

BRECCIA-HOSTED GOLD ON THE NORTHERN BURIN PENINSULA, NEWFOUNDLAND

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ABSTRACT

The Lodestar prospect consists of sulphide–oxide mineralized breccias of magmatic–hydrothermal or phreatomagmatic origin. The prospect contains significant gold mineralization within polyolithic breccias associated with the Powder Horn Intrusive Suite, near Goobies. The best grades obtained by exploration companies from chip-channel sampling of the mineralized breccia consist of 4.98 g/t Au and 14.8 g/t Ag over a 15.9 m width, along with one area that returned an assay of approximately 2.0 % Zn. Earlier assays returned values of 6.13 g/t Au over 4.7 m and 4.91 g/t Au over 3 m. Recent samples channeled by the owner of the property indicate 5.6 g/t Au over 8.5 m including 12.6 g/t Au over 1 m.

The Powder Horn Intrusive Suite is a multi-phase intrusive suite, having both pre- and post-brecciation (mineralization) phases. Pre-mineralization rocks consist of sedimentary units of the late Neoproterozoic Musgravetown Group, which are hornfelsed in areas close to the intrusion, medium-grained gabbro/diorite, and minor felsic material. Post-mineralization phases include fine-grained gabbro/diorite, felsic phases, and diabase dykes.

The main mineralized breccia, which occurs at the contact of the host sedimentary rocks and the pre-breccia gabbro/diorite, is exposed over approximately 25 m and contains gold mineralization in association with copper, arsenic, and zinc. The mineralization dominantly occurs as the matrix of the breccia, whereas unmineralized sections of the breccia contain actinolite/chlorite within the matrix. The breccia clasts consist of the host sedimentary material, pre-breccia gabbro/diorite, quartz–feldspar porphyry, diabase, and minor fine-grained granite. The sedimentary and gabbro/diorite clasts were locally derived from the wall-rock, however, the quartz–feldspar porphyry clasts have not been observed in outcrop in the area of the showing and are therefore assumed to be derived from depth. In places, these porphyry clasts contain pre-breccia mineralization, and they also appear to be finely comminuted, thereby producing a rock-flour matrix in portions of the breccia and possibly indicating transportation from depth. Many characteristics of the Lodestar prospect correspond to a magmatic–hydrothermal origin for the breccia, produced by fluid exsolution from a gold-bearing intrusive system. The presence of exotic mineralized quartz–feldspar porphyry clasts within the breccia suggests that mineralization may be related to a deep Cu–Au porphyry system. If so, the prospect may have formed in a transitional environment between a deep mineralized porphyry system and a shallow epithermal system. The Lodestar prospect is, therefore, very significant because it indicates the potential for additional porphyry-style mineralization within the Powder Horn Intrusive Suite, as well as elsewhere on the Burin Peninsula.

INTRODUCTION

Gold mineralization has been known to occur in rocks of the Avalon Belt (O'Brien *et al.*, 1998) of the southern Appalachians for the past 200 years. The Avalon Belt was the site of North America's first gold rush (Carpenter, 1972), however, in the Newfoundland part of the belt, widespread gold mineralization has been suggested and documented for

only about twenty years (Hussey, 1978; Taylor *et al.*, 1979; McKenzie, 1983, 1986; O'Driscoll, 1984). During this period, numerous discoveries have been made and large, auriferous, alteration belts have been delineated (e.g., Huard and O'Driscoll, 1984, 1985, 1986; McKenzie, 1986; Tuach *et al.*, 1988; Huard, 1990; Hayes and O'Driscoll, 1990; O'Brien *et al.*, 1996, 1998, 1999; Dubé *et al.*, 1998).

¹ Mineral Deposits Section

In 1998, significant gold mineralization was discovered in polyolithic breccias associated with the Powder Horn Intrusive Suite in the Goobies area by Mr. Leroy Smith, a prospector, from Arnold's Cove Station. He staked the area, and optioned it to Noveder Inc. Channel samples collected by them returned values of 6.13 g/t Au over 4.7 m and 4.91 g/t Au over 3 m. Noveder Inc. re-optioned the property to NDT Ventures Ltd. They carried out an exploration program during December, 1998 that included prospecting, gridding, soil geochemical sampling, ground geophysical surveying, backhoe trenching and rock sampling. The best results obtained by NDT from chip-channel sampling in mineralized breccia of the main showing returned values of 4.98 g/t Au and 14.8 g/t Ag over a 15.9 m. In addition, one area returned an assay of approximately 2.0% Zn. Ownership of the property reverted back to Mr. Leroy Smith in 1999. He named the occurrence the "Lodestar Prospect" and did additional trenching and sampling in December, 1999. This work has extended the main zone and added previously unknown zones. Recent channel samples indicate 5.6 g/t Au over 8.5 m including 12.6 g/t Au over 1 m (L. Smith, personal communication, 2000).

The purpose and scope of this project by the senior author is to complete a detailed examination of the geology, geochemistry, geochronology, petrography, and metallogeny of the Powder Horn Intrusive Suite as part of a M.Sc. thesis at the Department of Earth Sciences, Memorial University, under the supervision of Dr. Derek Wilton.

Previous work in this area includes regional mapping by Rose (1948), Anderson (1965), McCartney (1958, 1967), O'Driscoll (1977) and O'Driscoll and Hussey (1976/77). No mapping more detailed than 1:50 000, or exploration has been previously done in the area. The recent discovery provides a new target for additional exploration.

REGIONAL GEOLOGY

The Goobies–Come By Chance area (Figures 1 and 2) is divided into two structurally contrasting geological terranes separated by a system of faults that are an extension of the Paradise Sound Fault. Southeast of the fault, the area is underlain by a thick succession of late Neoproterozoic sedimentary rocks (Connecting Point Group) that is overlain by the mixed volcanic and sedimentary assemblage of the Musgravetown Group. These, in turn, are overlain or faulted against Lower Cambrian shales. Rocks in this belt have been openly to tightly folded about northeast-trending axes and do not display any schistosity. Northwest of the fault lies a belt of chlorite–sericite schists derived from volcanic, sedimentary and intrusive rocks and are now considered to be part of the Marystown Group. Intrusive rocks in the area (Figure 2) are granite, quartz–feldspar porphyry and diorite

of the Sall the Maid Intrusive Suite and diorite, gabbro and felsic dykes of the Powder Horn Intrusive Suite.

Connecting Point Group (Hayes, 1948) rocks are located on the eastern side of the map area and are separated from other rocks in the area by the Come-by-Chance fault (Figure 2). They include green, grey and brown, regularly bedded and laminated sandstone, siltstone and shale. In places, thick massive sandstone beds occur within the thinly bedded sequences. A medium- to coarse-grained green conglomerate unit occurs toward the top of the sequence and was previously mapped as part of the Musgravetown Group (McCartney, 1967). It lies along strike of and is similar to, rocks mapped as part of the Connecting Point Group on Long Island, Placentia Bay (O'Driscoll and Muggridge, 1979; Figure 1).

The Musgravetown Group (Hayes, 1948) underlies the central part of the map area (Figure 2). It consists of green to grey, graded and crossbedded sandstone, pebbly sandstone, conglomerate and grey to black thinly bedded sandstone and shale. In places, detrital magnetite is common as thin lenses and wisps within the beds. These rocks have been altered to a dense black hornfels close to the Powder Horn Intrusive Suite. Sedimentary features can generally be recognized within the hornfelsed rocks.

The Marystown Group (Strong *et al.*, 1978) rocks are exposed in the northwestern part of the map area (Figure 2). They are composed of mafic and silicic volcanic flows and pyroclastic rocks, including crystal, lithic and crystal-lithic tuffs and agglomerates. These rocks have been isoclinally folded and are overprinted by a strong penetrative north- to northeast-trending, steeply dipping foliation and have been regionally metamorphosed to chlorite and sericite schists. These rocks were originally included in the Love Cove Group because of their similar composition and intense deformation. It has been demonstrated in the Bonavista Bay area that the Love Cove Group underlies the Connecting Point Group conformably (O'Brien and Knight, 1988) and has an age of 620 ± 2 Ma (O'Brien *et al.*, 1989). However, a recent age of the rocks on the Burin Peninsula indicates they are ca. 572 Ma (O'Brien *et al.*, 1999) and are younger than the Love Cove Group. The Marystown Group rocks are therefore equivalent in age to rocks of the Musgravetown Group, which unconformably overlies the Connecting Point Group.

The Random Formation (Walcott, 1900) overlies rocks of the Musgravetown Group in the north-central part of the map area and consists of white to brown orthoquartzite, quartz sandstone and interbedded dark grey to green micaceous siltstone and sandstone. Rocks of the Adeyton Group (Jennes, 1963) overlie the Random Formation and are char-

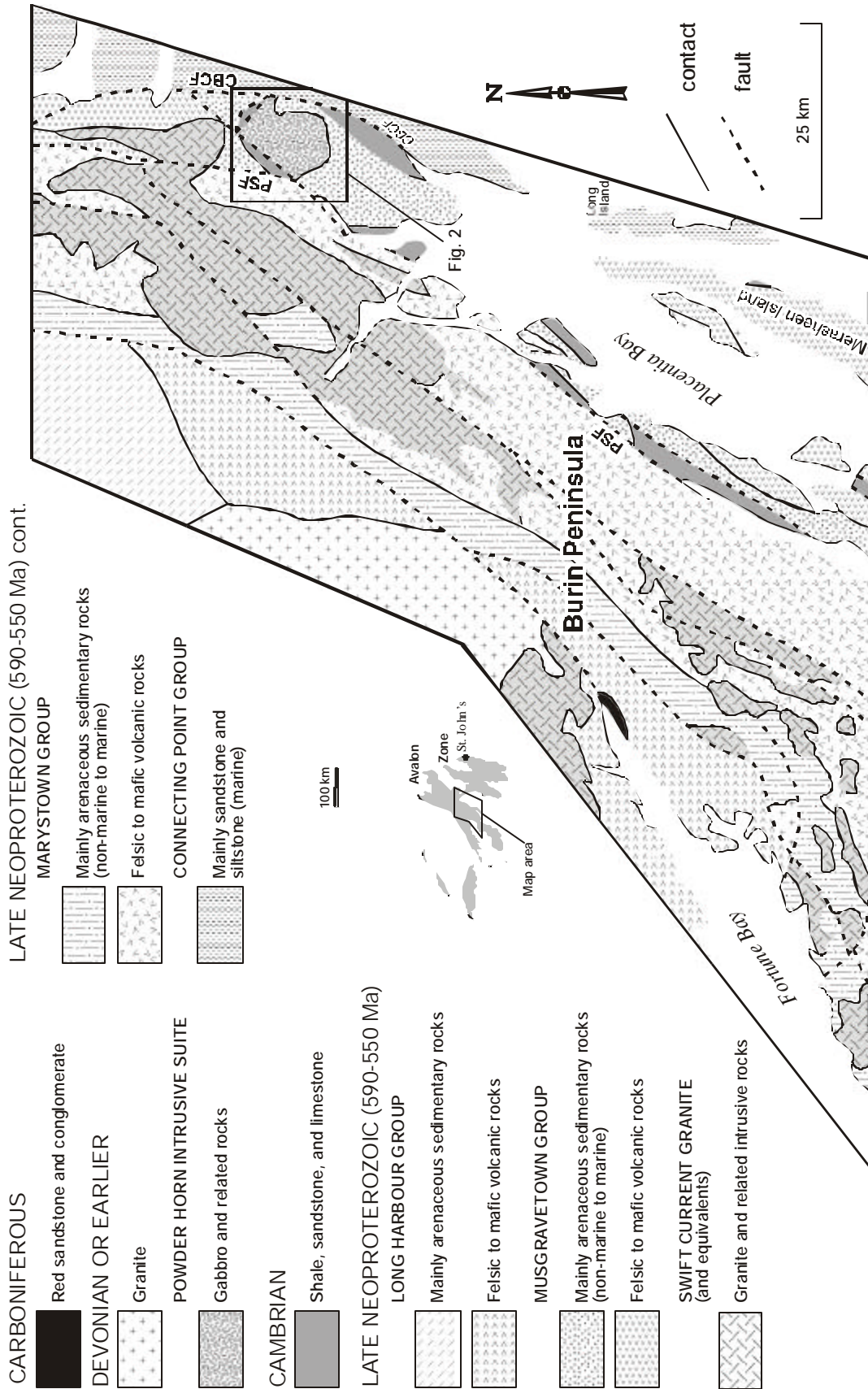


Figure 1. Generalized geological map of the northern Burin Peninsula, PSF - Paradise Sound fault, CBCF - Come By Chance fault.

Geology of the Powder Horn Intrusive Suite

DEVONIAN OR EARLIER

9 Beige, pink and orange, fine-grained granite and quartz to quartz-feldspar porphyry (Sail the Maid Granite)

POWDER HORN INTRUSIVE SUITE

8 Pink to orange, fine-grained granite, aplitite and quartz to quartz-feldspar porphyry

7 Dark green, fine-grained diorite to gabbro with a pilotaxitic texture. Porphyritic (plagioclase and/or amphibole) in places

6 Medium- to coarse-grained, black to dark green and white gabbro to diorite

CAMBRIAN

5 Purple and green slate and shale; pink limestone beds and nodules (Adeyton Group)

4 White crossbedded quartzite and interbedded green micaceous siltstone and sandstone (Random Formation)

PRECAMBRIAN

3 Green and grey, graded and crossbedded sandstone, black siltstone and green conglomerate. Purple and red sandstone and shale near top (Upper Musgravetown Group)

2 Chlorite and sericite schist derived from mafic and silicic, crystal-lithic tufts (Marystown Group)

1 Green, grey and black, well bedded siltstone, sandstone and slate. Green polymictic conglomerate (Connecting Point Group)

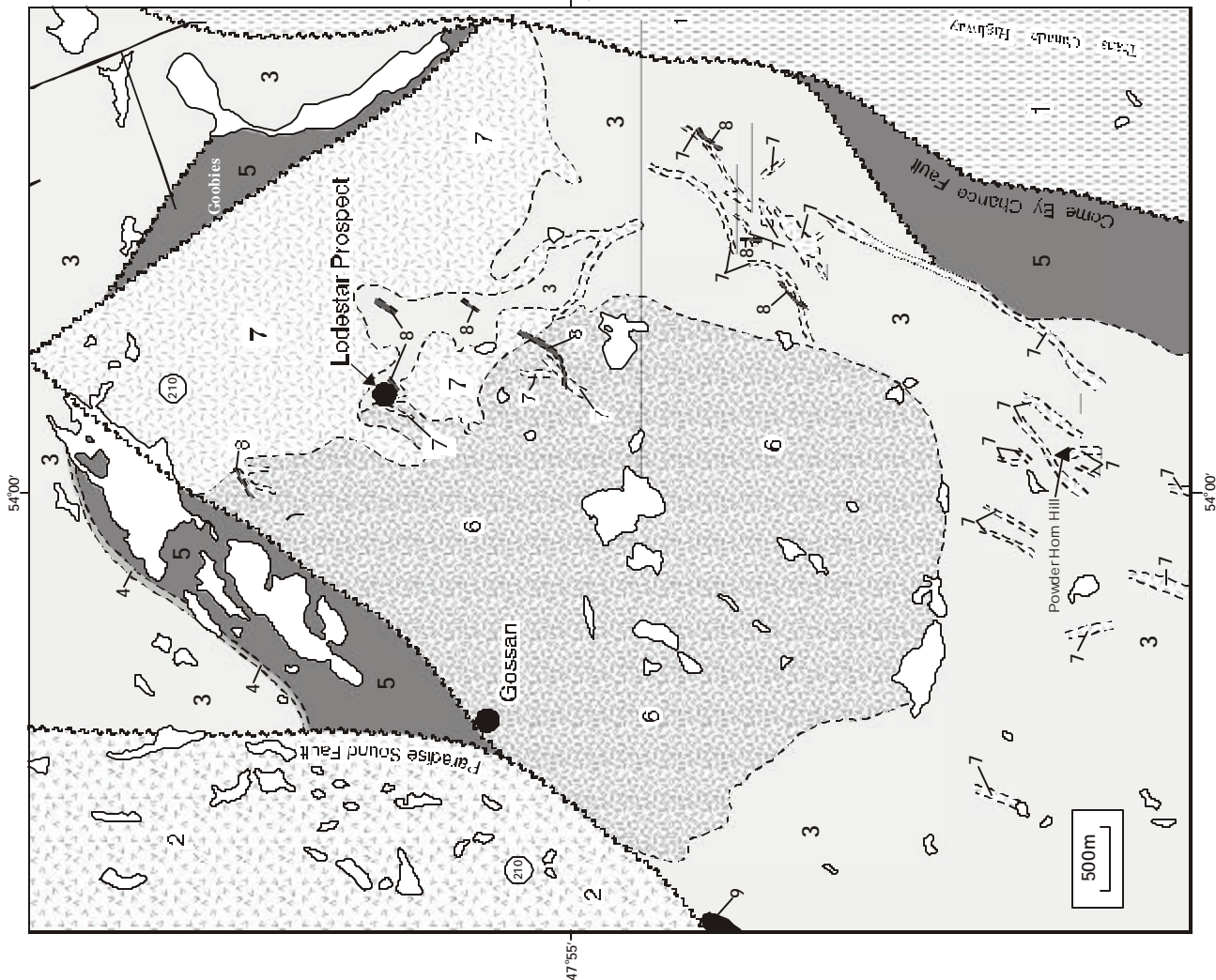


Figure 2. Geology of the Powder Horn Intrusive Suite and surrounding areas.

acterized by red, purple and green shale and slate containing many nodules and nodular beds of pink and grey algal limestone. The limestones contain fossils consisting mainly of the shelly fauna hyolithids. Rocks of the Adeyton Group are exposed as faulted blocks along the Come By Chance fault and along splays of it and the Paradise Sound fault. Minor outcrops of black shale are exposed in the town of Goobies and may be a remnant of middle Cambrian rocks (McCartney, 1958).

The Sall the Maid Granite outcrops on the western edge of the map area and extends southwestward along the trace of the Paradise Sound fault as discontinuous intrusive bodies to the North Harbour area. It is composed of beige to pink and orange, fine-grained granite, quartz \pm feldspar porphyry and green to grey diorite. It intrudes the late Neoproterozoic and Lower Cambrian rocks in the North Harbour area and is presumed to be Devonian.

POWDER HORN INTRUSIVE SUITE

The Powder Horn Intrusive Suite is a multi-phase intrusion, dominated by diorite/gabbro and lesser amounts of felsic and diabase material. The intrusion is exposed as an elliptical body located at the intersection of the Isthmus of Avalon and the northern part of the Burin Peninsula (Figure 1) near the town of Goobies. This study was initiated to investigate the origin of recently discovered gold mineralization associated with polyolithic breccias at the Lodestar prospect. The prospect occurs in the north-central part of the intrusion and is located approximately 2.5 km to the southwest of Goobies and approximately 1.5 to 2.0 km along a woods road off the Burin Peninsula Highway (Route 210, Figure 2).

Contact relationships between the various phases of the intrusion and country rock are well exposed, and allow for the relationships between the various phases and mineralization to be determined. Due to the lack of subsurface data, however, it is difficult to interpret the nature and extent of the mineralized breccia at depth. Preliminary interpretations suggest that the mineralized breccias have a phreatomagmatic or magmatic–hydrothermal origin.

Work carried out during the 1999 field season identified five significant rock units, each with internal variations; these phases being defined as either pre- or post-brecciation (mineralization). The existence of pre- and post-breccia phases within the intrusion is important in terms of the timing and mode of emplacement of the mineralization (*see below*).

The pre-mineralization rocks consist of (1) a sedimentary unit, which is assumed to host the intrusion and which

has been intensely hornfelsed, (2) a medium- to coarse-grained, equigranular, black and white gabbro/diorite, and (3) one small felsic dyke, which is presumed to be pre-mineralization because it is brecciated in part of the showing where the breccia is unmineralized. The post-mineralization rocks consist of (1) a fine-grained, dark-green, equigranular diorite to gabbro having a pilotaxitic texture, (2) pink to orange quartz–feldspar porphyry dykes and fine-grained granite dykes, and (3) diabase dykes.

PRE-BRECCIA UNITS

As previously mentioned, the sedimentary rocks (Musgravetown Group; Unit 3, Figure 2) in the area of the intrusion have been intensely hornfelsed and altered. In places, however, the hornfelsed sediments still exhibit small laminations and bands of dark and light material, which are presumably remnants of a primary depositional layering. These sediments are also commonly magnetic, indicating the presence of either primary detrital magnetite or the introduction of magnetite into the sediments by the intrusive rocks. In areas close to the intrusion, the sedimentary rocks are totally hornfelsed, and appear as a very fine-grained black rock, making up a thermal aureole to the intrusion. Due to the grain size and the extent of the hornfelsing, identification of metamorphic minerals in hand sample is difficult. Away from the intrusive phases, the sedimentary rocks consist of thinly bedded to massive, black, grey and green sandstones, pebbly sandstones, siltstones and shales, of the late Neoproterozoic Musgravetown Group. The sedimentary rocks are both overlain by and fault bounded against a sequence of quartzites and sandstones and a group of red and green shales containing beds and nodules of pink and grey limestone that correspond to the Cambrian Random Formation and Adeyton Group (Units 4 and 5, Figure 2).

The other major pre-mineralization unit consists of the medium- to coarse-grained, equigranular, black and white gabbro/diorite phase of the Powder Horn Intrusive Suite (Unit 6, Figure 2). There is some compositional variation within this intrusive rock that gives rise to two main subdivisions (not separated on Figure 2). The first subdivision contains plagioclase, pyroxene, amphibole, biotite and rare quartz, whereas the second subdivision consists of only plagioclase, pyroxene, and biotite. These rocks are slightly magnetic in places and are therefore assumed to contain accessory magnetite. A gradational transition between each subdivision is observed in this intrusive phase.

One small felsic dyke is brecciated and, therefore, pre-dates the breccia and mineralization. This is important in terms of classifying the mechanism of brecciation and is dealt with below.

POST-BRECCIA UNITS

Post-mineralization, fine-grained, dark green, diorite to gabbro (Unit 7, Figure 2) varies throughout the intrusion. In places, this unit is simply equigranular with a pilotaxitic texture and no phenocrysts, whereas in other areas it contains phenocrysts of plagioclase and/or amphibole; some plagioclase phenocrysts being in the range of 1 to 10 cm in length. This phase of the intrusion is also slightly magnetic in places (i.e., contains some accessory magnetite). Primary sulphides (dominantly pyrite) are also disseminated throughout this phase.

The felsic dykes (Unit 8, Figure 2) associated with the intrusion range from a very fine grained aplite, to a feldspar porphyry, to a quartz–feldspar porphyry. These felsic phases are assumed to represent high-level intrusions.

CONTACT RELATIONSHIPS OF THE INTRUSIVE PHASES

All phases of the Powder Horn Intrusive Suite intrude, and thermally metamorphose the surrounding sedimentary rocks, which are dominated by the late Neoproterozoic Musgravetown Group. This relationship is evident in areas where relict primary layering or banding in the sediments is crosscut or cut-off by phases of the Powder Horn Intrusive Suite.

In some areas, small inclusions or xenoliths of sedimentary rocks, commonly magnetic, are present within the intrusive phases, thereby indicating intrusive contact relationships. These sedimentary xenoliths are especially common in the pre-mineralization (early) gabbro/diorite. Schlieren textures are common at the contact between the sediments and the early gabbro/diorite indicating possible partial assimilation of the sedimentary rocks.

Intrusive contacts between the post-breccia (late) gabbro and the pre-breccia (early) gabbro/diorite are generally sharp and marked by chilled margins. This relationship is also observed where the post-mineralization felsic dykes are in contact with early and late gabbro/diorite. All phases appear to have been intruded by diabase dykes.

In the southeastern part of the map area (Figure 2), a dyke of the post-breccia diorite/gabbro intrudes and thermally metamorphoses Cambrian shales. The contact is well exposed along a brook that flows from the Powder Horn Hill area to the Come By Chance river. This indicates that at least this phase of the intrusion is post-Cambrian.



Plate 1. Main mineralized zone of the Lodestar prospect.

MINERALIZATION

Contact relationships observed at the Lodestar prospect (Plate 1) indicate that the breccia was emplaced in the vicinity of the contact region between the early gabbro/diorite and the host sedimentary rocks. Both of these units were at least locally sampled by the breccia as indicated by the presence of clasts of these rocks within the breccia. The mineralized breccia has been intruded by the fine-grained diorite (Unit 7), quartz–feldspar porphyries (Unit 8), aplite dykes (Unit 8), and diabase dykes. The fine-grained diorite has well-defined chilled margins against the breccia and is also observed to cut off the mineralized breccia.

Within the map area, the only other indication of sulphide mineralization is located at the western contact of the pre-breccia gabbro/diorite and sedimentary rocks where the presumed location of a faulted contact is marked at surface by a thick layer of rusty indurated till. In one area, the till is cemented by gossanous iron-oxide, thereby indicating the possibility of sulphides at depth. However, it is not known if this mineralization is related to the Lodestar style of mineralization.

CHARACTERISTICS OF THE MINERALIZED BRECCIAS

The mineralized breccia (Plate 2) is exposed over approximately 20 m (Figure 3) and contains gold in association with copper, arsenic and zinc mineralization. The mineralization occurs as the matrix in parts of the breccia, whereas unmineralized parts of the breccia have a rock-flour

or actinolite/chlorite matrix. The breccias at the main showing, as well as proximal breccias, contain hydrothermal (secondary) magnetite in the matrix. The breccia contains rounded to angular clasts of the host sedimentary rocks, the early diorite/gabbro, quartz porphyry, quartz–feldspar porphyry, diabase and minor fine-grained granite (Plates 3 and 4). Clast size varies from <1 cm up to ~ 50 cm, but the clasts are typically <10 cm. The sedimentary and gabbro/diorite clasts were derived from the wall rocks, which the breccia transects, and therefore are presumed to be locally derived. This is supported by the fact that some clasts are brecciated in such a way that adjacent clasts have matching margins and can thus be reassembled like jigsaw puzzle pieces. In some cases, mineralization fills in small cracks in the clasts caused by the local brecciation (Plate 5).

The quartz porphyry, quartz–feldspar porphyry, and fine-grained granite clasts have not been observed in outcrop in the area of the showing and therefore are presumed to represent samples derived from depth. Various evidence supports this idea. Some of the quartz and quartz–feldspar clasts appear to contain pre-breccia mineralization that consists of stringers or veinlets of sulphide mineralization within the clasts (Plate 6). Also, the rock-flour matrix appears to consist of finely comminuted pieces of these clasts; comminution presumably being due to the transport process. This idea of varying sources, or varying depths of clast acquisition, will be important in the classification of the breccia type and understanding of the brecciation processes that will be dealt with in future studies.

The breccia is dominantly clast-supported with varying amounts of matrix (~ 5 to 15%). The matrix consists of sulphides, chlorite/actinolite and rock flour, all of which vary in proportion throughout the breccia. Where mineralized, the matrix consists of arsenopyrite, pyrite, chalcopyrite, magnetite, bornite, and sphalerite. The matrix mineralization also overprints and forms veinlets and fine disseminations within some of the breccia clasts and is therefore, assumed to be syn- to post-brecciation. The overprinting texture is predominantly associated with the quartz and quartz–feldspar porphyry clasts whereby mineralization, in the form of arsenopyrite and/or pyrite, rims and overprints the clasts (Plate 7). This indicates some chemical affinity between the mineralization and these clasts.

The gold is assumed to be associated with the arsenopyrite, pyrite, and, to a lesser extent, the chalcopyrite. The



Plate 2. Mineralized auriferous breccia at the Lodestar prospect. Visible mineralization consists of pyrite, arsenopyrite, chalcopyrite and magnetite.

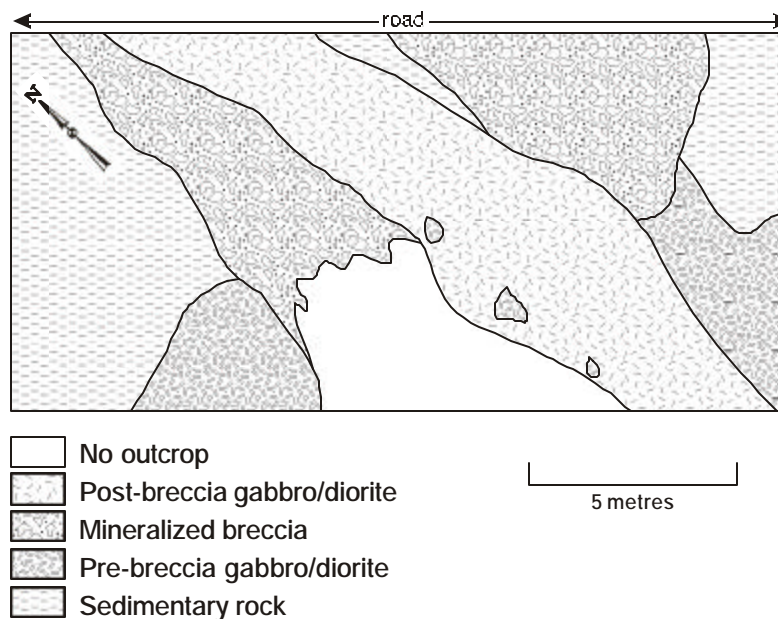


Figure 3. Plan view of main mineralized zone of the Lodestar prospect.

actual distribution of the gold with respect to the sulphide minerals in the matrix of the breccia, however, awaits further assay results. Within the breccia, the different sulphide minerals appear to be segregated into arsenopyrite-rich and pyrite-rich zones; the explanation for this zonation awaits further study.

Minor alteration is visible as concentric rings around the sedimentary clasts (Plate 3), and some chlorite and epidote alteration is also observed in the area of the breccia, although this alteration is not very substantial. Apart from

this, the host rocks and clasts within the breccia display very little alteration.

The mineralized breccias exposed at the Lodestar prospect are interpreted to be of either phreatomagmatic or magmatic–hydrothermal origin. According to Sillitoe (1985), the main difference between these two breccia-forming processes is that the magmatic–hydrothermal system involves breccia formation due to the release of hydrothermal fluids from a magma chamber, irrespective of the original source of the fluids concerned (i.e., magmatic, meteoric, connate, etc.), whereas a phreatomagmatic system involves the formation of a breccia due to the interaction of a magma with an external source of water. Another difference is that magmatic–hydrothermal breccias typically form at deep or porphyry levels and get eroded to display pipe-like forms, although these need not vent to the surface (Corbett and Leach, 1998), whereas phreatomagmatic (diatreme) breccias are typically associated with high-level porphyry intrusions and therefore may vent in the form of a diatreme or maar volcano, or they may occur as dykes that exploit pre-existing structures (Corbett and Leach, 1998). Many of the characteristics present at the Lodestar prospect correspond to a magmatic–hydrothermal origin for the breccia (Sillitoe, 1985), namely:

- 1) the presence of finely comminuted pieces of rock, termed rock flour, which makes up part of the matrix at the showing,
- 2) the presence of pre- and post-breccia felsic intrusions, and
- 3) the presence of hydrothermal magnetite in the matrix in parts of the showing.

DISCUSSION AND CONCLUSIONS

Consistent contact relationships were observed between the various intrusive phases throughout the map area. The host sedimentary rocks were initially intruded and hornfelsed by the pre-breccia gabbro/diorite. This was followed by brecciation and mineralization at the contact of the sedimentary rocks and the pre-breccia gabbro/diorite and then by the other intrusive phases, including the post-breccia gabbro/diorite, the felsic intrusions, and the diabase.

Based upon observations from the Lodestar showing, it is postulated that the hydrothermal breccia was the product of fluid exsolution from a gold-bearing intrusive system. The presence of the exotic mineralized quartz and quartz–feldspar porphyry clasts within the breccia suggests



Plate 3. Breccia at the Lodestar prospect containing clasts of gabbro, sedimentary rocks, diabase and quartz–feldspar porphyry. Note alteration rims in some sedimentary clasts.



Plate 4. Quartz–feldspar porphyry clast in mineralized breccia at the Lodestar Prospect.

that the mineralization and breccia process may be related to a deep Cu–Au porphyry system and that the showing may represent some transitional environment between a deep mineralized porphyry system and shallower epithermal environment. The high-level felsic intrusions, which intrude the pre- and post-breccia gabbro/diorite, probably represent late stage intrusions from a deep parental magma chamber. The main process driving the brecciation process in this type of environment would be the violent exsolution of magmatic–hydrothermal fluids from cooling porphyry stocks at

depth (Corbett and Leach, 1998). As the magma source cools at depth, volatiles exsolve from the silicate magma, collect and become over-pressured. These over-pressured volatiles eventually escape violently causing brecciation of the overlying rocks. The volatiles commonly exploit zones of weakness such as a fault or, in the case of the Lodestar prospect, a contact between different rocks to produce the brecciation. Once the volatiles become decompressed, they propagate upward to a lower pressure regime. This allows an increased release of fluids from the magma body at depth, which results in brecciation of the above units and mixing and milling of clasts within the breccia (Corbett and Leach, 1998).

The Lodestar showing therefore, has considerable significance as a possible indication of a larger, Cu–Au porphyry system at depth. This showing highlights the potential for other occurrences along the contact of the sediments and the early gabbro/diorite in the Powder Horn Intrusive Suite, and also opens up the possibility of porphyry-style mineralization on the Burin Peninsula as a whole. A good place to explore for these types of porphyry deposits would be in the known high-sulphidation epithermal systems that occur along the length of the Burin Peninsula.

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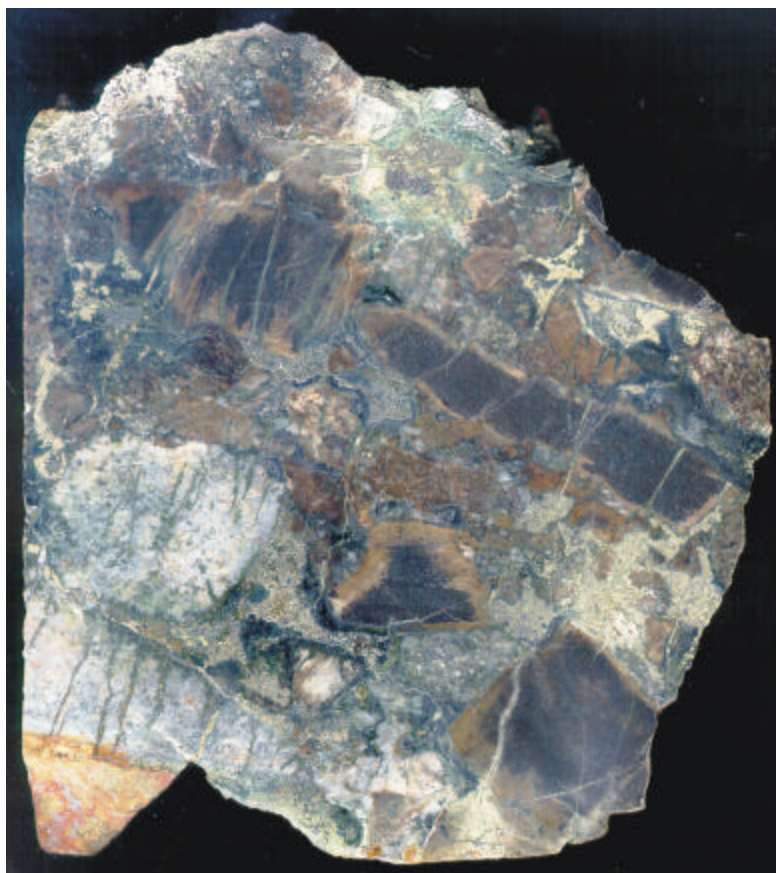


Plate 5. Polished slab of breccia with gold-bearing sulphide matrix and both sedimentary and felsic intrusive clasts. Some mineralization fills small cracks caused by late fragmentation of clasts. (Field of view 12 cm.)

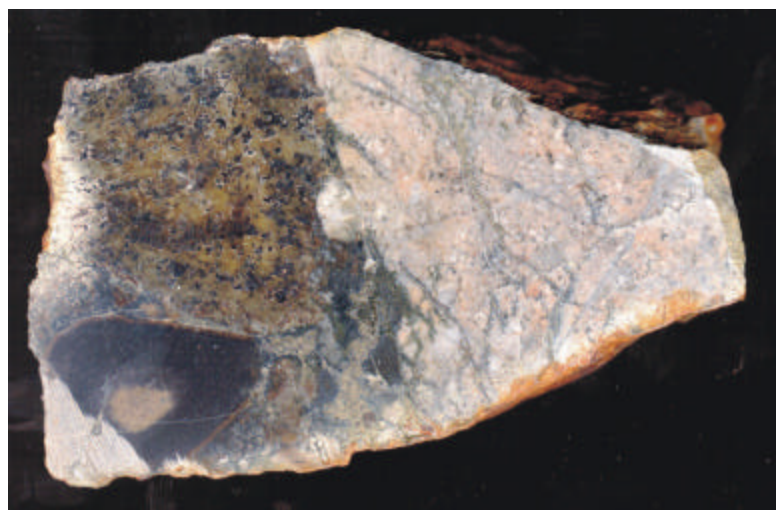


Plate 6. Polished slab of breccia with quartz-feldspar clast on right containing sulphide veins that may have been present prior to brecciation. (Field of view 8 cm.)

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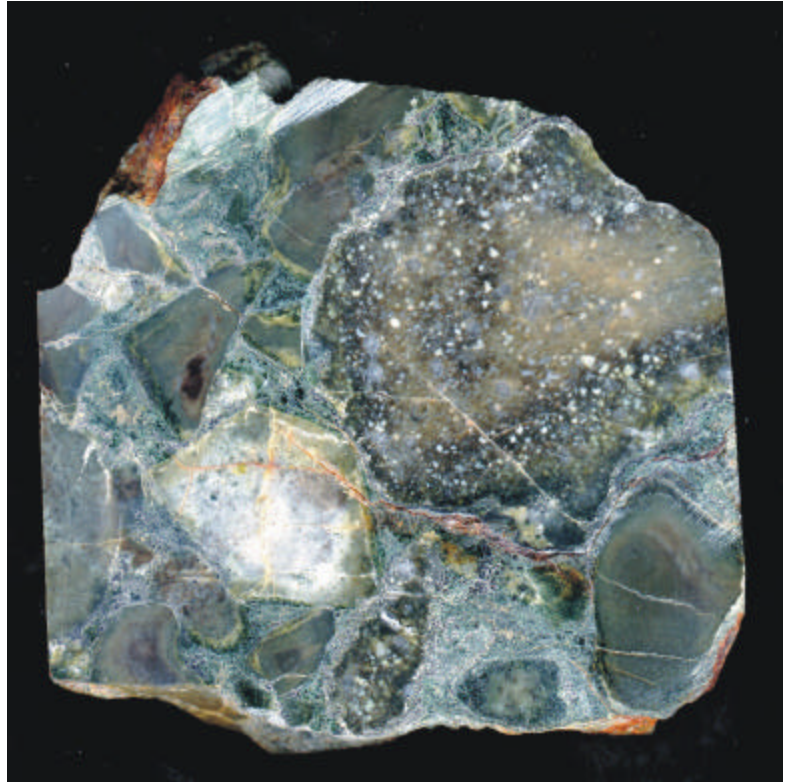


Plate 7. Polished slab of breccia containing quartz–feldspar porphyry clasts that have been preferentially rimmed and overprinted by arsenopyrite (grey). The prominent clast at the top right is peppered with minute arsenopyrite crystals that cannot be seen in this view. The obvious grey spots are quartz crystals. (Field of view 10 cm.)

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