarding how rocks on one side of a shear zone have been moved relative to those on the other side (*see* Box 5).

Table 1. Highlights from HighREE Island (Search Mineral Inc., press release, June 11, 2011, *http://www.searchminerals.ca/newsreleases/NR06-13-11.pdf*)

HIGHREE ISLAND DRILL HIGHLIGHTS						
Hole No.	Hl-10-04	Hl-10-06	Hl-10-07	Hl-10-08	Hl-10-08	Hl-10-11
Interval (m)	16.37-16.67	17.17-17.39	19.24-20.62	137.64-137.68	169.05-169.07	32.35-33.79
Length (m)	0.3	0.22	1.38	0.04	0.02	1.44
Y	2510	1993	1112	681	1972	1506
Zr	22380	12150	6062	31590	2423	2812
Nb	3850	1400	528	317	2730	1266
La	1410	1150	650	2520	538	488
Ce	2920	2860	1426	4670	1210	1349
Pr	324	339	182	428	142	194
Nd	1120	1170	755	1590	637	731
Sm	186	280	176	222	184	223
Eu	11.8	18.1	12.2	10.3	12.7	13.8
Gd	175	285	137	145	213	231
Tb	40.8	61.6	28.1	21	48.8	49.2
Dy	334	392	181	120	335	310
Ho	88.7	85.8	36.6	24.7	76.3	57.5
Er	326	248	110	79	234	152
Tm	57	38	17	13	32	20
Yb	399	212	105	92	156	100
Lu	57.5	24.8	14.3	16.0	18.3	12.7
LREE	5960.0	5799.0	3187.5	9484.0	2711.0	2985.9
HREE	1489.8	1365.6	640.7	520.3	1126.0	945.5
HREE + Y	3999.8	3358.6	1753.1	1201.3	3098.0	2451.4
TREE	7449.8	7164.6	3828.2	10 004.3	3837.0	3931.4
TREE +Y	9959.8	9157.6	4940.6	10 685.3	5809.0	5437.2
%HREE	20.0	19.1	16.7	5.2	29.3	24.0
%HREE + Y	40.2	36.7	35.3	11.2	53.3	45.1

Notes:	All amounts parts per million (ppm). 10,000 ppm = 1% = 10kg/tonne
REE	Rare Earth Elements: La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu (Lanthanide Series)
TREE	Total Rare Earth Elements: Add La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu
LREE	Light Rare Earth Elements: Add La, Ce, Pr, Nd, Sm
HREE	Heavy Rare Earth Elements: Add Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu
Y	Y not included in HREE due to relatively low value compared to most Lanthanide Series HREE
%HREE + Y	% (HREE+Y) / (TREE+Y)
%HREE	% (HREE / TREE)

augen gneiss, and a plagioclase–amphibole ± garnet unit (derived from a gabbroic protolith). The supracrustal sequences consist of variably mineralized felsic volcanic and metasedimentary rocks (Plate 4a), and largely unmineralized mafic volcanic rocks. The volcanic rocks lack primary structures, and are highly folded and mylonitized, thus making protolith identification difficult. The excursion locality shows an almost complete cross section of the volcanic Road Belt package. Apart from REE mineralization, narrow pyritic zones are also present and purple fluorite is present on joint surfaces. Epidote and chalcopyrite can be seen on the south side of the road.



Box 5. *Kinematic indicators.*

The first phase drill program at the nearby Foxtrot Prospect consisted of 23 holes, drilled in late 2010 and early 2011 (refer to Search Minerals news release, Nov. 2, 2010), that intersected LREE–Zr–Y–Nb mineralization at depths of 50 and 100 m along a 2 km strike length. Mineralization consists of fergusonite, allanite and zircon in metamorphosed fine grained felsic volcanic rocks. Weighted averages from the best interval (DDH FH-10-08: 90.3 m) give values of 245 ppm Dy, 1311 ppm Y, 11 233 ppm Zr, 684 ppm Nb and 0.90 % TREE (not including Y) or 1.04% TREE + Y over 5.3 m (true width). Other, wider, mineralized intersections range from 8.03–11.57 m length (true width). The assays of the highest grade intersections are markedly con-

Stop 2.3. Road Belt gneiss of supracrustal origin with green amazonite leucosome

Stop 2.4. Pegmatite with huge biotite at 'Discovery' outcrop.

Stop 2.4. Graphite (top left)

Stop 2.5. Near-horizontal lineations, interpreted to be Grenvillian

Plate 4. *Outcrop photographs for localities 2.3, 2.4 and 2.5.*

sistent throughout the Phase 1 holes (Search Minerals press release, May 26, 2011, *http://www.searchminerals.ca/newsreleases/NR05-26-11.pdf*). Results are given in Table 2.

Stop 2.4. Amphibolitic Gneiss with Pegmatite; between St. Lewis Inlet and Port Hope Simpson (554578 5814696)

This locality shows amphibolitic and quartz dioritic gneiss with common concordant pegmatite stringers. These rocks are derived from gabbronoritic and leucogabbronoritic rocks that, regionally, appear to be part of the Alexis River intrusion. Amphibolite is partially melted resulting in the development of irregular white pegmatitic patches containing hornblende. Although

Table 2. Highlights from Foxtrot Prospect (Search Mineral Inc., press release, May 26, 2011, *http://www.searchminerals.ca/newsreleases/NR05-26-11.pdf*)

FOXTROT PROSPECT - REE MINERALIZED DDH INTERVALS

Hole No.	FH-10-05	FH-10-05	FH-10-06	FH-10-06	FH-10-07	FH-10-08
Interval	124.2 m	150.2 m	61.1 m	123.1 m	107.3 m	90.3 m
True Thickness	9.49 m	3.7 m	8.03 m	11.02 m	11.57 m	5.26 m
Y	1170	951	1204	1303	1094	1311
Zr	9935	7873	12 186	11 834	9788	11 233
Nb	666	733	907	749	791	684
La	1896	1447	1948	1862	1980	1812
Ce	3591	2919	3918	3970	3777	3795
Pr	425	353	447	454	430	451
Nd	1650	1361	1702	1756	1576	1767
Sm	285	233	307	309	262	327
Eu	14.2	11.7	15.3	15.7	13.1	17
Gd	225	184	239	249	209	267
Tb	36	29.3	37	41	36	41
Dy	205	169	217	235	193	245
Ho	37	31.0	41	47	35	46
Er	109	90.4	115	129	100	129
Tm	15	12.9	17	18	13	18
Yb	94	81.3	104	115	86	114
Lu	13.8	12.8	16.2	16.8	12.4	17.5
TREE	8596.8	6935.4	9121.1	9216.9	8722.1	9047.0
TREE + Y	9766.8	7886.6	10 324.7	10 520.0	9815.6	10 358.4
HREE	749.8	622.4	799.1	865.6	697.9	895.4
HREE + Y	1919.8	1573.6	2002.7	2168.7	1791.4	2206.8
%HREE	8.72%	8.97%	8.76%	9.39%	8.00%	9.90%
%HREE + Y	19.66%	19.95%	18.40%	20.62%	18.25%	21.30%

Note:	All amounts parts per million (ppm). 10,000 ppm = 1% = 10kg/metric tonne
REE	Rare earth elements: La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu (Lanthanide Series).
TREE	Total rare earth elements = total (ppm) of the Lanthanide Series elements.
LREE	Light rare earth elements = La, Ce, Pr, Nd, Sm.
HREE	Heavy rare earth elements = Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu.
Y	Herein not included in HREE due to low market value compared to most Lanthanide Series HREE.
%HREE + Y	(HREE+Y) / (TREE+Y)
%HREE	(HREE / TREE)

strongly deformed, the rock is not intensely mylontized, in contrast to outcrops on the north side of the St. Lewis Inlet causeway.

A noteworthy pegmatite contains biotite and K-feldspar crystals up to 1 m across (Plate 4b). This is the original 'discovery' rock that led to the extensive exploration program now underway by Search Minerals Inc. Interesting minerals at this site are graphite (Plate 4c), titanite, specular hematite and small uncommon grains of chatoyant feldspar.

Stop 2.5. Garnetiferous Granitoid and Amphibolitic Gneiss; between St. Lewis Inlet and Port Hope Simpson (553818 5816841)

The south end of the outcrop is characterized by granite gneiss. Progressing north there is an increase in amphibolite with associated white concordant veins. This is followed by syenite/monzonite gneiss containing abundant garnet (retrograded in part). Much of the amphibolite also contains abundant, tiny (1–2 mm) garnets. The amphibolite also shows irregular melt patches, some containing pale green K-feldspar (*cf.* amazonite). The amphibolite is associated with pink and grey granodioritic gneiss. Locally, it contains pyrite. The abundance of garnet distinguishes this outcrop from those farther south. It is interpreted here to mean that a deeper crustal level is exposed, consistent with the north-side-up sense of movement seen in kinematic indicators between here and the St. Lewis River.

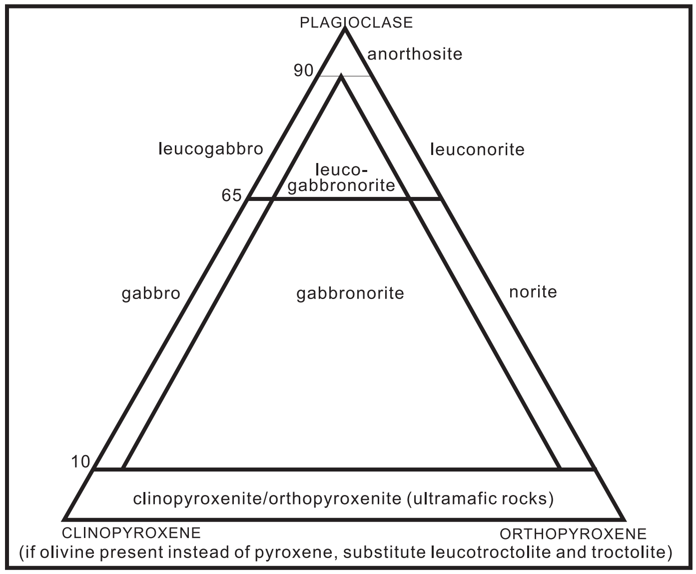
A major fault is interpreted to pass about 800 m south of this locality to explain the abrupt change in lineation orientation – steep south of the fault versus near horizontal here. The near horizontal lineations are interpreted to be Grenvillian (Plate 4d).

DAY 3. PORT HOPE SIMPSON TO CARTWRIGHT

Day 3 will be devoted to gaining familiarity with rock types and structural relationships within the Lake Melville terrane, and, if time permits, also the Hawke River terrane (Figure 7).

Stop 3.1. Alexis River Anorthosite; Quarry on North Side of Alexis River (547414 5823482)

The Alexis River intrusion is a body of anorthosite–leucogabbronorite (*see* Box 6 for mafic/anorthositic rock classification) and associated metamorphic derivatives that extends for at least 160 km along strike within the Lake Melville terrane. It rarely exceeds 10 km in width and is commonly less than 5 km wide. The extremely elongate shape of the body is interpreted to be mostly a consequence of deformation related to a Grenvillian dextral-strike-slip structural regime. The unit consists mostly of anorthosite and leucogabbronorite, but also includes some gabbronorite, amphibolite, and diorite/quartz diorite gneiss (the latter interpreted to be derived from leucogabbronorite). The unit has not been dated, but it is assumed to be *ca.* 1650–1640 Ma.



Box 6. *Classification of anorthosite and gabbronoritic rocks.*

Two main rock types are present at this locality. One is anorthositic; the other is pegmatite. The anorthositic rock has a splotchy grey and white, recrystallized appearance. It is no longer the pristine igneous rock that it would have been at time of crystallization, having subsequently been deformed and metamorphosed, presumably mostly the result of Grenvillian metamorphism. Much of it is not true anorthosite, but, rather, a metamorphosed leucogabbronorite (Plate 5a). In its igneous state, the principal minerals were clinopyroxene, orthopyroxene and calcium-rich plagioclase. The pyroxenes have been hydrated during metamorphism to form amphibole. The original igneous plagioclase, although still plagioclase, has been recrystallized into polygonal aggregates.

The pegmatites are the result of injection of granitic magma along irregular, pre-existing fractures. The pegmatites are not severely metamorphosed, so are interpreted to be late Grenvillian. Many have been brecciated during late-stage brittle faulting. An interesting feature of the pegmatites is that some carry abundant allanite (Plate 5b). Allanite is a light-REE-rich (high in La and Ce) epidote-group mineral and can be easily recognized by its jet-black glassy appearance and the presence of radiating fractures surrounding individual grains. On its own, it is not normally considered of economic interest, but it may be associated with other REE-bearing minerals that are. The late-stage alteration has led to a wide range of alteration minerals, particularly hematite (dark

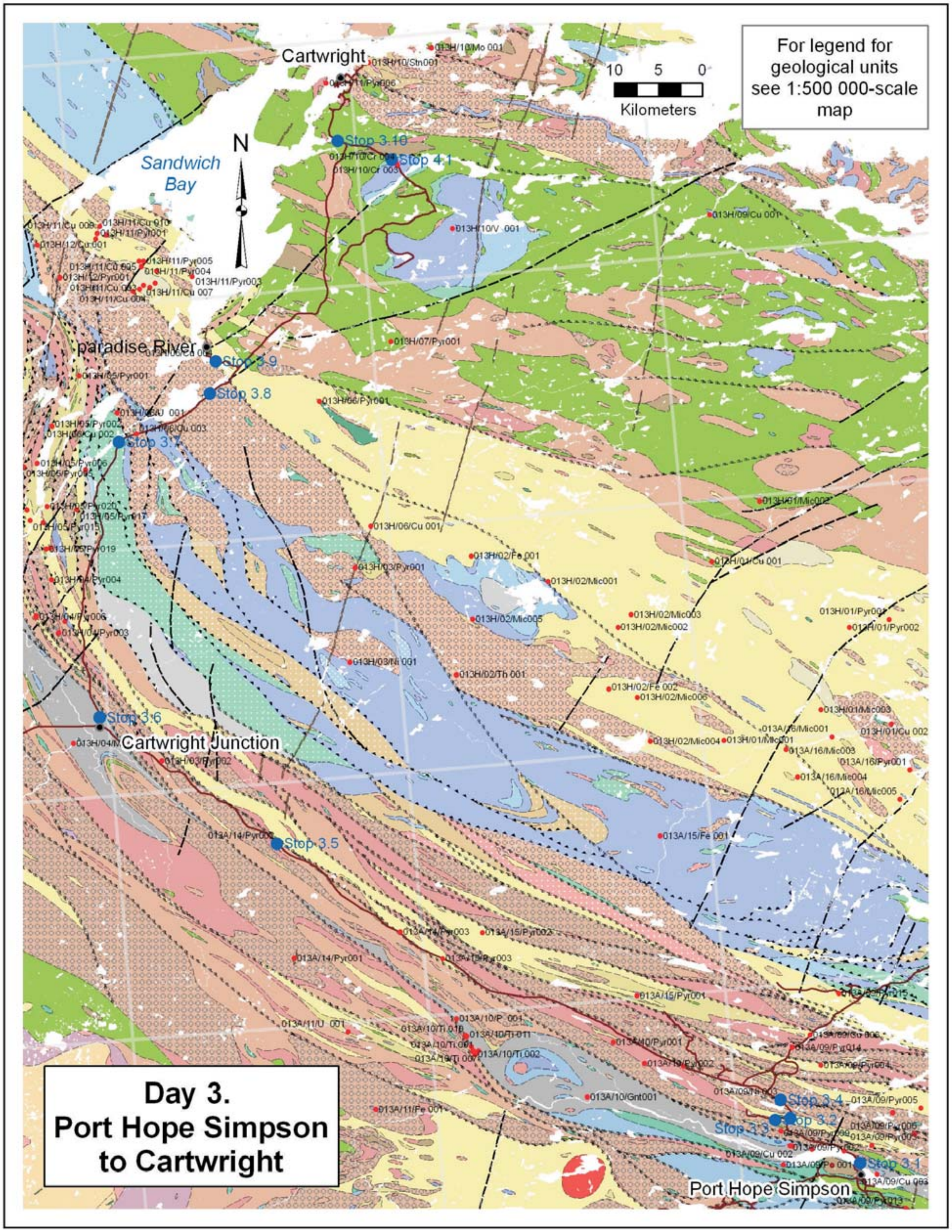
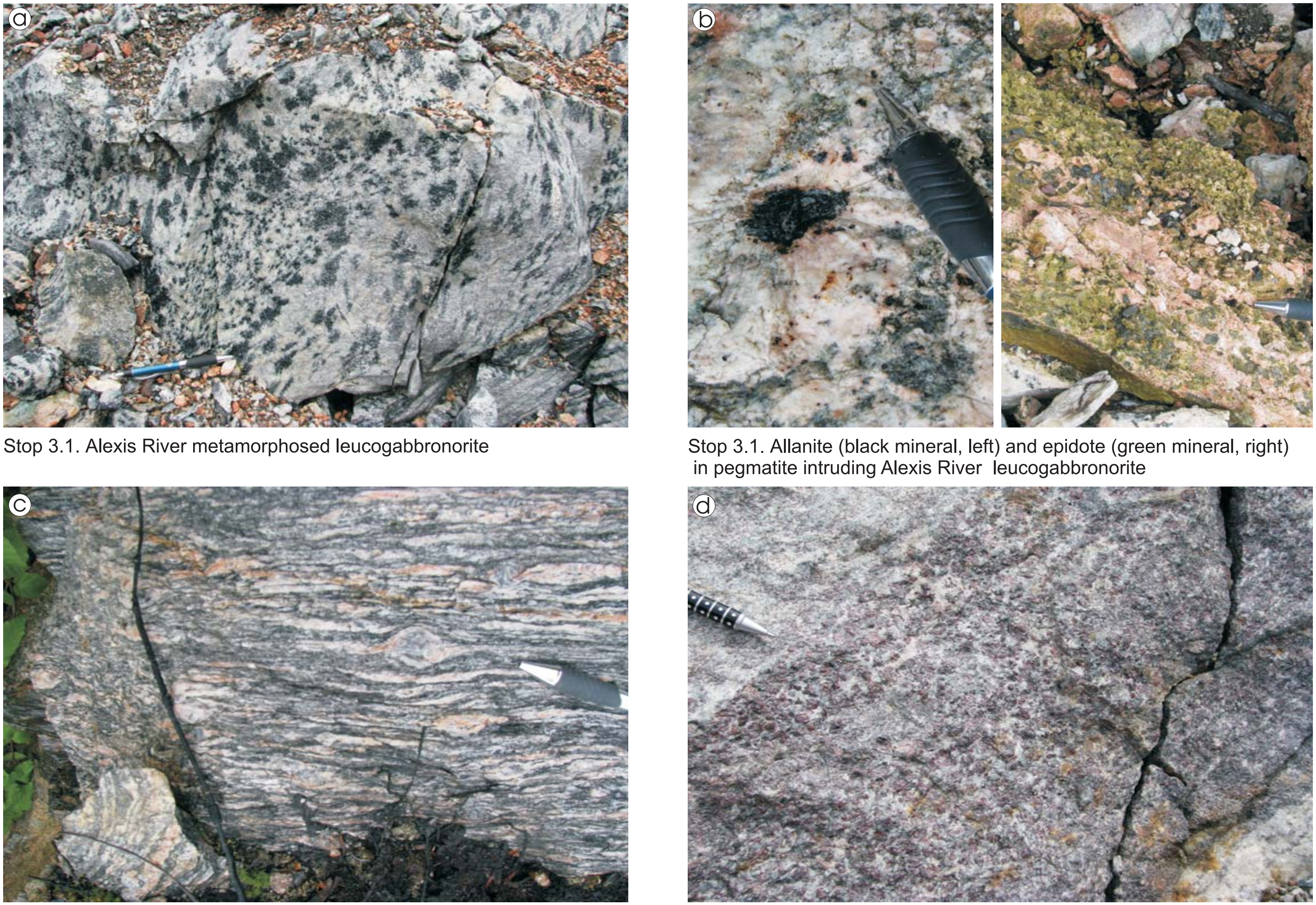


Figure 7. *Excursion route and stops for Day 3 – Port Hope Simpson to Cartwright.*



Stop 3.1. Alexis River metamorphosed leucogabbronorite

Stop 3.1. Allanite (black mineral, left) and epidote (green mineral, right) in pegmatite intruding Alexis River leucogabbronorite

Stop 3.2. Rotated megacrysts in K-feldspar megacrystic granitoid rock

Stop 3.3. Abundant mauve-pink garnet in pelitic gneiss

Plate 5. *Outcrop photographs for localities 3.1, 2.2 and 3.3.*

red), chlorite (dark green), epidote (yellow-green; Plate 5b), calcite and quartz (both white). Cavities in the breccia host some zeolite-family minerals (stilbite, scolecite, chabazite) plus illite, albite and prehnite. An attempt was made to determine the cause of the purple colouration of plagioclase, but was unsuccessful; it may be due to traces of hematite.

The Alexis River anorthosite intrusion is a worthwhile exploration target in eastern Labrador, as it hosts pyrite, copper (± Ni), ilmenite and garnet occurrences.

Stop 3.2. K-feldspar Megacrystic Granitoid Rock with Rotated K-feldspar Megacrysts; Woods Road 11 km West of Port Hope Simpson (538232 5829204)

Two of the most abundant rock types in the Lake Melville terrane are K-feldspar megacrystic granite/granodiorite and sillimanite–garnet–biotite pelitic gneiss. K-feldspar megacrystic granitoid rock is seen at this site and pelitic gneiss at the next. A sample from a body of K-feldspar megacrystic granitoid rock in the Lake Melville terrane has yielded an age of 1678 ± 6 Ma. Typically, the K-feldspar megacrysts measure roughly 2 by 2 cm, but can be much larger (4 by 6 centimetres is not uncommon). The dominant mafic mineral is biotite, but with some relict hornblende. Apart from forming readily mappable units, the megacrystic granitoid rocks are very useful because, when the K-feldspar megacrysts have been rotated (Plate 5c), they provide excellent kinematic information (*see* Box 5). At this locality, the sense of movement is unequivocally dextral.

Stop 3.3. Sillimanite–Garnet Pelitic Gneiss; 11.5 km West of Port Hope Simpson (539944 5829246)

One of the more distinctive rock types in eastern Labrador is pelitic gneiss containing garnet, sillimanite and biotite. Some layers at this locality are particularly garnetiferous (greater than 80% garnet). Garnet in pelitic gneiss has a characteristic liliac, mauve or rose colour (Plate 5d). The pelitic gneiss is probably one of the oldest rock types in eastern Labrador. The best estimate for its age is 1810–1770 Ma.

This rock type is a potential host for Cu–Au mineralization, especially where the rock is associated with amphibolite derived from mafic volcanic rocks. No mineralization of economic significance has been identified at this locality, although the rock is rusty looking due to minor pyrite.

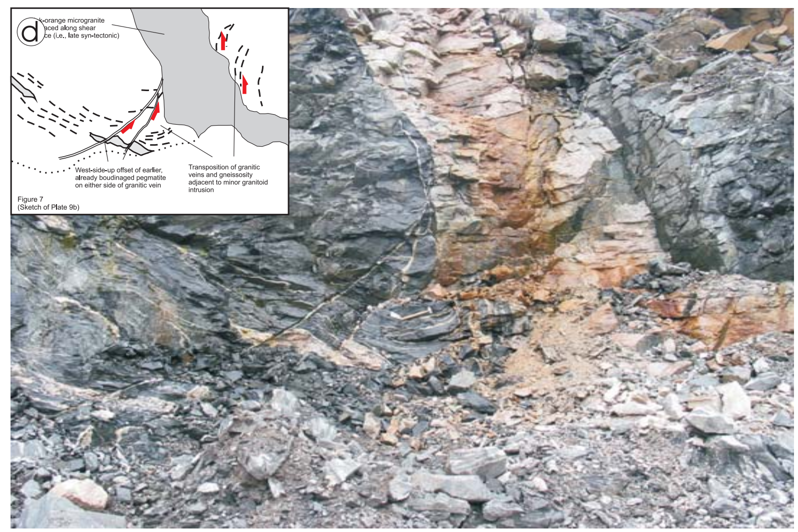
Stop 3.4. Gossan; North Side of Shinney's Waters; 14 km West of Port Hope Simpson (539017 5831419)

The western part of this outcrop consists of metagabbronorite. In weathered blocks both orthopyroxene (honey brown) and clinopyroxene (grey–green) can be seen, as well as hornblende and biotite, which formed during metamorphism. In places, the gabbronorite is abnormally rich in mafic minerals (*i.e.*, it approaches is mela-gabbronorite), and, locally, it may even be ultramafic (greater than 90% dark minerals). The eastern part of the outcrop consists of garnetiferous psammite, which is interpreted to be a metamorphosed silty sediment. At the contact between the two is a 2-m-wide ferruginous gossan (Plate 6a), a sample of which yielded 0.26% Ni and 0.16% Cu (Gower, 2010).

Stop 3.4. Fragments of gossan containing significnat Ni and Cu values

Stop 3.5. Long Range dyke, 1 m wide (black), intruding granitoid gneiss. Note drill holes due to sampling for paleomagnetic studies

Stop 3.6. Alexis River anorthosite, showing reaction coronas between olivine (rusty-brown cores) and plagioclase (white)



Stop 3.7. Grenvillian pegmatite intruded during faulting. In this region, the sense of movement is consistently northeast-side-down

Plate 6. *Outcrop photographs for localities 3.4, 3.5, 3.6 and 3.7.*

Claim maps for the area shows a pattern that was initiated in this area in 2007 and has been progressively expanded along strike since then in both a northwest and southeast direction. The earliest claims staked, by Capella Resources, do not include this occurrence, indicating that it was not the initial target, although the area was included in a claim block staked a few months later. Apart from some small claim blocks owned by individual prospectors, most of the staking has been carried out by EagleRidge Resources Ltd.

Stop 3.5. K-feldspar Megacrystic Granitoid Rock, Pelitic Gneiss and Long Range Dykes; 28 km West of Charlottetown Turnoff (484471 5865203)

Most of the quarry is made up of two rock types, (i) garnet–sillimanite–biotite pelitic gneiss, in which garnet is very abundant and up to 3 cm across, and (ii) a garnet-bearing, K-feldspar megacrystic biotite granitoid rock containing ovoid megacrysts commonly measuring 3 by 2 cm. Rare remnants of amphibolitized mafic dykes and, also rare, discordant, pegmatitic dykes are present. The deformation is too severe to have preserved rotated feldspar structures, and the texture is best termed porphyroclastic. Sense of shear can still be determined to have been dextral from asymmetric shears. This site is an excellent locality at which to appreciate how variation in strain can change the appearance of the rock.

These rocks are discordantly intruded by unmetamorphosed mafic dykes belonging to the 615 Ma Long Range swarm. A 0.5 m-wide dyke can be seen on the northwest side of the quarry, and three closely spaced dykes (1.0, 0.5 and 0.3 m) are exposed on the north wall. The northwest dyke shows classic bayonet and bridge structure. The mafic dykes contain plagioclase phenocyrsts up to about 2 cm long. Quenched plagioclase in the groundmass can be seen with a hand lens. The dykes are also amygdaloidal and have marked chilled margins. These dykes are on line with some much larger dykes to the north having a similar trend. The dykes contain minor sulphide. Elsewhere, some of the larger Long Range dykes may include up to 2-m-wide sulphide-rich margins. Some sulphide-rich pegmatites are present and also some magnetite-sulphide-bearing pegmatites characterized by greenish plagioclase.

Shallow drill holes in one of the dykes and the adjacent country rock indicate sampling for paleomagnetic studies (Plate 6b).

Stop 3.6. Alexis River Anorthosite; 1 km North of Cartwright Junction (465585 5881178)

The Alexis River intrusion here is anorthositic. Although still extensively recrystallized it is much closer to its igneous appearance than its correlative at Port Hope Simpson. Here deformation is relatively minor and the shapes of primary mafic crystals, and to a lesser extent, plagioclase, can be clearly seen. The primary mafic minerals were olivine, orthopyroxene and clinopyroxene. All are fringed by corona minerals (metamorphic orthopyroxene, clinopyroxene and amphibole; Plate 6c). The cores of most mafic grains are altered to platy silicate minerals (*e.g.*, serpentine). The distinct mauve colouration of plagioclase seen previously is also present.

The anorthosite is intruded by an amphibolitized mafic dyke, which can be traced across the floor of the quarry by the distribution of rubble. The amphibolitized dyke is migmatized and shows more strain than its host rock. Later pegmatites are also present.

Stop 3.7. Syn-kinematic Pegmatites, Emplaced During Northeast-side-down Brittle-ductile Grenvillian Faulting (470403 5912175)

The host rock at this locality is a dark grey to black weathering, fine grained, recrystallized mafic rock that is a metamorphic derivative of gabbronoritic rocks belonging to the White Bear Arm complex. The White Bear Arm complex is a huge, underprospected, gabbronoritic body that extends for about 120 km along strike and is 10–15 km wide. In this region, the metamorphic derivative rocks are characteristically mylonitic and show a top-to-the-west sense of movement, which is interpreted to be Labradorian.

The mafic rock is intruded by numerous pegmatites and microgranites (Plate 6d). The pegmatites were emplaced along faults that consistently show a northeast-side-down sense of movement. The emplacement of the pegmatites is suggested to have taken place during faulting, probably at the moment when the rocks failed, unable to deform any more by flowage. The same pattern is repeated at many other outcrops in the vicinity, implying a considerable regional downthrow to the northeast.

As an age of 1029 ± 2 Ma (Schärer *et al.*, 1986) was obtained from one of these minor granitic intrusions (8 km south of this locality), these pegmatites are interpreted to be Grenvillian and the downthrow to explain why the Hawke River terrane does not show severe Grenvillian metamorphism.

Stop 3.8. Paradise Arm Pluton (481142 5916806)

The K-feldspar megacrystic biotite granodiorite at this locality is part of the Paradise Arm pluton. The rock is homogeneous and non-migmatitic, but shows considerable strain variation, some parts being mylonitic. It contains rare quartz veins, and amphibolite occurs as fine-grained, lenticular boudins that probably represent former mafic dykes. Kinematic indicators suggest northeast side up.

Stop 3.9. Paradise River Metasedimentary Gneiss (482104 5920404)

Where it is crossed by the highway, the Paradise metasedimentary gneiss belt is only about 2.5 km wide, in contrast to its southeastern end where its width is over 40 km. At this locality, the rock is typical pelitic gneiss. It is mottled pink, creamy and black; medium to coarse-grained, well-banded, contains some mafic enclaves and is intruded by deformed pegmatitic dykes. The prevailing mineral assemblage is garnet–sillimanite–biotite–feldspar-quartz–opaque minerals. Kyanite is found sporadically at the northwest end of the belt and cordierite prevalent at the southeast end.

Stop 3.10. Earl Island Quartz Diorite (498034 5944231)

The rock here is a medium- to coarse-grained, fairly homogeneous diorite to quartz diorite. It is somewhat migmatitic, showing incipient partial melting to give white concordant and discordant veins. Also present are later pinkish pegmatitic sweats with large hornblendes. The rocks are cut by numerous late-stage hematized and silicified fractures, probably related to the Sandwich Bay graben.

DAY 4. CARTWRIGHT TO GOOSE BAY

Day 4 will be mostly spent driving, but stops will be made to consider the mineral potential of mafic rocks in eastern Labrador, and to address the crustal boundary between Labradorian and Pinwarian rocks (Figure 8).

Stop 4.1. Dykes River Layered Mafic Intrusion; 6 km From Highway Along Woods Road (503961 5941547)

The surface rocks include, (i) amphibolite to leucoamphibolite with ultramafic stringers, (ii) leucoamphibolite containing abundant enclaves of amphibolite, exhibiting a wide range of fine-, medium- and coarse-grained, non-porphyritic and porphyritic textures, (iii) metamorphosed ultramafites, probably derived from dunite and pyroxenite, and (iv) olivine gabbro coronite. The rocks have not been dated at this site but are correlated with Labradorian mafic intrusions elsewhere, which have 1650–1640 Ma ages.

The rocks are rusty-weathering in places and also contain lenses of metallic oxide, up to 30 cm wide and several metres long. On the basis of anomalous chemistry, four sites have been designated as Cr occurrences. A site about 10 km southeast of this locality in similar mafic rocks has high V.

This area was investigated by 407824 Alberta Ltd–High G Minerals. The rocks are described as peridotite, olivine gabbro and schillerized gabbro. A ground magnetic and EM survey was carried out in 1996 (Clarke and de Carle, 1996) and four holes were drilled in 1997 (Lucko, 1997). Sulphides, where encountered, are generally <1-2%, but locally exceed 5%. Ilmeno-magnetite is common. Lucko mentions that local prospectors obtained assays up to 2200 ppm Cu from samples collected elsewhere in this district.

Stop 4.2. Labradorian? Granodiorite Gneiss with (Gravity Collapse?) Z-fold Structures (408614 5852516)

The purpose of this stop, in combination with Stop 4.3, is to demonstrate the field basis for positioning the boundary between Labradorian and Pinwarian regions in the interior part of eastern Labrador. That such a boundary exists relies on geochronological data (Gower *et al.*, 2008a).

The dominant rock at this locality is a pink-, creamy- and grey-weathering granodiorite gneiss (Plate 7a). It is well-banded, has abundant white and pink leucosome, and is also characterized by biotitic veneers and amphibolitic layers. Of particular note here are recumbent Z folds giving a down-dip sense of movement. Zones of K-feldspar megacrystic material, generally only a few metres wide, are also present. Rare planar pegmatitic dykes, some carrying large biotite flakes, discordantly intrude the gneiss. At the south end of the outcrop is a 40 m-wide layer of homogeneous granodiorite showing gradational margins into the adjacent gneiss.

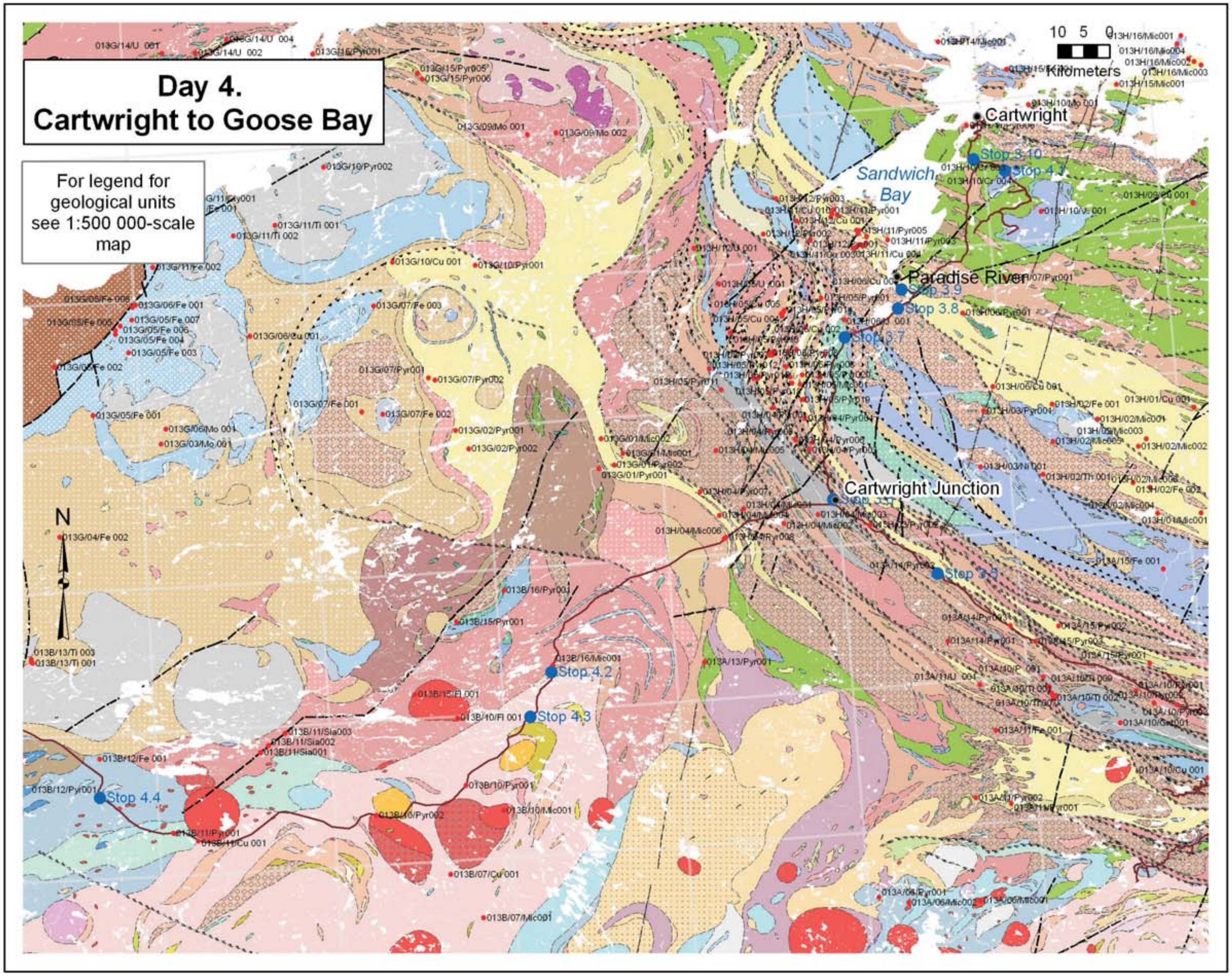


Figure 8. *Excursion route and stops for Day 4 – Cartwright to Goose Bay.*

Stop 4.2. Labradorian? gneiss showing (gravity collapse?) Z-fold structures.

Stop 4.3. Pinwarian? granite

Stop 4.4. Mafic/ultramafic rocks of the No-Name Lake intrusion.

Stop 4.4. Pegmatite bearing sulphide (left) and characterized by large hornblende crystals (right) intruding No-Name Lake mafic intrusion

Plate 7. *Outcrop photographs for localities 4.2, 4.3 and 4.4.*

Stop 4.3. Pinwarian? Granite (403892 5844263)

See comment above regarding the purpose of the previous stop and this one.

The rock at this locality is a grey- to pink-weathering, fine- to medium-grained recrystallized granite (Plate 7b) showing a flat-lying foliation that tends to be wavy and gradational into gneissic character in places. Although there is some compositional heterogeneity resulting from concentrations of lensy K-feldspar-rich material, the rock is overall fairly homogeneous, which is a major distinction from the rock seen at Stop 4.2. The difference in appearance is interpreted to be due to the rocks at Stop 4.2 having experienced deformation (Labradorian) that did not affect the rocks here, because they were emplaced later.

One xenolith containing fine-grained green clinopyroxene and a broad mantle of hornblende has been noted. Amphibolite xenolilths are also present.

Neither the Pinwarian nor the Labradorian granitoid rocks have significant recognized mineral potential, but understanding their regional distribution may well be important with respect to other mineral exploration targets; for example, the location of a belt of mafic intrusions (an example of which will be seen at Stop 4.4) may be tectonically controlled by the Labradorian–Pinwarian crustal boundary.

Stop 4.4. No-Name Lake Mafic Intrusion (319715 5835587)

At the west end of the outcrop, the rock is a black-weathering, medium- to coarse-grained, recrystallized hornblende-bearing melagabbro to ultramafic rock (Plate 7c) containing minor disseminated sulphide. Minor clinopyroxene-bearing leucogabbronorite is also present. Farther east, the rock type grades into a monzogabbronorite. These compositional variations indicate igneous layering. The No-Name Lake body is part of a string of mafic intrusions that may be spatially controlled by the boundary between Labradorian and Pinwarian rocks. The age of these intrusions is uncertain, but is thought to be Pinwarian, based on an age of 1473 ± 19 Ma (Gower *et al.*, 2008a) from a gabbroic pegmatite 13 km to the east.

The mafic rocks are intruded by 2-m-wide, sulphide-bearing, pink and white pegmatites characterized by large amphibole crystals and carrying both pyrite and chalcopyrite (Plate 7d).

DAY 5. POPE'S HILL, SOUTHWEST OF GOOSE BAY

Day 5 will be devoted to examining REE mineralization discovered by Silver Spruce Resources Inc., in the Pope's Hill area (Figures 9 and 10).

Note: Co-ordinates for Day 5 are given as UTM NAD 27, Zone 20

Contributed by Alex Chafe, Silver Spruce Resources Inc.
and Silver Spruce Resources press release (July 21, 2011)

Stop 5.1. Lower Brook Metamorphic Suite (602898 5877891)

This outcrop provides an opportunity to examine, for the first time on this excursion, pre-Labradorian rocks (1810-1770 Ma) in the Grenville Province in Labrador. The rocks are grouped as the Lower Brook Metamorphic Suite (Plate 8a). This outcrop comprises complex migmatitic gneiss having protomylonite to mylonite fabrics. Structural features include tight to isoclinal folding and syn-deformational faulting. Discordant pegmatites, probably of various ages, are also present. From oldest to youngest, the principal rock types are, (i) pink, straight-banded granitic gneiss, (ii) black, intermediate to mafic dykes containing minor sulphide, (iii) later, pink, recrystallized granite (which intrudes the straight-banded gneiss), and (iv) pegmatite (partly hematized and sulphide bearing).

Stop 5.2. Pope's Hill Main Pit (600256 5878270)

Mineralization here was first discovered in 2006 by Silver Spruce Resources Inc., and the area was identified as a uranium target. In 2011, samples up to 24% total REE + yttrium (TREE+Y) were found, leading the way for further exploration. Layering in the pit dips south and strikes approximately east-west. The structural relationship of the rocks is obscured by strong brittle-fracture brecciation and alteration along the pit walls.

Mineralized rocks in the pit are observed in broken fragments and outcrop along the pit floor. Mneralization is exclusively related to (and hosted by) by a pink to medium-red, coarse-grained syenite (Plate 8b), up to 10 m wide, consisting of K-feldspar, clinopyroxene, and minor secondary quartz. REE at economic-concentration levels (reaching tens of percent) are present in massive dark grey to black bands or veins up to 15 cm wide (Plate 8c), rich in allanite, titanite, pyroxene, apatite, K-feldspar and possibly other as-yet-unidentified REE-bearing minerals, and associated with minor sulphide (pyrrhotite). Mineralized rock is rich in thorium, hence is radioactive, giving scintillometer counts up to 5000 cps (versus a background around 200 cps).

In addition to the mineralized, syenitic layers, garnet-rich granitic gneiss is found throughout the area, similar to that observed at Stop 5.1.

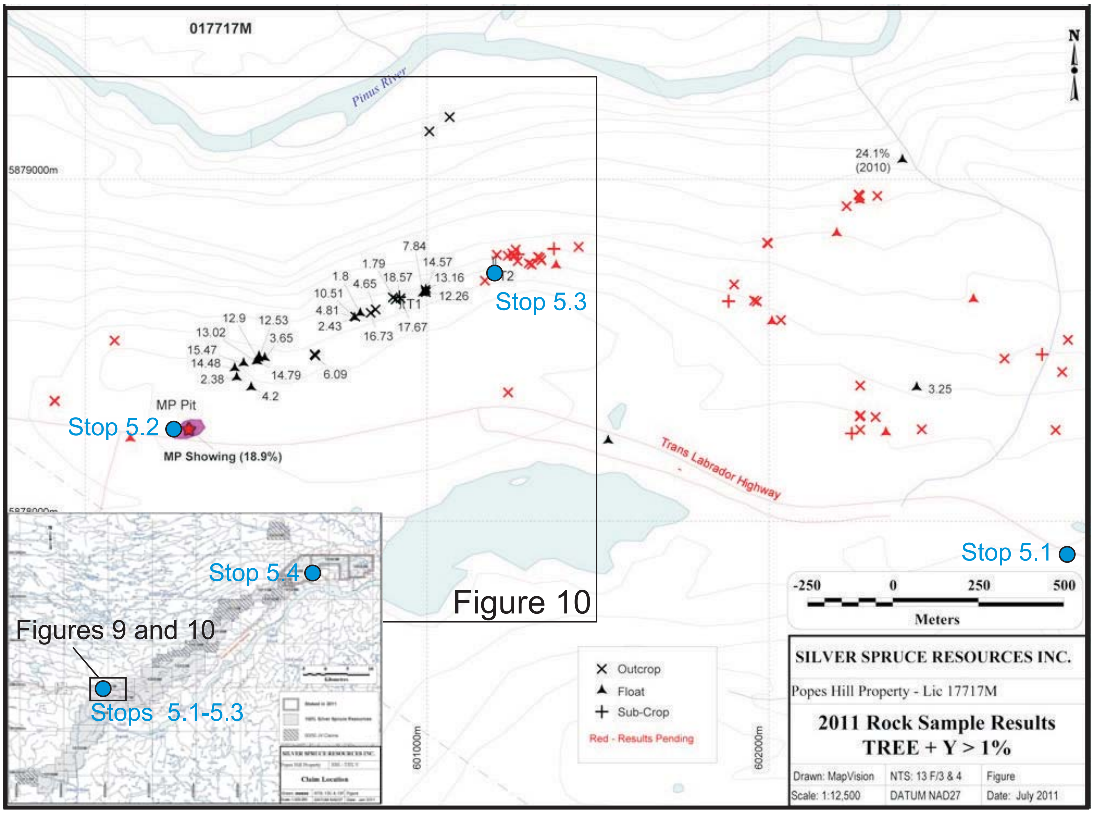


Figure 9. *Pope's Hill area; 2011 rock sample TREE + Y results.*

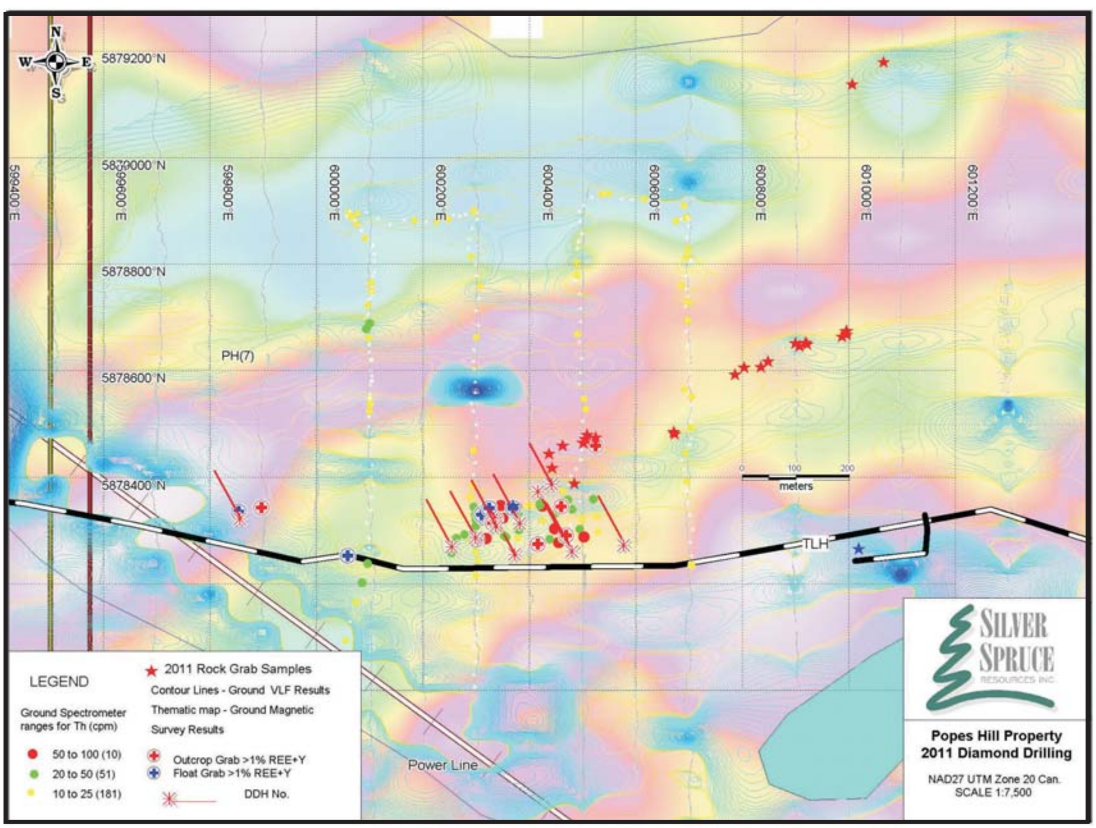
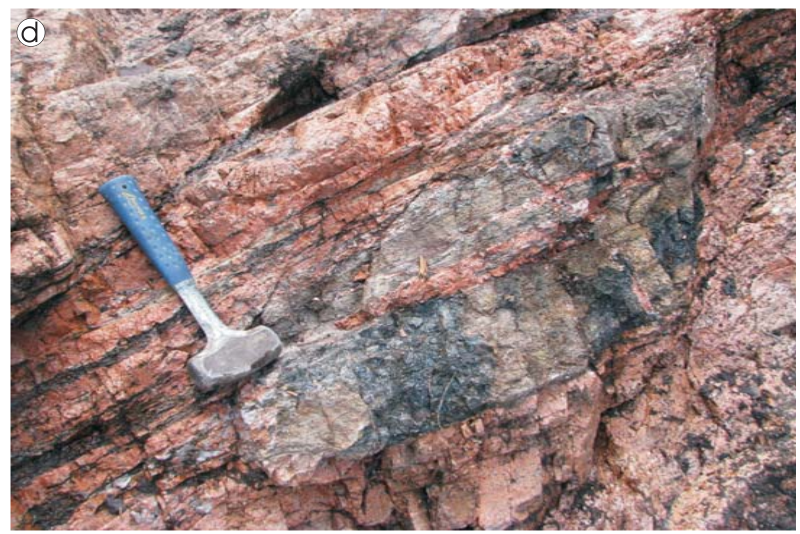


Figure 10. *Pope's Hill area; 2011 diamond drilling.*

Stop 5.1. Lower Brook Metamorphic Suite

Stop 5.2. Syenitic pegmatite host to REE mineralization

Stop 5.2. Mineralization in black band and its syenitic host.



Stop 5.3. REE mineralization (black material) in strongly deformed syenitic host rock

Plate 8. *Outcrop photographs for localities 5.1, 5.2 and 5.3.*

Stop 5.3. Pope's Hill Trend, Trench 2 (601254 5878779)

Trench 2 is located 1100 m east of the main pit. The host rock is a pink-weathering, medium- to coarse-grained, strongly foliated syenite. The mineralization is similar to that seen in the Main Pit, namely as massive, brown or black veins 10-20 cm wide (Plate 8d).

Sampling of both bedrock and float indicates continuity of mineralization between Trench 2 and the Main Pit (an area that also includes Trench 1, 800 m east of the Main Pit), thus yielding a minimum strike length of 1 km. Outcrop grab samples within this zone yield total REE + Y values up to 17.7%, averaging 4.7%.

Stop 5.4. MRT Property, Trench 1 (648747 5906007)

Mineralization here differs from that at Pope's Hill in that sulphide concentration is higher (including chalcopyrite), REE-bearing allanite and titanite seem less abundant, and the host rock consists of mafic (amphibolite) gneiss and clinopyroxene pegmatite. The fabric and mineralization are south-trending, unlike the northeast-trending mineralization observed at Pope's Hill. Three significant values of 5.65%, 5.96% and 10.4% total REE were located in float (2) and outcrop (1). In addition high U values, unrelated to REE sites, were located in the southern part of the property.

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REFERENCES

Bostock, H.H.
1983: Precambrian rocks of the Strait of Belle Isle area. *In* Geology of the Strait of Belle Isle, Northwestern Insular Newfoundland, Southern Labrador, and Adjacent Quebec. *Edited by* H.H. Bostock, L.M., Cumming, H. Williams and W.R. Smyth. Geological Survey of Canada, Memoir 400, pages 1 73. [NFLD/1430].

Clark, S.J.
1997: Evaluation of the Kiex/Short claim group, Red Bay, Labrador. Unimin Corporation. Newfoundland and Labrador Geological Survey, Assessment File 012P/16/0084, 15 pages.

Clarke, A.H. and de Carle, R.J.
1996: First year assessment report on prospecting and geochemical and geophysical exploration for licences 4587M and 4953M-4954M on claims in the Dykes River area, Labrador. 407824 Alberta Limited. Newfoundland and Labrador Geological Survey. Assessment File 013H/10/0051, 57 pages.

Gower, C.F.
2010a: Bedrock geological maps for the Grenville Province and adjacent Makkovik Province in eastern Labrador. Geological Survey Division, Department of Natural Resources, Newfoundland and Labrador, Maps 2010-01 to 2010-25, 1:100 000 scale.

2010b: Mineral occurrences and metallogenesis in eastern Labrador. Geological Survey Division, Department of Natural Resources, Newfoundland and Labrador, Open File LAB/1571.

Gower, C.F., Heaman, L.M., Loveridge, W.D., Schärer, U. and Tucker, R.D.
1991: Grenvillian magmatism in the eastern Grenville Province, Canada. Precambrian Research, Volume 51, pages 315-336.

Gower, C.F., Kamo, S. and Krogh, T.E.
2008b: Indentor tectonism in the eastern Grenville Province. Precambrian Research, Volume 167, pages 201-212.

Gower, C.F., Kamo, S., Kwok, K. and Krogh, T.E.
2008a: Proterozoic southward accretion and Grenvillian orogenesis in the interior Grenville Province in eastern Labrador; evidence from U-Pb geochronological investigations. Precambrian Research, Volume 165, pages 61-95.

Heaman, L.M., Gower, C.F., Perreault, S.
2004: The timing of Proterozoic magmatism in the Pinware terrane of southeastern Labrador easternmost Quebec and northwest Newfoundland. Canadian Journal of Earth Sciences, Volume 41, pages 127-150.

Laracy, P.J.
1996: First year assessment report on beneficiation tests for licences 1481M on claims in the area north of Black Bay, southeastern Labrador. Triassic Properties Limited. Newfoundland and Labrador Geological Survey, Assessment Report 012P/16/0086, 17 pages.

1998: Second and third year assessment report on market studies and industrial mineral quality for licences 1481M and 4831M on claims in the area north of Black Bay, southern Labrador. Laracy, P.C. and Triassic Properties Limited. Newfoundland and Labrador Geological Survey, Assessment Report 012P/16/0087, 44 pages.

Lucko, W.M.
1997: Second year assessment report on diamond drilling exploration for licences 4587M and 4953M-4954M on claims in the Dykes river area, Labrador. 407824 Alberta Ltd and High G Minerals Corporation. Newfoundland and Labrador Geological Survey, Assessment File 013H/10/0053, 28 pages.

McConnell, J.W. and Ricketts, M.J.
2010: A high-density lake sediment and water survey in southeastern Labrador (NTS map areas 2M/13, 3D/4-5, 12-13, 12/P6-7, 9-11, 13A/1, 9, 16, and 13H/1-11). Geological Survey Division, Department of Natural Resources, Newfoundland and Labrador, Open File LAB/1538.

Schärer, U., Krogh, T.E. and Gower, C.F.
1986: Age and evolution of the Grenville Province in eastern Labrador from U-Pb systematics in accessory minerals. Contributions to Mineralogy and Petrology, Volume 94, pages 438-451.

Tucker, R.D. and Gower, C.F.
1994: A U-Pb geochronological framework for the Pinware terrane, Grenville Province, southeast Labrador, Journal of Geology, Volume 102, pages 67-78.

Wasteneys, H., Kamo, S., Moser, D., Krogh, T.E., Gower, C.F. and Owen, J.V.
1997: U-Pb geochronological constraints on the geological evolution of the Pinware terrane and adjacent areas, Grenville Province, southeast Labrador, Canada. Precambrian Research, Volume 81, pages 101-128.

Appendix 1. Minerals mentioned in text and their chemical composition (simplified)

Aegerine	$NaFeSi_2O_6$
Albite	$NaAlSi_3O_8$
Allanite	$Ca_2(Al,Ce,Fe)_3Si_3O_{12}(OH)$
Alkali feldspar	$(K, Na)AlSi_3O_8$
Amphibole	Group of minerals that includes actinolite, tremolite and hornblende
Amazonite	$KAlSi_3O_8$ having Pb substitution for some K
Apatite	$(Ca,F,Cl)Ca_4P_3O_{12}$
Arsenopyrite	FeAsS
Biotite	$K_2(Mg,Fe)_2AlSi_3O_{10}(OH)$
Calcite	$CaCO_3$
Carbonate	Group of minerals that includes calcite and dolomite
Chabazite	$Ca_2Al_4Si_8O_{24}.12H_2O$
Chalcopyrite	$CuFeS_2$
Chlorite	$(Mg,Fe)_5Al_2Si_3O_{10}(OH)_8$
Clinopyroxene	$(Ca,Fe,Mg)SiO_3$
Cordierite	$(Fe,Mg)_2Al_4Si_5O_{18}.nH_2O$
Epidote	$Ca_2(Al,Fe)_3Si_3O_{12}(OH)$
Feldspars	Group of minerals that includes albite, plagioclase, amazonite, microcline and K-feldspar
Fergusonite	$(Y,Er,Ce)(Na,Ta)O_4$
Fluorite	CaF_2
Garnet	Group of minerals that includes andradite and grossularite
Graphite	C
Hematite	Fe_2O_3
Hornblende	$Ca_2(Mg,Fe,Al)_5Si_8O_{22}(OH)_2$
Illite	$KAl_4Si_7AlO_{20}(OH)_4$
Ilmenomagnetite	$(Fe,Ti)_3O_4$
K-feldspar	Group of K-bearing feldspars that includes microcline
Kyanite	Al_2SiO_5
Magnetite	Fe_3O_4
Molybdenite	MoS_2
Mica	Group of minerals that includes biotite, muscovite and phologopite
Microcline	$KAlSi_3O_8$
Nephelene	$Na_3(Na,K)Al_4Si_4O_{16}$
Olivine	$(Fe,Mg)SiO_4$
Opaque oxides	Group of minerals that includes hematite, leucoxene, magnetite and sulphide
Orthopyroxene	$(Fe,Mg)SiO_3$
Plagioclase	$(Na,Ca)Al_{3-2}Si_{2-3}O_8$
Pyrite	FeS_2
Pyrrhotite	$Fe_{1-x}S$
Quartz	SiO_2
Scolecite	$CaAl_2Si_3O_{10}3H_2O$
Serpentine	$Mg_3Si_2O_5(OH)_5$
Sillimanite	Al_2SiO_5
Stilbite	$NaCa_2Al_5Si_{13}O_{24}.2H_2O$
Sulphide	Group of minerals that includes pyrite and pyrrhotite
Titanite	$CaTiSiO_5$
Zircon	$ZrSiO_4$

Appendix 2. Glossary of technical terms used in text

Note that these are informal definitions, presented without full regard for various genetic or other subtleties of meaning that might be implied.

Alkalic	Igneous rocks abnormally rich in sodium and/or potassium
Amphibolite	A metamorphic rock composed mostly of hornblende and plagioclase – typically derived from a basaltic igneous rock.
Amphibolite facies	A grade of metamorphism characterized by 450-700°C temperatures and 4-7 kb pressures
Anhedral	Used to describe minerals without well-defined crystal shape
Assay	Chemical analysis
Boudin	A sausage-shaped pod of rock produced by deformation
Colour index	The percentage of dark minerals in a rock
Diabase	A fine- to medium-grained basaltic igneous rock composed of plagioclase and clinopyroxene
Euhedral	Used to describe minerals having well-defined crystal shape
Felsic	Used to describe rocks composed mostly of feldspar and quartz
Geochronology	The science of dating rocks (especially by using isotopic methods)
Gneiss	A metamorphic rock having alternating layers of light and dark minerals; generally produced by partial melting
Granoblastic	A metamorphic texture in which all minerals are roughly the same size
Greenschist facies	A grade of metamorphism characterized by 300-450°C temperatures 2-4 kb pressures
Grenvillian	A mountain-building event that occurred between 1085 and 985 million years ago
Gossan	A rusty-looking rock resulting from oxidation of sulphide minerals
Hematization	A low-grade metamorphic process involving the formation of hematite
Hornfels	A fine-grained metamorphic rock having an equidimensional mineral texture; usually formed adjacent to a hot intrusive body.
Iapetus	The name given to an ancient ocean that existed between 540 to 450 million years ago
Igneous	Formed from a molten rock (magma)
Isoclinal	Used to describe folds having parallel limbs
Labradorian	A mountain-building event that occurred between 1710 and 1600 million years ago
Leucosome	The light part of a metamorphic rock resulting from partial melting of its parent rock
Mafic	Used to describe rocks composed mostly of dark-coloured minerals
Makkovikian	A mountain-building event that occurred between 1800 and 1700 million years ago
Melanocratic	Used to describe rocks having a colour index of at least 60%
Metamict	Used to describe minerals that have experienced radiation damage, but retain their external form (*e.g.*, allanite)

Metamorphism	The process that converts igneous and sedimentary rocks to other rocks by heat and pressure
Metasedimentary	Used to describe a metamorphosed sedimentary rock
Micaceous	Used to describe rocks having abundant mica
Migmatite	A metamorphic rock consisting of a mixture of unmelted and melted (and later crystallized) material
Mylonite	A finely laminated rock produced by extreme deformation
Orogeny	A process that involves mountain building; generally occurring at crustal plate margins
Paragenesis	An association of contemporaneously formed minerals
Pegmatite	A very coarse-grained rock, generally of granitic composition and found in dykes and veins
Pelite	A metamorphosed mudstone
Petrography	The science of describing rocks, especially applied to microscope studies
Phanerozoic	A division of time younger than 540 million years
Phyllosilicate	A class of sheet-like minerals, especially micas
Pinwarian	A mountain-building event that occurred between 1520 and 1460 million years ago
Pluton(ism)	A deep-seated igneous intrusion (deep-seated igneous and metamorphic processes)
Porphyroblast	An abnormally large crystal formed during metamorphic recrystallization
Porphyroclast	An abnormally large crystal remaining after (or formed during) deformation
Proterozoic	The period of time between 2500 and 540 million years ago
Protolith	The original rock before it was metamorphosed
Psammite	A metamorphosed sandstone
Schist	A metamorphosed rock easily split into thin layers
Sericitization	A low-grade metamorphic process involving the formation of sericite (a muscovite-like mineral)
Slickensides	Striations on a fault surface resulting from friction during fault movements; indicates direction of fault displacement.
Subhedral	Used to describe minerals with some well-defined crystal shape
Supracrustal	Used to describe rocks formed at the surface
Symplectic	Used to describe a mineral texture formed by the intergrowth of two minerals
Tectonism	The process that causes mountain building
Terrane	A geologically distinct region, typically bounded by faults
Volcanoclastic	A clastic rock made up of volcanic material