# LITHOLOGICAL MAP OF THE HIGH-SULFIDATION HOPE BROOK GOLD DEPOSIT, NEWFOUNDLAND[1-2-3]

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1 Published with permission of Royal Oak Mines
2 Contribution to the Canada-Newfoundland Agreement on Mineral Development
3 This map is based on detail mapping by B. Dubé and K. Lauzière and compilation of work by Stewart (1992), O'Brien (1990), O'Brien et al. (1991) and several unpublished maps, sections and reports by BP-Selco Division, Hope Brook Gold Inc. and Royal Oak Mines.

Digital compilation and cartography by Eric Boisvert, Ruth Boivin and Nicolas Léonard, Geological Survey of Canada (GSC-Québec).

## LEGEND

### EARLY DEVONIAN

- CH — Chetwynd Granite (390 ± 3 Ma)
- HO — Hornfels (metamorphic contact zone)

### SILURIAN

LA POILE INTRUSIVE SUITE

- HN — Hawks Nest Pond Porphyry (418 +2/-1.5 Ma) fine-grained biotite-bearing plagioclase-quartz-potassic feldspar porphyritic intrusion

LA POILE GROUP (429 ± 2 to 422 ± 2 Ma)

- CC — Cinq Cerf Brook Conglomerate
- CCb — Polymictic boulder-pebble conglomerate.
- CCv — Volcaniclastic tuffaceous sandstone and tuff.
- GB — Mylonitized Grand Bruit Gull Pond Tuff (429 ± 2 Ma)
- GBqp — Quartz pebble conglomerate
- GBs — Sandstone
- GBv — Felsic volcanic tuff, chert and volcaniclastic rocks intruded by local quartz-feldspar porphyry dikes.
- GBpc — Polymictic conglomerate

### LATE PROTEROZOIC AND YOUNGER

- MD — Undistinguished fine- to medium-grained mafic to intermediate dikes and sills. Commonly highly magnetic. Unstrained to highly strained. Intermixed with local Whittle Hill Sandstone units.

### LATE PROTEROZOIC SEQUENCE

ROTI INTRUSIVE SUITE SUBVOLCANIC COMPLEX, WITH EXTRUSIVE COMPONENTS, EMPLACED WITHIN THE WHITTLE HILL SANDSTONE.

- DS — Sill-dike complex
- DSqp — Sill-dike complex with up to 70-80% felsic to intermediate blue quartz-bearing quartz-feldspar porphyritic rocks (QFP) (based on the interpretation that most of the protolith of the intense argillic alteration zone is QFP), mafic intrusions (Late Proterozoic and younger) and includes some volcaniclastic rocks.
- DSqm — Sill-dike complex with similar proportion of felsic to intermediate blue quartz-bearing quartz-feldspar porphyry and mafic intrusions (Late Proterozoic and younger) and includes some volcaniclastic rocks.
- DSm — Sill-dike complex mainly composed of mafic to intermediate intrusions of various ages (Late Proterozoic and younger) commonly feldspar-phyric and magnetite-bearing, with some quartz-feldspar porphyry and some volcaniclastic rocks. Mainly based on drill holes intersections.
- DSx — Undivided zone of felsic to intermediate blue quartz-bearing quartz-feldspar porphyry and mafic intrusions. The latter could be younger than Late Proterozoic. Mainly compiled from Stewart (1992).

- QFP — Monzonitic to granodioritic to trodhjemitic blue quartz-bearing quartz-feldspar porphyry of Roti Intrusive Suite. Contains rutile. Locally strongly magnetic.
- FP — Feldspar ± quartz porphyritic monzogranitic to granodioritic intrusions of Roti Intrusive Suite. Contains rutile.
- LT — Coarse- to fine-grained volcaniclastic (lapilli to ash tuff ?) Highly siliceous unit characterized by sub-angular to sub-rounded mm- to cm-scale clasts of various compositions and/or mm-scale grey quartz grains, sparse rounded blue quartz grains and rutile. Intermixed with QFP dikes and local blue quartz-bearing QFP. Intruded by mafic dikes-sills.
- AF — Fine-grained volcaniclastic (ash flow to crystal tuff ?) Highly siliceous unit characterized by mm-scale angular to sub-rounded grey quartz (crystal, glass shards... ?), rutile and some blue quartz phenocryst in an aphanitic matrix. Intermixed with some lapilli tuff (LT). Locally intruded by meter-wide blue quartz-bearing QFP. Intruded by younger mafic to intermediate dikes-sills (MD).
- TP — Third Pond Tuff Mafic epiclastic, flow and tuff units
- WH — Whittle Hill Sandstone Volcaniclastic-epiclastic rocks including sandstone, tuffaceous sandstone, greywacke, siltstone, argillite and minor conglomerate/lapilli tuff. All intruded by some blue quartz-bearing quartz feldspar porphyry and mafic intrusions.

### GEOLOGICAL SYMBOLS

- Mapped outcrop
- Trench
- Prospect
- Mine grid — E11500 / N 4600
- Open pit wall
- Surface projection of Drill Holes* — Color according to intersected lithology. For simplification mafic-intermediate dikes-sills are not shown. Based on drill core logs by BP-Selco and re-logged by B. Dubé. CW0280 and CE0291 are drill hole numbers.
- *Drill Hole sections were plotted at ± 50 m on the nearest 100 meters space mine grid.
- Geological contact (defined, approximate, assumed, compiled and interpreted)
- Major brittle strike-slip fault
- Major high angle reverse-oblique fault

0 100 m
Scale 1:2500

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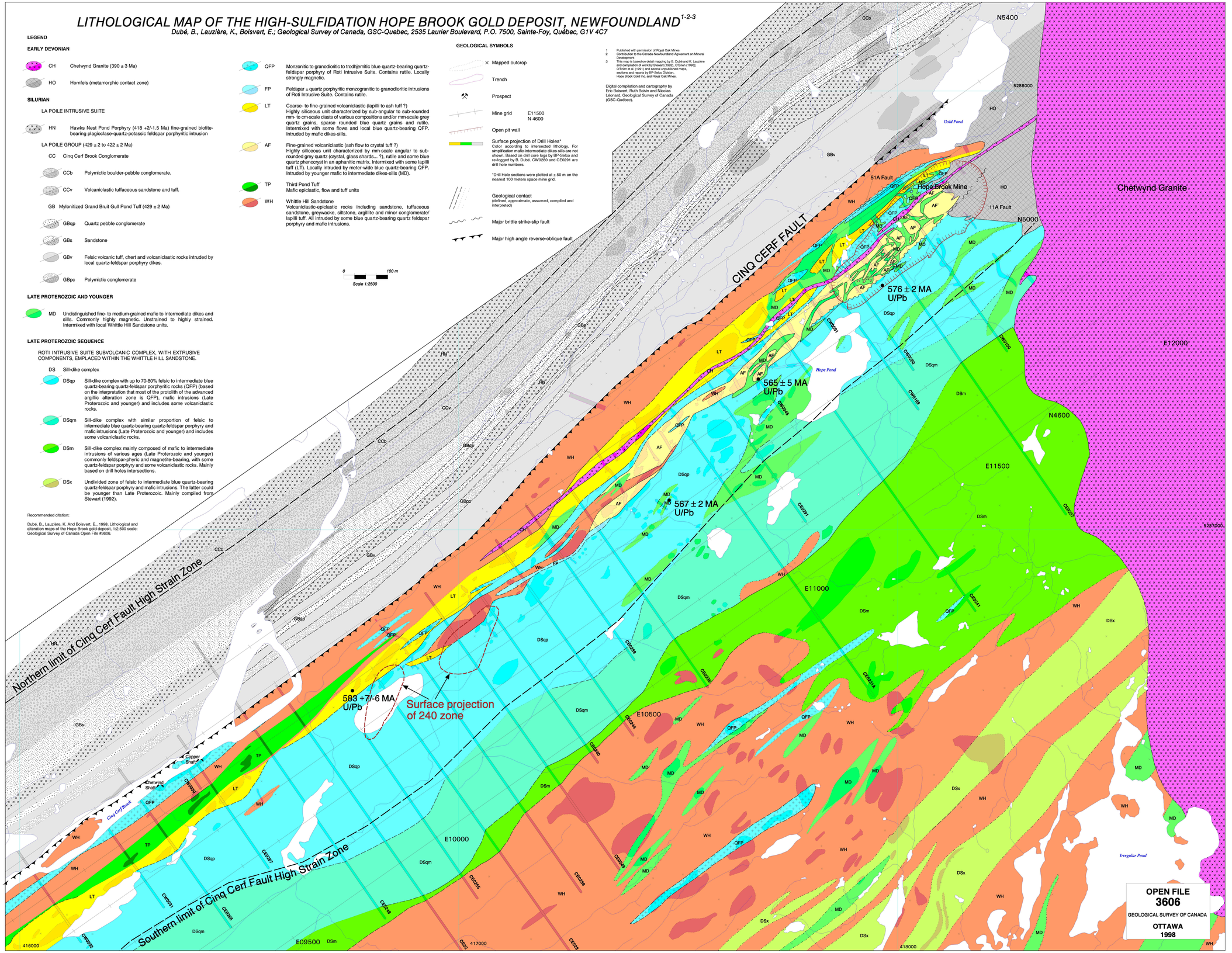


## ABSTRACT

The Hope Brook gold mine is a high-sulfidation epithermal gold deposit hosted by Late Proterozoic rocks of the Northern Appalachian Avalon Zone, in southwestern Newfoundland. The deposit (45 t Au) is enclosed within a zone of hydrothermal alteration > 3 km long and up to 400 m wide.

## REGIONAL GEOLOGICAL SETTING

The area around the deposit comprises two main lithological sequences, from the southeast to the northwest: 1) a greenschist grade Late Proterozoic sequence and 2) the La Poile Group, a Silurian (429-422 Ma) greenschist facies cover sequence of subaerial felsic volcanic and associated epiclastic rocks, unconformably overlying the Late Proterozoic cover sequence and now separated from it by the Cinq Cerf Fault Zone (O'Brien et al., 1991). The Late Proterozoic cover sequence consists of the Whittle Hill Sandstone and overlying Third Pond Tuff (O'Brien et al., 1991). Both units are intruded by the Roti Intrusive Suite (Dunning and O'Brien, 1989) a multiphase calc-alkalitite suite distinguished by the presence of blue quartz eyes. The different phases of the Roti Intrusive Suite include granodiorite (578 ± 10 Ma), the Betty's Pond Tonalite (563 ± 4 Ma) and quartz-feldspar porphyry intrusions (O'Brien et al., 1991; Stewart, 1992; Dubé et al., 1998).

The Whittle Hill Sandstone and the overlying Third Pond Tuff constitute a conformable, regionally north-facing succession that includes, in its basal parts, polymictic conglomerate, grading upward into quartz-rich sandstone and, in its upper parts, into local distal turbidites with rare felsic volcanic layers (O'Brien et al., 1993). The Third Pond Tuff is dominated by water-lain mafic and felsic tuffs and agglomerates with local volcanogenic sedimentary rocks formed late in the tectonic evolution of the basin (O'Brien et al., 1993). The nature and distribution of these Late Proterozoic units indicate that mafic and felsic volcanism took place during sedimentation (O'Brien, 1989).

The Chetwynd Granite is a post-tectonic, high-level biotite granite dated at 390 ± 3 Ma (O'Brien et al., 1991). It cuts across all ductile fabrics and has a well developed thermal aureole (McKenzie, 1986; Yule et al., 1990; O'Brien et al., 1991; Stewart, 1992).

The Silurian evolution of the area comprises two main stages: 1) Mid Silurian opening of the La Poile basins and deposition of the La Poile Group overlying the Late Proterozoic cover sequence, and 2) the Late Silurian closing of the basins and coeval deformation of the composite Late Proterozoic - Early Ordovician sequence (O'Brien et al., 1991). The Cinq Cerf Fault Zone, which in most areas juxtaposes the Whittle Hill-Third Pond succession against the La Poile Group cover sequence, represents the most important Silurian structure. The fault dips steeply to the SE and is interpreted as a Silurian listric thrust zone (O'Brien, 1989). The Cinq Cerf fault zone is also thought to be regionally transgressive relative to the La Poile Group stratigraphy (O'Brien, 1989), although it is interpreted to coincide overall with the unconformity originally located at the base of the La Poile Group.

## GEOLOGY OF THE DEPOSIT

The Hope Brook deposit occurs within the Whittle Hill Sandstone-Third Pond Tuff succession, in the hanging wall of the Cinq Cerf Fault Zone (Yule et al.,1990; Stewart, 1992; Dubé et al., 1995; 1998). The deposit occurs in a zone of highly strained, metamorphosed and intensely altered rocks in which it is difficult to recognize the original host lithologies. Nevertheless, several descriptive lithotectonic units or domains can be mapped in the deposit area. From NW to SE, the mine sequence is composed of Whittle Hill Sandstone which includes sandstone, tuffaceous sandstone, greywacke, siltstone, argillite and minor conglomerate/lapilli tuff. Further to the northwest, the Whittle Hill Sandstone is in tectonic contact with highly strained felsic volcanic and volcaniclastic rocks of the La Poile Group across the Cinq Cerf Fault Zone. Locally, mafic volcaniclastic rocks of the Third Pond Tuff and blue quartz-bearing quartz-feldspar porphyries (QFP) of the Roti Intrusive Suite are intercalated within the Whittle Hill Sandstone. Other QFP dikes with rutile and blue quartz that are strongly magnetic are located immediately to the northwest of the deposit.

Farther SE, there is a sequence of coarse to fine-grained felsic volcaniclastic rocks (LT), up to 70 m thick and more than 3 km long. This sequence is characterized by cm- to mm-scale, sub-angular to sub-rounded clasts of various compositions (porphyry, sedimentary rocks) and mm-scale, sub-angular quartz as well as minor blue quartz and rutile in a fine grained matrix. These volcaniclastic rocks are interpreted as comprising mainly lapilli to ash tuff and are now highly siliceous due to superimposed intense hydrothermal alteration. They are most probably correlative with similar unaltered tuff (Third Pond Tuff) present at the same stratigraphic position within the Proterozoic cover further to the southwest (e.g. O'Brien et al. (1993). This volcaniclastic unit is on strike with a highly altered metre-wide, coarse volcaniclastic rock, occurring immediately to the north of the ore zone, which is variously interpreted as a debris flow, a volcanic-hydrothermal breccia or mixed with possible conglomerate. It is difficult to definitively establish the primary nature of the lithologies due to the intense hydrothermal alteration and deformation. All these rocks are locally intruded by blue-quartz-bearing QFP's.

The host rocks to the ore zone are interpreted to consist mainly of fine-grained felsic volcaniclastic rocks (ash flow to crystal tuff?) (AF), and/or very fine grained intrusions, intermixed with some coarser-grained volcaniclastic rocks (lapilli tuff?). All these units are now highly siliceous due to the intense younger hydrothermal alteration. Local metre-wide blue quartz bearing QFP's are also present. The fine-grained volcaniclastic rocks grade laterally to the SW into a homogeneous fine- to medium grained unit characterized by quartz, white micas, alunite and pyrite, which is interpreted as a strongly altered Whittle Hill Sandstone horizon preserved mainly to the SW of the deposit.

The structural hanging wall to the ore zone consists of a sill-dike complex more than 400m thick. It corresponds to the dike swarm described by Stewart (1992). This complex can be subdivided into three sub-zones, from northwest to southeast: 1) a zone (DSqp) up to 200 m wide dominated by blue quartz bearing QFP's and minor feldspar-quartz porphyries (FQP) of trondhjemite/tonalite to monzogranite to granodiorite compositions with a subordinate proportion of mafic intrusions and volcaniclastic units; 2) an approximately 150m wide zone (Dsqm) containing similar proportions of blue-quartz bearing QFP/FQP's and intermixed mafic intrusions with some volcaniclastic rocks; 3) a 40-50 m wide zone (Dsm) composed mainly of mafic to intermediate intrusions of various ages, commonly feldspar phyric and magnetic, with some QFP/FQP and volcaniclastic rocks. Immediately southeast of the deposit. This sub-zone is more than 350 m wide and represents an almost massive mafic-intermediate intrusive complex. Southeast of the sill-dike complex, the area is underlain by Whittle Hill Sandstone epiclastic rocks intruded by mafic and some FQP sills and dikes which give way southward to the Betty's Pond Tonalite.

**Note: For a detailed geological description of the deposit and U-Pb zircon dating see Stewart (1992) and Dubé et al. (1998).**

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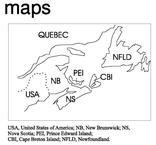
## Location maps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