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ABSTRACT

Recent mapping and lithogeochemical sampling of the late Neoproterozoic epithermal veins and breccias at the Bergs Prospect (Manuels area, Avalon Peninsula) has documented the first example of bonanza-grade, low-sulphidation gold mineralization in the Newfoundland Avalon Zone.

Grab samples collected from multidirectional, crustiform-banded silica–hematite veins and vein-breccia that intrude silica-altered rhyolite and rhyolite breccia in outcrop in the central part of the Bergs Prospect yielded the following high-grade gold assays: ***54.30 g/mt, 26.50 g/mt,*** *and* ***23.60 g/mt;*** *a replicate analysis of the pulp of the 54.3 g/mt Au assayed 45.9 g/t Au. Other veins in the same outcrop assayed* ***4.9 g/t, 1.65 g/mt, 0.34 g/mt, 0.27 g/mt, 0.14 g/mt*** *and* ***<7 ppb g/mt*** *(detection limit). Four of five grab samples of banded vein fragments collected from subcropping angular breccia located ca. 85 m to the northwest of the high-grade gold veins contain anomalous gold:* ***7.75 g/mt, 5.41 g/mt, 4.87 g/mt, 2.06 g/mt****. The latter rock unit contains variably sized banded vein fragments in matrix of non-siliceous, earthy hematite, and is unlike* in-situ *style of vein breccias common elsewhere in the area. Flow-banded rhyolite outcropping ca. 10 m to the east of the high-grade vein exposure contains numerous small veins (28 over 3 m); chip samples yielded low-grade anomalous gold values (****0.1 and 0 .11 g/mt****).*

EASTERN AVALON ZONE LOW-SULPHIDATION GOLD

The Bergs Prospect is one of several well-preserved examples of precious metal-bearing epithermal systems of late Proterozoic age that occur in the Avalon Zone of the eastern Newfoundland Appalachians. It is one of two exposed, low-sulphidation auriferous banded vein systems discovered in late Neoproterozoic rhyolite flows and tuffs, west of the Topsail Fault, near the community of Manuels (O'Brien *et al.*, 1998, 2001a; Mills *et al*., 1998; O'Brien, 2002; O'Brien *et al.*, 2003; Figure 1). Similar style veins and/or breccias have also been documented in a comparable setting east of the Topsail Fault, 25 km south of Manuels (Country Pond; O'Brien *et al.*, 2001b) and 30 km northeast of Manuels (Grog Pond; B. Sparkes, Rubicon Minerals, personal communication, 2002). The Bergs veins and the sub-parallel vein and breccia systems at the nearby (ca. 1.5 lateral distance) Steep Nap Prospect occur at the north end of a narrow but regionally extensive, ca. 15 km-long, tectonized belt of epithermal alteration, best known for its pyrophyllite–diaspore deposits (Vhay, 1937), including the Oval Pit Mine (O'Brien *et al.*, 1998). The latter has been interpreted as part of the advanced argillic facies of a high-sulphidation-type hydrothermal system (*see* O'Brien *et al.*, 1998; Dubé *et al.*, 2001). The principal gold occurrences in this belt are shown in Figure 2.

Gold in the Bergs and Steep Nap prospect occur in veins composed of crustiform- and colloform-banded chalcedonic silica, macroscopic and microscopic bladed calcite pseudomorphed by silica, and variable amounts of white or hematite-dusted, orange adularia. Hematite, chlorite and illite are common phases in veins and related breccias. Individual veins have variable strike lengths at surface; the widest can be traced more-or-less continually for at least 500 m. In the Steep Nap system, veins and breccias are exposed discontinually over a strike length of ca.1.5 km. The veins and breccias occur in a late Neoproterozoic sequence of subaerial, red to maroon rhyolitic to rhyodacitic flows, tuffs and breccias of the 585-570 Ma Manuels Volcanic Suite, part of the larger, previously undivided Harbour Main Group (*see* O'Brien *et al.*, 2001b). A subhorizontal, fossiliferous Lower Cambrian shale-rich cover sequence unconformably overlies the low-sulphidation system at the north end of the epithermal belt (O'Brien, 2002).

THE BERGS GOLD PROSPECT

Gold-bearing crustiform banded, low-sulphidation-style epithermal quartz veins and breccias of the Bergs Prospect were discovered in late Neoproterozoic silica-altered subaerial rhyolite flows and volcaniclastic rocks near the eastern margin of the Holyrood Horst of the Avalon Peninsula in 2001 (O'Brien, 2002). At that time, gold assays up to **7.2 g/t** in grab samples were returned from

outcrop, subcrop, and large angular boulders of silica–hematite-altered and hydrothermally veined subaerial volcanic rocks at the community of Manuels, Conception Bay South (O'Brien, 2002; Figure 2). Excavations at the site of a new housing development at the north end of the prospect exposed an extensive area in which mineralized and/or altered float, subcrop and outcrop occurred. Chip sampling of silica altered breccia (including vein breccia) exposed at that time, returned results averaging about **250 ppb Au over 20 m**. Since then, grab samples up to **9.6 g/t** have been obtained from banded veins during recent mineral exploration around the Bergs Prospect (B. Sparkes, Rubicon Minerals, personal communication, 2003). A preliminary description of the geological setting of the Bergs Prospect is given in O'Brien, 2002. The local setting and age of the low- and high-sulphidation systems in this area are amongst the topics addressed by an ongoing MSc dissertation by the second author.

NEW GOLD DATA

Mapping and sampling of the Bergs Zone was carried out by the authors in 2003, as part of a larger investigation of the style and regional setting of epithermal alteration and precious metal mineralization in the Newfoundland Avalon Zone. Work carried out at that time, in the central part of the Bergs Prospect (in the area of a small, privately-owned golf course) has identified gold-bearing crustiform veins in at least two different geological environments.

In the first, several crustiform-banded silica–hematite veins and spatially associated vein-breccia intrude rhyolite and rhyolite breccia with weak yet pervasive silica alteration. The latter appears unique to the Bergs Prospect and is unlike silica alteration associated with high-sulfidation alteration in the regional epithermal belt. Grab samples from several intact and internally brecciated veins of variable orientation in this low, ca. 6 m x 1 m outcrop have yielded the following Au assays: **54.3 g/mt, 26.50 g/mt, 23.60 g/mt, 4.9 g/t, 1.65 g/mt, 0.34 g/mt, 0.27 g/mt, 0.14 g/mt** and **<7 ppb g/mt** (detection limit). The initial assay of the pulp of the 54.3 g/mt Au sample returned a result of **45.9 g/t** Au. The three highest-grade gold assays came from veins occurring across a width of approximately 1 m. Vein orientations vary between northeast and northwest with the dominant trend being north-south. The high-grade veins display well-developed and distinct mm-scale crustiform banding and very local colloform banding; veins are hematite-bearing and brecciated internally. Chalcedonic silica in the veins appears to be darker grey than that seen elsewhere in the prospect. The mineralized material contains two phases of red hematite, with the earlier hematite being intergrown with silica; in addition, specularite is developed locally. A flow-banded rhyolite outcrop, approximately 10 m to the east of the high-grade vein exposure, contains numerous small veins (28

veins over 3 m); two chip samples collected during the initial sampling yielded low-grade anomalous gold values (**0.1 g/mt**).

Gold also occurs in a distinctive volcano-sedimentary/hydrothermal breccia that has been identified only in the Bergs Prospect. The breccia has a deep red, earthy hematite-rich, non-siliceous matrix, which weathers recessively, and in which are set numerous variably broken, variably sized, equant to platy fragments of silica and crustiform-banded silica-hematite vein material. Fragments of hydrothermal veins and vein breccia occur throughout the host breccia. The rock unit is neither an *in-situ* hydrothermal breccia nor an internally brecciated vein complex, and bears similarity to modern hydrothermal eruption breccias (J. Hedenquist, personal communication, 2003). Subcrop of this unique breccia occurs about 85 m to the northwest of the area of bonanza-grade gold. Four of five grab samples taken from banded vein fragments in the breccia contain anomalous gold: **7.75 g/mt, 5.41 g/mt, 4.87 g/mt,** and **2.06 g/mt.**

Gold and selected trace and rare earth element data (INAA from Activation Labratories) from initial sampling are presented in Table 1. Gold data from re-assay of pulps and assay of material collected in follow-up sampling are given in Table 2 (INAA from Activation Labratories). A sketch showing distribution of high-grade samples in the outcrop adjacent to the "Bergs golf course" is presented in Figure 3.

CONCLUSIONS

The low-sulphidation veins and breccias of the Bergs Prospect are examples of widespread, robust, well-preserved systems characterized by variably anomalous gold content and discrete zones of multi-gram gold concentrations. New data presented above: i) prove the hypothesis that these Neoproterozoic low-sulphidation veins should contain bonanza-grade concentrations of gold, ii) indicate that highly prospective crustal levels are preserved in these Neoproterozoic systems, and iii) underscore the importance of high density sampling in prospecting within these systems.

ACKNOWLEDGMENTS

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Table 1: INAA analysis from initial sampling (see Table 2 for re-assay and results from additional samples)

Field number	Lab number	**Au**	**Ag**	**As**	**Ba**	**Br**	**Cr**	**Cs**	**Fe**	**Hf**	**Hg**	**Ir**	**Mo**	**Na**	**Rb**	**Sb**
		ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	%	ppm	ppm
OB-03-29	1943075	**23**	-5	3.3	540	-0.5	-5	-1	0.7	5	-1	-5	-1	3.1	48	0.4
OB-03-32	1943076	**106**	-5	2.2	730	-0.5	-5	-1	0.41	4	-1	-5	-1	0.5	81	4.8
OB-03-33	1943077	**96**	-5	7.1	320	-0.5	-5	-1	0.42	-1	-1	-5	-1	0.1	31	6.2
OB-03-34	1943078	**45900**	30	6.1	450	-0.5	10	1	2.81	-1	-1	-5	-2	0	40	8.4
OB-03-35	1943079	**5410**	-5	9.3	180	-0.5	-5	7	1.25	1	-1	-5	6	0	41	7.6

		Sc	**Se**	**Th**	**U**	**W**	**Zn**	**La**	**Ce**	**Nd**	**Sm**	**Eu**	**Tb**	**Yb**	**Lu**	**Lu**
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
OB-03-29	1943075	3.6	-3	3.6	1.1	-1	-50	22	63	20	5.5	1.7	1	4.5	0.65	0.7
OB-03-32	1943076	1.7	-3	2.9	0.9	-1	-50	15	34	13	3	0.9	-0.5	2.5	0.39	0.4
OB-03-33	1943077	0.6	-3	0.7	0.6	-1	-50	4.3	8	5	0.7	-0	-0.5	0.6	0.09	0.1
OB-03-34	1943078	2.1	-3	-0.2	-0.5	6	59	12	33	23	11.2	2.5	2.8	4.4	0.66	0.7
OB-03-35	1943079	2.6	-3	1.1	-0.5	-1	90	10	25	10	2.4	0.8	-0.5	1.2	0.2	0.2

Field number	**UTM E**	**UTM N**
OB-03-29	353099	5263275
OB-03-32	353184	5264338
OB-03-33	353166	5264360
OB-03-34	353149	5264364
OB-03-35	353087	5264221

TABLE 2: Gold assays and sample locations referred to in the text.

Lab Number	UTM E	UTM N	Field number	**Au g/mt**	area	Lithology	Notes
1943076	353184	5264338	OB-03-32	**0.11**	Berg's prospect	banded silica/red-hematite veins	original sampling
1943077	353166	5264360	OB-03-33	**0.1**	Berg's prospect	banded silica/red-hematite veins in flow-banded rhyolite	original sampling
1943078	353149	5264364	OB-03-34	**45.9**	Berg's prospect	chalcedonic silica and red hematite vein and breccia in massive to banded rhyolite breccia	original sampling
1943079	353087	5264421	OB-03-35	**5.41**	Berg's prospect	brecciated vein material in sediment-style angular volcanogenic breccia*	original sampling
re-assay	353149	5264364	pulp of 1943078	**54.3**	Berg's prospect	see 1943078 above	re-assay of original sampling
re-assay	353087	5264421	pulp of 1943079	**5.35**	Berg's prospect	see 1943078 above	re-assay of original sampling
1943107	353087	5264420	Berg's-03-1X	**2.06**	Berg's prospect	banded silica/red-hematite fragments in angular breccia*	resampling in area from which 1943079 was collected
1943108	353087	5264420	Berg's-03-2X	**7.75**	Berg's prospect	banded silica/red-hematite fragments in angular breccia*	resampling in area from which 1943079 was collected
1943109	353087	5264420	Berg's-03-3X	**4.87**	Berg's prospect	banded silica/red-hematite fragments in angular breccia*	resampling in area from which 1943079 was collected
1943111	353087	5264420	Berg's-03-4X	**0.07**	Berg's prospect	banded silica/red-hematite fragments in angular breccia*	resampling in area from which 1943079 was collected
1943112	353149	5264367	Berg's-03-5X	**26.50**	Berg's prospect	chalcedonic silica and red hematite vein and breccia; approximate site of 1943078	resampling of outcrop from which 1943078 was collected
1943113	353149	5264367	Berg's-03-6X	**4.94**	Berg's prospect	banded vein with dark grey and black silica interbanded with grey/white silica	resampling of outcrop from which 1943078 was collected
1943114	353149	5264367	Berg's-03-7X	**0.34**	Berg's prospect	coarsely "vuggy" to massive silica adjacent to chalcedonic silica-hematite vein/breccia	resampling of outcrop from which 1943078 was collected
1943115	353149	5264367	Berg's-03-8X	**23.60**	Berg's prospect	banded (locally crustiform) chalcedonic silica vein and breccia	resampling of outcrop from which 1943078 was collected
1943116	353149	5264367	Berg's-03-9X	**0.14**	Berg's prospect	small cm-scale quartz-hematite vein	resampling of outcrop from which 1943078 was collected
1943117	353149	5264367	Berg's-03-10X	**1.65**	Berg's prospect	chalcedonic silica/ red-hematite vein and breccia	resampling of outcrop from which 1943078 was collected
1943118	353142	5264347	Berg's-03-11X	**0.27**	Berg's prospect	quartz-red hematite vein and associated breccia	20m S along strike from area of samples 1943107 to 1943117
1943119	353142	5264347	Berg's-03-12X	**<0.07**	Berg's prospect	quartz-hematite vein and breccia with minor K-feldspar alteration	20m S along strike from area of samples 1943107 to 1943117
						* possible hydrothermal eruption breccia	

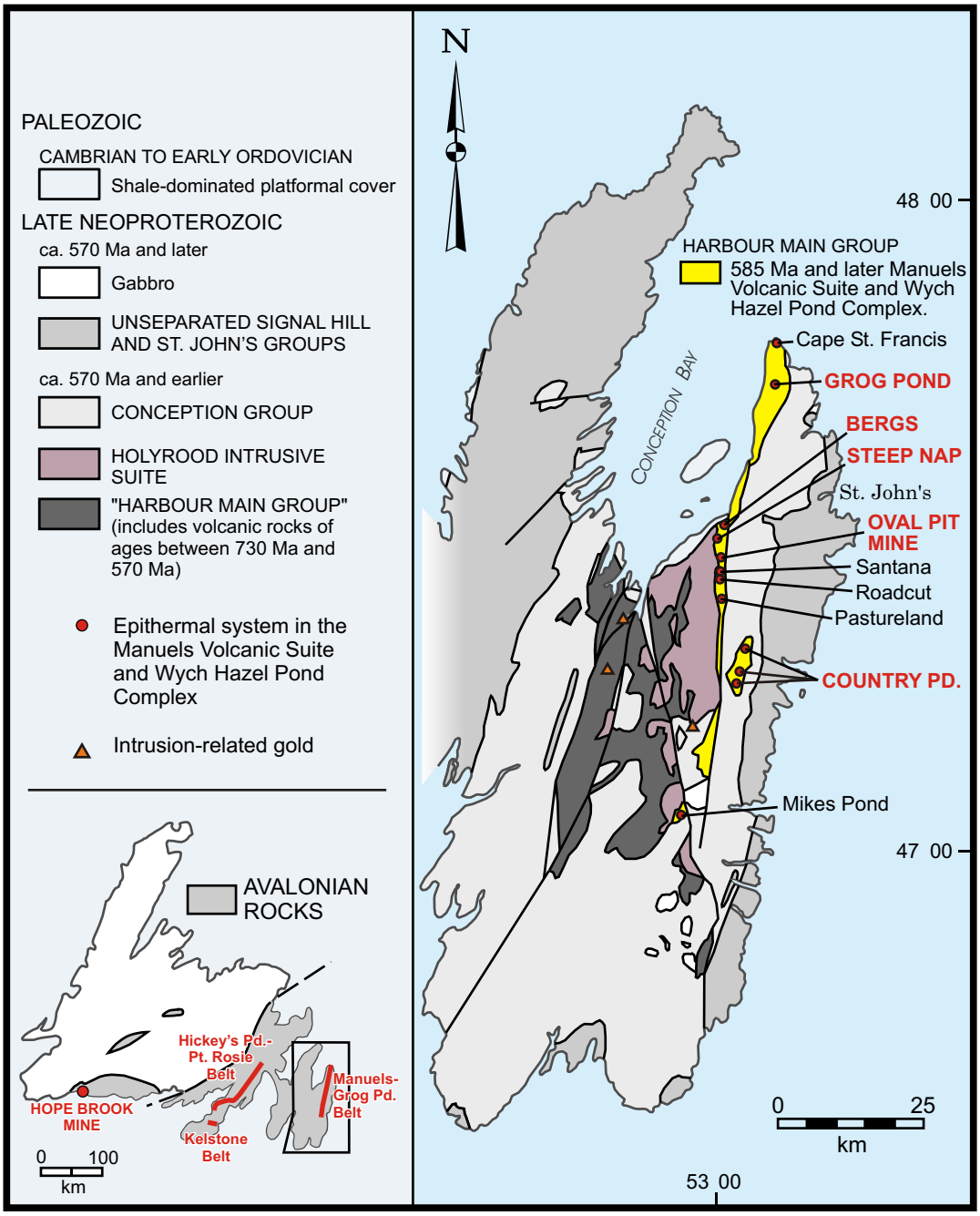

Figure 1: Regional geological setting of low-suphidation gold in the eastern Avalon Peninsula.

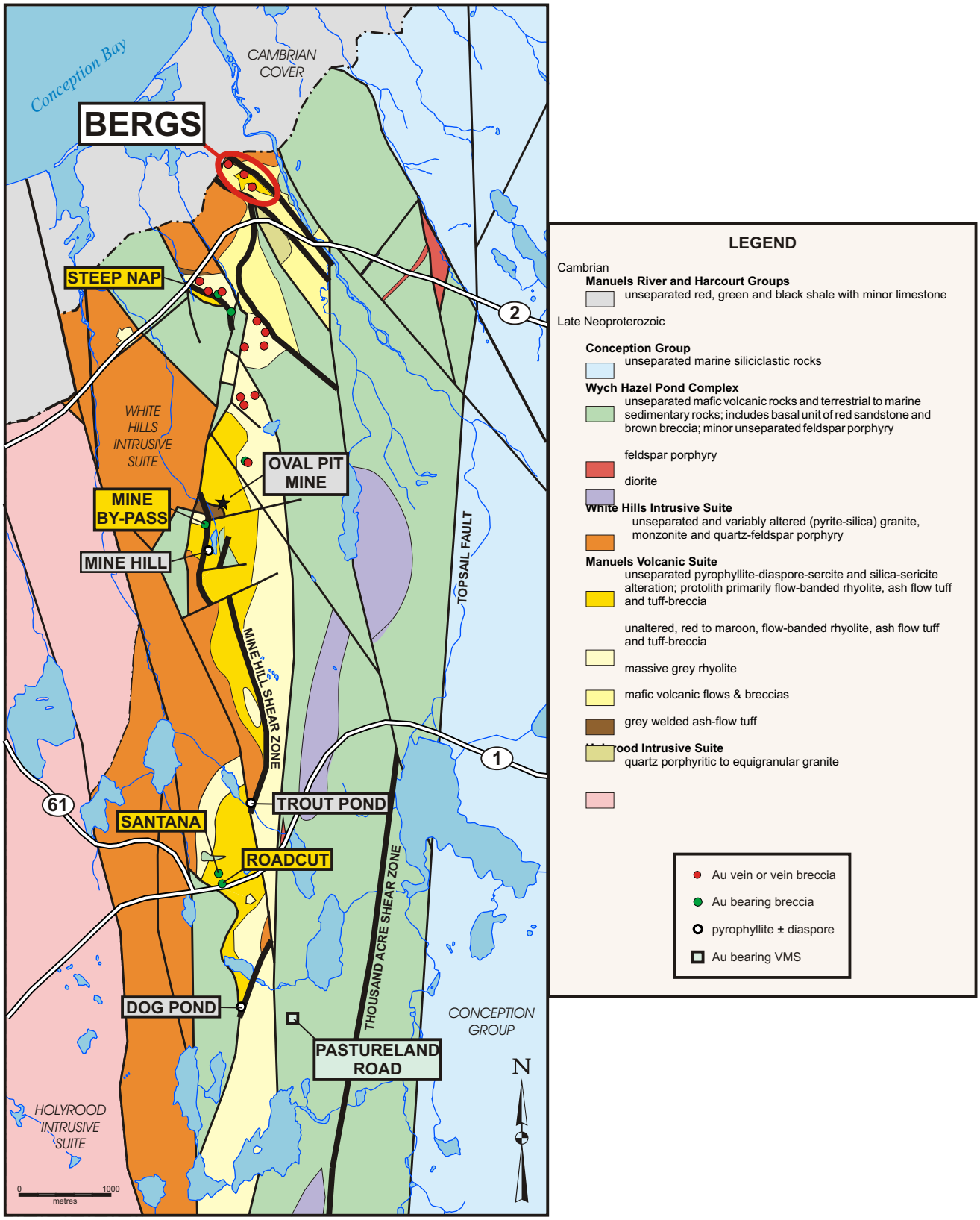

Figure 2: Geological setting of gold mineralization in Manuels Volcanic Suite in the area between Manuels and the Thousand Acre Marsh.

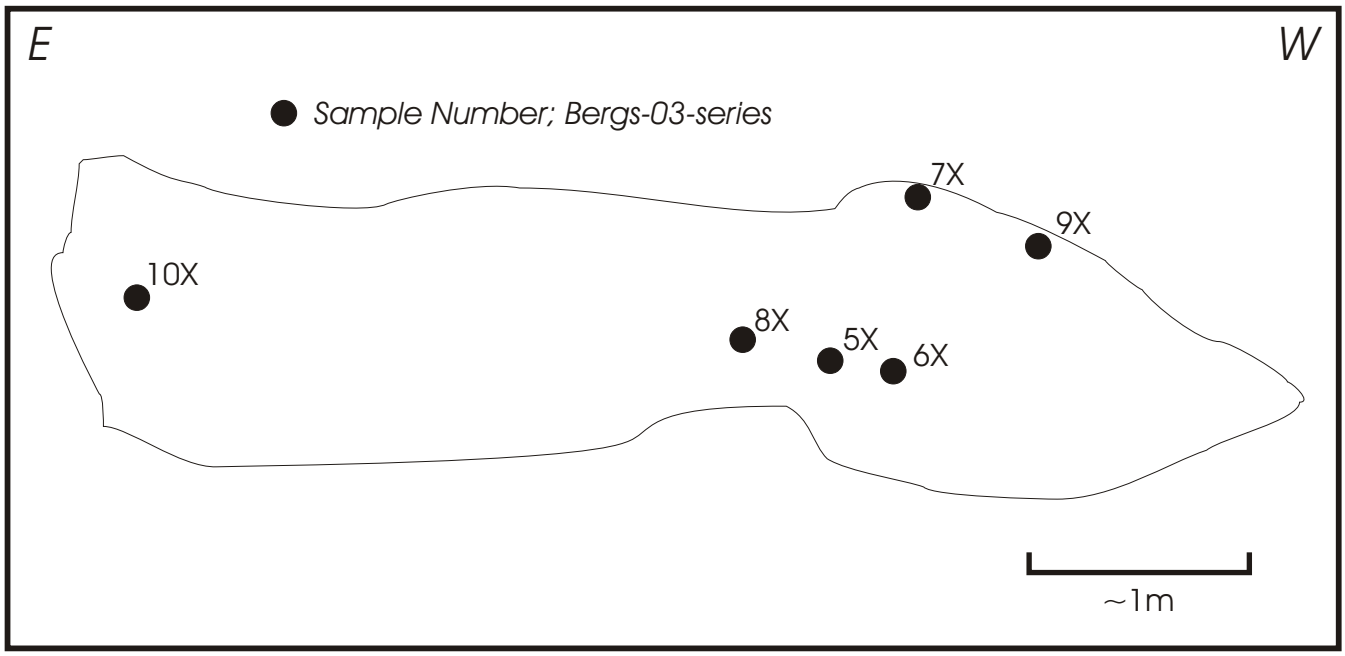

Figure 3: Sketch showing sample locations from the "Berg's Golf Course" outcrop