MINERAL RESOURCES BRANCH

Selected economic mineral deposits of the Walton Belt, Hants County, Nova Scotia.

A field trip conducted by the Nova Scotia Prospector's Association, and the Nova Scotia Department of Natural Resources

Spring 2003

Open File Report ME 2003-1

Ron Mills, George O'Reilly and Dr. Howard Donohoe

NOVA SCOTIA
Natural Resources

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The site of the world's largest known deposit of barite, Walton, Hants Co., Nova Scotia - present day.

Field Trip Leaders:
Ron Mills,
George O'Reilly,
Dr. Howard Donohoe.

OFR ME 2003-01

Dedication:

Roughly one year ago, the Nova Scotia Prospector's Association conducted a field trip to the Cobequid Highlands, for the purpose of education and the usual social intercourse shared by prospectors who wish to further their activities and industry. A significant locality visited as part of the trip was the area around Londonderry, Colchester County. Field trip guides are rarely augmented by the addition of a local person. However, the stops in the vicinity were a departure from this routine. At Londonderry, the association was joined by local historian Trueman Matheson, the author of, "A History of Londonderry, N.S.". We were also treated to a measure of quiet hospitality at his home, where he and his wife Stella offered the association members present a brief respite from the heat of the day during our lunch break.

Londonderry is today a small quiet village, but the past glory of a proud town and its people was brought to life by this remarkable gentleman through his stories, humourous anecdotes, personal experiences and a museum he managed as part of the intimate commitment he had with his community. Londonderry eventually faced a juggernaut of economics, as most mining towns eventually do and, for the most part, faded into history. Many people present were not aware that Trueman was facing a juggernaut of his own at the time, locked in a courageous battle with cancer. In early December of 2002, Truman succumbed to this battle.

Community leader, teacher, husband, father. This field guide is dedicated to the memory of Trueman Matheson.

Left to right, Trueman Matheson, field trip guide Dr. Howard Donohoe, NSPA president Lindsay Allen and NSPA appreciation award presenter Doug Bowes.

Introduction:

The economic geology of Hants County offers insight into mineralization developing from a period from continental collision and uplift, an ocean reopening under a tropical sky, glacial cover and finally present day. These are represented by rocks ranging in age from the Cambrian, represented on this field trip by the Meguma Group and overlying unconformable Horton Group strata, which are in turn unconformably overlain by the Carboniferous Windsor Group, and overlying clastics and unconsolidated sediments of the Cretaceous and Pleistocene.

The Meguma Group (400-700 million ybp) was formed as a series of offshore muds and uplifted in a major orogeny known along the eastern seaboard by several names (Caledonian Orogeny, Acadian Orogeny, Appalacian Orogeny, etc). This tectonic event closed the ancient Ocean Iapetus forming the rocks we generally associate today with Nova Scotian gold fever, as they were intruded by Devonian plutonism and related (precious metal laden) secondary mineralization.

The Windsor Group consists, for the most part, of a series of limey clastic rocks which infilled the northeast trending Minas geosyncline, a small sub-basin of the discontinuous Maritimes Basin of eastern Canada, as well as other clastics from siltstones to conglomerates. Many of these rocks formed breccias, as they were associated with graben development and tectonism. Others formed thinly stratified lenses and layers of limey muds. Some of these beds, due particularly to their (limey, reducing) chemistry and/or competence (permeable, thus inviting fluid invasion, or impermeable cap rocks) formed important elements within local environments that invited deposition of mineralization after deposition.

With respect to economic geology, the most important formation currently recognized within the Windsor Group is a relatively thin basal unit consisting of thinly bedded, slightly limey, often dark, banded mudstones known as the Macumber Formation. A great deal has been written about the formation, yet few people alive today can consistently positively identify rocks that come from it. This is partially due to the fact that within the synclinal sub-basin in which the Macumber is found, there existed many different depositional environments. This eventually led to facies changes within the formation that were complicated tectonically, chemically and spatially. The Macumber is poorly exposed and barely traceable over any of its length, partially due to these changes. This has led to a situation where a great deal of disagreement exists today between academics as to where the Macumber begins and ends along facies boundaries, stratigraphical boundaries (such as the overlying Pembrooke Formation), or whether these boundaries should exist at all. Whether or not these arguments are justified, one fact remains: the Macumber Formation has hosted some of the most important economic deposits of mineralization in the nation and the world. Indeed, the Macumber hosted Tennycape manganese mine was once the largest producer of the commodity in the nation, while Walton was the largest producer of barite in the world and, to this day remains the largest known deposit of that commodity on the planet, as well as an important former producer of silver and base metals.

These deposits have peculiar similarities to deposits known as, “Irish deposits”. Large base metal deposits in Ireland have formed where low to medium temperature, mineral rich fluids have invaded permeable stratigraphies of limey rocks in pulses with resulting mineralization in succeeding phases, with minerals replacing one another as the evolution of the deposit progresses. These phases usually take place with relatively long periods of tectonic and depositional hiatus. This situation is one we will see at some of these sites we will visit on this trip. At some sites there is evidence that only a primary or later phase of mineralization was

present. At others, more than one phase is present, often with spectacular results.

The main Walton pit in 1964. The light coloured rectangle in the lower right quadrant of the photo is a large shovel working at the bottom of the pit near the lowest bench.

Overlying the limey Windsor Group rocks and the related clastic sediments, Cretaceous aged deposits (65 - 144 ybp) may also be formed and still present, if they have not been obliterated by glacial reworking. While the Cambrian rocks record the advent of a continental collision, Cretaceous aged sediments formed as the supercontinent of Pangea was breaking up and oceans were opening as opposed to closing. At this time, temperatures were warm, and global sea levels high, as there was no polar ice anywhere. Landscapes were, therefore, much lower than they are by comparison to today. A tropical climate contributed to the development of saprolitic weathering of many rock types in-situ, which were often reworked by fluvial activity. This lead to the development of important unconsolidated Cretaceous sediments.

These unconsolidated deposits are tremendously important to the economic framework of Nova Scotia. We will visit one of these important deposits in order to see what valuable lessons may be gleaned from this site as well.

Field Trip Itinerary

Saturday, June 14, 2003

08:30	Ar	Tim Horton's Coffee Shop at Windsor Exit 5A, Route 101. Field Trip Overview and Safety Considerations.
09:15	Lv	
09:30	Ar	STOP 1-1. Little Meander River Gold Placer; Gold panning.
10:45	Lv	
11:10	Ar	STOP 1-2. Scotia Slate.
12:10	Lv	
12:20	Ar	Courthouse Hill — Lunch STOP 1-3. Rawdon Fault.
13:00	Lv	
13:10	Ar	STOP 1-4. West Gore Au-Sb Mine
14:10	Lv	
14:20	Ar	STOP 1-5. Centre Rawdon Au Mine
15:05	Lv	
15:30	Ar	STOP 1-6. Shaw Resources
16:30	Lv	

Sunday, June 15, 2003

09:00	Ar	Goss Bridge, Shubenacadie River at South Maitland. Field Trip Overview and Safety Considerations.
09:15	Ar	STOP 2-1. Titanium Sands in the Shubenacadie River at Goss Bridge.
10:15	Lv	
10:45	Ar	STOP 2-2. Tennycape Manganese Mine.
12:00	Lv	
12:15	Ar	STOP 2-3. Magnet Cove — Lunch
12:45	Lv	
12:55	Ar	STOP 2-4. Red Marble Showing
13:25	Lv	
13:40	Ar	STOP 2-5. Walton Ba-Cu-Pb-Zn-Ag Mine
14:45	Lv	
14:55	Ar	STOP 2-6. 3 km Base Metal Showing
15:15	Lv	
15:35	Ar	STOP 2-7. Cheverie (Kipps Beach);
16:35	Lv	

A NOTE ABOUT SAFETY

All field trips involve some degree of risk. We are going to brief you about potential problems and hazards and how you can minimize the exposure to these. You may wish to follow our example when you lead your field trips. We suggest that having an adequate first aid kit is essential and a trained first aider highly desirable.

Our purpose is not to scare you but to present what solicitors may describe as information leading to informed decision making. You or others make the decision to go on the field trip or not to go. On this field trip we are not asking you to sign a release; however, we are going to brief you about specific safety practices, special protective equipment and how to keep yourself and others from problems.

In all areas where cliffs overhang or are steep, we will ask you to wear hard hats. This is common practice now with most geologists and collectors. When you are examining cliff faces, stay only long enough to get a sample, photograph and/or the information you need; less exposure to possible falling rocks is certainly a good idea! At the top of cliffs, stay away from the edge; it may undercut, weak or simply treacherous.

Use only a rock hammer for breaking samples. Carpenter's hammers are not appropriate as the metal will often splinter and send steel chips flying! Make sure others are away from you when you use a rock hammer. In fact, turn your back on them. Wear eye protection (safety glasses or prescription eyeglasses with hardened lenses) when breaking rocks.

In an operating mine or quarry, follow the directions from either the trip leaders or designated employee(s) of the company. Do not linger near, in or on, former mine workings; they may cave in without notice. Often former underground mine workings have limited or no oxygen in the air and weak roof conditions making any ventures into these former mines extremely hazardous. This caution also applies to all of Nova Scotia and elsewhere.

In tidal locations, be aware of the tide times. Never venture out unless you know the tide times and are sure of a safe return. The Fundy tides are the highest in the world and can cut you off from your access without any warning. Be sure the points of land that you go around are going to remain above the high tide line for your safe return. Be aware of slippery sea weed and green algae. Both can be treacherous footing and are to be avoided.

In summary, making safety a factor for everyone on a field trip ensures fewer problems with participants, parents, school administrations, governments and other institutions. Use common sense and encourage your students to do the same.

Stop 1-1 Little Meander River Gold Placer

Directions:

From the parking (meeting) area., we will turn right and proceed under the overpass following for approximately 5 km to Sweets Corner, turning left onto highway 14 toward Brooklyn. At the main intersection in Brooklyn, we will get on highway 215 (south) toward Newport for 1 km, bearing left at MacKay Section. Follow the road for 1.5 km over the Little Meander River to a hill approximately 250-300 metres beyond where we will park.

History:

This site is known to have been worked for a short time in the 1860's by several workers for placer gold. The actual location worked by prospectors at that time has been a matter of some conjecture but, prospector Roland Anthony believes he has narrowed the area down considerably.

At one time this site was believed to be an example of a Meguma Group - Horton Group contact placer like the one at Fall Brook, Hants County, but, is now understood to be a modern placer consisting of free gold dispersed from Meguma veins that coincidentally lie close to a contact with the overlying Horton Group clastic rocks in the east limb of the MacKay Settlement anticline.

In the early 1900's, considerable money was spent damming the Meander River and building sluices (Industrial Advocate, Vol. 4). Antimony is also known to be present in the area as well (O'Reilly, 1996)

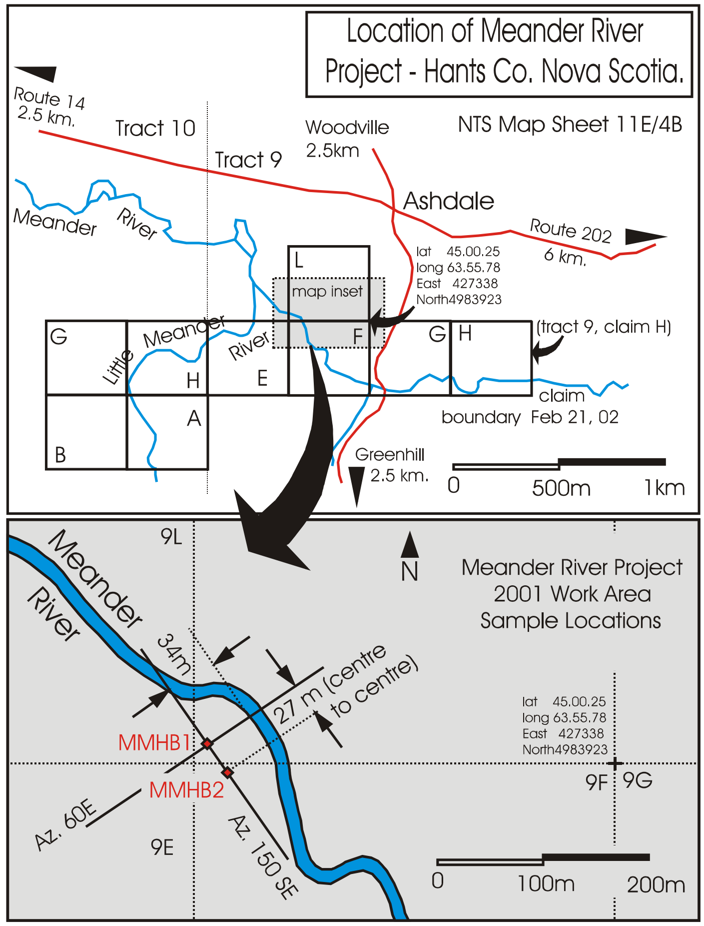
The exploration program has consisted of several small heavy equipment - dug pits, the media from which has been sluiced by Mr. Anthony with encouraging results. However, the program has been beset with permitting delays and red tape due to the involvement of several government departments, despite acute attention to detail paid to permitting applications on the part of the prospector involved and a fully co-operative landowner. The project has become an example of defects in the government's, "One Window Approach", to permitting.

Site Description:

A stratigraphic column drawn for this site would put the mineralized gold veins near the top of the Meguma Group, close to its contact with the Horton Group. Pits, believed to be sunk on Meguma quartz vein material, are present to the immediate area southwest and upstream, of the modern placer target. The pits exist on both sides of the stream in the steep bank of the stream cut, above the small flood plain. The orientation of the veins is stratabound, and much vein material may be seen in the alluvium of the stream in the small flood plain at the bottom of the stream cut. Cross veins are regionally common in this area, however, and are known to be present at Rawdon Centre and Ardoise.

Discussion:

Gold dispersed from these veins glacially, would have been demobilized by fluvial action and sorted into the flood plain area, where they would be further sorted into the more coarse and basal sections of the alluvium, where it would come in contact with Meguma Group basement. Meguma basement, when seen in any cleaned, glacially scoured outcrop, is filled with fractures and cracks, providing excellent riffles and a good depositional environment conducive to gold accumulation. Commonly, in the Yukon and other areas where placers are actively worked, heavy equipment will remove the top several inches of basement rock along with the alluvium to be sluiced and concentrated. This heavy equipment, "sniping", is one of the best known methods for increasing grade head levels at commercial placer developments. Mr. Anthony (pers. com.) has indicated that heavy equipment buckets of the top few inches of basement in his exploration pits had the best returns.



References:

1996: O'Reilly, G. A. Mineral Occurrence Database Card for Little Meander River, Hants Co., N.S.. Nova Scotia Department of Natural Resources Mineral Occurrence Database Mineral Occurrence Card E04-007

1899-1907: Industrial Advocate, News Nuggets. v 14, No. 8. Nova Scotia Department of Natural Resources Miscellaneous Report A 322.

Stop 1-2 Scotia Slate

Directions:

From the lunch area at Courthouse Hill, we will proceed west for 1 km on the gravel road until intersecting the pavement and continue in the same direction for another 5 km to Cheese Factory Corner. Here we will turn left and take the next immediate left up the hill. Follow this for 2.3 km to Frasers Road on the left. Follow Fraser's Road to the quarry at the end of the road.

ACTIVE QUARRY WARNING:

This is an active quarry. The usual warnings are in effect regarding hard hats and steel toes. As well, **THIS PIT HAS UNSTABLE SIDES and WILL NOT BE APPROACHED BY US**. The slate has extremely sharp edges. Falls of stone in this type of benching are common and would be hazardous. **We will look at outcrop on the edge of the pit, only.** Heavy equipment may be moving between the pit and the active inventory sections of the development site. Stay alert!

----SPECIAL NOTE----

NO CAMERAS!!!!!!!!!

NO PHOTOS MAY BE TAKEN AT THIS SITE!!! IF CAMERAS ARE SEEN ON THIS PART OF THE FIELD TRIP THE SITE VISIT WILL IMMEDIATELY BE CUT SHORT AND THE SITE VISIT WILL BE TERMINATED BY SCOTIA SLATE PRODUCTS.

History (and future):

The idea that would spark the development of this company actually had its root in Europe in the Second World War. Albert MacPhee, a shareholder, experienced first hand, the beauty of slate roofing tiles commonly used in European cities. He realized that rocks on family property back in Nova Scotia could be used for similar building materials as well. Decades would pass before the earnest investigation of the slate at this site as a building material, at first, to tile the roof of a family home. Terry MacPhee, Albert's nephew, would eventually make a trip to Vermont with Debra Donovan to investigate the slate building material industry there and slowly, a vision of a company emerged that would develop and market a line slate products.

A small, aggressive company, Scotia Slate Products relies heavily on the talents of their executives. Debra does the marketing and strategy work while Terry manages the pit and shop. In a small company such as this, education and operational talent keep it competitive. The company's offices, pit development, gear etc (not including the value of the land) represents an approximate investment of $800,000. It presently employs a work force of 17, mostly local people.

Scotia Slate is in a good position as businesses of this type go, since the principal persons involved in the company own the land to the quarry as opposed to leasing it, unlike competitors. Also unlike other producers of similar material, this company doesn't sell by the ton. Product is sold by the square foot and therefore the price gets higher as the product becomes thinner. This is presumably due to shop work to split stone when clients order it as such.

A common question at a site such as this involves waste. All operations such as this have waste but, the company presently has a low percentage of waste and envisions a day when it will have no waste. Large pieces are marketed as flagstones, smaller pieces may be marketed as wall building material, gravel sized detrius as road building material, etc. The company is constantly trying to expand its horizons and hopes to employ wire saws to enhance productivity by helping to expand the product line while lowering the percentage of less valuable waste at the mine site.

Site Description:

At the pit, note the absence of pyrite and secondary mineralization (other than chlorite and garnet porphroblast development) in the stone. This is tremendously important, as this pit is competing with products from India and China, which often are competitively priced but, of poorer quality, with secondary unstable iron in the matrix. As at the West Gore site, the bedding planes here are close to the cleavage planes, and partially account for the excellent cleavage development which is Scotia Slate's bread and butter. On the far side of the pit (along the road) we will see a naturally weathered outcrop with slatey cleavage development that is less obvious due to the high degree of polish on the glacially paved surface.

Discussion:

Scotia Slate Products has been instrumental in the betterment of the local building stone industry and have been working to develop the, "Atlantic Cnada Dimension Stone Association," to help themselves, and others, market their products in a more efficient manner. The company sees the unique geology of Nova Scotia, with so many different rock types in close contact to one another, as giving the province a natural advantage to the development and marketing of building stone products to the clients that would use them.

Stop 1-3 Courthouse Hill, Lunch, and the Rawdon Fault

Directions:

Proceed to Gore and look for the signs that say “Courthouse Hill” on the east side of Route 354.

Site Description:

The purpose of this stop, besides having lunch and a beautiful view, is to appreciate land form development and the boundary between the Meguma Group and the younger Carboniferous rocks.

As you look to the north, you are looking into an area underlain by the softer Early Carboniferous rocks. Courthouse Hill and the high ground east and west of Gore is underlain by quartzite and slate of the Meguma Group that is more resistant to weathering. Thus the harder rocks hold up the hills and the softer rocks underlay the valleys and low areas. An examination of the stream patterns shows that many of the Rawdon Hills stream valleys are oriented NW-SE or NE-SW. The NE trending valleys are following the beds and lithologic units in the Meguma Group. The NW trending valleys exist because weathering and erosion have been concentrated along joints, faults and fractures in this NW orientation. Mechanical weathering such as freezing and thawing and wetting and drying combines with chemical weathering to produce the destruction of rocks. The joints and fractures are a natural location for intensive weathering because the rock is broken and not homogeneous. Glaciers have also sculpted the land in the past 75 000 years and by about 11 000 years ago all of the ice had melted.

The Rawdon Hills are surrounded on the north and east by Carboniferous rocks. The boundary on the east is an angular unconformity. On the north a fault separates the older rocks from the younger.

Next to the Rawdon Fault conglomerates and sandstones of the Horton Group (approximately 350 million years) overlie the Meguma with an angular unconformity. Fragments of the Meguma appear in the bottom beds of the Horton. Later the Windsor Group (approximately 330 million years) has unconformably overlain the Horton Group. Each of these unconformities represent a period of lost time where there was no deposition and/or erosion.

Discussion:

Rock deformation created by large scale events (continent sized scale) is well represented here in the Rawdon region. The collision of two terranes (Avalon and Gondwana) created a period of mountain building called the Acadian Orogeny at about 390 million years ago. This event produced folds and cleavage in the Meguma rocks at this location

The younger rocks have also had some amazing deformation. NE of the Rawdon Hills the limestones of the Windsor Group have been folded into an anticline, which then has been rotated into a syncline shaped fold called a synformal anticline. This unusual structure accompanies a low angle thrust fault that affected the Windsor Group after it was deposited. Most of this deformation is middle Carboniferous, about 320 million years old.

The sequence of events in the Rawdon area is:

1: deposition of the Goldenville quartzites,
2: deposition of the Halifax Formation slates,
3: folding, uplift and erosion of the Meguma Group and then deposition of the Horton Group,
4: erosion and deposition of the Windsor Group,
5: major low angle thrusting and folding,
6: faulting along the Rawdon and Roulston Corner faults pushing the Rawdon Hills up and the Carboniferous rocks down,
7: deposition of Cretaceous sands and clays and then movement on the Rawdon Fault (down thrown to the north), and
8: weathering and erosion by water and ice and glacial deposition to produce the current landscape.

Deposition of the Rocks:

Rocks of the Meguma Group were deposited offshore of the Gondwana continent beginning about 520 million years ago. The sands from the continent, which included South America, Africa, Antarctica, India, Saudi Arabia, and Madagascar, were deposited northward into a shallow part of the ocean. Later the sands cascaded down the slope in density currents called turbidity flows and formed the thick and thin layers of quartz rich sandstone that is now metamorphosed to quartzite. In Late Cambrian time (about 500 million years ago) the source of the sand changed and only mud and silt were available to accumulate in the ocean. These rocks, which became the Halifax Formation, were hardened into shale and siltstone and later metamorphosed into slate during mountain building.

Rocks of the Horton Group were deposited on land from rivers. Some of the landscape of this area about 350 million years ago was hilly or mountainous judging from the conglomerates in the Horton. By 330 million years the land had either subsided or had been worn down and then was flooded with a shallow sea. The limestones of the Windsor Group were deposited during this time.

Cretaceous rocks are not exposed here but represent river deposits of sand and clay about 100 million years ago. Glaciers deposited unsorted till over all rocks as the ice sheets melted and retreated.

References:

2001 Horne, R. J., Macdonald, L. A., and King, M. S., Geological Map of the Meguma Group in the Rawdon Area (Part of NTS 11E/04), Hants County, Nova Scotia; Nova Scotia Department of Natural Resources, Map ME 2001-1.

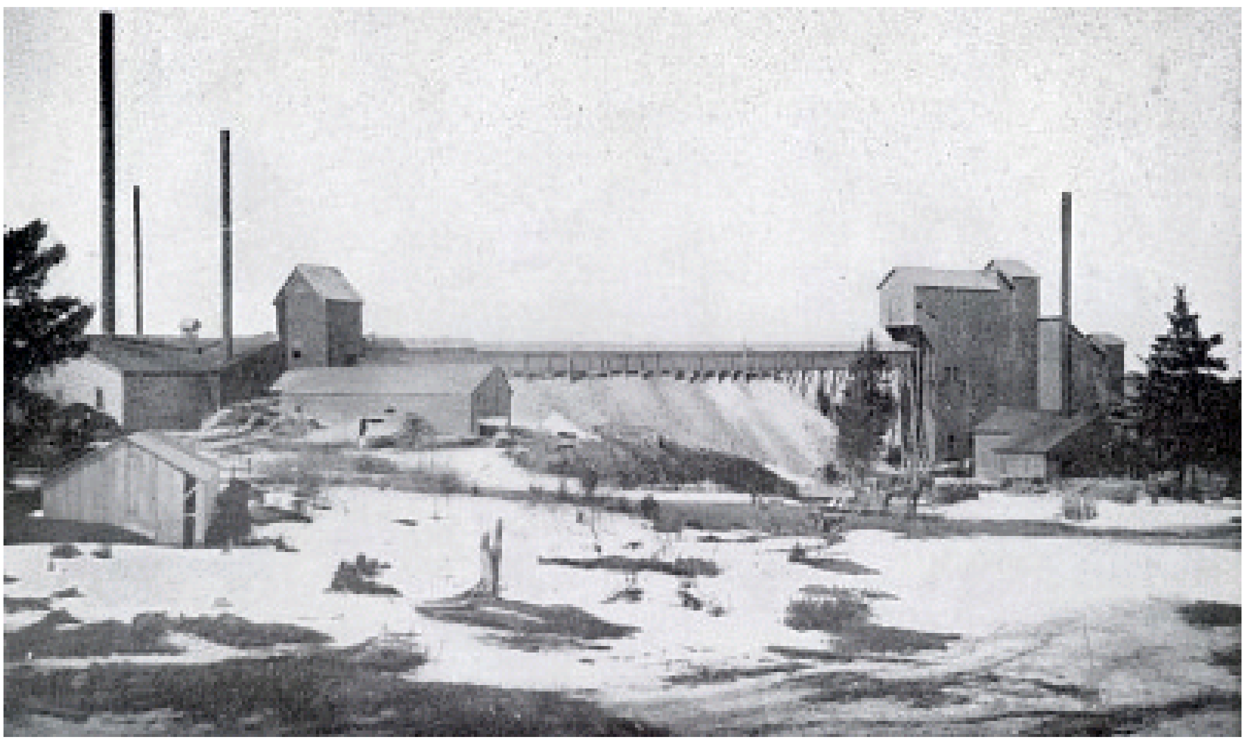
Stop 1-4 West Gore Gold and Antimony Prospect

Directions:

From the parking area at Centre Rawdon, continue for a few hundred metres and turn left onto the paved road. Drive for 1 km and turn right at the intersection. Drive for 4.5 km and bear right after the second bridge. Follow this for another 2.7 km to a very hard right onto a gravel road and follow it for another km to the end.

History:

Mineralized float boulders containing Sb were discovered while exploring for gold in the area in 1880. The float was subsequently traced to two large mineralized fissure veins in Cambro-



Production at West Gore circa 1916.

Ordovician Meguma Group rocks, striking ENE and dipping approximately 45 degrees SE. The site was mined for Sb and Au, with numerous shafts developed, the deepest being 259 metres, at which point good ore continued to be encountered. The ore was hand cobbed and shipped to England where it was smelted.

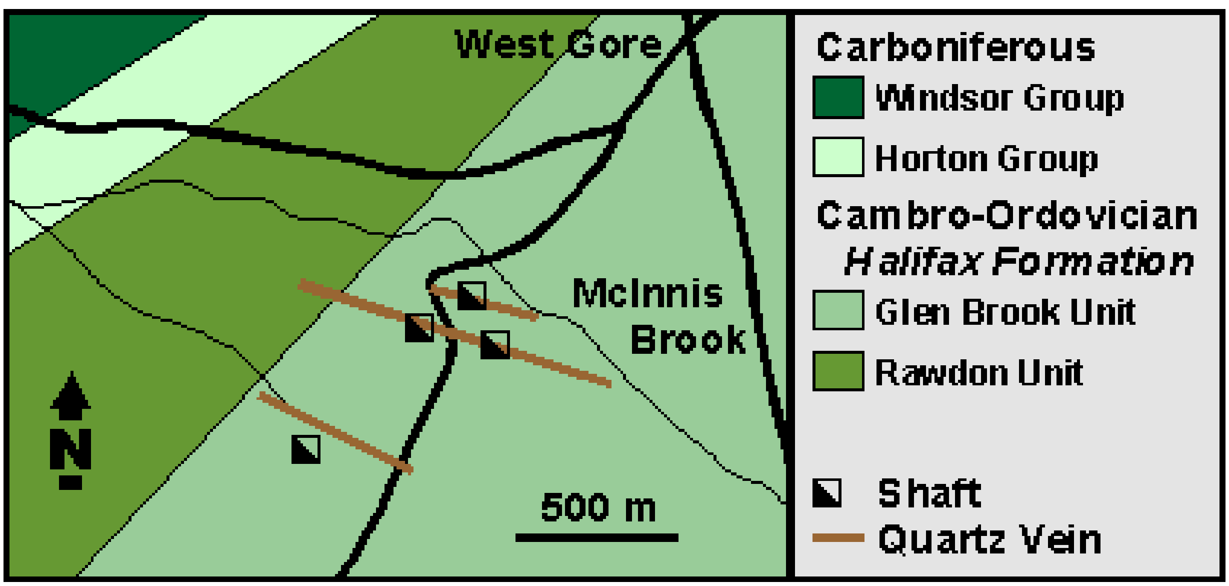
Site Description and Geology:

The developed veins are 308 m apart, striking 305º Az and dipping 85º SW. The veins are cut by minor quartz stringers, originating from a diffuse foot wall, with a well defined head wall contact. The extent of the main vein has been traced for 366 m along strike, where it pinches out in a contact with massive Goldenville Formation to the south, and contact with a second northeasterly trending shear system to the north.

Main ore minerals were stibnite, native antimony and native gold and native silver, with accessory pyrite and arsenopyrite and quartz-carbonate which has an affinity for gold mineralization as well. Minerals reported to have been returned from the site also include kermesite, valentinite, and secondary iron sulphides. Slatey rocks along the ore zone display a notably high degree of sericite alteration. Antimony ore consists of finely brecciated slate within the shear zone (O'Reilly, 196). A heavy mineral concentrate of this material, reduced to 20 mesh, yielded 25% arsenic, 15.25% antimony and 9 to 11 ounces of gold / ton (O'Reilly, 1996).

Discussion:

As we ascend the road toward the site, note the slatey cleavage in the outcrop in the road washout which is commonly seen in the Rawdon area. The cleavage and bedding planes here are as close to being parallel as they ever get, to within 15 degrees. The cross veins run almost parallel to the direction of the roadway as we climb the hill. The veins were probably emplaced in structurally incompetent layers of shear. Jointing can be seen in the outcrop oriented in the same direction as the veins. Note brecciation in veins at the site. Note some of the alteration



West Gore Antimony-gold deposit (after Kontak). Note bedding - vein relationship.

minerals at the site as well. Chlorite (often massive), apatite and fluorite, all attest to events indicating a varied geochemical alteration history at West Gore.

The area holds excellent exploration potential yet. Rich float has been located on a hill between the two veins and is believed to originate from a third, yet undiscovered vein. Approximately 1.6 km southeast, approximately 1 ton of ore grade float boulders were exploited from another undiscovered source. Swamps along the northeast extension of the main zone display Fe oxides that may be the result of Fe-Sb-Au mineralization but these targets have not been explored to any appreciable degree.

References:

1996: O'Reilly, G. A. Mineral Occurrence Database Card for West Gore, Hants Co., N.S. Nova Scotia Department of Natural Resources Mineral Occurrence Database Mineral Occurrence Card E04-001.

1996: Kontak, D. J., Horne, R. J. and Smith, P. K. Hydrothermal Character of the West Gore Sb-Au Deposit, Meguma Terrane, Nova Scotia, Canada. Economic Geology, V. 91, p.1239-1262.

Stop 1-5 Centre Rawdon Gold District

Directions:

From the iron bridge at Stop 1-1 at Little Meander River, continue east on the road for 1.2 km to a "T" intersection. Turn left and drive north for 3.7 km through the Ashdale to the intersection with Highway #14 at Woodville. Turn right and drive east on Highway #14 for 9.05 km to the main intersection at Centre Rawdon. Turn right and drive south on the road toward South Rawdon for about 1 km to a gravel road leading east and up a long, gradual hill. The Cope Workings of the Centre Rawdon Gold District are found on both sides of this road about halfway up the hill.

Site Description:

Mining at Centre Rawdon took place in two main areas. The Cope Workings (sometimes called the West workings) are found on the side of the hill west of Highway #14 and the East Workings are found in the woods in behind the church to the east of the highway. On this stop we will examine only the Cope Workings as they are the more substantial and easier to get to. The northwest-trending quartz fissure vein, from which all gold was mined in the Cope Workings, crosses the road leading up the hill about halfway between the stream at the base of the hill and Highway #14 at the top. Shafts are found on both sides of the road but the main shaft, and most substantial mine dumps are to be found north of this connector road. The mill for the mine was located at the base of the hill on the north side of the connector road along the edge of the swampy area. The mine tailings are in the swampy area and will likely be hard to find.

Geology of the Deposit:

Although the Centre Rawdon Gold District was a small producer (6,744 oz from 5,335 tons crushed), it's geology is somewhat unique when compared to other Meguma Group hosted lode gold deposits and is the reason it is included as one of our stops. All production from the Centre Rawdon District was from northwest-trending, fault controlled, quartz fissure veins. The veins strike 340° and dip between 75-80° east. The Cope Workings actually consist of two distinct veins, the Cope Lead and the West Lead that converge together in the northern section of the workings. Although they join together, they still remain separated by a band of crushed slate for the entire exposed length. It's also important to note that a considerable amount of the gold was obtained from the faulted and crushed slate that is also found in the fault zones.

It may be more than coincidence that the mineralized veins at Centre Rawdon occupy northwest-trending fault zones as do the mineralized quartz-carbonate veins at the West Gore Sb-Au Mine a few kilometres to the northeast. We will be visiting West Gore at Stop 1-4, but even though there are marked differences in mineralization style and overall mineral assemblage at the two deposits, the strong structural control to the vein emplacement is significant. Add to this the fact that both deposits are found along the south side of the regional scale, northeast-trending

Rawdon Fault and one has to wonder if movement on this major fault zone governed emplacement for the veins at both deposits.

Stop 1-6 Shaw Resources Sandy Desert Cretaceous Sand Operation

Directions:

From the Scotia Slate Products site, we will backtrack out to the pavement, and back toward the way we came for 1.5 km where we will turn left just past a barn, be careful not to miss the turn. After 2 km we will intersect highway 14, bear left and follow this for 5 km past a church on the right. Approximately 500 metres past this turn left off the highway onto a gravel road and follow it for 5 km staying left at the intersection and continuing for another 3.2 km to another left. Follow this to the end of the road.

Safety:

An extra note is warranted here, as Shaw Resources is a very safety oriented company, which requires not only that visitors wear the usual safety hats and approved shoes, but we are also required to wear long pants, orange vests and safety glasses while on the site.

WARNINGS:

As we approach the pit, heed warnings from the field trip leaders as **THERE IS A RELATIVELY STEEP WALL RECEDING INTO DEEP WATER** in the pit, close to the road near the area where we will park, and to the left of the pit heavy equipment access decline.

THE STOCKPILE IS VERY DANGEROUS and is not stable on the side facing away from the pit because of the heavy equipment used.

History (and Future):

Silica was the primary element used in sandblasting as the industry developed. L. E. Shaw began its operation with the extraction of brown sand from an esker formed on the property for such use, in the 1950's to the 1970's. The company grew during that period based on this need as well as other markets that were developed in conjunction with other industries such as the LaFarge cement plant at Brookfield. The brown sand from the esker had several marketing limitations, however. As many of these markets became, “higher tech”, they were growing less tolerant of deleterious materials in the aggregate. Shaw was keen to find a similar, better commodity that had better future marketability.

In 1978 Scott Paper was bulldozing a road not far from the Shaw operation when the dozer driver, a part time prospector with experience looking at aggregate (he was the brother of the L. E. Shaw pit operations manager), recognized a beautiful white sand being torn up by his blade. This was surprising, as he noted there was no exposure of such sand to be seen anywhere in the locale. He staked the claims, approached Scott Paper regarding the possibility of putting a deal together with L. E. Shaw and a deal was struck to investigate the resource. Sixty holes were drilled by L. E. Shaw to explore the size of the sand deposit, research the quality of the commodity, and make decisions on pit size and shape as the exploration project progressed. The deposit was found to host a fine clean sand, as well as other excellent products, that could expand the range of markets L. E. Shaw was servicing at the time. These ranged from glass sand to clean aggregates with clast sizes larger than sand to clays for specialized industrial use. The fact that the site was just a few kilometres from Shaw's existing (esker) milling operation didn't hurt either. The pit was in operation shortly thereafter.

Silica is not used for the purpose of sandblasting today, and to stay on top of this business companies must develop new markets as old ones fade or become obsolete. No one would have imagined when the pit opened in the late 1970's some of the markets that would be filled by products made from this material. Today, these include waste water treatment plant filter beds and bunker sand in new golf courses opening to service the growing segment of baby boomers trading in hockey gear and Honda Interceptors for golf clubs. Shaw has a considerable amount of marketing muscle and about 30 products, altogether, are marketed from this remarkable deposit.

The pit is a seasonal operation. Water in the pit is first pumped to a natural wetlands area close by in a pumping routine that generally lasts 6 weeks to 2 months. Approximately 150,000 tons of material is benched and stockpiled at that point. A single mining operation will provide enough material to meet operational needs for 2-3 years. The pit should be able to meet current consumption levels for at least 25 years. The entire Shaw Resources operation supports approximately 50 employees.

Look closer and you will see that long term site remediation is underway as well. Drainage water is diverted around the pit at this time though a series of wide ditches, where it is naturally filtered through small swampy areas consisting of cattails, etc, which are encouraged to grow at the site. Some reclamation has already been done on the far side of the pit including contouring, hydroseed and tree planting. The final plan for the site will be to leave the pond, redirecting water inputs and outputs through it. There are few such clean freshwater lakes in the area and the final result should be very nice. Indeed, Shaw has a hard time keeping ATV drivers from stopping here and swimming in the summer! On the day the pit was visited to review safety concerns, a Canada goose was swimming in the pond and many deer tracks were noted at the site as well. Shaw's current reclamation activities contrast starkly with the reclamation of a forestry operation next to the site which appears poorly managed, to say the least, by comparison.

Geology (and lessons to be learned):

There are several interesting points of note to the pit. The geology here consists of a Carboniferous aged unit, overlain by the Cretaceous aged deposit, overlain by Pleistocene tills, in a small syncline. On the far side of the pit to the left, one will see a small canyon-like, "U shaped notch". This consists of (Carboniferous) gypsum. This is overlain by the white sand. On the (far) right side of the pit one can see the synclinal shape of the resource, with sand in the centre, flanked by a thin unit, on either side of clay. This is underlain by a further succession of sand as we move outwards on either side, and another layer of clay strata to the outside of the lower sand units.

On the left side of the pit, one can see that there is a certain degree of mixing between the Carboniferous and Cretaceous parts of the section. However, note the Pleistocene contact close to the right of the pit access decline. The contact is knife-sharp with no mixing whatsoever. There is no evidence of the deposit above the contact, despite the fact that trees may be growing only a metre over it. Note the contacts on the far sides. This is the case everywhere around the pit.

Note the trees in the area. There are a large percentage of pine trees, which will only tolerate very well drained soil. Herein lies an important lesson for prospectors that may come across such a site. If on digging a pit by hand such sand is encountered, continue to dig or auger to be sure it is not just a leached layer. If it is determined to be a Cretaceous sand, it could consist of a valuable deposit. Shaw is interested in such deposits if found within 20 kilometres of their currently existing wash plant. In other areas of the province, the value of any resource depends on the ability to market material as a raw resource, unless another plant could be found that could sort, screen, wash the commodity, and market it on a large scale.

For Tomorrow:

This ends day one of the field trip. We will meet on the west side of the bridge at Maitland at 9 a.m. to visit the site of titanium sand concentration in the Shubenacadie River in the morning.

Don't be late! We are racing against the tide!!!

Stop 2-1 Shubenacadie River Titanium Sands

Directions:

Proceed via Highway #215 to South Maitland. At South Maitland, immediately after crossing Five Mile River, take the road leading east from Highway #215 towards Brookfield and Truro. The bridge over the Shubenacadie River is a few hundred metres away, and the meeting point for the start of Day 2 of the field trip is a grassy area on the left (north) side of the road at the west end of the bridge (Fig. 2-1). The grassy area is accessed via a short gravel road that leads to the westernmost of the series of railway bridge abutments that cross the river parallel to the highway.

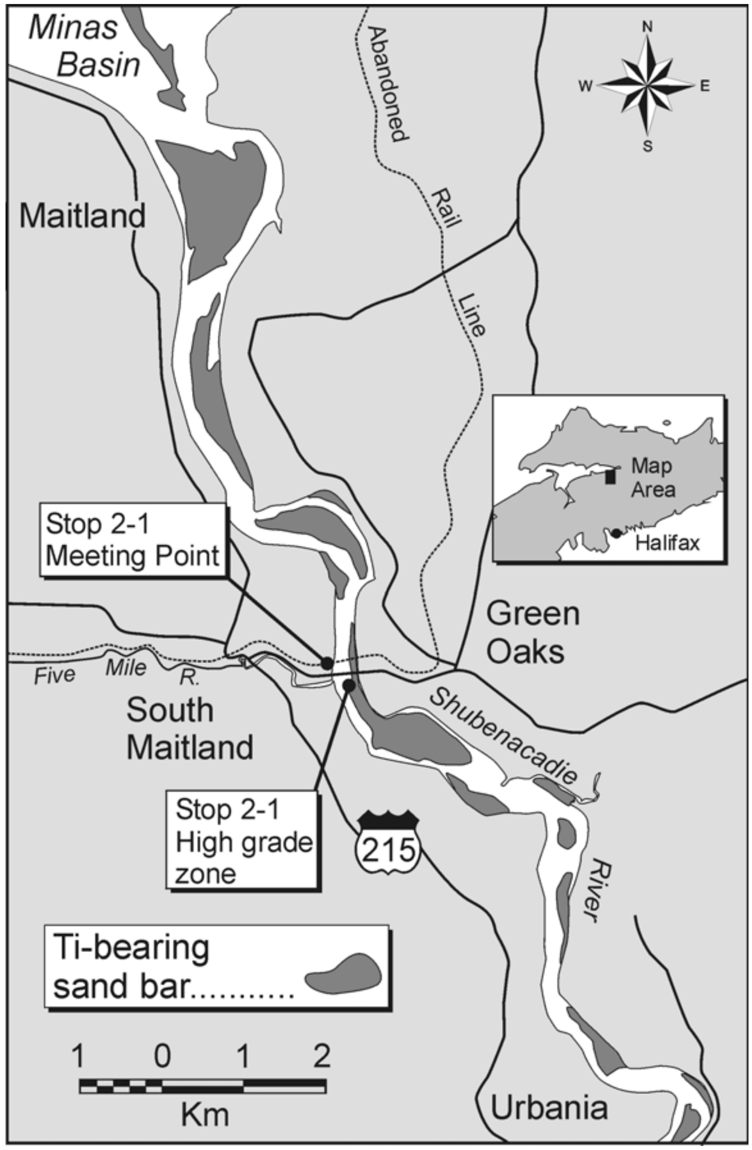


Figure 2-1 Titanium-bearing sand bars of the Shubenacadie River.

Once a quick overview is provided we will return to the cars, cross the bridge and park along the highway past the east side of the bridge. **Please pull completely off the pavement and be wary of traffic on exiting your vehicles.** Proceed on foot down over the bank along either side of the bridge to the shore. Just at the base of the embankment you will encounter a few metres of gooey red mud which is a bit messy to cross but, once across it, you are on the sands themselves which are a solid base and no problem to walk on. You will immediately notice wisps of black, heavy minerals in the sands but our stop will be a short distance south from the bridge to a prominent point on the sand bar in which there is a high grade zone. This area of high grade is only exposed at low- to mid-tide and is easily recognizable as a prominent black patch in the sand bar.

Exploration History and Site Description:

The Shubenacadie River may soon be famous for more than having the world's highest tides. The river is currently the focus of an exciting and promising exploration and development play for titanium. It's true that titanium is a "new age mineral" and most people think of things like titanium golf clubs and other sporting equipment but in reality, most of the world's production of the metal is used as paint pigment and in the production of plastics and paper. It's true that it is an important structural material and this is due mostly to the fact titanum is about twice as strong as iron and half as heavy. A modern commercial airliner consists of about 6% titanium. The metal is also used heavily in medical applications like joint transplants and plates etc. and this is due to the fact that titanium is strong, wears well and is one of the only metals that is non-toxic to humans and seldom rejected by the body.

Titanium Corporation Incorporated has been exploring the lower reaches of the Shubenacadie River, and tidal flats of the Minas Basin east from the river mouth, for the past 5-6 years. Heavy mineral-rich sand bars have been known on the river since the time of the early Acadian settlers in the region who once considered them as a source of iron. However, it was found the main mineral in the sands was the Fe-Ti mineral ilmenite, which was not considered a high quality source for Fe in those days. The Ti-sands were included in an inventory of "*Various Industrial Mineral Commodities*" (NSDME Report 92-1) by R. H. MacDonald in 1992 and this report was followed up on by local geological consultant Jason Ross took note of the bright industry forecast for titanium in the future.

The initial exploration efforts of Jason, and subsequently Titanium Corp., have indicated a world class resource of titanium-bearing heavy minerals occurs in the sand bars of the upper reaches of Minas Basin and as far up the river as Admiral Rock. To date, various programs of vibra-core drilling have indicated a probable resource of a massive 330 941 945 t of sand with an average heavy mineral grade of 1.936% with a 0.9% cut-off. This heavy mineral concentrate consists of three Ti-bearing minerals, ilmenite (Fe-Ti-oxide), rutile (Ti-oxide) and leucoxene (a weathering product of other Ti-minerals), as well as recoverable amounts of zircon and garnet. These figures are considered to be somewhat conservative as the drill program only went to a maximum of about 5 m depth even though many of the Ti-rich sand bars extend to greater depth.

From high on the bridge the sand bars have a reddish colour except for the odd dark coloured high grade patch. However, when we actually get down on the sands and examine them first hand, you will see that thin black wisps of heavy mineral occur throughout the entirety of the bars. The wisps produce a finely laminated appearance that is not merely restricted to the upper few centimetres of the bar. We suggest you scrape off a sample bag full of heavies from the high grade patch and you will quickly appreciated the heft of the material. The origin of the heavy minerals in the bars is not known for sure and it is likely they came from more than one source. However, one likely source is the large amount of Triassic age, North Mountain basalt that has been eroded off from the western mainland. Perhaps more important than the source of the minerals is the role that the massive Fundy tides have played in formation of the deposit. It would appear the tides over the eons with their corresponding repetitious transfer of huge amounts of energy, has acted as a natural wilfey table, constantly working and re-working the sands and concentrating the heavy fraction into what we see today.

The river and it's massive tides, have been Titanium Corp.'s best friend may also be it's worst enemy. On the friendly side, the tides played a key role in formation of the deposit and will play a key role in returning the bars to their pre-mining condition. Furthermore, the muddy condition of the water is due to the high energy level keeping the water at it's maximum sediment load. The river cannot carry any more sediment such that any clouding produced by the sand extraction operation will not muddy the water any further. On the negative side, trying to conquer this massive transfer of high energy water to allow extraction of the resource is going to be quite an engineering challenge. Titanium Corporation intends to extract the resource by way of a two dredge system employing gravity separation. There will be no chemicals used in the separation process. One dredge will essentially vacuum up the sand and the heavy mineral fraction will be separated off in a series of gravity spirals on the second dredge. The heavy mineral fraction will be slurried to shore and from where it will be transported to a central processing plant somewhere nearby. The remaining sand (approximately 97% of the original sandbar) will be returned to the river where the natural energy of the ebb and flow of the massive tides will return the bar to it's original form in short order.

Stop 2-2 Tennycape Manganese Mine

Directions:

Proceed back to Highway #215 from Stop 2-1. Turn right on Highway #215 and drive north then west through Maitland, Selma and Noel to Tennycape some 35 km away. From the bridge over the Tennycape River, continue west on the highway for about 1 km to a gravel road leading south from the highway. Drive south on this road for 1.15 km to a woods road on the right leading to the west. This is the old mine road leading to the mine but we will probably have to proceed on foot from here as in the springtime the first portion of this road is usually very wet. Walk along the mine road for 650 m to a grassy area with a woods road on the left. This point is essentially in the centre of the old mine workings.

Site Description:

The main shaft (165' deep) is found to the left (south) of the mine road about 20 m further west from the intersection described above (Fig. 2-1). **Remember, this is an abandoned mine site, please exercise common sense and caution as there are shafts and other excavations about.**

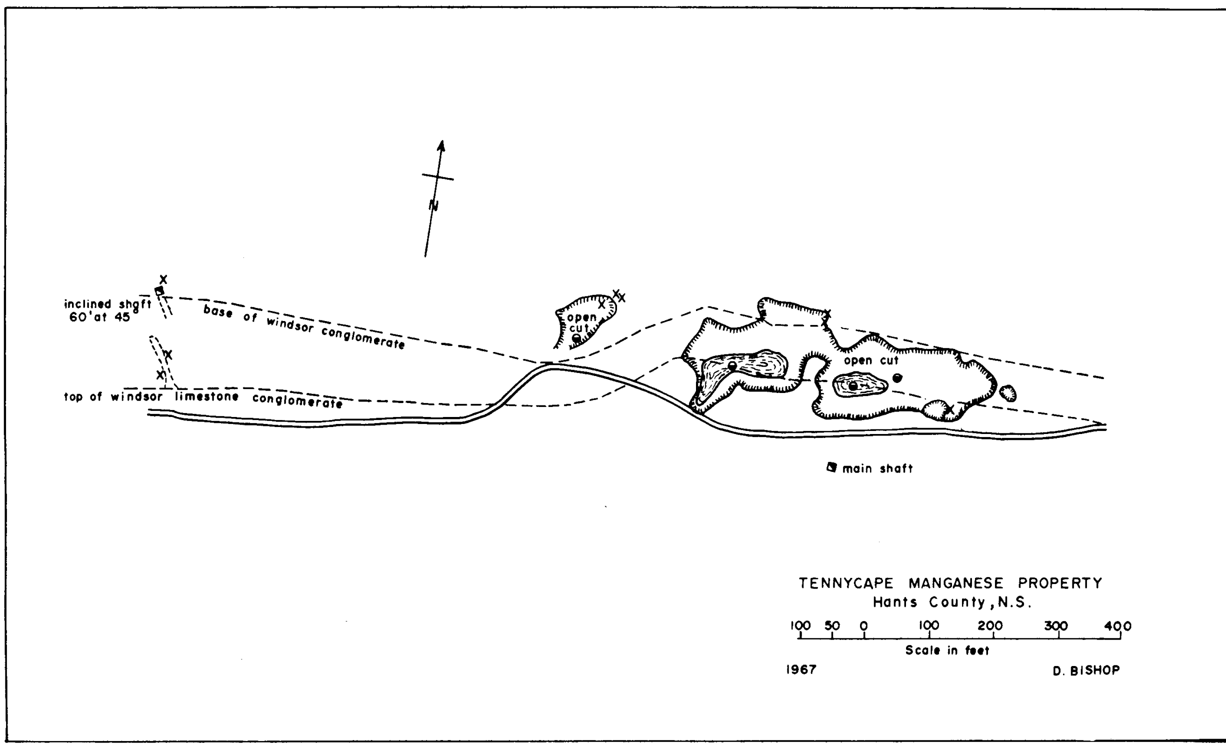


Figure 2-2 Geology and location of workings of the Tennycape Manganese Mine.

You will also notice two large, water-filled open cuts to the right (north) of the mine road. At most times the water in the eastern of the two open cuts is clear enough for you to see another of the 5 or 6 shafts found on the property. There is a considerable amount of exposure and loose material about the area of the open cuts but one must look hard to find mineralized material. Perhaps your best chance of finding good mineral specimens may be on the extensive, but very overgrown, waste rock dumps in the woods immediately to the south of the main shaft.

Mine History and Geology:

This site has a significant past. For a time, the Tennycape Mine was one of the countries most prolific producers of manganese and had a reputation for producing world class examples of pyrolusite, the main Mn-mineral found here. It is not uncommon at all to find examples of Tennycape ore in mineral books and in mineral specimen collections around the world. Mining started here in 1862 but at that time all production was from large blocks of pyrolusite found in the glacial till about this area. By 1870, a large lense of ore was found in the bedrock and production started from open cuts and underground workings. This particular lense produced 1000 tons over 10 years. Between 1880 and 1900, Tennycape was Nova Scotia's biggest Mn producer and one of the biggest in the country. By the turn of the century work at the mine had dropped off considerably and was sporadic until 1917 when the last real activity took place here. In it's hey day the mine produced about 200 tons of Mn-oxide a year and in total about 4,000 tons of chemical grade Mn-oxide was produced.

The Mn mineralization here occurs along the contact of the reddish sandstones and shales of the Horton Group(to the north) with the limestones and limestone breccias of the Windsor Group (at the mine and to the south). Throughout the Walton Belt this lithological interface is extremely important from a mineral deposit formation viewpoint and Day 2 of this field trip will stress this at most of our stops. Most of the mineralization at Tennycape is found within the finely laminated Macumber Formation limestone and in the lower portion of the immediately overlying Pembroke Limestone Breccia. The Mn mineralization, predominantly pyrolusite with lesser manganite and psilomelane, has a strong structural control but it is also obviously associated with the limestone units (lithological control). This is the recurring theme of the mineral deposits of the Walton Belt where it appears most deposits are localized where northwest-trending faults intersect the lower Windsor Group Macumber Formation and Pembroke Breccia.

Stop 2-3 Walton Red Marble Quarry

Directions:

From Tennycape, we will turn left (west) back on the pavement and follow highway #215 for approximately 11 km until we reach the village of Walton. We will turn left at the store and follow the Walton Woods Road for a few hundred metres to stop near a cemetery on the right hand side, next to a church. We will convene in the parking lot next to the cemetery.

History:

Joe Richman, a prospector interested in marble in 1999, was investigating the availability of the commodity in and around the Walton area, as occurrences of marble are well described in several documents that go back almost a century. Using air photos from the DNR library and following what appeared to be karst topography, Joe stumbled upon an old quarry at Walton where it appears marble was removed from the site in the past. It is unclear where the marble may have been taken, or for what use. The site may prove to be a good future site for development of tile, blocks for sculpting or perhaps agricultural lime for a local market. There is a note on Fletcher's sheet regarding the occurrence of red marble at the site but, nothing else is known about it.

Site Description:

The marble strikes NE-SW, and appears to be at least 5 to 10 m thick, though it may be thicker (this is still quite thin, in quarryable terms, and is probably the reason for the lack of development at the site). The marble lies along a faulted and folded block of Windsor Group limestone, oriented northwest and plunging south. It is underlain to the north by the early Carboniferous aged Horton Group overlain toward the south by the Windsor Formation of mid Carboniferous age. Depth is unknown, character of local thickness (pinching and swelling) is unknown. Faulting in the area is known to be intense.

Discussion:

To develop any rock as a dimension stone, the stone must look different and spectacular. The marble at this site fits the bill very well. It is a bright reddish marble with intricate fillings of fractures and stylolites with a white marble that offsets the colour of the red very nicely and produces a stunning face when cut with a saw.

Marbles such as these tend to be filled with cracks and fractures to a depth of at least 5 m of the surface, from the effects of frost and weather. In order to properly assess the value of the site, a large piece of heavy equipment, (such as an excavator) would need to remove this friable rock layer to determine the actual jointing pattern of the commodity *in situ*. Large blocks, and an unchanging pattern of jointing and fracture filling, are key features to investigate when one is considering the extent of any such an industrial mineral commodity for the purpose of developing it as a building material. The larger the blocks, the more valuable they are. Due to the intense nature of the local faulting patterns, it is believed that this marble would not form the larger blocks needed for dimension stone marketability.

To develop the site as an agricultural lime, the key feature is the 'crushability' of the commodity, as it must be sieved to very fine mesh sizes in order to be spread on fields and breakdown quickly. Other than transport, crushing costs are the single largest costs a producer would have to consider. Crushing can be expensive and has brought many a small project to a standstill for such an endeavour. Of course, landowner involvement must be achieved as well, for any such developments.

As a matter of interest, to reach the site, we will pass through a graveyard with many interesting headstones in it. Note the bright white gravestones in the graveyard. These stones, now somewhat pitted from the scourge of acid rain, were made from a beautiful white marble local to the Walton area, and produced for headstones for a period of time in the last century. Note also the (more recent) headstone of Donald Cox. Formerly an underground miner at Walton, he and his family were so proud of this heritage that the image of a miner graces his memorial.

References:

1905: Fletcher H. Geological Map for the Province of Nova Scotia, Hants County (Walton Sheet No. 74) Geol. Surv. Can. Map 74 1905.

Stop 2-4. Walton Harbour (Magnet Cove) - Barium Loading Facility

Directions:

This short stop is about 300 metres north from where we will park for Stop 2-3. There is better parking at this site so, we will actually move the cars rather than just walk.

History and Discussion:

This is a whistle-stop and is for interest only. It is interesting because of the ignominious nature of the Walton harbour area. Muddy, somewhat run - down and uninteresting, this place holds an important place in history regarding the building of one of the worlds largest and most successful companies.

Dresser Industries was named for it's founder, Solomon Robert Dresser (1842 - 1911). A Michigan born man, Dresser was a drilling engineer, specializing in (what was then) the new technology of vulcanized rubber, and who made his living in the oilfields of Pennsylvania. He developed and patented the, "Dresser Cap Packer", a device used to keep water and oil separated underground. The packer was one of many available at the time and Dresser's Bradford, Pennsylvania company struggled. However, unlike many of the other devices used for this purpose, Dresser's packer was made from rubber. This led to another technology Dresser developed in 1885 to seal drilling pipe with a rubber coupling so that natural gas could not escape. This led to the first development of pipelines over great distances, which Dresser developed as well, to transport gas to cities and became a cash cow for Dresser's company.

As Dresser's company became wealthier, the company undertook an aggressive campaign to become a top oilfield service and supply company and acquired other companies in the drilling field that manufactured, serviced and maintained valves, heaters, pumps, engines, compressors, pipes, oil derricks, refractories, and drill bits. In 1927 the conversion of Dresser to a public company was overseen by its executive branch, one of whom, Prescott Bush, was the grandfather of George W. Bush. Dresser had become a huge company by any standard but, a prime acquisition was needed that kept it from growing larger, the mineral barite.

Barite is used to make drilling muds and fluids, a key element in the oilfield drilling business. At the time, barite came from many small sources around the free world. It was an expensive, virtually impossible commodity to control. The discovery of the huge barite deposit at Walton in 1940 would change this situation.

Barite was known to be present at Walton since the turn of the century but not until Springer Gold Mines drilled off the extent of the Walton deposit was the magnitude of the deposit appreciated. In 1941, Canadian Industrial Minerals Limited (CIM) began to develop the deposit, and Dresser eyed the development as an important element in controlling the oilfield service industry. Magnet Cove Barium Corporation (Magcobar, Inc.) was created as CIM's marketing tool and Dresser quickly obtained the company now that it could control world barite prices with the procurement.

Now, Magcobar-Dresser became the world's premier supplier of low cost drilling fluids (to itself) and the company again underwent ravenous expansion as it squeezed out smaller competitors by increasing the price of drilling fluids to them. As these smaller companies folded, many of them pioneering companies with unique technologies they had developed, Dresser bought them all, concentrating patents for incomparable processes under the Dresser umbrella. Dresser further expanded into cranes, gasoline service station pumps, and specialized heavy equipment for the oilwell service and mining industries.

Dresser's sales were US$4B in 1992. Shortly after, Dresser acquired M-I Drilling Fluids, Baroid, Wheatley TXT and Atlas International, it's only large competitors left at the time. Dresser now owned everything between the oil in the ground and the gasoline in the car tanks except for the oil companies themselves. Oil companies, although many of them had seats on the Dresser board, were obviously uncomfortable with these developments. If Dresser acquired a marketing arm, they might begin to feel the sting of higher rates to bring their products to market.

Shortly after these last big acquisitions, Dresser was investigated and brought before a federal anti-trust committee. It was decided that in order to comply with the board's anti-trust regulations, Dresser had to break itself up and sell its interests in several of its companies. Despite the breakup, Dresser remains the world's third largest oilfield service company. The number one and two companies are former Dresser companies as well. Executives of these companies sit on the boards of one another, as well as oil companies and vice versa. The story is evidently far from over.

Walton Harbour is a long way from the posh boardrooms of Houston, Dallas and Manhattan. Its only businesses today are a corner store selling cigarettes, flair pens and rubber boots and a pub with a leaky roof and perhaps a half dozen regulars playing VLT's. But Magnet Cove forever holds a place in history as a key building block in a commercial empire that today influences our very lives through fuel prices, is worth billions and stretches around the globe.

References:

1996: Kontak, D. J. Carbonate Hosted Zn-Pb-Ba-Ag-Cu Deposits in the Lower Carboniferous of Nova Scotia: The Irish Connection. Nova Scotia Department of Natural Resources, Minerals and Energy Branch ME-50.

1996: Payne, Darwin. Dresser Industries. The Handbook of Texas Online: The General Libraries at the University of Texas At Austin and the Texas State Historical Association www.tsha.utexas.edu/handbook/online/articles/view/DD/dod4.html

Stop 2-5 Walton Barite Base Metal Mine

Directions:

From the barium loading facility at Magnet Cove, we will drive across the bridge and continue west 1.75 km along the paved road to a left hand turn. We will continue south along this road for approximately 2.5 km to the Walton mine site.

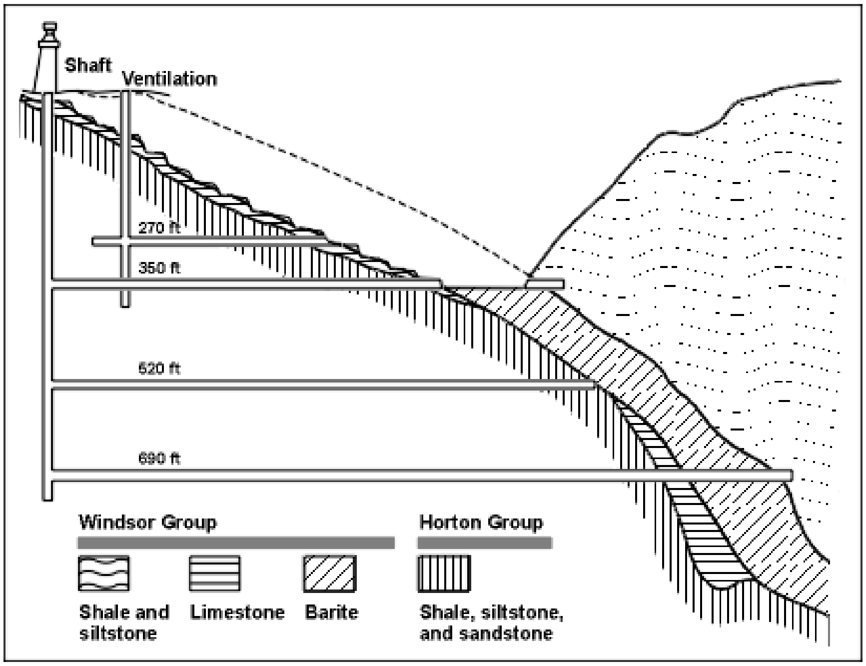
History:

We have reviewed part of the history pertaining to the development of barite at Walton with the description of Springer Gold Mines drilling program from the stop at Magnet Cove. The program was instituted when prospector Roscoe Hiltz located and described a small barite outcrop in 1940 that had been known but whose location had been lost to antiquity since 1894. Springer instituted the drilling program based on this find. As the exploration program progressed, a relatively new geophysical exploration technique measuring local gravity anomalies was employed. As it turned out, the Walton ore body had an excellent gravity signature and this would guide the Springer drills and eventually help geologists understand the shape and outline of the pit. Mining operations commenced in 1941. Now a very profitable mine, Walton was actually far more important to its owner as a supplier of a commodity that could help Dresser position itself world wide against competitors that also needed barite. The best, however, was yet to come for Walton.

Nova Scotia Department of Mines staff present during the 1956 drilling program that found the base metal ore body at Walton.

Almost twenty years would pass before the next major developments at Walton. Base metals were known to exist in Walton ore and the lab on site, kept an eye on ores extracted from the pit and underground shafts. This eventually led to a drilling program that was instituted by the Nova Scotia Department of Mines in 1956. This led to a major base metal find beneath the Walton barite ore body consisting of a Pb-Zn-Ag-Cu ore body that really turned the Walton mine into a winner. With all of the development infrastructure in place and new base metal separation mill costs covered by income from the barite ore body, the new ore zone was a tremendous asset and was exploited by a series of lateral developments to the south and under, the barite ore body, beginning in 1961.

Early in the 1970's a problem was encountered that sealed the mine's fate. A mine engineer, having ignored the warnings of the pit geologist at the time, blasted into a face intersecting a large shear zone and water immediately began flooding into the mine. Efforts were undertaken to try to grout the shear but it was too large and well developed. A pumping operation was instituted but, after several months it was noticed the water was no longer fresh but brackish. The shear intersected the sea several kilometres away. With the pumping becoming more expensive, as the flooding became worse, a decision was made to abandon the mine. The barite mining continued above the water line, production increased on the base metal ore body until it was mined out and the pillars were robbed in the last days of underground mining. It took the pit years to fill and barite production continued as the mine went through its shut down phases. The last load of barite was taken from the pit in 1978, ending a glorious period for the local economy and its people.

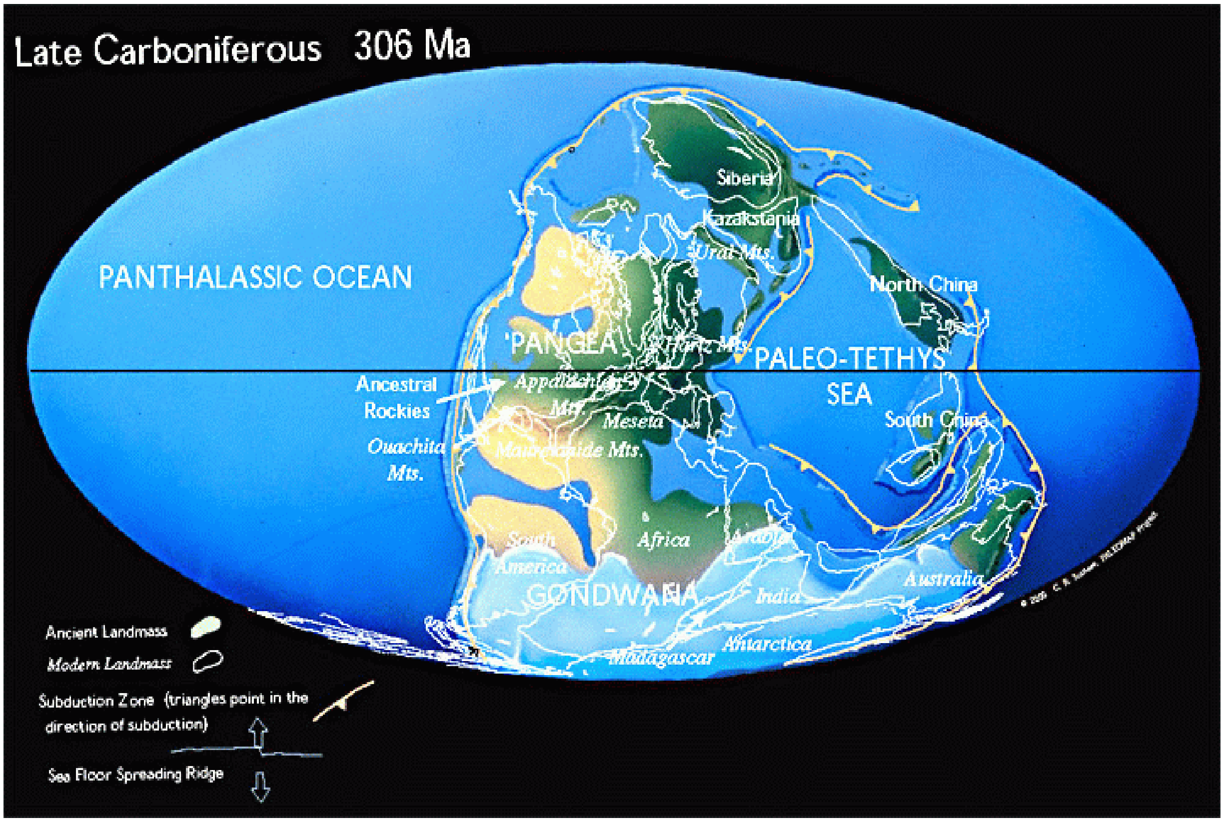


The mine accounted for 90% of all barite produced in the nation when in production. It has produced 4.3 million tons of the commodity and with an estimated 1.4 million tons still in the deposit, not exploitable by modern technology, it remains the world's largest deposit of barite known today.

A small program of production may be in the cards for Walton in the near future. The current claim holder is undertaking a study and light production of some of the low percentage dump material that was rejected when original production transpired will take place this summer. Whether this leads to anything larger is anybody's guess.

Geology:

Boyle (1972) did the most comprehensive regional study of the geology in the region and its relationships to Walton. He concedes that the geology is extremely complicated and anyone looking at maps of the area and considering academic arguments regarding O^{18} isotopes and the movement of Carboniferous fluids would tend to agree. However, if we consider the development of ores at Walton in simpler terms, this can help us make some generalizations that cover most scenarios regarding other mineralization that might appear in the area.



During the Carboniferous, Ireland and Nova Scotia were found within the same region.

Walton has been compared to, "Irish type", base metal deposits. We should consider several elements of the Irish model. But before we do that, there is another important element here to consider as well, and that is timing. In the Irish model, the overall driving factor resulting in mineralization is continental collision and extension. Remember, the same things were going on here at the time. As a matter of fact, Nova Scotia and Ireland were in the same region.

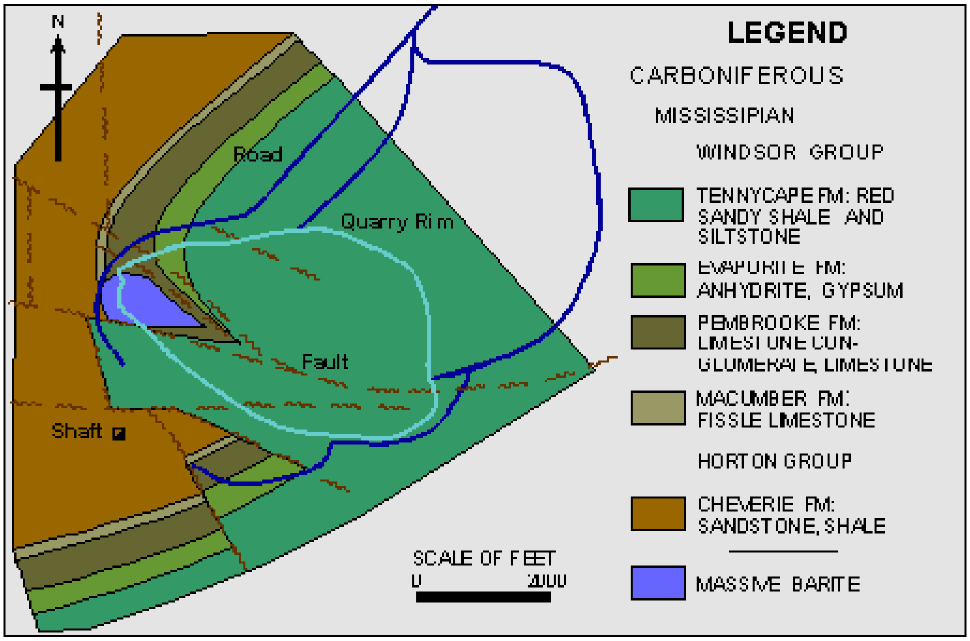
In the Irish model, Irish deposits occur:

1. Preferentially in the lowest Carbonate unit (the Macumber which is at the base of the Windsor Group),
2. They are stratabound (as is Walton),
3. Along or adjacent to normal faults that form conduits for ascending fluids (like the one that flooded the mine),
4. Sphalerite and galena are principal sulphide minerals with varying Fe, but always with Ba present, which may form a dominant phase (Walton!)
5. They display complex sulphide textures and complex solutions resulting in complex replacement minerals (such as aplowite and moorhouseite).
6. (Now the academic arguments begin) they formed from moderately saline, slightly acidic

sulphur poor solutions which, became mixed with sulphur rich brines (aka, Carboniferous seawater moving through the faults).

Plus...

They are in a transgressive sequence...(Windsor Group is transgressive.....)
Lying on top of Devonian red beds.....(top layers of Horton are red beds, barely post Devonian...)



In the Irish deposit model, mildly acidic hydrothermal fluids move along regularly spaced regional faults and encounter carbonate sediments, causing an increase in fluid pH, resulting in sulphide precipitation and deposition in replaced textures. The mixing of the waters is one of the main points of argument here so we will keep it simple, the waters have to mix somewhere, whether it be because they follow permeable lithologies under increasing hydrostatic pressure from tectonic uplift, or they move along faults doesn't much matter. The elements are all there, in Ireland and at Walton. Ultimately, that is all that matters.

References:

1972 Boyle, R. W., The Geology, Geochemistry, and Origin of the Barite, Manganese, and Lead-Zinc-Copper-Silver Deposits of the Walton-Cheverie Area, Nova Scotia, Geological Survey of Canada, Bulletin 166.

2003 Dommelen, R., Walton Barite Mine, Nova Scotian Mineral Localities. A website devoted to raising awareness about mineral collecting in Nova Scotia. 5 pages. http://is2.dal.ca/~dommelen/Walton.html

1988 Fowler, J. H.; Barite, Celestite and Fluorite in Nova Scotia, Nova Scotia Department of Natural Resources, Minerals and Energy Branch, Information Circular ME 15.

STOP 2-6. Three Kilometre Showing

Directions:

From Walton mine site, proceed 3 km south to an intersection on the right. The showing is on the northwest side of the intersection.

History:

This site was discovered by prospector John MacIsaac while investigating the Fuchtwanger Mine close by in the same area in 1999.

Geology:

These rocks represent the Horton Group near the top of the section and strike approximately north south, or run parallel to the road, with the Horton Group on the west side of the road and the Macumber and Windsor Group on the other side of the road, presumably not far away (tens of metres??). There is a shear running through the pit accompanied by brecciation as well. Evidence of hot hydrothermal fluids with iron are present in the brecciated host. There is also evidence of Ba present in toothed spars infilling some of the veins and veinlets deposited in the fractures.

Discussion:

Obviously, the fluids here had to be hot. Note the high degree of hydraulic fracturing in the brecciated clasts and the “boiled up,” appearance. Note also the blackened character of some of the brecciated clasts. It may be due primarily to weathered hematite but could also be a function of a petroliferous character in the host Horton Group at the time (something we will see at our next stop). This could help explain the depositional (reducing) environment of the showing as well.

Why the hydraulic fracturing here? The Macumber was a mudstone, hence (presumably) relatively impermeable in places. It could be forming a cap rock, not far from the site.

References:

Three kilometre occurrence: H01-053; Nova Scotia Dept Natural Resources Mineral Occurrence Database. NSDNR, 1701 Hollis St. Halifax, N.S.

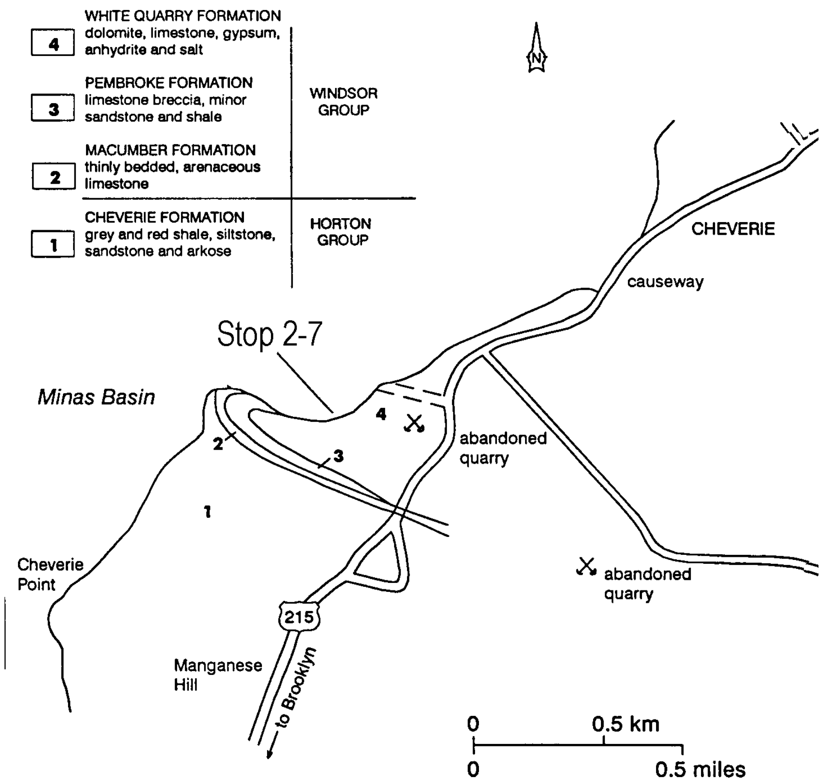
Stop 2-7 Horton Group-Windsor Group Contact at Cheverie

Directions:

Proceed back to Highway #215 from Stop 2-6. Drive west on Highway #215 to the community of Cheverie. Drive 750 m south on Highway #215 from it's intersection with the New Cheverie Road to a country lane (Ross Road) on the right leading out to Kipps Beach and White Head (see Figure). Drive out and park near where the road meets the shore but please respect the rights of the landowners with respect to parking your vehicles.

Site Description:

This stop is located on the eastern shore of the Avon River estuary near it's transition to the Minas Basin. The tidal range here is very high, in the order of 15 m. The coincidence of extreme tidal action, erosion and complex geological structure has resulted in an excellent locality to view the upper part of the Horton Group and the contact with the overlying Windsor Group. The site is best visited at low- to mid-tide as much of the exposures are in the tidal zone. We will be visiting at high tide so we will be limited to shoreline cliff exposures. The cliffs here are not overly high, but care still should be taken relative to rock falls and becoming tide-trapped. Anhydrite was quarried at two sites here in the past. One quarry is adjacent to the beach while the other is a short distance on the other side of Highway #215. The anhydrite was shipped out via a wharf adjacent to the quarry beside the beach.



Geology of the contact of the Horton and Windsor groups at Stop 2-7, Cheverie, Hants County.

Comments on Geology:

The Cheverie stop provides a small window into the complex and interesting late Paleozoic basin geology and the intense deformation of these rocks related to movements on the Cobequid-

Chedabucto Fault System. Here you will see sedimentary red bed sequences of the upper Horton Group in contact with Windsor Group rocks belonging to the limestones of the Macumber Formation, limestone breccia of the Pembroke Breccia and anhydrite of the White Quarry Formation.

A main focus of this field trip is to show the economic importance of the lower Windsor Group stratigraphy. These rocks are well exposed here and we will end the trip off with one last discussion of these rocks. Their chemical receptiveness and porosity are certainly important factors and the latter can be shown here with excellent exposure of the Pembroke Breccia. The origin of the brecciation in these rocks has never been settled. Is it syn-sedimentary, tectonic, karst-related or a mix of more than one of these processes.

The lower Windsor Group rocks throughout the Walton Belt are known to be hydrocarbon bearing and this stop is an excellent spot to see this phenomena. The White Quarry Formation, in particular, is known to reek of hydrocarbons. Strike any of the brown-tan coloured carbonate units that occur within the anhydrite here with your hammer and you will most likely notice a very obvious oily smell.