OFR ME 2010-3

2010 Fall Field Trip

Geology and Rare Earth Element Potential of the Devono-Carboniferous age Volcanic and Peralkaline Granitic Rocks, Cobequid Highlands, Nova Scotia

Field Trip Leaders

T. G. MacHattie, G. A. O'Reilly and R. F. Mills
Nova Scotia Department of Natural Resources,
Mineral Resources Branch

October 2nd and 3rd, 2010

Field Trip Itinerary:

Saturday, October 2, 2010

9:00 am Assemble at the Tim Horton's parking lot, Debert Industrial Park. Driving from Halifax on the TCH, take Exit 13 and drive toward Debert to the Tim Horton's on the right. Departure shortly after 9:00 am.

Stop 1-1 Annandale Falls, East Wentworth.
(NAD83 UTM N5051789; E461094)

Stop 1-2 Byers Brook Formation sediments and volcanics.
(NAD83 UTM N5050986; E463604)

Stop 1-3 Byers Brook Formation agglomerate outcrop.
(NAD83 UTM N5046052; E465233)

Lunch Stop.

Stop 1-4 The high thorium Harts Lake peralkaline granite.
(NAD83 UTM N5047042; E464810)

Stop 1-5 REE-rich granite veins intruding the Hart Lake Pluton.
(NAD83 UTM N5047167; E464083)

Stop 1-6 REE-rich mineralized granite.
(NAD83 UTM N5047686; E464535)

Stop 1-7 Recently discovered silica alteration zone in Byers Brook Formation rhyolite.
(NAD83 UTM N5049459; E470342)

End of Day 1, return to Truro. Overnight at Stonehouse Motel.

Sunday, October 3, 2010

9:00 am Meet at the Stonehouse Motel, Truro by 9:00 am. Depart shortly thereafter.

Stop 2-1 Younger Dryas podsol at Folly Lake Quarry.
(NAD83 UTM N5045122 E457832)

Stop 2-2 Arrowhead Falls on Byers Brook at Warwick Mountain.
(NAD83 UTM N5051465; E470984)

Stop 2-3 Oil shale between 2 basalt flows at Warwick Mountain.
(NAD83 UTM N5049646; E471025)

Lunch Stop

Stop 2-4 Oxford Tripoli Company Diatomite Mine, East New Annan.
(NAD83 UTM N5046878; E476832)

Stop 2-5 East Mountain gabbro quarry, East Mountain.
(NAD83 UTM N5028513; E484177)

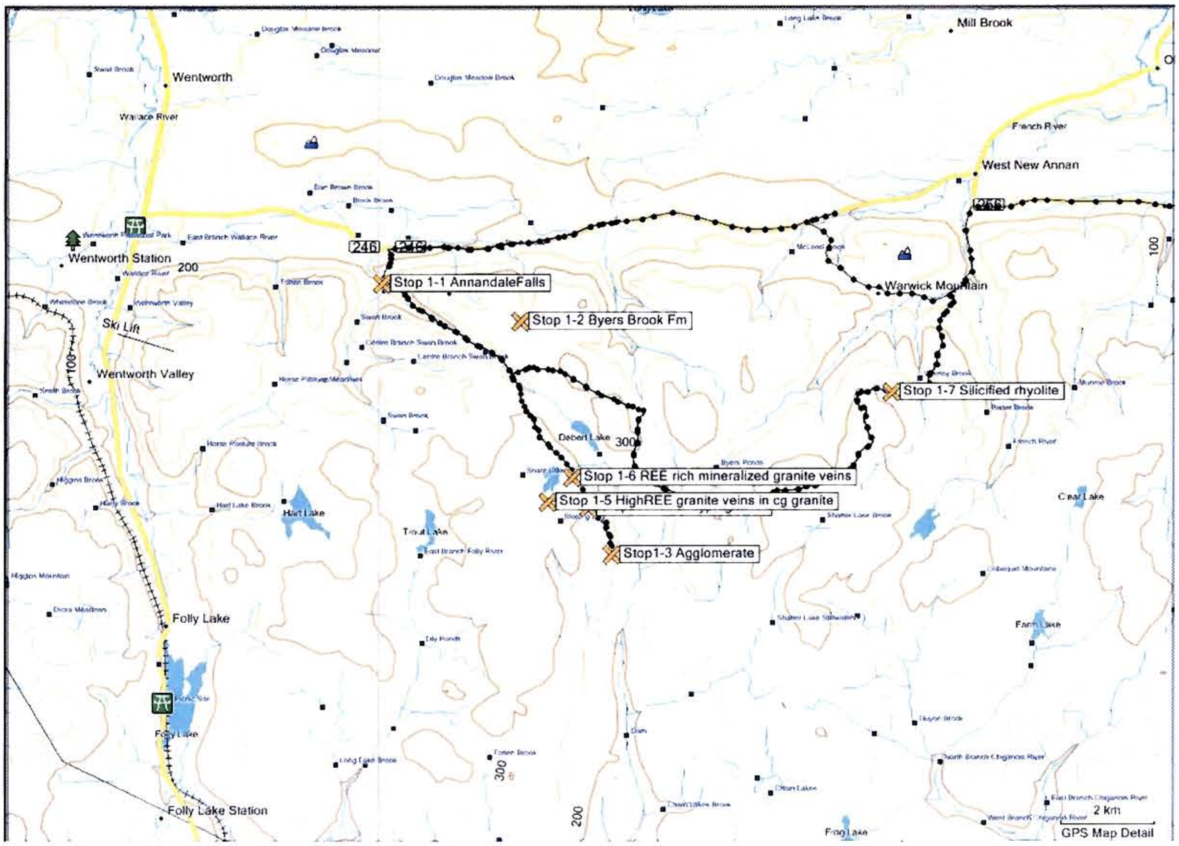

Figure 1 Day 1 field trip stops.

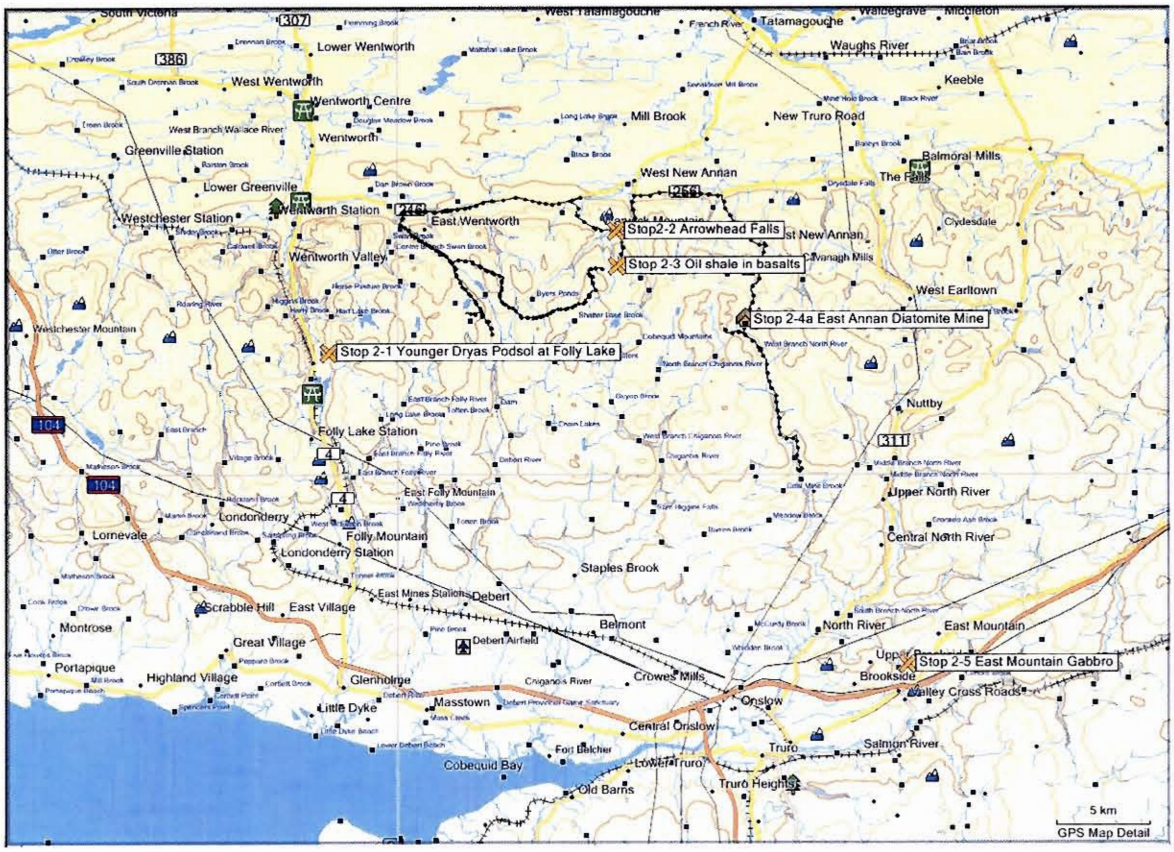

Figure 2 Day 2 field trip stops.

Day 1 - Saturday, October 2, 2010

Stop 1-1: Annandale Falls.

Directions:

Depart from the Tim Horton's, Debert Industrial Park and proceed west through the village of Debert to the intersection with Highway #4 at East Mines Station. Drive north on old Highway #4 for about 21.5 km through the community of Wentworth Valley to the intersection with Highway #246 on the right. Turn right and drive east on Highway #246 for 4.8 km to a logging road on the right. The entrance to this road is 500 m east of the bridge over East Branch Wallace River. Turn right and drive south on this logging road for 750 m to a road on the right. Even though this side-road is easily passable, we will park here as it will be difficult for all of us to find parking and turning around space if we take our vehicles any further. In any event, Stop 1-1 is only a short walk down this road. Walk 50 m down this side-road where there are paths leading to the top of Annandale Falls on the right.

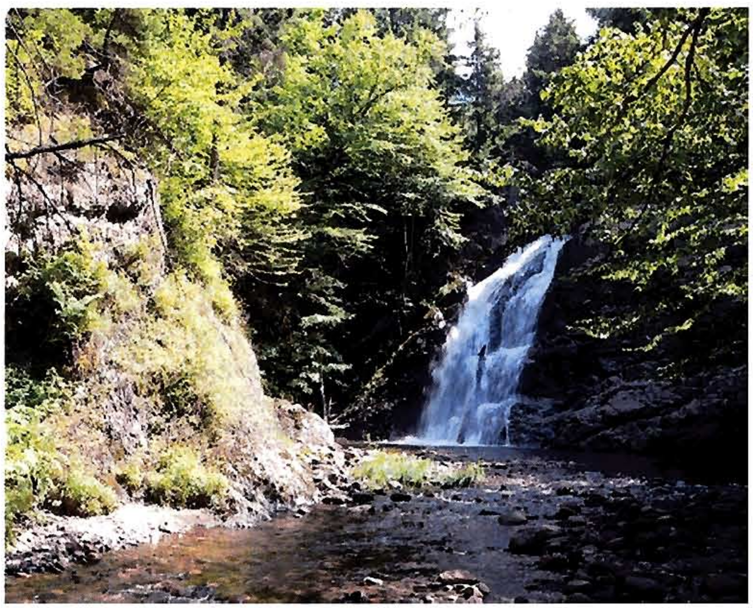

Figure 3 Annandale Falls, East Wentworth, Colchester County.

Background and Description:

A nice start off to the trip will be to view the spectacular Annandale Falls. It is surprising how little known Annandale Falls is considering how easy it is to access and how spectacular a view it provides (Fig. 1). Reaching the top of the falls is simple and easy but please be careful as it is a good 30+ m drop do the base of the cliffs. Access to the base of the falls is quite a bit more difficult. There is rope assisted path down the east bank of the gorge located about 80 m downstream of the falls, but it is still quite a physical challenge to use it. Feel free to do so but please be careful and remember, going down is the easy part, climbing back up is quite a chore. It's quite a view though. Further down the river the drop is easier but obviously will require a much longer walk. It's a difficult falls to photograph if there is any amount of water cascading down the gorge. Mist rising from the falls tends to collect and funnel downstream clouding your camera lens.

Stop 1-2: Byers Brook Formation sediments and volcanics.

Directions:

Leave Stop 1-1 and continue south along the logging road for 2.3 km to another logging road on the left. Follow this logging road east for 950 m to Stop 1-2 located in a bedrock aggregate quarry.

Stop Description:

The Late Devonian and early Carboniferous period in the geologic evolution of Nova Scotia was a harsh time with a lot of things happening tectonically. It was a time of continental collision, very rapid mountain building and movement along the regional scale faults that comprise the Cobequid-Chedabucto Fault Zone. In northern Nova Scotia, these fault movements set up an extensional, rifting environment (pull apart basin) which allowed very large mafic magmas derived from the mantle to rise up and be emplaced in the lower crust (underplating). Heat from these melts triggered melting of the lower crustal igneous rocks to produce felsic magmas of A-type or peralkaline granitic affinity. This is commonly referred to as bimodal magmatism where mafic and felsic magmas of the same age are found co-existing. The abundance of fault structures allowed portions of each of these magma types to rise through the crust, reach the surface and extrude as thick, voluminous lava flows. The bimodal volcanics in this area produced the Fountain Lake Group which consists of a lower Byers Brook Formation dominated by felsic volcanics like rhyolite (extrusive equivalent of granite) and minor basalt as well as an overlying Diamond Lake Formation dominated by much more mafic basaltic lavas (intrusive equivalent of gabbro). Interbedded with both these volcanic types are sedimentary red and maroon coloured beds typical of a continental rift environment.

Exposed in and surrounding this aggregate quarry are outcrops of sedimentary rocks of the Late Devonian to Early Carboniferous age Byers Brook Formation. Stratigraphically, the rocks at this stop are at approximately the middle of the Byers Brook Formation sequence. You should have no problem finding flows of pink to creamy coloured flow banded rhyolite interbedded with maroon and reddish sandstone and siltstones. The Byers Brook Formation, by definition, is a thick sequence of felsic (rhyolite) and mafic (basalt) volcanic rocks interbedded with red-bed sediments. However, at this stop the proportion of sediment to volcanic is much higher than is typically found elsewhere.

At the northwest end of the quarry the industrious among you may find some good specimens of altered volcanic with well developed fluorite crystals and pyrite cubes in a hydrothermally altered fault gouge.

Stop 1-3: Byers Brook Formation agglomerate.

Directions:

Return down the hill to the main logging road and turn left (south). Continue south on the main logging road for 5.1 km and park. The outcrops of Byers Brook Formation agglomerate that comprise Stop 1-3 are found along both sides of this interval of the road.

Stop Description:

This stop is an outcrop of agglomerate which is essentially a volcanic conglomerate. Stratigraphically we are very near the base of the Byers Brook Formation. These are the first appearance of volcanic rocks in the Devono-Carboniferous sequences in this region. By nature, agglomerates are very fragmental rocks and are often the result of violent volcanic eruptions. Large chunks (bombs) of magma and previously crystallized lava are thrown out of the volcanoes to fall to earth and accumulate as beds of agglomerate. Quite easily you should be able to see the fragmental makeup of the outcrop and diverse collection of "bombs" that it contains.

Lunch Stop.

Stop 1-4: High thorium Hart Lake/Byers Lake Peralkaline Granite.

Directions:

Leave Stop 1-3 and return north along the logging road for 1.1 km to a section of pinkish granite outcrops on both sides of the road. An outcrop of granite on the left (west) side of the road comprises Stop 1-4.

Stop Description:

Intruded into the Byers Brook Formation is a granite of similar composition to the rhyolite flows that comprise the formation. This pluton is known as the Hart Lake/Byers Lake Pluton and at this stop we will see a typical outcrop. The similarity in composition and age of these two melts has led many to postulate that they are, in fact, genetically related. It's thought that the granite pluton is an intrusive remnant of the actual melt that gave rise to the volcanic lavas that extruded and formed the Byers Brook Formation.

The Hart Lake/Byers Blake Pluton is a medium- to coarse-grained, amphibole bearing, alkali feldspar-rich, granite. Usually it is some variation of pink in colour. Research by Dr. Georgia Piper and her students at St. Mary's University have shown that this pluton, and several others of the same age and composition that occur elsewhere in the Cobequid Mountains, may chemically be classified as A-type or peralkaline granite. Being peralkaline is a chemical classification and means that the granite has an abundance of alkali elements (K and Na) relative to the amount of Al such that there is too much K and Na than can be accommodated by making the main rock forming mineral feldspar. Typically, a peralkaline granite will have potassic and/or sodic mineral phases reflective of the high K and Na content of the melt. In short, peralkaline granites are K- and Na-rich granites and, more importantly, from an economic standpoint, globally are often associated with economic concentrations of rare earth elements (REE's).

The limited analytical research data that exists for these peralkaline granites coupled with the airborne gamma-ray spectrometric data from federal government surveys has shown that there are areas within them with an anomalous content of thorium. This region of the Hart Lake/Byers Lake pluton is one of these Th-rich areas and outcrops such as this one at Stop 1-4 reflect this. Portions of this outcrop reach a radioactive background in the order of 1000 counts per second (cps). Typical granitic outcrops would tend to exhibit background radiation in the order of 150-250 cps so values between 500-1000 cps (i.e. 3 to 5 times higher) are considered on the high side of what would be considered background radiation. What's more important is that, at this location, this elevated background has been found to be due to elevated content of Th, which is considered an indicator element for REE mineralization.

Stop 1-5: REE-rich granite veinlets intruding the Hart Lake/Byers Lake Pluton.

Directions:

Drive north from Stop 1-4 for 240 m to a side spur logging road on the left (west). Follow this spur road west 530 m to where it ends. On foot, continue west along a skid road for 120 m to where it turns southwest then continue another 80 m to a prominent pink granite outcrop.

Stop Description:

Intruding this outcrop of medium- to coarse-grained Hart Lake/Byers Lake granite are found thin veinlets of pink-orange, fine grained granite. The veinlets are significantly more radioactive than the host Hart Lake/Byers Lake granite and it has been determined that this radioactivity is due predominantly to an elevated Th content. The recent mapping of Trevor MacHattie in this region has shown that this particular fine grained granitic phase is host to very significant levels of REE's. Although the volume of the REE-rich granite veining at this location is minor, the fact the veins intrude the Hart Lake/Byers Lake Pluton is a significant observation. The intrusive relationship confirms that the REE-rich veins post date the main felsic intrusive event that gave rise to the Hart Lake/Byers Lake Pluton.

Stop 1-6: REE-rich mineralization in sheeted granite veins.

Directions:

Return to the main logging road from Stop 1-5 and drive north for 470 m and park. This area marks the eastern edge of a large area of mixed volcanic and plutonic rocks into which are intruded a number of veins and small dykes of REE-rich peralkaline granite. Stop 1-6 will consist of one site showing an example of this veining intruding Byers Brook Formation felsic volcanic rocks and some diabase dykes that intrude them. It is from this area, and these veins, that the most significant levels of REE mineralization have been found to date.

Stop Description:

This more or less can be considered the discovery zone for this type of REE mineralization currently being explored for in the province. The first indications that elevated levels of REE's may occur in the Byers Brook Formation rocks was suggested in diamond drilling carried out in this region by Gulf Minerals during exploration for uranium throughout the Cobequid Mountains in the late 1970's. Assay work done on drill core samples by Gulf Minerals and some subsequent study of these rocks for a M.Sc. thesis by D. Gower (Memorial University) indicated a few small intesections rich in Th, Zr and some of the rare earth element suite of elements. It wasn't until some more detailed followup mapping by Trevor MacHattie over the last 2 years and subsequent exploration by Lyndsey Allen, the current mineral rights holder, during the last year that many more sites of elevated REE mineralization started to be located in outcrop and boulder fields.

Figure 4 Dyke of REE-rich peralkaline granite intruding diabase dike at Stop 1-6.

At this stop you will see veins of reddish-orange, medium-to fine-grained granite intruding a mixed package of Byers Brook Formation rhyolite flows and intrusive diabase dykes (Fig. 4). It's important to note that the REE-rich veins intrude both the rhyolite as well as the diabase dykes. Previously, the diabase dykes were thought to be the youngest intrusive event in this region. Obviously, this is now known not to be so. The veins occur from small stringers up to half a metre thick and intrude in a number of orientations but most appear to have a flat-lying, anastomosing, sheet-like form. To date, values of total REE's in the order of 1% have been returned from these veins. These are considered to be very economically promising REE levels and these, coupled with the fact that exploration continues to turn up more and more sites of the mineralization, places this property near the top of the list of sites to keep an eye on.

Stop 1-7: Silica alteration zone in Byers Brook Formation rhyolite.

Directions:

Return to the vehicles and continue north on the main logging road for 2.6 km to a logging road on the right (east). Follow this logging road east for 11 km to where it ends on a knoll amongst some prominent felsic and mafic volcanic outcrops. This is a long drive over a rocky road but at least the panoramic views of the highlands are quite nice.

Stop Description:

Trevor MacHattie found this interesting location as a result of his mapping this past summer. While probably having nothing to do with REE mineralization, it is still a site of possible economic significance. At this location you will find a zone of very well developed silica alteration within flow banded rhyolite of the Byers Brook Formation. Interbedded with the rhyolite are pyroclastic flows and amygdaloidal basalt. Stratigraphically it's thought that this sequence is quite close to the top of the Byers Brook Formation, therefore, just below the overlying Diamond Brook Formation. Although most of the alteration and it's attending pyrite mineralization appear related and confined to the rhyolite, it is clear that the alteration overprints the mafic flows too. At present there are no analytical results from this interesting showing, however, even if this immediate location does not return interesting gold or base metal numbers, the intensity and style of the alteration clearly warrants examination along strike. Isn't that what prospectors are for?

End of Day 1. Return to East Wentworth via the same logging roads. Follow the original route to Truro.

Day 2 - Sunday, October 3, 2010

Stop 2-1: Younger Dryas podsol at the Folly Lake Aggregate Quarry.

Directions:

From Truro, take the TCH (Highway 104) west toward Amherst and exit on to Highway #4 either via the road through Debert (Exit 13) or by taking the exit off the TCH on to Highway #4 (Exit 11). Drive north on old Highway #4 through Folly Mountain to Folly Lake on the right. At the north end of Folly Lake turn off to the entrance into the rather substantial Lafarge Canada gravel aggregate operation that dominates the terrain north of the lake. An example of a Younger Dryas podsol is exposed on one of the till cuts in a little used portion of the pit.

Stop Description:

What is termed the Younger Dryas stadial was a brief (1,300 ± 70 years) cold climate period between approximately 12,800 and 11,500 years ago. It was preceded by an even more brief warming period that lasted approximately 3-4 centuries, in which peat, soils, shrubs and small trees developed as the glaciers receded.

During the Younger Dryas the northern hemisphere saw a rapid return to glacial conditions in the higher latitudes in sharp contrast to the warming of the preceding interstadial deglaciation. It has been postulated that these climatic transitions each occurred over a period of a decade or so, but their onset may have been faster. In the UK, fossil evidence (from beetles) suggests that mean annual temperature dropped to approximately 5°C, and periglacial conditions prevailed in lowland areas, while icefields and glaciers formed in upland areas. Nothing of the size, extent, or rapidity of this period of abrupt climate change has been experienced since.

The interglacial period was very warm. Beetle species taken from a site in New Brunswick are of cotton boll weevils suggesting the climate at that time had warmed up to one that equates nowadays to that of Maryland and Virginia. Al Gore would find explaining this abrupt climate change significantly challenging. It is generally believed that the observed climactic response was due to a change in the behavior of the Gulf Stream since data from South America does not indicate widespread climate change of the same suddenness occurred in the southern hemisphere.

In Nova Scotia, the Younger Dryas is especially important because of the extent of glacio-lacustrine flooding it caused due to ice damming at the head of the Minas Basin. In that area, several large rivers including, the North River at Onslow-Bible Hill, the Salmon River and the Shubenacadie outlets were all dammed by a plug of ice that suddenly formed over the Minas Basin. This caused flooding of large areas of central mainland Nova Scotia. The backup of water from the Shubenacadie River was so great that Glacial Lake Shubenacadie (as it has become known) flooded the mainland over a large area and to depths as great as 90 feet. At that point the water rise became so high that the lake drainage reverted to a southward flow and emptied through the Grand Lake - Mic Mac Lakes drainage system and into the Atlantic through what is now Halifax Harbour.

The deposits related to the Younger Dryas commonly host the mastodon remains that are found in Nova Scotia. This has led to a type section for the Younger Dryas that grades upward through well sorted sands or other outwash, overlain by a relatively thin peaty podsol. The podsol is, in turn, overlain by a series of lacustrine clays that, in places such as Lantz, formed important industrial mineral deposits of clay and silica sand. This is overlain by till from the Younger Dryas advance.

The LaFarge gravel aggregate quarry at Folly Lake is an interesting site. Here, a significant glacial advance through the Wentworth Valley has bulldozed up a large terminal moraine of glacial outwash that forms the quarry material. The outwash not only formed good gravel, since it is relatively well washed, but also forms a dam that holds back Folly Lake. Take note of how the lake is perched high above the Wentworth Valley and drains down steeply toward the north several tens of metres below.

Figure 5 Mastodon remains being unearthed at the Milford gypsum quarry.

The particular site has not formally been established to be Younger Dryas because nothing taken from here has ever been dated. The quarry section is also missing the clay series typical of the dryas but this may just be due to it being at the top of a large hill of moraine through which there was no lacustrine drainage. The missing clay at the Folly Lake quarry can be explained by westward drainage out of the Wentworth valley. The podsol here is capped by till.

Clay, however, has been noted a few kilometers to the north at the Wentworth ski hill where, at the base of the hill Stea and Mott (1998) found clay on runs above the ski lodge at heights in excess of 55 m. This attests to the great thickness of ice that dammed water at this location. Note the trees and branches sticking out of podsol in the side of the bank. This wood, kept in an oxygen free environment and has not rotted significantly over the last 11,000 years. This is quite common of Younger Dryas podsols and is the reason why pollen, beetles and wood may be retrieved for dating by radiocarbon means.

Stea R. R., and Mott, R. J., 1998: Deglaciation of Nova Scotia Stratigraphy and Chronology of Lake Sediment Cores and Buried Organic Sections: Géographie physique et Quaternaire, v. 41, p. 279-290.

Stea, R. R., Piper, D. J. W., Fader, G. B. J. and Boyd, R. 1998:Wisconsinan glacial and sea-level history of Maritime Canada, a correlation of land and sea events. Geological Society of America Bulletin 110, no. 7, 821-845.

Stea, R.R., 2003: A Virtual Field Trip of the Landscapes of Nova Scotia: Nova Scotia Department of Natural Resources, Mineral Resources Branch website. www.gov.ns.ca/natr/meb/field

Stop 2-2: Arrowhead Falls on Byers Brook, Warwick Mountain.

Directions:

Leave Stop 2-1 and continue north on Highway #4 for 4 km to the intersection with Highway #246 at Wentworth Station. Drive east along Highway# 246 for 12.5 km to the Warwick Mountain Road on the right (south). Turn and drive along the Warwick Mountain Road for 3.1 km to the bridge over Byers Brook. Immediately downstream of the bridge as a large outcrop of felsic volcanic rock followed by the small, but very pretty, Arrowhead Falls (Fig. 6).

Figure 6 Arrowhead Falls, Warwick Mountain, Colchester County.

Stop Description:

Not much to say about this location other than it would be a shame to pass by here without taking the time to have a look at yet another one of Nova Scotia's picturesque waterfalls. The large volcanic outcrop one encounters upstream of the falls is worth a look. This outcrop is a spherulitic rhyolite flow located stratigraphically near the very top of the Diamond Brook Formation, the upper of the two formations that comprise the Fountain Lake Group. Spherulites are radial growths of minerals and examples of these occur throughout this outcrop.

Stop 2-3: Oil shale between two basalt flows, Warwick Mountain.

Directions:

Leave Stop 2-2 and continue east along Warwick Mountain Road for 480 m to a logging road on the right. Follow this logging road southwest for 2 km to a small rock quarry on the left. This quarry is Stop 2-3.

Stop Description:

This rather innocent looking site recently raised some degree of excitement between a couple of DNR's geologists who have a background in sedimentary geology. At this site you will find a sequence of fine-grained, dark grey, organic shale sandwiched between two flows of massive, amygdaloidal basalt. The shale may actually be an oil shale or, at least, may originally have been an oil shale but has had it's petroleum content obliterated by heat from the enclosing volcanic lava. In any event, at minimum, it is an organic-rich shale of probably lacustrine origin. A sample has been sent off for palynology (i.e. study of pollen contained therein) to determine the age of this bed.

Why the interest? It's highly probable that the basaltic flows here belong to the Diamond Brook Formation that underlies this area. However, most of the sediments interbedded within the Byers Brook and Diamond Brook formations are red and maroon clastic sediments typical of highly oxidized continental weathering conditions. This is quite a departure from the depositional environment denoted by the presence of oil shale. In fact, it has been suggested that this unit may actually be time equivalent to the Horton Group thus suggesting possible link between these two units. At minimum, the presence of this unit indicates there was a marked change in depositional environment during the latter stages of deposition of the Diamond Brook Formation.

Lunch Stop at Warwick Mountain.

Stop 2-4: The Oxford Tripoli Company Diatomite Mine, East New Annan.

Directions:

Return to the Warwick Mountain Road and turn right. Drive north for 2 km to West New Annan. Turn right and drive east 4 km to the intersection that comprises Central New Annan. Turn right and drive south for 3.5 km to the intersection at East New Annan. Turn right on the Sugarloaf Mountain Road (also called Truro Road) and drive south for 4.6 km to a straight section of the road immediately south of an intersection with a logging road on the left. The remnants of the kiln and other buildings associated with the Oxford Tripoli Company diatomite mine operation are found in the woods along the west side of the road at this point (Fig. 7).

Stop Description:

Between 1889 and 1955 Nova Scotia had a fairly lucrative period of mining of diatomaceous earth. Most commonly referred to as diatomite, it is also referred to a infusorial earth. Diatomite is actually a mineral or rock formed by the accumulation over time of the shells of microscopic diatoms, an organism of the algae genera, that has thrived within many of our alpine lakes since the last ice age. The diatoms extract silica to make their shells from the water in the lakes and bogs and, upon their passing, their shells sink and accumulate as beds up to a few metres thick and often covering a few hectares in area.

Diatomite has a number of unique and important uses. Their shells are essentially pure silica and they are very small. A mere 1 cm^3 of diatomite contains millions of shells. The shells are permeated by microscopic pores and spiney protrusions that together form a delicate, lace-like structure and this character is useful in a number of applications. One very important application is use as a filter aid in the beverage industry for the clarification of wine, beer and fruit juices and in water purification systems. Diatomite is also calcined and used as an absorbent where it can absorb up to 5.5 times it's dry weight. As a filler, diatomite within concrete makes a stronger, lighter product which is much more resistant to saltwater erosion. The list goes with my point being that diatomite has many unique uses and is thus of considerable value.

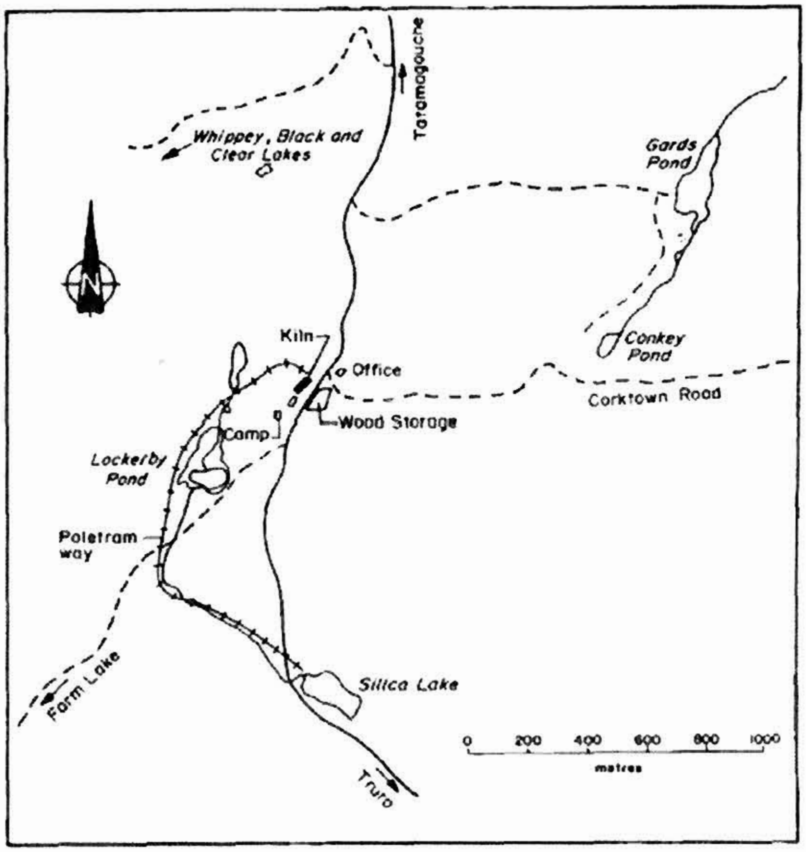

Figure 7 Workings of the Oxford Tripoli Company East New Annan, Colchester County.

Lakes with beds of pure and impure diatomaceous earth are common throughout Nova Scotia but the biggest and, more importantly, purest of the deposits tended to occur within lakes and bogs of highland regions and underlain by crystalline metasedimentary and plutonic rocks. The reasons for the accumulation of the deposits are predominantly twofold. Firstly, the crystalline basement rocks provided a ready and continuous source of the silica to the lakes and bogs via underground springs. Equally important was the cool, pristine conditions within our highland lakes where the low temperature tended to limit the number of competing organisms for nutrients such that the diatoms could dominate. Since the diatom was the dominant organism within these lakes, the deposits they formed tended to be much purer.

Mining of diatomite in Nova Scotia took place in many locales but most notable were large deposits on Digby Neck and a couple of sites in the Cobequid Highlands. In the Cobequids, a large deposit in Silica Lake at Castlereagh high above Bass River was developed by the Oxford Tripoli Company in 1899 and produced until 1923 when the deposit was deemed exhausted. This operation produced about 540 tons of dry diatomite a year which was sold to the American rubber manufacturing industry (e.g. Goodrich, Goodyear). Following closure of the Castlereagh operation, the Oxford Tripoli Company developed an operation at East New Annan where they produced diatomite from several small lakes (one of which is also called Silica Lake) and bogs (Fig. ??). The operation at East New Annan produced 7700 tons of dry finished product between 1928 and 1940 when the plant was destroyed by fire. Their product exported to several markets including the St. Lawrence Sugar Refinery in Dartmouth, the St. Helen's Cable and Glass factory in England, Goodyear Tire in the U.S.A, At Stop 2-4 we will see the now overgrown site of the plant (kiln) and offices as well as the former producing Lockerby Pond where the linear remnants of the drag line scars are still visible (Fig. 8).

In most of the Nova Scotia past diatomite production operations extraction of the material was done by some mixture of drag lines and/or hand digging. Typically, the lake or bog would be drained or at least lowered and the material transported to the plant where it would be heated to burn off impurities and produce a dry product. At some locations, such as here at East New Annan, a kiln was constructed for calcining. Drying and calcining of diatomite requires considerable heat energy and this was supplied by burning hardwood collected from surrounding forests. A considerable resource of diatomite remains within Nova Scotia's lakes and ponds with a conservative estimate placing it in the many hundreds or thousands of tonnes. However, the obvious environmental issues associated with extracting the material would seem to be prohibitive to any future operation. At least we know it's there if we need it.

Figure 8 Remnants of drag line scars in Lockerby Pond, East New Annan.

Stop 2-5: East Mountain Gabbro Quarry, East Mountain.

Directions:

Return to the Truro Road and drive south for 18 km through McCallum Settlement to the bridge at North River. Turn left, cross the bridge and you will immediately intersect Highway #311. Turn right and drive south on Highway #311 for 3.1 km to Mountain Lee Road on the left (sometimes referred to as Brookside Road). Drive east on Mountain Lee Road for 5 km to the traffic lights at the intersection with Highway #4 at Valley Crossroads. Turn left and drive north on Highway #4 for 560 m to a point immediately north of the TCH overpass. Between the overpass and the stop sign of the west bound TCH off ramp, you will notice a gated gravel country lane on the left side of Highway #4. This lane leads north about 1.5 km past an old saw mill to where it ends at a currently operating bedrock aggregate quarry. This quarry operation is extracting rock from the East Mountain gabbro pluton and is Stop 2-5.

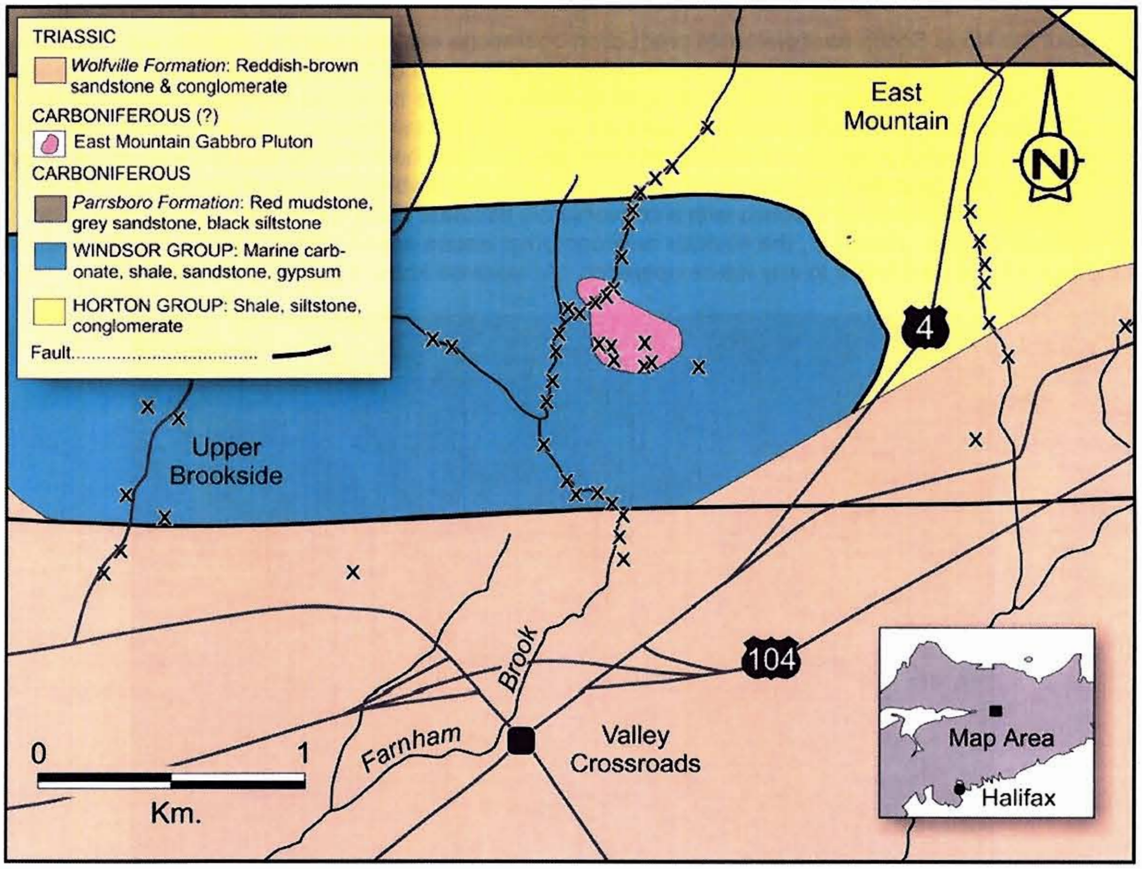

Figure 9 Geology of the East Mountain area, north of Truro, showing the East Mountain Gabbro Pluton.

Stop Description:

There is a currently producing bedrock aggregate quarry developed in a gabbro intrusion at Stop 2-5 (Fig. 9). Early geology maps of this area, prior to quarry development, indicated outcrops of gabbro within Horton Group sediments. Recent mapping associated with the federal/provincial Targeted Geoscience Initiative in 2004 (TGI-2) showed that actually, the pluton actually intrudes Windsor Group sediments. The gabbro is typically purple-grey colour and is texturally inhomogeneous. For the most part, the gabbro is fine- medium-grained and, interestingly, large portions of it resemble volcanic rock. However, elsewhere it clearly looks intrusive. In fact, recent exposures made by the aggregate operator now suggest that perhaps both volcanic and intrusive rocks are present suggesting the intrusion is some sort of volcanic pipe like structure.

We'll examine the rocks and discuss these possibilities on the trip. Walk about and you'll notice the presence of several "pods" within the gabbro containing an abundance of plagioclase and light coloured tremolite. These pods are gradational with the massive, porphyritic gabbro and are believed to be the result of metasomatic processes in the melt during crystallization. Veins of jasper and a reddish carbonate can also be found intruding the gabbro. The industrious among you may turn up nice samples of these minerals.

So Ends the Field Trip.

Return to the TCH interchange at Valley Crossroads and have a safe journey home.