GAC
NEWFOUNDLAND SECTION

Fall Field Trip

September 27-29, 2013

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EVOLUTION OF THE WESTERN AVALON ZONE AND RELATED EPITHERMAL SYSTEMS

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Photo: Blue lazulite occurring within quartz-specularite veins; Monkstown Road prospect

GEOLOGICAL ASSOCIATION OF CANADA
NEWFOUNDLAND AND LABRADOR SECTION

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Field Trip Guide and Background Material

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SAFETY INFORMATION

General Information

The Geological Association of Canada (GAC) recognizes that its field trips may involve hazards to the leaders and participants. It is the policy of the Geological Association of Canada to provide for the safety of participants during field trips, and to take every precaution, reasonable in the circumstances, to ensure that field trips are run with due regard for the safety of leaders and participants. GAC recommends steel-toed safety boots when working around road cuts, cliffs, or other locations where there is a potential hazard from falling objects. GAC will not supply safety boots to participants. Some field trip stops require sturdy hiking boots for safety. Field trip leaders are responsible for identifying any such stops, making participants aware well in advance that such footwear is required for the stop, and ensuring that participants do not go into areas for which their footwear is inadequate for safety. Field trip leaders should notify participants if some stops will require waterproof footwear.

Field trip participants are responsible for acting in a manner that is safe for themselves and their co-participants. This responsibility includes using personal protective equipment (PPE) when necessary (when recommended by the field trip leader or upon personal identification of a hazard requiring PPE use). It also includes informing the field trip leaders of any matters of which they have knowledge that may affect their health and safety or that of co-participants. Field Trip participants should pay close attention to instructions from the trip leaders and GAC representatives at all field trip stops. Specific dangers and precautions will be reiterated at individual localities.

Specific Hazards

Some stops on this field trip are in coastal localities. Access to the coastal sections normally requires short hikes, in some cases over rough, stony or wet terrain. There is a strong possibility that participants will get their feet wet, and we recommend waterproof footwear. We also recommend footwear that provides sturdy ankle support, as localities may also involve traversing across beach boulders or uneven rock surfaces. Coastal localities present some specific hazards, and participants MUST behave appropriately for the safety of all. Participants must stay clear of the cliff edges at all times, stay with the field trip group, and follow instructions from leaders. Please stay away from any overhanging cliffs or steep faces, and do not hammer any locations immediately beneath the cliffs. In all coastal localities, participants must keep a safe distance from the ocean, and be aware of the magnitude and reach of ocean waves. If it is necessary to ascend from the shoreline, avoid unconsolidated material, and be aware that other participants may be below you. Take care descending to the shoreline from above.

Other field trip stops are located on or adjacent to roads. Participants should make sure that they stay off the roads, and pay careful attention to traffic, which may be distracted by the field trip group. Roadcut outcrops present hazards from loose material, and should be treated with the same caution as coastal cliffs. Other outcrops may be in disused quarries or excavations, or may require short hikes from roads across possibly uneven and/or wet terrain. Weather is unpredictable in this area and participants should be prepared for a wide range of temperatures and conditions. Always take suitable clothing. A rain suit, sweater, sturdy footwear are essential at almost any time of the year.

The hammering of rock outcrops, which is in most cases completely unnecessary, represents a significant "flying debris" hazard to the perpetrator and other participants. For this reason, we ask that outcrops not be assaulted in this way; if you have a genuine reason to collect a sample, inform the leaders, and then make sure that you do so safely and with concern for others. The trip visits some outcrops that have unusual features, and these should be preserved for future visitors. Frankly, our preference is that you leave hammers at home or in the field trip vans.

Subsequent sections of this guidebook contain the stop descriptions and outcrop information for the field trip. In addition to the general precautions and hazards noted above, the introductions for specific localities make note of specific safety concerns such as traffic, water, cliffs or loose ground. Field trip participants must read these cautions carefully and take appropriate precautions for their own safety and the safety of others.

INTRODUCTION

The Avalon Zone of Newfoundland is host to well-preserved examples of epithermal-style mineralization that are amongst some of the oldest known in the world. The Avalon Zone forms the easternmost portion of the Appalachian orogen in much of North America, and extends from the Carolina Slate Belt in the south, to the Avalon Peninsula of Newfoundland in the north, where it represents the northeastern termination of the orogen (Williams, 1979; O'Brien *et al*., 1996; O'Brien *et al*., 1998; Foley and Ayuson, 2012). Historical gold producers within the Avalon Zone include the Hope Brook deposit in Newfoundland, and the Brewer deposit and correlatives in the Carolina Slate Belt (Scheetz, 1991; Dubé *et al.*, 1995; O'Brien *et al*., 1998, 1999; Foley and Ayuson, 2012). In Newfoundland, classic examples of both high- and low-sulphidation epithermal mineralization have been identified, and locally these two types of systems display a close spatial association with one another (O'Brien *et al.*, 1998; Sparkes *et al*., 2005 and references therein).

Late Neoproterozoic volcanic rocks and related sedimentary rocks of the Avalon Zone are the primary hosts to these epithermal systems and they also record the development of a more extensive peri-Gondwanan orogenic system, which later became reworked during mid-Paleozoic orogenic events that formed the Appalachian Orogen. The Avalon Zone is characterized by widespread magmatic activity ranging in age from *ca.* 760 – 550 Ma (O'Brien *et al*., 1996). During this time, magmatic arcs formed within arc and back-arc environments or analogous continental extensional type settings (O'Brien *et al*., 2001 and references therein). Within the volcanic sequence, high-level intrusions resulted in the formation of regional-scale magmatic-hydrothermal systems, which were locally accompanied by precious metal deposition. Most of the epithermal alteration and related mineralization identified in the Avalon Zone is hosted within subaerial felsic volcanic rocks ranging in age from 590–550 Ma. The volcanic rocks are intercalated within thick sequences of marine, deltaic and fluviatile siliciclastic sedimentary rocks, which formed within basins of varying dimensions, setting, complexity and age. The deposition of these sedimentary sequences can locally be demonstrated to have played a vital role in the preservation of the underlying epithermal systems through rapid burial (*e.g.* Sparkes *et al*., 2005).

The western Avalon Zone of Newfoundland hosts numerous occurrences of high-sulphidation-style epithermal alteration, which are locally accompanied by gold mineralization (*e.g.*, Dubé *et al*., 1995; O'Brien *et al*., 1998; O'Brien *et al*., 1999; Figure 1). Individual belts of high-sulphidation alteration can be traced intermittently along strike for up to 16 km along the Burin Peninsula, and these host variably-developed alteration assemblages including quartz, pyrophyllite, alunite, muscovite, illite and locally topaz, diaspore, dumortierite and lazulite. Significant mineralization, primarily consisting of gold but also containing silver, copper, arsenic and antimony locally accompanies the alteration, making such zones attractive targets for mineral exploration.

More recently, the recognition of low-sulphidation-style chalcedonic silica veins and related breccias within the western Avalon Zone of Newfoundland highlight the potential for this style of mineralization within that region; several of these zones are auriferous (Seymour, 2006;

Sparkes, 2012 and references therein). Exploration in the vicinity of the Big Easy prospect (Figure 1) has identified low-sulphidation gold mineralization hosted within sedimentary rocks of the Musgravetown Group, which are some of the youngest host rocks to such mineralization in the region.

Regional Geology of the Western Avalon Zone

The Avalon Zone of Newfoundland is dominated by late Neoproterozoic volcanic and sedimentary rocks, which include several discrete volcanic and sedimentary sequences, ranging in age from ~ 760 Ma to ~ 550 Ma. The rocks of most interest in the context of this excursion are the younger parts of the succession, commencing at ~ 570 Ma. Late Neoproterozoic rocks are in turn overlain by a Cambrian platformal sedimentary cover sequence that marks the cessation of volcanic activity and related epithermal systems within the Avalon Zone (O'Brien *et al*., 1996 and references therein). The Neoproterozoic rocks, along with the associated Paleozoic cover sequence, are unconformably overlain by Late Silurian to Early Devonian terrestrial volcanic and associated siliciclastic rocks, preserved within isolated outliers throughout the Burin Peninsula (O'Brien *et al*., 1995). Within the Avalon Zone of Newfoundland the intensity of Paleozoic deformation broadly increases from east to west toward the Dover and Hermitage Bay faults, which mark the western extent of Avalonian rocks and defines their tectonic contact with the adjacent Gander Zone (Widmer, 1950; Younce, 1970; Blackwood and Kennedy, 1975; Kennedy *et al*., 1982). Consequently, examples of epithermal-style alteration and mineralization in the west are generally more strongly deformed than those located farther east on the Avalon Peninsula. The majority of the deformation is attributed to the Devonian Acadian orogeny (Dallmeyer *et al*., 1983; Dunning *et al*., 1990; O'Brien *et al*., 1991; O'Brien *et al.*, 1999; van Staal, 2007); however evidence for older, Precambrian deformational events is also locally preserved (*e.g.* Anderson *et a*l., 1975; O'Brien, 1993; O'Brien *et al*., 1996; O'Brien, 2002).

Within the western Avalon Zone, epithermal alteration and mineralization is most abundant in volcanic rocks of the ca. 590–570 Ma Marystown Group (Strong *et al*., 1978a, 1978b; O'Brien *et al*., 1999). This sequence generally comprises greenschist-facies subaerial flows and related pyroclastic and volcaniclastic rocks ranging in composition from basalt, through andesite and rhyodacite, to rhyolite. The volcanic rocks are of both calc-alkaline and tholeiitic affinity (Hussey, 1979; O'Brien *et al*., 1990; 1996; 1999). The Marystown Group represents the main core of the Burin Peninsula, forming a broad-scale anticlinorium, which is flanked to the east by a shoaling-upward sequence of marine to terrestrial sedimentary rocks of the Neoproterozoic Musgravetown Group (O'Brien, *et al*., 1999); volcanic rocks at the base of the Musgravetown Group (Bull Arm Formation) have been locally dated at 570 +5/-3 Ma (O'Brien *et al*., 1989).

To the west and north, the Marystown Group is overlain by the *ca.* 570 to 550 Ma Long Harbour Group. The Long Harbour Group is dominated by shallow marine sedimentary rocks and subaerial felsic volcanic rocks of alkaline to peralkaline affinity, along with related clastic rocks, which pass conformably upward into fossiliferous Cambrian sedimentary rocks related to the development of a platformal cover sequence (Williams, 1971; O'Brien, *et al*., 1984; O'Brien *et al*., 1995). The Long Harbour Group is divisible into a lower volcanic sequence (Belle Bay

Formation) and an upper volcanic sequence (Mooring Cove Formation), which are separated by a clastic sedimentary unit known as the Anderson's Cove Formation (O'Brien *et al.*, 1984). Rhyolites from both the Belle Bay and Mooring Cove formations have been dated at 568 ± 5 and 552 ± 3, respectively (O'Brien *et al*., 1994).

North of the Burin Peninsula, the volcano-sedimentary sequence can be traced northeast to the area of Bonavista Bay (Figure 1), where it is truncated by the Dover Fault (O'Brien, 1987; O'Brien and Knight, 1988). In the area of Bonavista Bay, the *ca.* 620 Ma Love Cove Group and the conformably overlying siliciclastic sedimentary rocks of the Connecting Point Group form a 5 km thick succession, referred to as the Eastport basin (O'Brien and Knight, 1988; Knight and O'Brien, 1988). A tuff bed from the middle of the Connecting Point Group stratigraphy was dated at *ca.* 610 Ma (Dec *et* al., 1992).

The volcano-sedimentary rocks spanning the area between the Burin Peninsula and Bonavista Bay are divisible into two broad northeast–southwest trending belts, separated by sedimentary rocks of the Musgravetown Group. These two belts represent two different packages of volcanic rocks; the Love Cove Group is confined to the eastern belt while younger volcanic rocks inferred to be related to the *ca.* 570 Ma Musgravetown Group dominate the western belt (O'Brien *et al*., 1992; O'Brien and Holdsworth, 1992). Both the eastern and western belts contain local evidence for epithermal mineralization (*i.e.* Big Easy, Calvin's Landing; Sparkes, 2012; Figure 1). Within the volcanic rocks of the Bonavista Bay area, numerous zones of silicification, pyritization and sericitization have also been identified, and are locally accompanied by anomalous gold mineralization (up to 575 ppb Au; O'Brien and Knight, 1988). In the area of Bonavista Bay, an angular unconformity locally separates rocks of the Connecting Point Group from the overlying Musgravetown Group (O'Brien, 1993).

Several high-level plutons dominated by granitoid rocks intrude along the western margin of the Avalon Zone in Newfoundland. Most occur within the Burin Peninsula area and form a broad, semi-continuous, north-northeast trending plutonic belt consisting of hornblende-biotite granite, diorite and gabbro (Figure 1). Limited geochronological data are available for these plutonic units, but the Swift Current Granite (Figure 1) is locally dated at 577 ± 3 Ma (O'Brien *et* al., 1998). Other plutonic units, including the Cape Roger Mountain Granite and the "Burin Knee Granite" are inferred to be coeval with the Swift Current Granite (O'Brien and Taylor, 1983; O'Brien *et al*., 1984). At the northeastern end of the belt, in the vicinity of Bonavista Bay, the Louil Hills Intrusive Suite is dated at 572 +3/-2 Ma and is interpreted to be coeval with alkaline volcanism associated with the Musgravetown Group within the western belt of volcanic rocks (O'Brien, 1987; O'Brien *et al*., 1989). In the area northwest of the Burin Peninsula, the Long Harbour Group is locally intruded by the Cross Hills Intrusive Suite, which has a preliminary age of 547 +3/-6 Ma and hosts Zr–Nb-REE mineralization (Tuach, 1991). This intrusion represents one of the youngest magmatic events prior to the cessation of hydrothermal activity within the region.

Epithermal-Style Mineralization: a summary

The Geological Survey of Newfoundland and Labrador completed regional mapping in much of the area of the field trip during the 1970s, and regional work on gold mineralization in the region was completed in conjunction with the Geological Survey of Canada in the 1990s (*e.g.,* Dubé *et al.,* 1995; O'Brien *et al.,* 1998; 1999). More detailed examination of individual prospects and newly-recognized areas of alteration and mineralization was initiated by the Survey in 2011, and the regional framework and initial results of field work are summarized by Sparkes (2012). Aspects of the mineralization are also part of an ongoing M.Sc. project by Sarah Ferguson at Memorial University, with support from the Research Development Corporation (RDC). For more details on individual areas visited during the field trip, readers are referred to Sparkes (2012) and references therein. For a detailed review of epithermal-style precious metal mineralization, readers are referred to White and Hedenquist (1995). This section contains a simplified summary and an explanation of some of the terminology that applies to these deposits.

Epithermal systems are predominantly "near surface" (<2 km depth) features that can be associated with the development of gold, silver and base metal mineralization. These systems are broadly subdivided into two main categories, namely high- and low-sulphidation systems, but in more deeply eroded areas, porphyry copper related mineralization may also be present (Figure 2a). High-sulphidation and low-sulphidation systems display some similar styles of mineralization and alteration, but the two systems can be separated based on the presence of several key ore minerals along with the alteration related to the formation of the mineralization. Understanding the distribution and zonation of these alteration minerals is vital in targeting the most prospective portions of epithermal systems.

High-sulphidation systems, also known as quartz-alunite-pyrophyllite-dickite-kaolinite systems, are generally dominated by disseminated or replacement style ore, which often contain copper minerals such as covellite or enargite, along with gold. This mineralization is commonly developed within zones of "vuggy" silica and alunite alteration which is surrounded by a broader zone of pyrophyllite-illite dominated alteration (Figure 2b). High-sulphidation systems are characterized by development of broad alteration haloes, resulting from high temperature, acidic, oxidized, hydrothermal fluids, which result in pervasive alteration of the original host rock.

Low-sulphidation systems, also referred to as quartz-adularia-sericite-calcite systems, are mostly vein or stockwork style mineralization which is predominantly associated with chalcedonic silica with or without adularia. These systems are generally sulphide-poor and are dominated by gold and silver mineralization, but may also be anomalous in copper, lead and zinc. Low-sulphidation systems are predominantly associated with very narrow, restricted alteration haloes dominated by illite or illite-smectite alteration assemblages (Figure 2b), which result from low temperature, near neutral, reduced, hydrothermal fluids. Surficial sinter deposits related to the development of these systems are often barren with respect to precious metals, but can be enriched in other elements such as mercury, selenium, antimony, arsenic and locally molybdenum.

A comparison of common alteration minerals associated with the development of high- and low-sulphidation systems, taken from White and Hedenquist (1995) are listed below.

Mineralogy of gangue -frequency of occurrence (abundance)		
	Low-sulphidation	High-sulphidation
Quartz	ubiquitous (abundant)	ubiquitous (abundant)
Chalcedony	common (variable)	common (minor)
Calcite	common (variable)	absent (except as overprint)
Adularia	common (variable)	absent
Illite	common (abundant)	uncommon (minor)
Kaolinite	rare (except as overprint)	common (minor)
Pyrophyllite-diaspore	absent (except as overprint)	common (variable)
Alunite	absent (except as overprint)	common (minor)
Barite	common (very minor)	common (minor)

Trip Itinerary

During the afternoon of day one we will examine some of the oldest as well as some of the youngest Precambrian sedimentary rocks preserved within the western Avalon Zone, whilst traveling to the Clarenville area. During day two, we will travel to the northern Burin Peninsula area to view examples of intrusion-related and high-sulphidation related alteration and associated mineralization, in addition to a few stops along the coast, to hopefully take in the scenery, if it is not shrouded in fog! On day three we will make a short excursion from Clarenville to the Thorburn Lake area to examine an example of low-sulphidation style mineralization at the Big Easy prospect, before heading back to St. John’s in mid-afternoon.

It is possible that the order of these excursions will need to be adjusted in the light of weather conditions, but we hope not. It is also possible that the order of stops on a given day may require some adjustment, or that some stops will need to be omitted due to time constraints.

UTM coordinates are provided for stops for the convenience of future guidebook users. Note that these are all with reference to the NAD 1927 map datum and UTM Zone 21.

DAY ONE FIELD TRIP STOPS

Stop 1.1: Sutton Barite Vein

Plate 1: Location reference for stop 1.1 (#1 on map).

UTM: 732332E/5287140N

The stop is exposed on the right hand side of the TCH, approximately 1.3 km north of the intersection of the TCH and the Newfoundland T'Railway, and 2.5 km west of the junction for Little Harbour (Plate 1). There is a parking area on the westbound side of the highway. <u>Exercise extreme caution while walking along of the highway, and please be aware of traffic coming from both directions.</u>

The Sutton prospect consists of several cm-scale, subparallel, pink and white barite veins hosted within siliciclastic sedimentary rocks of the Connecting Point Group. These host rocks represent some of the oldest sedimentary rocks that we will see during the course of the field trip. At this location we are very near the structural contact that separates the sedimentary rocks of the Connecting Point Group to the west from the younger Musgravetown Group to the east. Here the rocks of the Connecting Point Group dip moderately towards the northeast, and are crosscut by several east-west trending, m-scale, fine-grained mafic dykes. The latter are abundant within the Connecting Point Group, and will be seen elsewhere.

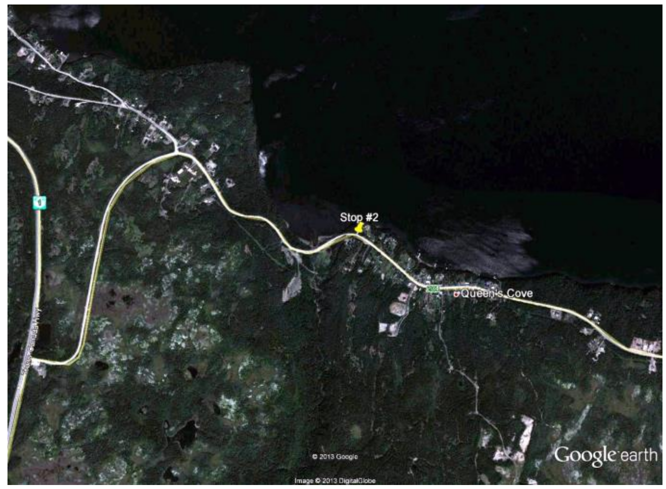
The barite veins consist of massive and locally bladed barite. These veins are developed along a northeast trending fracture cleavage and dip steeply towards the west (Plate 2). Locally minor amounts of chalcopyrite and galena have also been reported (O'Driscoll *et al*., 1988). Barite occurrences within the Avalon Zone were documented by Howse (1992), and over 40 separate occurrences have been identified in the Avalon Isthmus area alone. The origin of these veins, which locally crosscut units as young as early Cambrian, is unknown, but it has been suggested that granitoid intrusions exposed on islands in Placentia Bay may have played a role in their genesis (Howse, 1992).

From Stop 1.1, continue westward on the TCH, to the junction for Route 204 (signposted for Little Hearts Ease).

Stop 1.2: Connecting Point Group

Plate 3: Location reference for stop 1.2 (#2 on map).

UTM 728679E/5322046N



This stop is located approximately 2.8 km off the main highway along route 204, just past the small beach (Plate 3). Please be aware of oncoming traffic and exercise caution around the high cliff face.

Stops 1.2 to 1.6 will provide a west to east cross-section through some of the oldest to some of the youngest Neoproterozoic rocks exposed on the northwestern Avalon zone and demonstrate the contrasting styles of basin development. The geology of this area has most recently been mapped by Normore (2012) and the reader is referred to that report and references therein for a more detailed description of the geology. The stops are also described in an article published in the Newfoundland Journal of Geological Education some years ago (O'Driscoll, 1982).

At this stop we again see the deep-water marine sedimentary rocks of the Connecting Point Group, which here are dominated by thinly bedded dark grey to black sandstone and shale, dipping moderately to the west. Several low-angle white carbonate veins crosscut the outcrop along the north side of the road, while rare pinkish subvertical barite veins are exposed along the south side. There is unfortunately no intersection between carbonate-rich and barite-rich veins. Again, numerous mafic dykes crosscut the unit, but are difficult to distinguish from the sedimentary rocks due to their similar coloration. The most obvious dyke is on the north side of the roadcut, where it is recognizable from its massive and blocky nature compared to the enclosing sedimentary rocks, and by a greater intensity of carbonate veining. Locally, minor <1m-scale folds are developed on the south side of the roadcut, and are best seen at its eastern end. Some of these folds have a box-like or chevron-like pattern.

These rocks represent the relative deep-marine offshore setting, prograding to a shelf/slope environment with increasing amounts of volcanic detritus higher in the section (Normore, 2012). On a regional scale these rocks conformably overlie the *ca.* 620 Ma volcanic rocks of the Love Cove Group (Dec *et* al., 1992). However, in this area the two units are separated by the Come By Chance Fault of McCartney (1958), which is located along the western shore of the cove to the immediate west of this location. This structure defines the eastern limit of some of the oldest volcanic rocks in the region, known as the Love Cove Group (Figure 3; Normore, 2012). Rocks of the Connecting Point Group form part of the Eastport basin of O'Brien and Knight (1988), which represents a *ca.* 5 km thick succession comprised of both the Love Cove and Connecting Point groups.

Stop 1.3: Musgravetown Group – Bull Arm Formation

Plate 4: Location reference for stop 1.3.

UTM 741211E/5322172N

This stop is located approximately 1.5 km west of Hodge's Cove, and about 14 km from Stop 1.2 (Plate 4). It provides an excellent view across the southwest arm of Random Sound. Caution – high cliff face. Please be aware of oncoming traffic.

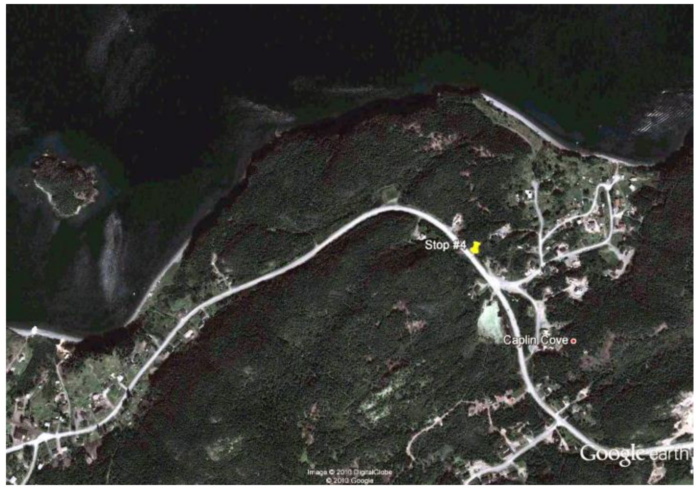
We have now crossed from the *ca.* 610 Ma Connecting Point Group into the *ca.* 570 Ma Bull Arm Formation of the Musgravetown Group. This unit forms the base of the Musgravetown Group, which is locally separated from the underlying Connecting Point Group by an angular unconformity (O'Brien, 1987; 1993). Within the 610–570 Ma time span separating these two units lies the 590-570 Ma Marystown Group, which is primarily exposed in the area of the Burin Peninsula, but is apparently absent in this area. The Marystown Group will be observed at a number of stops on Day 2.

The Bull Arm Formation represents a dominantly subaerial bimodal volcanic sequence; however in this area the unit is dominated by epidotized, massive, fine-grained basalt flows and associated volcaniclastic deposits. Looking north at the far side of the bay, rocks of the Connecting Point Group dominate coastal exposures to the west, whereas sedimentary rocks of the Musgravetown Group (Rocky Harbour Formation) dominate exposures to the east. Also evident on the far shore is a large kink-fold, which provides evidence of post-Cambrian deformation within the region. The fold is developed in the quartzites of the Random Formation, the lowermost unit of the overlying Cambrian succession, and sedimentary rocks of the uppermost Musgravetown Group (Crown Hill Formation) to the west (Plate 5).

Stop 1.4: Bull Arm Formation – Rocky Harbour Formation Transition Zone

Plate 6: Location reference for stop 1.4 (#4 on map).

UTM 743877E/5322753N



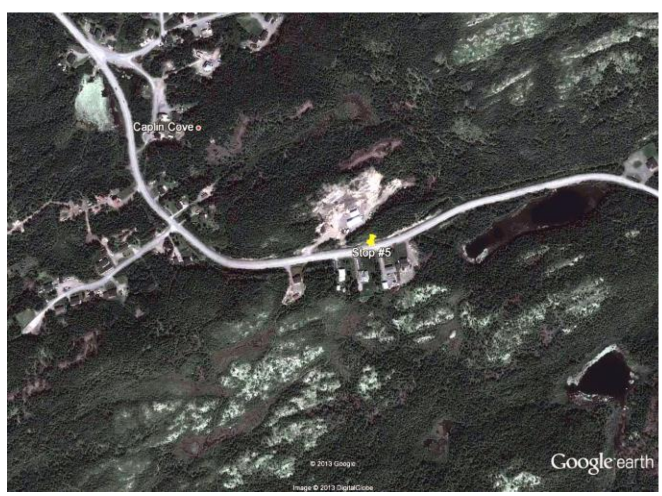
This stop is located near the town of Caplin Cove, about 2.5 km east of Stop 1.3 (Plate 6). The safest area for parking is by the mailboxes beyond the roadcut outcrops. Caution – high cliff face. Please be aware of oncoming traffic.

We have now moved up the stratigraphic section to the conformable contact between the mafic volcanic rocks of the Bull Arm Formation and the overlying siliciclastic sedimentary rocks of the Rocky Harbour Formation. At the eastern end of the roadcut grey-green coarse-grained sandstone and wispy interbedded siltstone represent rocks of the Rocky Harbour Formation, which here dip moderately to the southeast. As we move downsection (to the northwest) along the roadcut we see the conformable transition into the underlying fine-grained basalt, which is similar to that seen at Stop 1.3. The deposition of the Rocky Harbour Formation is interpreted to represent the transition into a tidal-influenced deltaic and wave-dominated lower shoreface depositional environment (Normore, 2012), following the waning of volcanic activity within the Musgravetown Group.

Stop 1.5: Rocky Harbour Formation Conglomerate

Plate 7: Location reference for stop 1.5 (#5 on map).

UTM 744478E/5322305N



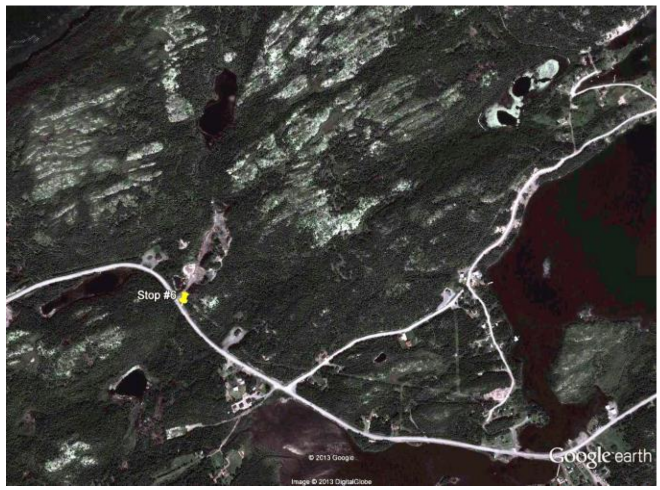
This stop is located east of Caplin Cove, approximately 1.5 km from Stop 1.4 (Plate 7). Caution – high cliff face. The west end of the roadcut is the safest area in which to examine the rocks, Please be aware of oncoming traffic.

At this location we see green, polymictic, clast-supported, pebble to cobble conglomerate, with well-rounded, cm-scale clasts within a coarse-grained green sandstone matrix (Plate 8). The clasts consist of abundant basalt and rhyolite along with lesser sedimentary clasts. These rocks represent part of the shallow-marine succession of the Rocky Harbour Formation which is comprised of a succession of tidal flats, interdistributary channels, and lower shoreface deposits (Normore, 2012). Although not exposed along this section, minor felsic volcanism also occurs at the top of the Rocky Harbour Formation, prior to the transition from shallow marine to terrestrial environments, and has been noted in several areas of Bonavista Bay (O'Brien and Knight, 1988; Normore, 2011; 2012). The possible occurrence of volcanic centers at this time may be an important factor in the formation of epithermal-style mineralization elsewhere in the Musgravetown Group (see Day 3 stops).

Stop 1.6: Musgravetown Group - Crown Hill Formation

Plate 9: Location reference for stop 1.6 (#6 on map).

UTM 745092E/5322343N



This stop is located a short distance east of Stop 1.5, east of Caplin Cove (Plate 9). Caution – high cliff face. Please be aware of oncoming traffic.

We have now crossed a fault and have moved up the stratigraphic section into the Crown Hill Formation of the Musgravetown Group, which represents the highest formation within the group.

At this location the outcrop consists of interbedded red sandstone and siltstone along with lesser granular conglomerate (Plate 10). Local wavy bedding can also be seen within the roadcut. These rocks formed within a fluvial and alluvial environment, which dominated near the end of the Neoproterozoic (Normore, 2012). This unit represents the highest point within the Western Avalon stratigraphy that we will see during the course of the field trip.

DAY TWO FIELD TRIP STOPS

The field trip stops for Day 2 are all located on the northern part of the Burin Peninsula and on the coast of Fortune Bay. They provide a representative sampling of rock types in the area and the styles of epithermal alteration and mineralization.

Stop 2.1: Lodestar Prospect

Plate 11: Location reference for stop 2.1 (#7 on map).

UTM 724851E/5312545N

The Lodestar prospect is located along an old gravel road that joins the Burin Peninsula highway about 4.4 km from its junction with the TCH. The road is no longer passable for vehicles and a walk of about 15 minutes is required (Plate 11). <u>Waterproof footwear is recommended for this stop.</u>

The Lodestar prospect was first discovered in 1998 by a local prospector while prospecting along a local resource road. This prospect represents a breccia-hosted, intrusion-related style of hydrothermal mineralization. The development of the hydrothermal brecciation is associated with the intrusion of the *ca.* 600 Ma Powder Horn Intrusive Suite (O'Brien *et al*., 2000) and is developed close to its contact with adjacent sedimentary rocks of the Connecting Point Group. The mineralized hydrothermal breccias are polylithic and include both fragments of sedimentary and magmatic units (Plate 12) and are interpreted to have a phreatomagmatic or magmatic-hydrothermal origin (Hinchey et al., 2000). The Powder Horn Intrusive Suite consists of several phases as outlined by Hinchey et al. (2000), these include a pre-mineralization medium- to coarse-grained, equigranular, black and white gabbro/diorite and rare felsic dykes; post-mineralization phases of the intrusion include fine-grained, dark green, diorite to gabbro and lesser aplite, feldspar porphyry and quartz-feldspar porphyry.

The mineralized breccia is exposed over an area measuring approximately 20 m in length (Figure 4) and is host to gold in association with copper, arsenic and zinc mineralization along with hydrothermal magnetite, all of which is hosted within the matrix of the breccia (Hinchey *et al*., 2000). The highest grade mineralization obtained from the area include a chip sample that assayed 4.98 g/t Au and 14.8 g/t Ag over 15.9 m (Hinchey *et al*., 2000), while localized higher grades of up to 12.6 g/t Au over 1m (L. Smith, personal communication, 2000) have also been obtained. Within the mineralized portions of the breccia, arsenopyrite, pyrite, chalcopyrite, magnetite, bornite and sphalerite are present, where unmineralized, actinolite and chlorite dominate the breccia matrix (Hinchey *et al*., 2000).

Table 1: Sample values corresponding to samples illustrated in Figure 4; data from Dearin and Fraser, 1999; concentrations are listed in column headings unless otherwise stated.

Sample #	Width (m)	Au (ppb)	Ag (ppm)	As (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)
14103	3.0	5	0.6	137	103	9	437
14104	3.4	8058	0.74 oz/T	>2200	2774	169	1676
14105	0.25	5180	0.71 oz/T	>2200	4898	65	464
14106	5.5	7525	0.64 oz/T	>2200	1775	178	443
14107	5.2	5	0.3	151	58	4	53
14108	1.5	5525	0.39 oz/T	>2200	2390	109	0.62 %
14109	9.1	5	0.3	73	42	2	54

Stop 2.2: Monkstown Road Shear Zone

Plate 13: Location reference for stop 2.2 (#8 on map).

UTM 686873E/5289484N

From the parking area at Stop 2.1, continue southward on the Burin Peninsula Highway to the Monkstown Junction. This stop is located approximately 2.9 km eastward along the Monkstown Road, near the power line (Plate 13).

This is our first stop within the Marystown Group, which is host to the bulk of the epithermal alteration preserved on the Burin Peninsula. This group represents a sequence of primarily subaerial, bimodal volcanic and associated volcaniclastic rocks ranging in age from 590-570 Ma.

The next three stops will provide a cross-section through the Hickey's Pond belt (Figure 1), which contains high-sulphidation style alteration locally in association with up to 31 g/t Au. Along the Monkstown Road the alteration forms two subparallel belts dominated by alunite-specularite alteration locally hosting up to 8.1 g/t Au. This zone can be traced intermittently for upwards of 20 km along strike, and is believed to form part of the more regionally extensive Hickey's Pond – Point Rosie Belt, which extends for more than 90 km across the Burin Peninsula.

At this stop we see the relatively unaltered, yet strongly deformed, host rock which is transformed by high-sulphidation alteration at subsequent stops. Here the rocks are affected by a regional chlorite-epidote alteration, and display an intense penetrative fabric. Deformation in the area is dominantly confined to relatively narrow (up to several hundred meters) high-strain zones, which form subparallel to the regional north-northeast trend of the geological units. Local evidence exists for reverse sense motion along some of these shear zones with thrusting towards the east.

Stop 2.3: Monkstown Lazulite Showing

Plate 14: Location reference for stop 2.3 (#9 on map).

UTM 688923E/5287375N

This stop is located approximately 5.8 km off the main Burin Peninsula highway along the Monkstown Road (Plate 14). It is a short walk north from the road and waterproof footwear is essential unless you wish to have wet feet for the remainder of the day. It is best to continue east along the Monkstown Road, then walk north, and backtrack to the UTM location, because the swamp north of the road is very wet and deep. Although hammering and sampling will be tempting, we ask that you refrain from despoiling the outcrop.

At this location we have now progressed into the main high-sulphidation style alteration zone, which is dominated by silica-alunite-specularite and lesser pyrophyllite alteration. The Monkstown Road lazulite showing (Huard, 1990; Huard and O'Driscoll, 1986), locally contains spectacular blue lazulite ($MgAl_2(PO_4)_2(OH)_2$) within quartz-specularite veins (Plate 15). Discrete zones of hydrothermal brecciation can also be seen within the outcrop, consisting of pale pink siliceous, angular, fragments within a dark grey, specularite-rich matrix; however, such breccia development is generally limited on a regional scale. Channel sampling of the outcrop by Cornerstone Capital Resources in 2009 fail to identify any significant precious metals mineralization in association with the lazulite veins (Labonte, 2010). However, the abundance of alunite in the region suggests the alteration formed at relatively shallow depths within the hydrothermal system, and grabs samples from within the alteration zone along strike to the north and south of this location locally produce assays of up to 1.2 g/t Au (Dyke, 2009). The western boundary of the alteration is defined by a muscovite-pyrite shear zone located about 200 m to the west and locally displays evidence of a reverse sense of motion with thrusting towards the east.

Stop 2.4: Tower Zone

Plate 16: Location reference for stop 2.4 (#10 on map).

UTM 692423E/5286147N

From Stop 2.3, continue for about 6.7 km east on the Monkstown Road, and turn on to a small side road by a shed. The outcrops and trenches require a short walk to the north, for which waterproof footwear is recommended (Plate 16)..

In driving from Stop 2.3 to here we passed through a section of unaltered mafic and felsic subaerial volcanic rocks. We are now in the second of the two subparallel belts of high-sulphidation-style alteration exposed along the Monkstown Road. The volcanic rocks hosting the hydrothermal alteration in this area have locally been dated at *ca.* 575 Ma. The formation of the hydrothermal alteration within the volcanic sequence is attributed to the intrusion of the coeval Swift Current Granite and related intrusions (O'Brien *et al*., 1999).

This area was the focus of detailed mineral exploration conducted by Cornerstone Capital Resources during the mid-2000s. In walking to the trenches we will pass through relatively weakly altered, but highly strained, lapilli-tuff containing cm-scale elongated polymictic fragments (Plate 17). The trenching at the prospect successfully exposed wide areas of silica-alunite-specularite alteration, but failed to identify any auriferous vuggy silica zones such as those developed at the Hickey's Pond prospect to the north. The highest value from channel sampling returned 62 ppb Au over 3.0 m (Figure 5; Dyke and Pratt, 2008). Alteration within the zone is very intense and has obliterated any evidence of the original rock type. Infrared spectroscopic analysis of the alteration in the area indicates that it is dominated by sodic alunite, along with lesser pyrophyllite and locally topaz; such mineral assemblages are indicative of a hot (250-300˚C) acidic environment. In contrast, the volcaniclastic rocks marginal to the main alteration zone are dominated by phengite (white mica) alteration which is indicative of a more neutral pH environment.

At the Tower prospect the alteration zone trends northeast and can be traced along strike for up to 950 m, and locally reaches up to 200 m in width. A northeast-southwest trending, steeply northwest dipping foliation is developed within the alteration zone, which locally displays evidence of folding in both the vertical and horizontal planes, similar to that observed at the Hickey's Pond prospect further to the north (*c.f.* O'Brien *et al*., 1999), where evidence exists for reverse sense motion, with thrusting towards the east. The alteration zone is bound by faulted contacts to the northwest and southeast and the zone is inferred to pinch out along faults to the northeast and southwest.

Stop 2.5: Baine Harbour Shear Zone

Plate 18: Location reference for stop 2.5 (#11 on map).

UTM 658440E/5246977N

From Stop 2.4, return to the Burin Peninsula Highway and continue southward to the Baine Harbour junction. Turn left towards Baine Harbour, and proceed approximately 4.5 km to a large quarry on the left hand side of the road (Plate 18). Be cautious of the cliff faces and stay well back from high areas.

This stop highlights the different styles of alteration present on the Burin Peninsula. At this location a northeast trending shear zone is host to pervasive white mica alteration, dominated by phengite with lesser muscovite, and abundant disseminated pyrite. Here the alteration is developed along a reverse sense shear zone, which is being thrust towards the east (Plate 19). The alteration contains no precious metal mineralization, but one sample from the area returned weakly anomalous selenium (5.2 ppm).

This style of alteration is barren with respect to gold mineralization and it is currently unclear whether it is linked to the regionally extensive epithermal-style alteration, or part of an entirely separate event. Ar-Ar dating of the shear zone by Dallmyer *et al*. (1983) has produced ages ranging from 369 ± 10 to 388 ± 10 Ma, indicating a much younger age (Devonian) for the formation of the alteration, although it remains possible that this has overprinted older Neoproterozoic alteration.

Stop 2.6: Rattle Brook Prospect

Plate 20: Location reference for stop 2.6 (#12 on map).

UTM 661595E/5257267N

From Stop 2.5, return to the Burin Peninsula Highway, turn right and drive north until the bridge at Rattle Brook. The outcrops are located approximately 250 m upstream of the bridge at Rattle Brook (Plate 20). Beware of oncoming traffic while crossing the road.

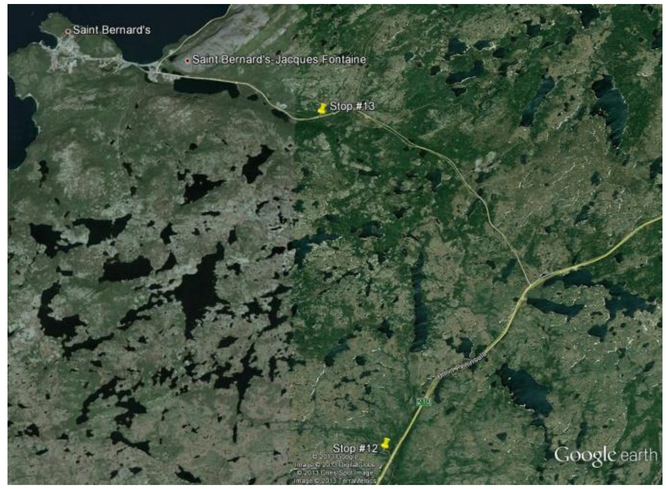
The Rattle Brook prospect represents another occurrence of advanced argillic alteration hosted within the volcanic rocks of the Marystown Group. Here the alteration is developed close to a fault structure which separates mafic volcanic rocks to the north, from felsic volcanic rocks to the south. Local intense silicification in association with pyrophyllite-alunite-dickite alteration is associated with anomalous gold mineralization. In some of the trenches the intense silicification has become tectonically brecciated during post-mineralization deformation. The hydrothermal alteration can be traced along strike for approximately 1.5 km, where it pinches out along a fault towards the west-northwest.

This area is unusual with respect to the regional northeast trending Hickey's Pond – Point Rosie Belt because here the overall trend of the alteration and the associated fabric within the host rock become deflected toward a more east-west orientation. Further along this trend towards the west-southwest is the Forty Creek and Stewart prospects (Sparkes, 2012 and references therein). The Forty Creek prospect represents a new discovery of an intermediate-sulphidation-style of mineralization, locally hosting up to 59 g/t Au and 2290 g/t Ag in association with lead and silver telluride minerals. The nearby Stewart prospect represents a zone of advanced argillic alteration extending for upwards of 4 km in length and up to 700 m in width, locally hosting anomalous Au and Cu mineralization. This zone may represent a telescoped epithermal system with the advanced argillic alteration superimposed on the underlying porphyry-related mineralization; work as part of an ongoing M. Sc. study at Memorial aims to provide further insight as to the nature and genesis of the alteration and related mineralization in the area of the Stewart prospect.

Stop 2.7: Berry Hills Granite

Plate 21: Location reference for stop 2.7 (#13 on map).

UTM 660355E/5264379N



From Stop 2.6, continue northward on the Burin Peninsula Highway, and then turn left on the road to St. Bernard's and Jacques Fontaine. The stop is located in a prominent roadcut about 6.2 km along this road (Plate 21). Beware of oncoming traffic and please exercise extreme caution around the high cliff faces!

These stops represent the Berry Hills granite, which is interpreted to be a one of the younger intrusive events located on the Burin Peninsula (*c.f.* O'Brien *et al.*, 1984). This unit primarily consists of medium-grained quartz-K-feldspar-rich granite, and is locally crosscut by meter-scale fine-grained mafic dykes. The granite is also noted to contain trace fluorite and molybdenite (O'Brien *et al.*, 1984). The granite is assumed to be of Devonian age, although it has never been dated; geochronology is presently in progress at the Geological Survey of Canada, through their TGI4 project.

Stop 2.8: Volcanic Rocks of the Long Harbour Group (Belle Bay Formation)

Plate 22: Location reference for stop 2.8 (#14 on map).

UTM 658084E/5266517N

From Stop 2.7, drive towards St. Bernards, and then turn right through Jacques Fontaine, and continue to prominent reddish outcrops opposite the town of Bay L'Argent. Please exercise extreme caution around the high cliff faces!

At this location we see the felsic volcanic rocks of the Long Harbour Group, which represent some of the youngest volcanic rocks preserved within the Avalon Zone of Newfoundland. These volcanic rocks represent a subaerial, bimodal volcanic sequence that hosts both high and low-sulphidation styles of epithermal alteration and local gold mineralization on the northwestern side of Fortune Bay (Figure 1); the unit is also associated with highly anomalous gold in lake sediment values (up to 24 ppb Au) to the northeast in the vicinity of Terrenceville.

At this roadcut you can locally see the well preserved volcanic textures that are common throughout the Long Harbour Group. Such features include local flow-banding and welded ash-flow tuff. Unfortunately there are no easily accessible examples of epithermal alteration within the Long Harbour Group, so we will now move on to the beach at Bay L’Argent to enjoy spectacular views and examine a representative collection of polished samples outlining the styles of alteration developed within some of these volcanic rocks.

Stop 2.9: Scenic Views and Polished Samples

From Stop 2.8, continue east, and turn on the road across the beach towards Bay L’Argent, where there is a safe parking area. If time permits, we may venture into the town for a few photographs, but we will first examine some polished slabs collected from the western side of Fortune Bay, at the high-sulphidation-style New Fortune prospect and the low-sulphidation-style Long Harbour prospect. *Please do not scratch the polished surfaces*.

New Fortune Prospect:

1) Pyrophyillitized ($Al_2Si_4O_{10}(OH)_2$) volcaniclcastic rock of the Long Harbour Group.
2) Diaspore ($AlO(OH)$) alteration; note the finely bladed texture of the alteration and the heaviness of the sample. Geochemical analysis of this sample produced 56.74 % Al_2O_3.
3) Massive silica alteration of volcaniclcastic host rock
4) Silica-pyrite alteration containing anomalous Ag (1.3 ppm), As (53 ppm), Hg (7 ppm) and Se (3.2 ppm).
5) Chalcedonic silica of an undetermined affinity, locally hosting up to 61 g/t gold. This mineralization occurs within approximately 750 m of the pyrophyllite-diaspore alteration.

Long Harbour Prospect

6) Flow-banded rhyolite hosting well-developed boiling textures lattice blading and adularia; sample contains 2.7 g/t Au and 4.2 g/t Ag.
7) Colloform-crustiform banded chalcedonic silica vein containing adularia and relic blading; sample contains 108 ppb Au and 0.3 ppm Ag.
8) Colloform-crustiform banded chalcedonic silica vein containing adularia; sample contains 36 ppb Au.

9) Cockade breccia developed marginal to the low-sulphidation related veining; sample contains 46 ppb Au.

10) High-level drusy silica vein indicating shallow levels of preservation within the low-sulphidation system.

11) Colloform-crustiform banded chalcedonic silica vein cores by thinly laminated chalcedonic silica interpreted to represent a near surface feature of the low-sulphidation system.

Rencontre East – Pools Cove Ferry Trip

Bay Bay L'Argent is the terminus for a passenger ferry to the isolated community of Rencontre East, and also to Pools Cove on the other side of Fortune Bay. This is not part of the GAC field trip, but it is an option for future independent users of this guidebook. It is an easy and inexpensive way to experience the spectacular coastal and marine scenery around the head of Fortune Bay. For the latest information on ferry schedules and costs, readers should consult the Government of Newfoundland and Labrador Website (www.gov.nl.ca).

Other Formations in the Long Harbour Group

The time available for this excursion will not permit the very scenic drive from Bay L'Argent to Harbour Mille, but it is an option for future independent users of this guidebook. This is a little-known but spectacular corner of the island of Newfoundland. These communities were formerly accessible only by water, and their locations are controlled by gravel beaches that connect to offshore islands. Harbour Mille is particularly scenic, and reveals good outcrops of the redbed facies of the Anderson's Cove Formation. Conglomeratic rocks of this formation are best exposed along the road about 11 km east of the junction in Jacques Fontaine, at UTM location 662899E/5270990N. The road trip provides excellent views of the rugged hills underlain by the Belle Bay Formation volcanic rocks and the Berry Hills Granite.

Stop 2.10: Ackley Granite

Plate 23: Location reference for stop 2.10 (#16 on map).

UTM 685487E/5294179N

From the St. Bernards area, return to the Burin Peninsula highway. Continue northward until the Monkstown Road junction, and then continue about 3.4 km; there are prominent granite outcrops west of the highway. A short access road provides a route to the outcrops, but this is in poor condition and may contain soft muddy spots (Plate 23).

Here we see a good exposure of the Ackley granite, which represents a Devonian (*ca.* 377 Ma) post-orogenic intrusion that intrudes along the Gander-Avalon tectonic boundary (Williams, 1979; Dickson, 1983; Tuach *et al*., 1986; Tuach, 1987). At this location several different xenoliths can be seen “floating” within the homogeneous, undeformed, coarse-grained granite, which here primarily consists of quartz-K-feldspar-rich granite (Plate 24). There are local examples of “rapakivi texture”, in which large K-feldspar phenocrysts are mantled by plagioclase. Several large cut blocks have been extracted from these outcrops during a past evaluation of the granite for its suitability as dimension stone. There has been no commercial production of stone from the site. In addition to the rock type, the superb glacial striae developed on subhorizontal surfaces are worthy of examination.

DAY THREE FIELD TRIP STOPS

The field trip stops for Day 3 are all located north of Clarenville, and most are related to the Big Easy project, a low-sulphidation style gold deposit that is currently under exploration by Silver Spruce Resources. In addition to several outcrops, we hope to also examine drill core from recent exploration. The itinerary may be subject to change according to the preferences of Company Personnel.

Stop 3.1: Love Cove Group

Plate 25: Location reference for stop 3.1.

UTM 721815E/5339683N

__This stop is located approximately 1.3 km west of Clarenville, on the road to the White Hills ski hill (Plate 25). Be attentive for traffic on the road.__

Here we are located in the Love Cove Group, which is flanked both to the east and west by the younger Musgravetown Group. Rocks of the Love Cove group commonly contain high strain zones such as the one developed here (Plate 26). These rocks represent the eastern margin of the Love Cove Group, which is located to the west of the Come By Chance Fault, separating these rocks from the Connecting Point Group as observed on Day 1. The age of the deformation developed at this location is not known, but a pre-Musgravetown Group deformation exists as indicated by the angular unconformity between the Musgravetown Group and the Connecting Point Group further to the north (*c.f.* O'Brien, 1993). From this stop we will continue to drive west, through the Love Cove Group, and the next stop will be in the siliciclastic sedimentary rocks of the Musgravetown Group, which flank the western margin of the older volcanic succession.

Stop 3.2: Musgravetown Group

Plate 27: Location reference for stop 3.2 and subsequent stops in the Big Easy area (#18 and #19 on map).

UTM 710338E/5351012N

From Clarenville, continue to Thorburn Lake and turn left on a gravel road just past the lake, located 7 km north (beyond) the junction for the Discovery Trail and Bonavista/Trinity. Stop at the quarry approximately 200 m along the road (Plate 27).

These outcrops reveal grey-green coarse-grained sandstone of the Musgravetown Group, locally displaying well-developed cross-bedding. These rocks dip moderately to the west and are inferred to have a faulted contact with the Love Cove Group volcanic rocks to the east. This stop illustrates the style of sedimentation and the relatively undeformed nature of the Musgravetown Group outside of the alteration zone that will be observed at the following stops. Immediately north of this location are flow-banded rhyolites, which are interpreted to represent the *ca.* 570 Ma volcanic rocks of the Bull Arm Formation (Wilton and Way, 2001).

Stop 3.3: Gold Mineralization at the Big Easy Prospect

From Stop 3.2, continue on the gravel road. There is an area suitable for parking at UTM 710335E/5349106N, which is relatively close to the powerline. From here an ATV trail leads to the main occurrence (Plate 27; Figure 6) and side trails lead to the other locations discussed below. Waterproof footwear is highly recommended for this section of the field trip. We will tour several of the exploration trenches to observe the styles of alteration and veining developed at the prospect before proceeding to the core storage area to examine some of the 2012 drillholes stored at Thorburn Lake.

The area near Thorburn Lake was examined by GT Exploration Limited in the mid-1990s (Harris, 1996). Initial interest in the area was generated by an anomalous lake sediment sample containing 10 ppb Au. Subsequent prospecting led to the discovery of a silica–pyrite alteration zone, which locally assayed up to 196 ppb Au, and measured up to 500 m in width and 1.8 km in length (Harris, 1996); however no further work was carried out on the prospect. In 2010, Silver Spruce Resources resumed exploration and carried out trenching and diamond drilling, which led to the discovery of well-developed low-sulphidation-style chalcedonic silica veins and related brecciation (*i.e.* Big Easy prospect; Silver Spruce Press Release, July 29, 2010). Trenching has also uncovered large blocks of layered chalcedonic silica material interpreted as sinter deposits related to hot springs (Silver Spruce Resources Press Release, November 3, 2010). Subsequent drilling has now produced some of the highest grade gold intersections within low-sulphidation-style epithermal systems in the Avalon Zone of Newfoundland. The first phase of diamond drilling on the property, in which the holes were oriented to the east returned up to 0.87 g/t Au and 33.5 g/t Ag over 30.5 m, including 6.05 g/t Au and 174 g/t Ag over 1.5 m (DDH BE-11-3) as well as local intersections of up to 7.65 g/t Au and 10 g/t Ag over 1 m (DDH BE-11-7; Silver Spruce Resources Press Release, May 3, 2011). The second phase of drilling was directed towards the west and intersected better vein development which locally returned values of up to 7.9 g/t Au and 130 g/t Ag over 1.2 m (Silver Spruce Resources Press Release, August 16, 2012).

The host volcaniclastic sedimentary rocks at the Big Easy prospect are correlated with the late Neoproterozoic Musgravetown Group (Meyer *et al*., 1984). The area immediately north of the Big Easy prospect, in the vicinity of Clode Sound, was mapped by O'Brien (1993). In this area, the Musgravetown Group is described as consisting of coarse-grained, mainly red, fluviatile clastic sedimentary rocks with locally developed basal conglomerate, overlain by a bimodal volcanic sequence. A rhyolite unit from the base of the Musgravetown Group has been dated at *ca.* 570 Ma and the sequence is locally unconformably overlain by Cambrian sedimentary rocks (Hayes, 1948; O'Brien, 1987; O'Brien *et al*, 1989). Within the immediate area of the Big Easy prospect, the sedimentary rocks distal to the development of the silica–pyrite alteration consist of red, coarse-grained sandstone and lesser interbedded pebble to cobble conglomerate. The extensive silica–pyrite alteration at the prospect hinders recognition of the host rocks, but relict rounded sedimentary clasts are locally observed suggesting that the host rock is similar to the surrounding sedimentary rocks outside the main alteration zone. A mafic dyke collected from drillhole BE-11-03, which crosscuts the silica alteration, was dated at 566 ± 2 Ma (Clarke, 2012), demonstrating the Neoproterozoic age of the low-sulphidation system. The preservation of surficial sinter deposits in a low-sulphidation system of this age makes this occurrence very unique.

Veins measuring up to 50 cm in width, displaying typical low-sulphidation-style textures such as crustiform–colloform banded chalcedonic silica and relict lattice blading (Plate 28). Some of the veins crosscut sedimentary layering at a relatively high angle. In addition, large blocks (interpreted to represent subcrop) containing cm-scale layers of chalcedonic silica interlayered with coarse-grained sandstone are also present. Elsewhere, fragments of similar chalcedonic material form clasts within coarse conglomeratic units. These relationships suggest the formation and simultaneous erosion of epithermal sinter deposits during the deposition of the late Neoproterozoic Musgravetown Group.

Stop 3.3a: Unaltered Musgravetown Group

We will first visit the area of drillhole BE-11-06 (Figure 6). In the vicinity of the drillhole collar, large blocks (interpreted as subcrop) illustrate the red coloration of the unaltered sandstone and interbedded pebble conglomerate. A small stream separates the unaltered and altered rock in this area; however the contact in drillcore is preserved as a sharp faulted contact.

Stop 3.3b: Trench 7

We are now into the main alteration zone, which consists of silicification and white mica alteration of the host sedimentary rocks. At this location several 10-20 cm wide chalcedonic silica veins cut across the outcrop. Note the difficulty in seeing the veins on the lichen-covered portion of the outcrop versus the stripped portion of the outcrop.

Stop 3.3c: Trench 4

Here we continue to move along strike within the alteration zone. Locally, relict bedding within the host sedimentary sequence appears to be westward dipping, and this is interpreted to still be the same host rock as observed at the last stop.

Stop 3.3d: Trench 6

This trench represents the southernmost exposure of the alteration zone. Here, layers of chalcedonic silica can be seen interbedded with the volcaniclastic sandstone (Plate 29). Locally, chalcedonic silica veins crosscut the sinter at relatively high angles to bedding. These large blocks of sinter material are interpreted as subcrop, as the bedding orientations do not seem to match with those taken elsewhere in the immediate vicinity. Drillhole BE-11-01, which was located just to the west of this location, and oriented towards the east, failed to intersect any significant sinter material in drillcore.

Stop 3.3e: Drill Core Display

The field trip will conclude with examination of representative drill core from the 2012 exploration program, which will take place at a cabin on Thorburn Lake that was used as a base for exploration work.

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Plate 2: Subparallel barite veins developed within the siliciclastic sedimentary rocks of the Connecting Point Group; Sutton prospect.

Plate 5: Kink-fold contact between the Crown Hill Formation (left) and the Random Formation (right); photo from Normore, 2012.

Plate 8: Pebble conglomerate of the Rocky Harbour Formation; Stop #1.5.

Plate 10: Interbedded siltstone, sandstone and granular conglomerate of the Crown Hill Formation; Stop #1.6.

Plate 12: Representative slabs of the hydrothermal breccia containing both sedimentary and intrusive fragments; Lodstar prospect.

Plate 15: Blue lazulite occurring within quartz-specularite veins; Monkstown Road prospect.

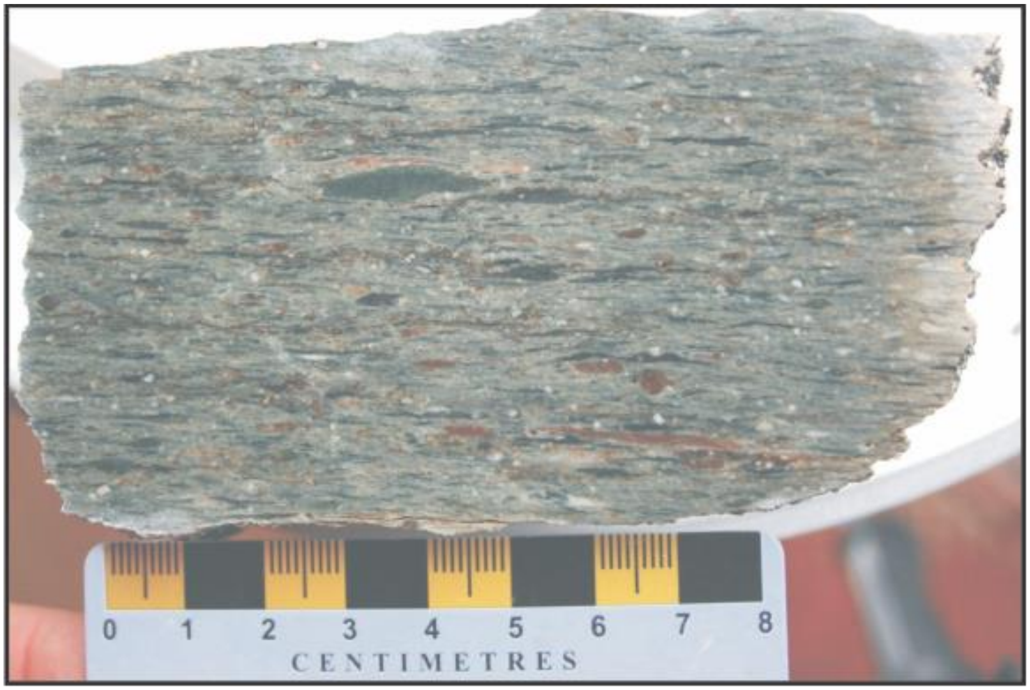

Plate 17: Lapilli-tuff marginal to the high-sulphidation related alteration; Tower prospect.

Plate 19: Baine Harbour shear zone, locally displaying a reverse sense of motion; note geologist for scale in left hand side of photo.

Plate 24: Examples of the various types of xenoliths preserved within the Ackley Granite; Stop # 2.10.

Plate 26: Intense fabric developed within rocks of the Love Cove Group; Stop #3.1.

Plate 28: Lattice bladed texture, indicative fluid boiling, hosted within chalcedonic silica vein, Big Easy prospect.

Plate 29: Sinter deposit consisting of alternating layers of chalcedonic silica and volcaniclastic sandstone; note local erosional truncation of beds indicating right way up; Big Easy prospect.

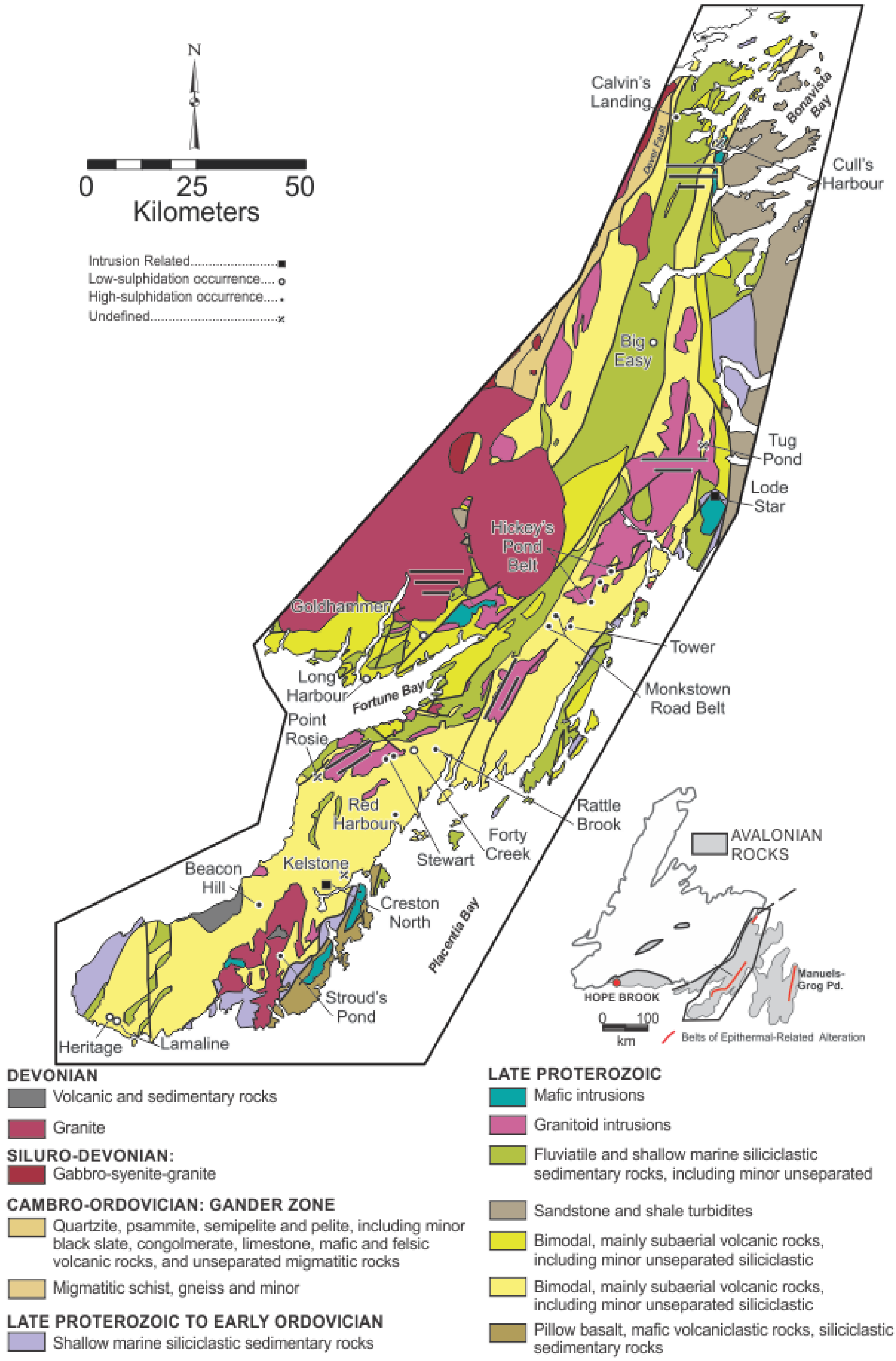

Figure 1: Regional geology map of the western Avalon Zone outlining the distribution of known epithermal prospects (modified from O'Brien *et al., 1998).*

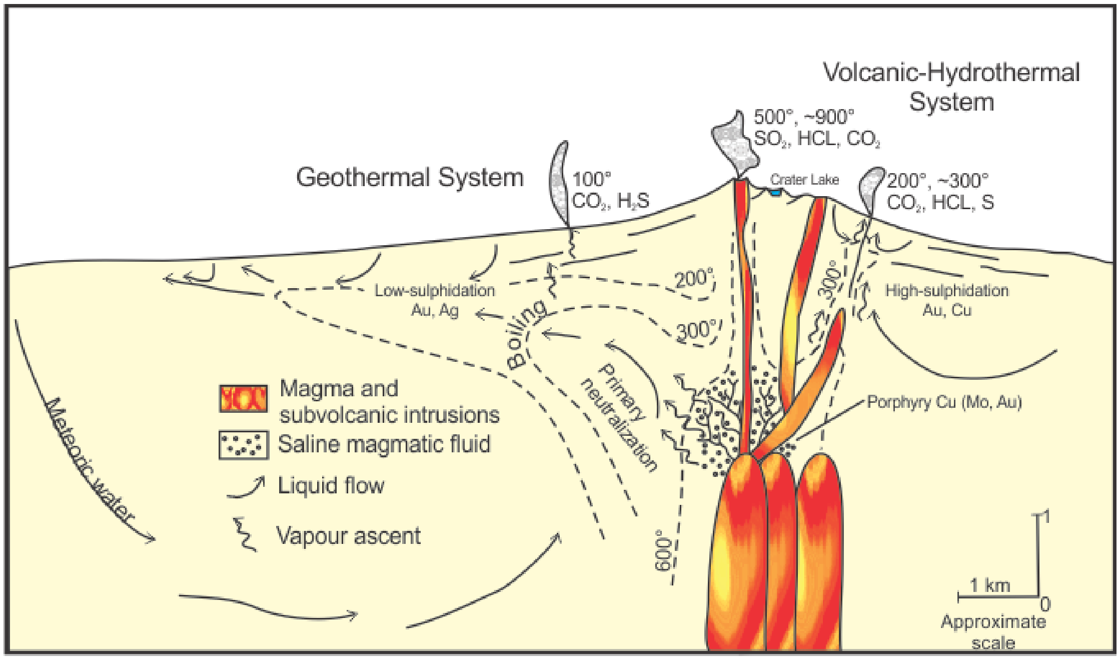

Figure 2a: Schematic cross section through an intrusive centered hydrothermal system outlining the environments of porphyry, high-sulfidation and low-sulfidation systems (Hedenquist and Lowenstern, 1994).

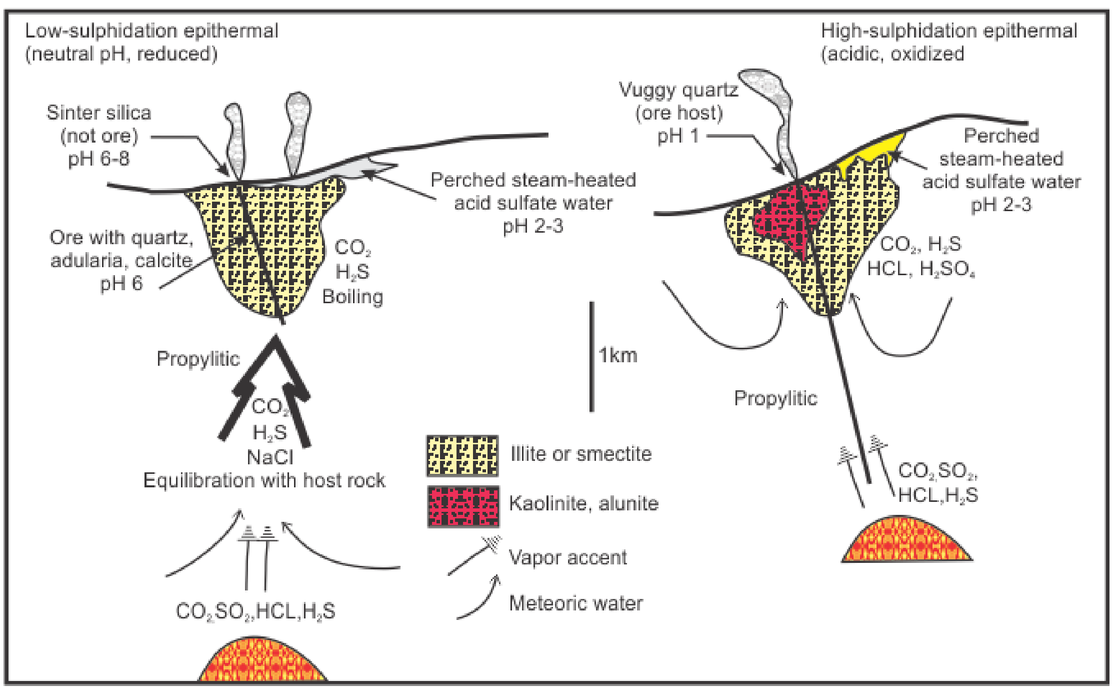

Figure 2b: Schematic diagram of the fluid types and alteration zoning around high- and low-sulphidation epithermal systems (from White and Hedenquist, 1995).

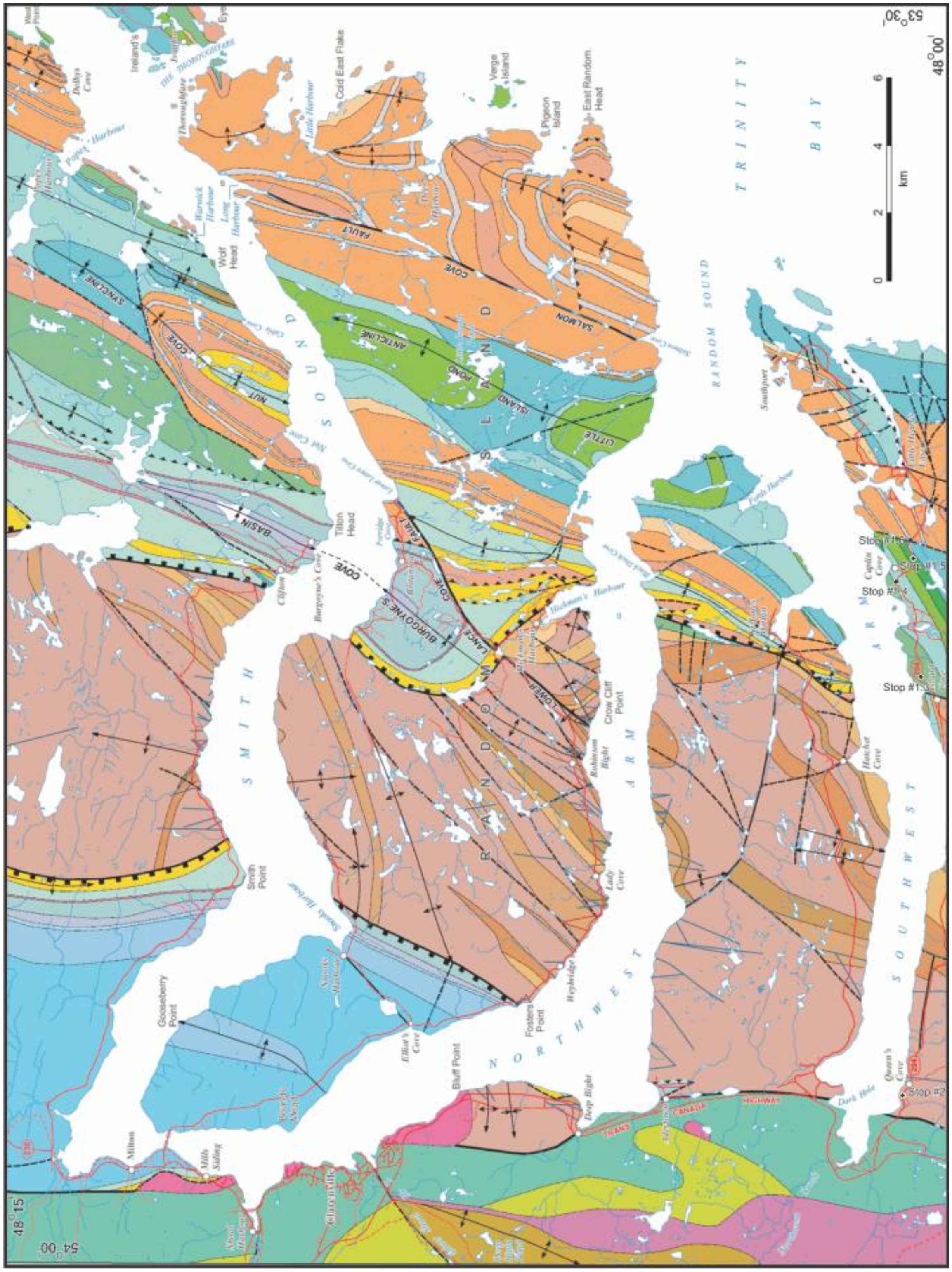

Figure 3: Geology of the Random Island map sheet (NTS 2C/04; Normore, 2012).

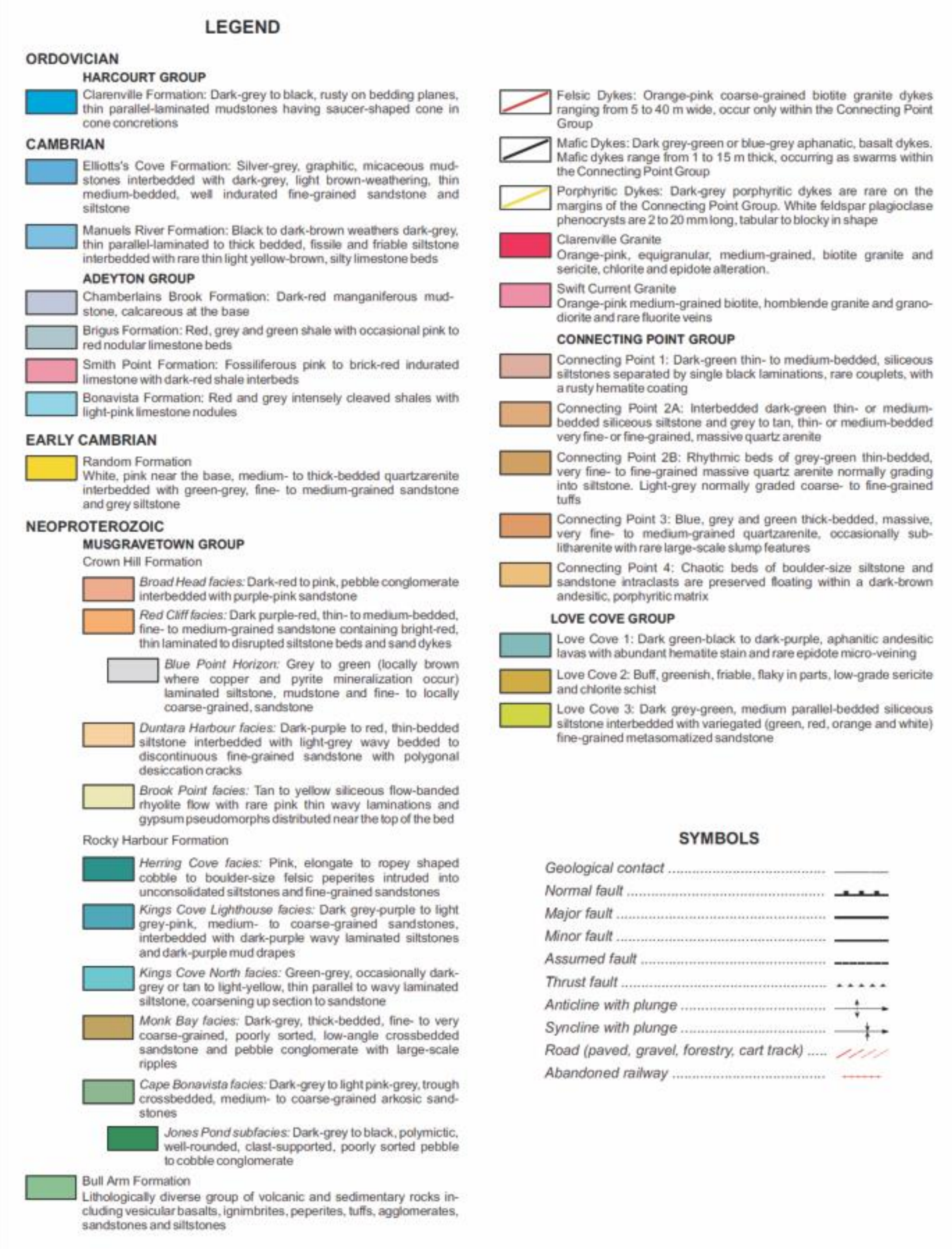

Figure 3: Legend for corresponding map of the geology of the Random Island map sheet (NTS 2C/04; Normore, 2012).

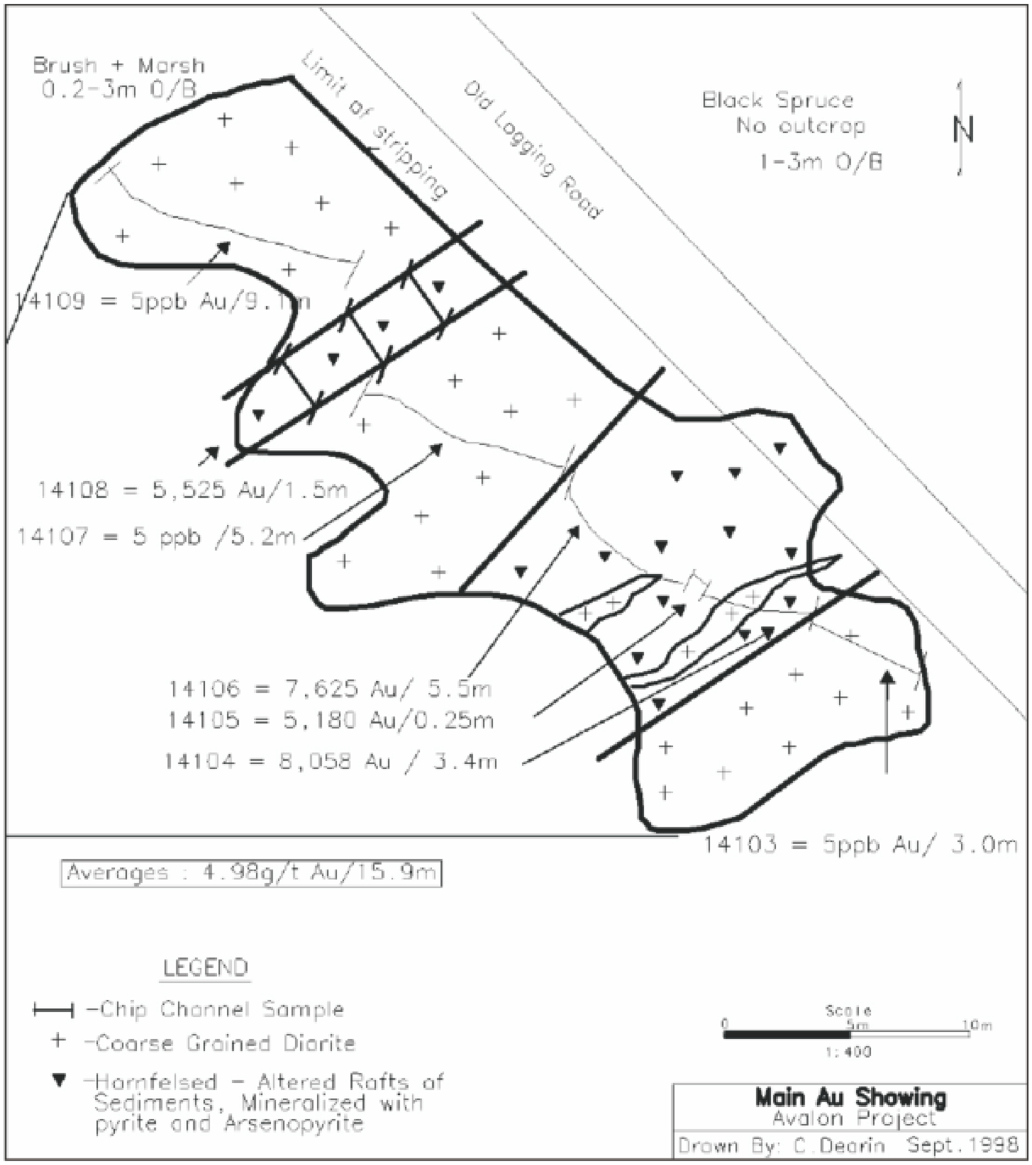

Figure 4: Schematic trench map of the Lodestar prospect outlining locations of channel samples and resulting assay values; Dearin and Fraser, 1999.

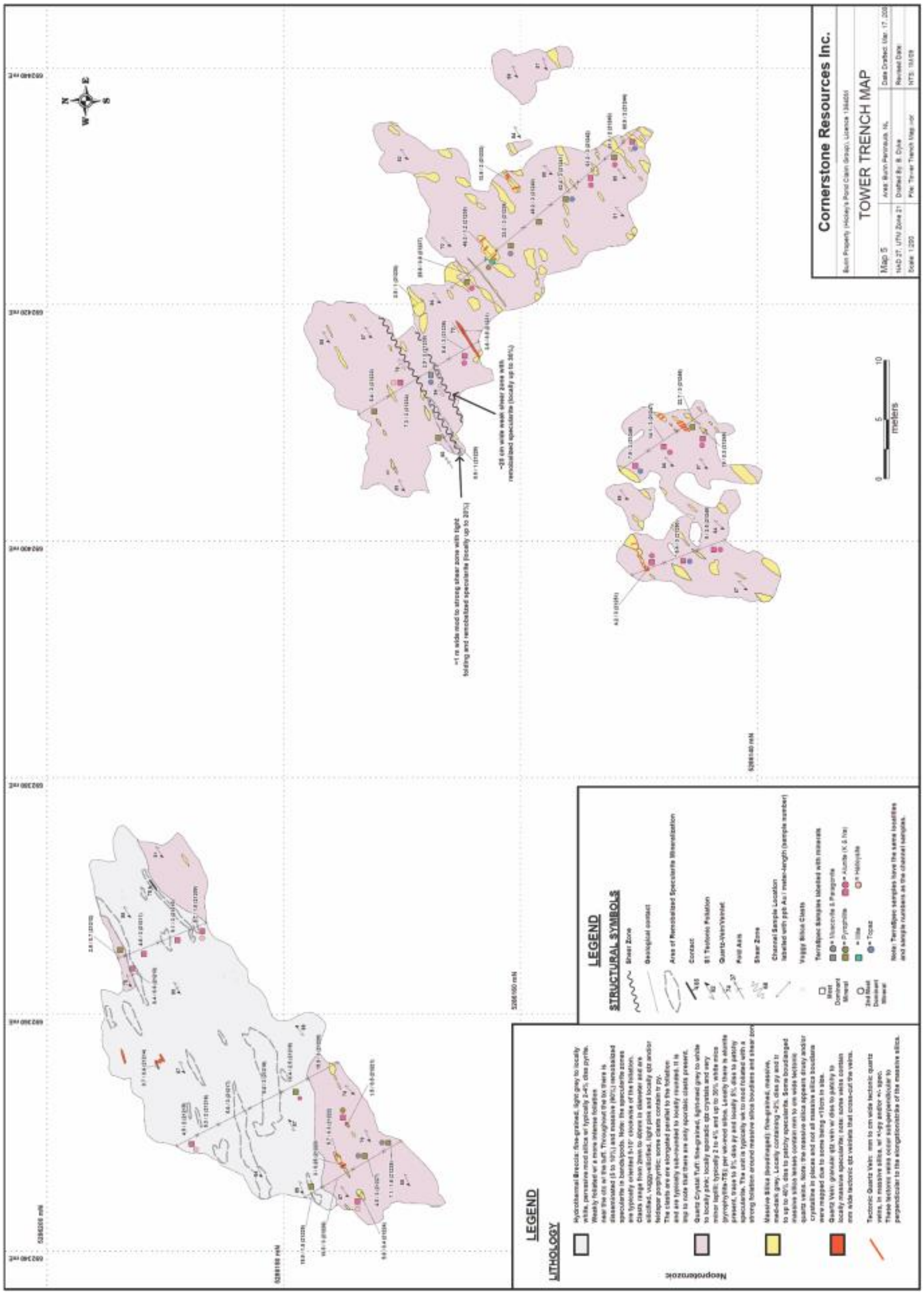

Figure 5: Trench map of the Tower prospect outlining location of channel samples and resulting assay values; Dyke and Pratt, 2008.

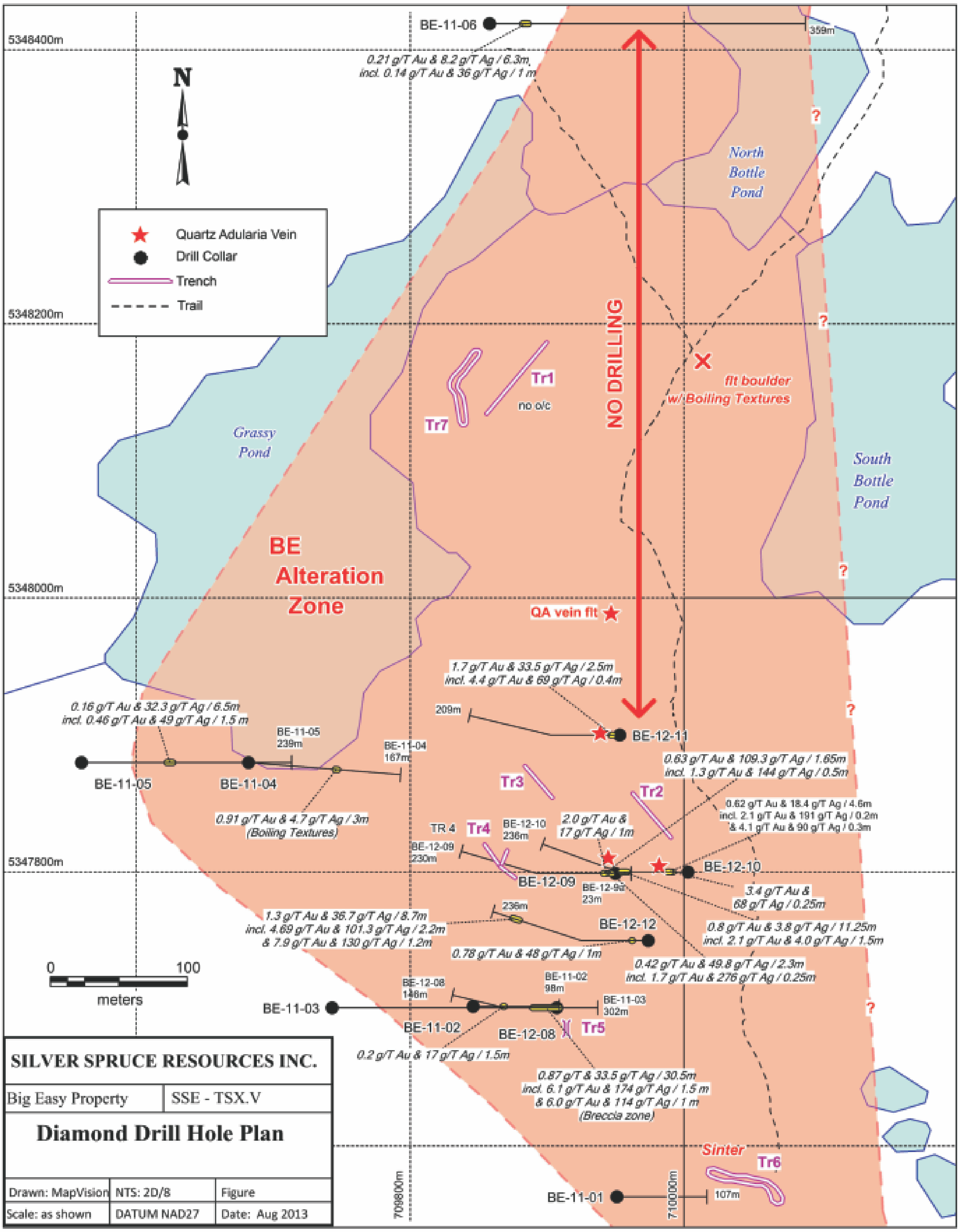

Figure 6: Schematic map outlining the location of the diamond drill-holes and exploration trenches at the Big Easy prospect, Silver Spruce Resources website, 2013.

NOTES

NOTES

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2013 Fall Field Trip

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