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NEW MINERAL OCCURRENCES ON NORTHEASTERN ELLESMERE ISLAND AND NEW OPPORTUNITIES FOR MINERAL EXPLORATION IN NORTHERN NUNAVUT

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Abstract

Significant sphalerite, galena and related geochemical indications of lead, zinc, cadmium and other metals are here reported from five recently discovered localities on northeastern Ellesmere Island, northern Nunavut: three in the Lower Ordovician Cape Clay Formation; two in Upper Cambrian and Ordovician portions of the Hazen Formation. Exploration for mineable quantities of these commodites is warranted in the immediate vicinity of each of these occurrences including prospecting of the host strata, property-scale geological mapping, geochemistry and geophysical surveys. Special attention should be given to favourable host rocks, such as those of the Cape Clay Formation, which are known to contain significant sphalerite and galena yet have little or no pyrite, iron oxide alteration or gossan. Reconnaissance exploration for carbonate-hosted sphalerite and galena is warranted throughout the exposure belt containing the Cape Clay Formation. Similarly, subdivisions D and "E" of the Hazen Formation are worthy of exploration for the same minerals. Exploration techniques should include ground traverses and prospecting of the favourable host units, aerial reconnaissance for and sampling of gossans within these strata, and careful examination of rocks in the immediate vicinity but beyond the obvious limit of any discovered gossans. Reconnaissance geochemical techniques are recommended including stream silt and heavy mineral sampling. Promising associated elements include Pb, Zn, Cd, Cu, As, Sb, Mo and P but not Ag.

Areas close to the Cambrian and Ordovician shelf edge on Judge Daly Promontory appear to be especially worthy of reconnaissance exploration. This study indicates that the Scoresby Bay and Cape Clay formations may each have been a regionally significant aquifer; each enclosed by an effective aquitard. For this reason, the entire exposure belt for these formations (including the upper part of the Turner Cliffs Formation of the southern Arctic Islands) is worth considering for long term exploration planning.

Geological conditions appear to have been favourable for sedimentary-exhalative deposits in various slope and basin facies rocks of the Hazen Formation. Especially noted are flat-laminated pyrite-rich mudrocks in Subdivision C on Judge Daly Promontory. Although the depositional setting and general composition of these rocks is attractive, all analyzed samples but one contain neither significant nor anomalous base metal concentrations (apart from iron) and the potential for nearby mineral deposits within these strata would appear to be slight.

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Introduction and previous work

Regional geology of the report area is provided by Trettin (1994). Mineral and hydrocarbon exploration on northeastern Ellesmere Island (Figs. 1, 2) dates from the 1973 work of J.C. Sproule and the discovery and subsequent assessment of carbonate-hosted galena and sphalerite mineralization by Great Plains Development Company of Canada Ltd. (McLaren et al., 1975) in strata assigned to the Copes Bay Formation (term now abandoned). The discovery prompted that company to undertake property-scale geological, gravity, EM, and IP surveys, and a reconnaissance geochemical program. Widely spaced stream silt samples were collected across much of the Kennedy Channel side of Judge Daly Promontory between Carl Ritter Bay and Cape Baird. Values greater than 155 ppm zinc, 122 ppm lead, or 6.3 ppm cadmium were considered anomalous. Zinc, lead and cadmium stream sediment geochemical anomalies were recorded in the general area of the showing and in a second area located 5 to 10 km northeast of Twin Glacier. However, results of follow-up prospecting (if any) were not reported.

At present, there are no outstanding mineral claims held within the Judge Daly Promontory area of northeastern Ellesmere Island. However, eighteen prospecting permits were issued to Cominco Ltd on Feb. 1, 1999. These include the following NTS map sheet areas: 120B04 (NE, SE, SW), 120B05 (NE, SE, SW), 120B06 (NW), 120B11 (NE, NW, SW), 120B14 (NE, SW), 120B15 (NW), 120C02 (NE, SW), 120C07 (SE), 120C08 (NW, SW). All are scheduled to expire on Jan, 31, 2004.

On the opposite side of Kennedy Channel in Washington Land, western North Greenland, an occurrence of sulphides is known from the mid-Ordovician Kap Jackson Formation (Fig. 1), and boulders containing galena, sphalerite and hydrozincite have been discovered on adjacent portions of the North Greenland coast (Jensen and Schønwandt, 1998). More recent is a report from southern Washington Land of significant sphalerite and galena mineralization in dolomitized carbonates tentatively assigned to the mid-Lower Ordovician Nygaard Bay Formation (Jenson and Schønwandt, 1998). Elsewhere, basin slope facies strata of the Amundsen Land Group in eastern North Greenland have proven to contain extensive sedimentary-exhalative (Sedex) sphalerite and galena in the massive sulphide deposits at Citronen Fjord (van der Stijl and Mosher, 1998). The overall resource there is estimated at 20 million tons of 7 per cent zinc with a central portion containing 7 million tons of 9 percent zinc and 1 per cent lead (van der Stijl and Mosher, 1998). Regional geological relationships indicate that similar favourable environments for Sedex mineralization and undiscovered carbonate-hosted sulphides exist throughout northwestern and southeastern Judge Daly Promontory, respectively.

Present work

The Geological Survey of Canada in co-operation with the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) of Hannover, Germany have recently completed the second of three planned field seasons intended to update and complete (to 1:125,000 scale) the bedrock geological mapping and to undertake supportive geological activities throughout coastal and inland northeastern Ellesmere Island between 79°00'N and approximately 81°33'N. The project area extends from Bache Peninsula and the head of Canon Fiord in the south to Cape Baird at the northeastern end of Judge Daly Promontory in the north, and from Kane Basin and Kennedy

Channel in the east to the drainage divide of the Agassiz Ice Cap and Archer Fiord (Fig. 1). Activities in 1999 were concentrated in the northern part of the project area with access to field localities provided by helicopter support from a base camp located near Carl Ritter Bay (Fig. 2). The aim of the present contribution is to provide a description of recently discovered base metal sulphide mineral occurrences, their geological setting, stratigraphic position and indications of mineral content based on total digestion ICP-MS and selected assay analyses of hand specimens. New observations concerning the nature and correlation of the Cambrian and Lower Ordovician portions of the basin-floor and basin-slope facies Hazen Formation with age-equivalent portions of the basinal succession in North Greenland and the adjacent shelf succession of northeast Ellesmere Island are summarized on Figure 10 and in a companion paper (Harrison et al., 2000).

Sample processing and analyses

Sample processing and analyses were contracted to Cantech Laboratories Ltd of Calgary who used the following procedures. Submitted samples were crushed to minus 10 mesh. A 300 gram portion (or what ever was available) was split and pulverized to minus 150 mesh (106 micron) for analysis. A 500 milligram aliquot of pulverized material was digested in a nitric-perchloric-hydrofluoric acid mixture and taken to dryness. The residue was dissolved in hydrochloric acid and diluted to volume. The solution was then analyzed for 28 elements using a Leeman PS-3000 Simultaneous Inductively Coupled Plasma Atomic Emission Spectrophotometer (ICP-ES) by aspirating into an 8,000 degree Kelvin argon plasma. Wet chemical procedures were used to obtain confirmation assays for cadmium, lead and zinc using various acids and analyzing the solutions by atomic absorption spectrophotometry (AAS). The instrument used was a Jarrell-Ash Video 12E Spectrophotometer. Tables 1 through 5 present results for minor elements of potential economic significance including Cu, Pb, Zn, Ag and Cd. Various major elements are also displayed in order to provide an indication of the bulk composition of the analyzed samples including Al (clays and sericite), Ca, Mg (calcite, dolomite), and Fe (pyrite and related oxides).

Description of mineral localities: Ella Bay Formation

Localities: *Pyritic mudstones northwest of John Richardson Bay* : HBB-98-38 (C-311571), HBB-98-39 (C-311572), HBB-99-44 (C-311577)

Air photo: A16603-56 (Fig. 3)

Location: NTS: 340A (Antoinette Glacier); HBB-98-38: 80°19.0'N, 072° 42.8'W; HBB-98-39: 80°19.0'N, 072° 41.0'W. Outcrops located on the northeast side of a major tidewater glacier 12.5 km northwest of John Richardson Bay.

Description: The Ella Bay Formation is locally subdivisible into three members (Plate 1a): a variegated and resistant lower member containing crinkly-laminated shallow water limestone (est. 125 m thick) arranged in cleaning upward cycles of pale hematitic red and pastel green argillaceous lime mudstone and well-washed yellow-weathering lime grainstone; a medial member (est. 380-400 m thickness) featuring recessive and dark coloured slaty graphitic mudrock with thin interbeds of pyritic lime mudstone (Plate 1b,c), and ripple cross-laminated fine grained sandstone, and; an upper cliff-forming member (up to 450-500 m thick) with mostly

pale grey and tan dolostone and interbeds of arenaceous dolostone. Three significant members of somewhat different description are also noted in the nearby section examined by de Freitas (1998; his section 179 located on Fig. 3). The medial sulphide-bearing mudrock is only about 100 m thick in that location. Large thickness variations in this unit are attributed to a local facies change to the gradationally overlying shallow marine member.

Analyzed samples: C-311571 (Stn. HBB-99-38) A sample of the medial slate and pyritic mudrock member was collected from a small stream-bank exposure at stream level with most outcrop obscured by large talus slopes. Exposed material is moderate yellowish grey and yellowish brown weathering argillaceous lime mudstone with interlaminated and intercalated dark grey slaty mudrock. ICP analyses indicate 2.9% pyrite.

C-311572 (Stn, HBB-99-39): Large ice tongue-marginal exposure of shallow-dipping slaty mudrock and interbedded flat or ripple cross-laminated pyritic lime mudstone. The mudrock also possesses a flat lamination but is transected by a pronounced slaty cleavage. Pyrite is concentrated in goethite-stained lime mudstone beds which are 1 to 10 cm thick each. The analyzed specimen (Plate 1b) has a well-developed slaty cleavage. Cubes and grains of pyrite are disseminated through the lime mudstone beds with some tendency to concentration along specific dark grey mudrock partings. ICP analysis indicates 8.5% pyrite.

Results: Table 1 and Appendices

Locality: *Pyritic mudstones southwest of Carl Ritter Bay:* Unit 8 of section 99-DTA-10

Air photo: A16610-132 (Fig. 4)

Location: NTS: 120B (Kennedy Channel); 80°51.14'N, 068° 50.9'W. Outcrop located in a southwest-draining gulley

Description: The sample site lies on the northeastern limb of an unnamed anticline, with beds striking 067°, and dipping 27° NW. This is part of a large outcrop of thinly laminated, dark to very dark grey phyllitic mudstone, interbedded with common, 1 to 10 cm thick beds of fine-to very fine grained, structureless sandstone. White 'bloom' is commonly developed on exposed surfaces. Cleavage variably developed in mudstone layers.

Analyzed specimen: C-412018: Disseminated pyrite, which forms euhedral crystals up to 1 mm, represents 5% of the interbedded mudstone and sandstone layers.

Results: Table 1 and Appendices

Table 1. Selected geochemical values for the Ella Bay Formation.

Ag ppm	Al %	Ca %	Cd ppm	Cu ppm	Fe %	Mg %	Pb ppm	Zn ppm	C-number	Station number
4.1	2.98	24.0	1.2	25	1.33	0.73	24	34	C-311571	HBB-98-38
2.2	3.71	14.0	1.7	22	3.93	1.27	12	33	C-311572	HBB-98-39
2.2	2.64	1.88	1.0	23	2.64	0.66	64	213	C-412018	99-DTA-10 unit 8

Scoresby Bay Formation

Locality: *Copper occurrence near Carl Ritter Bay*: Stn. 99-DTA-37

Air photo: A16680-12 (Fig. 5)

Location: NTS: 120C (Kennedy Channel); 80°57.70'N, 067° 47.4'W. Exposure is excellent on each side of the creek.

Description: This occurrence is located on the eastern limb of an unnamed anticline near Carl Ritter Bay. Beds are vertical and strike N53°E with stratigraphic top to the SE. The upper 31.5 m of the Scoresby Bay Formation at this locality contains abundant pseudobrecciated and zebra-patterned dolostone (Plate 2a,b). Minor malachite and azurite staining occurs in the upper 5 m. The host dolostone is light grey, medium crystalline, medium to thick bedded, and structureless. Dolospar forms up to 80% of rock, in decimetre-scale, bedding-parallel zones of pseudobreccia or zebra-patterned dolostone. White quartz occurs as the final, void-filling phase. The brecciation locally cuts across bedding. About 100 m up stream and along strike, the brecciation follows a minor fault zone and cuts at least 20 m into the overlying, unnamed oolitic unit. Mosaic breccia is dominant in this area, with decimetre-scale rotated blocks and common pyrite, but no copper-bearing minerals were observed.

Analyzed specimen: C-412151: Sampled copper mineralization occurs in 1 to 3 mm wide veins perpendicular to bedding. The primary copper sulfide is as yet unidentified, but it weathers to azurite and malachite. These veins comprise less than 1% of the rock mass in the upper 5 m of the Scoresby Bay Formation.

Results: Table 2 and Appendices

Table 2. Selected geochemical values for the Scoresby Bay Formation.

Ag ppm	Al %	Ca %	Cd ppm	Cu ppm	Fe %	Mg %	Pb ppm	Zn ppm	C-number	Station number
2.5	0.02	22.8	1.1	517	0.09	13.8	13	69	C-412151	99-DTA-37

Hazen Formation - Subdivision C

Locality: *Pyritic mudrocks northeast of Packdog Creek:* Stn. HBB-99-136

Air photo: A16609-170 (Fig. 6)

Location: NTS: 120C (Lady Franklin Bay); 81°22.72N, 066° 31.91'W. Felsenmeer and talus exposure on northeast bank of an unnamed creek draining into Archer Fiord. Sample locality is 3.6 km upstream from the sea level outlet and 5.7 km northeast of Packdog Creek.

Description: Subdivision C of the Hazen Formation is exposed here on the southeast limb of a southeast-vergent overturned anticline. While there is no firm outcrop of this unit at this station, beds in overlying Subdivision D are overturned and dip to the northwest at 82°. Indicated thickness of Subdivision C here is approximately 70 m thick. Subdivision C, stratigraphically above Subdivision B, features: a covered interval with some black chert in talus (ca. 5 m; Unit 1 of Subdivision C as described by Harrison et al., 2000); a unit of blocky fractured moderate grey to pale brown fine grained mature quartz sandstone (est. 25 m; Unit 2 of Subdivision C); limonite stained and gossanous flat-laminated lime mudstone and pyritic mudrock (ca. 20 m; Unit 3) which is gradationally overlain by; flat-laminated lime mudstone and slaty mudrock with less

iron oxide staining and no obvious sulphides (Unit 5). As these exposures are located some distance from the correlative Cambrian shelf margin, there is no Unit 2 as noted in the section at Station HBB-99-138 of Harrison et al. (2000) and other distinctive bedsets are missing. Scattered hand specimen pieces (including C-322715-1,2,3) suitable for geochemical analyses were collected from felsenmeer of Unit 3 at Stn HBB-99-136.

Analyzed samples: C-322715-1 Limonite stained argillaceous and dolomitic lime pyritic mudstone represented in a thin bed of 15 mm thickness. ICP analyses indicate 6.8% pyrite but none is visible on the dark grey fresh surface. An indistinct and somewhat wispy lamination is provided by dark grey mediumly crystalline carbonate and intercalated mud. Fracture is parallel to bedding.

C-322715-2 Lightly limonite-stained argillaceous dolomitic and pyritic lime mudstone. ICP analyses indicate 7.9% pyrite and is presumed to be concentrated in moderate grey flat laminations that alternate with dark grey laminations. Sample features a bed of 12 mm thickness and fracture parallel to bedding.

C-322715-3 Limonite-stained argillaceous and dolomitic lime pyritic mudstone. ICP analyses indicate 5.6% pyrite and is presumed to be concentrated in moderate grey flat laminations that alternate with mostly dark grey laminations. Sample features a bed of 10 mm thickness and fracture parallel to bedding.

Results: Table 3 and Appendices

Table 3. Selected geochemical values for subdivision B and C of the Hazen Formation.
* Results marked with an asterix have been confirmed by wet chemical assay.

Ag ppm	Al %	Ca %	Cd ppm	Cu ppm	Fe %	Mg %	Pb ppm	Zn ppm, %*	C-number	Station number
2.7	2.54	14.2	1.1	25	3.14	5.72	12	19	C-322715-1	HBB-99-136
2.8	2.58	19.0	1.6	34	3.67	5.13	11	147	C-322715-2	HBB-99-136
1.1	2.98	6.86	0.6	14	2.61	2.42	7	15	C-322715-3	HBB-99-136
1.6	0.01	14.5	1.3	13	1.79	7.72	57	222	C-322729	HBB-99-145
2.2	0.7	19.6	0.9	29	0.40	11.4	10	20	C-322730-1	HBB-99-145
0.7	6.97	0.93	0.5	31	4.45	0.71	31	43	C-322730-2	HBB-99-145
0.6	7.48	0.30	0.5	28	2.21	0.25	25	14	C-322730-3	HBB-99-145
0.1	5.28	0.16	0.6	59	16.3	0.24	52	58	C-322730-4	HBB-99-145
2.8	0.66	17.8	0.5	47	1.22	0.17	25	83	C-322731	HBB-99-150
1.5	0.96	0.44	0.5	22	0.57	0.15	40	90*	C-322756	HBB-99-183
1.7	0.40	5.30	6.5	33	0.47	2.53	104	0.28%*	C-322757	HBB-99-185
			1.2*				8*	478*	C-322757-1	HBB-99-185
			18*				50*	1.03%*	C-322757-2	HBB-99-185
2.3	2.33	14.7	0.5	25	1.05	1.14	31	55	C-322759	HBB-99-185
2.2	2.91	15.1	1.0	22	1.97	6.79	12	78	C-322760	HBB-99-185
1.7	7.47	2.39	1.4	41	2.40	1.45	68	195	C-322761	HBB-99-185
1.9	4.74	8.08	0.5	26	1.62	3.98	26	56	C-322762	HBB-99-185

Locality: *Pyritic mudrocks on Packdog Creek*: Stn. HBB-99-145

Air photo: A16609-170 (Fig. 6)

Location: NTS: 120C (Lady Franklin Bay); 81°21.32'N, 066° 50.83'W. Outcrop exposures are located on the southwest bank of Packdog Creek 3.4 km upstream from the sea level outlet and 5.7 km southwest of the Station HBB-99-136 in the same exposure belt of Subdivision C of the Hazen Formation..

Description: All five units of Subdivision C appear to be present in this section. Pyrite-rich mudrocks are especially well developed in the lower eight metres of Unit 1 (total ca. 25-30 m thick). Some beds possess a well developed limonitic alteration and slaty mudrock talus is coated with a mixture of white (iron?) sulphates or greenish iron oxides presumably resulting from the chemical alteration of pyrite. Analyzed samples were collected from the uppermost part of Subdivision B (C-322729) and as chip samples from each of the exposed beds throughout the lower eight metres of Unit 1, Subdivision C (including samples C-322730-1,2,3,4).

Analyzed samples: C-322729 Gossanous fractures pervade the top four metres of Subdivision B dolostone packbreccia. Vuggy and cavernous porosity is occupied by limonitized pyrite in irregular patches to several centimetres. Pyritic vugs are successively enveloped by a reddish ferroan carbonate (siderite?) and beyond this by secondary coarsely crystalline dolospar. A similar zonation of (limonitized) pyrite, iron carbonate and secondary yellow dolomite forms alteration haloes on most fracture planes. The secondary dolospar appears to replace the older dark grey dolospar that is typical of Subdivion B in most areas. A collection of pieces from various parts of the exposure were analyzed. ICP results indicate 3.9% pyrite although significant iron may be tied up in limonite or iron carbonate.

C-322730-1: Chip grab sample of a single bed of black mediumly crystalline lime dolostone from the lower eight metres of Subdivision C. Exact stratigraphic position uncertain. No apparent internal compostional layering. This material has a distinct sulphurous smell when freshly broken. ICP analysis indicates about 1% pyrite.

C-322730-2: Chip grab sample of a single bed of moderate to dark grey finely crystalline dolomite-bearing pyritic siliceous mudrock from the lower eight metres of Subdivision C. Exact stratigraphic position uncertain. Vague wispy discontinuous compostional layering. ICP analysis indicates about 9.6% pyrite but this is not visible on fresh surface.

C-322730-3: Chip grab sample of a single bed of dark grey finely crystalline pyritic siliceous mudrock from the lower eight metres of Subdivision C. Exact stratigraphic position uncertain. Blebs (to about 1 cm each) and discontinuous laminae of pyrite are obvious on fresh surface. ICP analysis indicates about 4.8% pyrite.

C-322730-4: Chip grab sample of a single bed of limonite-stained dark grey finely crystalline pyritic siliceous mudrock from the lower eight metres of Subdivision C. Exact stratigraphic position uncertain. Coarsely crystalline pyrite dendroids in masses up to 15 mm are obvious on fresh surface. ICP analysis indicates about 35% pyrite.

Results: Table 3 and Appendices

Locality: *Graphitic mudrocks on north fork of Pavy River:* Stn. HBB-99-150

Air photo: A16609-170 (Fig. 6)

Location: NTS: 120C (Lady Franklin Bay); 81°21.22'N, 066° 29.38'W. Outcrop exposures are located in the headwaters area of the north fork of the Pavy River. The sampled outcrop is

located on the south bank and is sandwiched between the river and a major fault that places carbonates of the Bay Fiord (or Bulleys Lump Formation?) in tectonic contact with Subdivision C of the Hazen Formation.

Description: The uppermost 15 m of Unit 4 of Subdivision C are in exposed contact with lime mudstones and flat laminated slaty mudrocks of Unit 5. Unit 4 features resistant dark yellowish brown weathering dolomitic mudstone interbedded with black graphitic calcareous and siliceous mudstone. Chip samples were collected from various beds of graphitic mudstone.

Analyzed sample: C-322731: Black graphitic calcareous and siliceous mudstone. Rock possesses an irregular set of fractures some of which may be parallel to a penetrative spaced cleavage. No obvious internal compositional layering. Indicated pyrite content is about 2.6%.

Results: Table 3 and Appendices

Locality: *Pyritic mudrocks of Cape Baird area* - locality 1: Stn. HBB-99-183

Air photo: A16680-87 (Fig. 7)

Location: NTS: 120C (Lady Franklin Bay); 81°21.09'N, 065° 18.69'W. Stream bank exposures located 15 km southwest of Cape Baird on a southwest-flowing tributary of an unnamed northwest-flowing stream. Outcrop was examined 3.8 km upstream from the sea level outlet on Lady Franklin Bay.

Description: The exposures in the vicinity of Stns. HBB-99-183 are located in the hinge area of a shallow plunging syncline; one of half a dozen air photo scale southeast-vergent folds that have been mapped in the Cape Baird area. The outcrops near Stn. HBB-99-183 are small, surrounded by intervening talus chutes, and feature various portions of the lower part of Subdivision C (units 1 to 4 as described by Harrison et al., 2000). Iron sulphides are contained in black dolostone and mudstones of Unit 1 (Subdivision C) and are also found in mudstones spatially associated with talus and outcrop of Unit 2 which is mostly mature fine grained quartz sandstone. Sample C-322756 was collected from within Unit 2.

Analyzed sample: C-322756: Black and very dark grey argillaceous and carbonaceous very fine grained quartz sandstone with lightly limonite-stained weathering surfaces. Samples appear to be mostly free of compositional lamination although scattered centimetre scale discontinuous black argillaceous partings (2-3%) were noted in several pieces. Tiny blebs of visible pyrite (1-2%) account for the modest iron content of the ICP analysis.

Results: Table 3 and Appendices

Locality: *Pyritic mudrocks of Cape Baird area - locality 2:* Stn. HBB-99-185

Air photo: A16680-87 (Fig. 7)

Location: NTS: 120C (Lady Franklin Bay): 81°29.13'N, 065° 25.56'W. Stream bank exposure located 17 km southwest of Cape Baird on a southwest-flowing tributary near its confluence with an unnamed northwest-flowing stream. Outcrop was examined at 2.2 km upstream from the sea level outlet on Lady Franklin Bay.

Description: The outcrop section at Stn. HBB-99-185 is located in the hinge area of a shallow plunging syncline; one of half a dozen air photo scale southeast-vergent folds that have been mapped in the Cape Baird area. The sampled section presents a complete exposure of all the

beds of Subdivision C. Readily identified are Unit 1 (mostly black limonite-stained chert: 4 m thick), Unit 2 (very fine sandstone in a beds that pinches and swells significantly along strike; local range of 3 to 7 m), Unit 3 (black chert and mudrock, minor argillaceous sandstone; est. 20 to 25 m) and Unit 5 (black fissile flat laminated mudrock and pyritic mudrock, scattered lime mudstone concretions; est. 40 m). Absence of Unit 4 and the abundance of black pyritic mudrock throughout a relatively thin unit 5 might be attributed to paleogeographic distance from the correlative Lower and Middle Cambrian shelf succession.

Analyzed samples: C-322757: Unit 1 of Subdivision C: interbedded black chert and lesser thin bedded dark grey dolomitic mudstone; a little white calcispar fracture fill and light limonitic surface alteration. About 1% pyrite indicated by ICP analysis. Chips collected from various beds for geochemical analyses.

C-322757-1: Black chert

C-322757-2: Moderate grey weathering dolomitic mudrock. ICP analysis indicates 1% Zn and 18 ppm Cd.

C-322759: Lower 25 m of Unit 5 of Subdivision C: Black fissile mudrock and black lime mudstone. Pyrite is common and occurs as scattered cubes, oxidized patches and concretions; the latter to six centimetres each. Average 2.3% total pyrite is indicated by ICP analysis. Chips collected from various beds for geochemical analyses.

C-322760: Ten to 15 m below top of Unit 5 of Subdivision C: flat laminated black and dark yellowish grey weathering argillaceous and dolomitic lime mudstone. Average 4.2% pyrite is indicated by ICP analysis and is likely concentrated as bedding-parallel dissseminated fine grains in light coloured laminae. Chips collected from various beds for geochemical analyses

C-322761 (Plate 1d): Ten m below top of Unit 5 of Subdivision C: flat laminated slaty black and dark yellowish grey weathering argillaceous and dolomitic mudstone. Average 5.2% pyrite is indicated by ICP analysis and is clearly concentrated in numerous light coloured laminae and thin beds. Pieces from a 1.5 m thick bedset was collected for analysis.

C-322762 (Plate 1e): Three to six m below top of Unit 5 of Subdivision C: flat laminated slaty black and dark yellowish grey weathering argillaceous and dolomitic mudstone. Average 3.5% pyrite is indicated by ICP analysis and is clearly concentrated in numerous light coloured laminae and thin beds. Chips collected from various beds for geochemical analyses.

Results: Table 3 and Appendices

Hazen Formation - Subdivision D

Locality: *Cape Baird area Zn-Pb Occurrence*: Stn. HBB-99-200

Air photo: A16680-87 (Fig. 7)

Location: NTS: 120C (Lady Franklin Bay): 81°29.64'N, 065° 13.99'W. Northwestern stream bank exposure located 13.5 km southwest of Cape Baird on a northeast-flowing tributary of the lower Pavy River. Outcrop was examined 13 km upstream from the sea level outlet near Cape Baird and 2.1 km southeast of the nearest part of Lady Franklin Bay.

Description: The sampled outcrop (Plate 2c), mostly surrounded by extensive talus slopes, is located in the medial part of Subdivision D of the Hazen Formation. Graphic estimates indicate this level to be about 140 m above the top of Subdivision C. The sampled exposure is 25

m long parallel to the adjacent stream course and features a 5.5 m thick section of beds that strike N83°W (declination 75°W) and dip 26° to the north. The lower five m of section starting at stream level is flat laminated moderate grey lime mudstone containing beds ranging from lamination scale up to about 20 cm thick each. An interval of slaty mudrock occurs at 2.0 m above base and scattered calcispar veinlets and lenses of goethite occur at 3 m. There is a steep westward-dipping slaty cleavage (N02°W/77°W) present throughout the outcrop. Some of these surfaces carry thrust-sense slickenlines. The top 0.5 to 1.0 m of section features a gossan cap of goethitic iron oxides that extends the full 25 m length of the outcrop. The full length of gossan is obscured by far travelled talus and likewise the upper surface is also talus covered. The northeast end of the outcrop (right side of Plate 2c) has the most complete exposure of gossan with more-or-less massive goethite and goethite crusts extending along strike for six metres and present through a thickness of up to one metre. The goethite crusts can also be found to coat small loose masses of brecciated sulphide-rich mudstone. Fresh surfaces appear to contain up to 40 to 60% pyrite and some visible galena (Plate 2d). Chip samples and fist sized pieces was collected from two distinct parts of the gossan. Sample pieces of C-322766 was collected from a zone of massive sulphides at the northeast end of the outcrop. C-322767 is from an adjacent interval of sulphide impregnated brecciated mudstone

Analyzed samples: C-322766-1 (Plate 2d): Massive sulphide. Major constituents include pyrite (51.8%), very dark brown sphalerite (8.6%), galena (2.3%), white and vitreous calcispar. The fabric of the rock is defined by centimetre scale flattened lenses of finely crystalline sphalerite embedded in massive finely crystalline pyrite. The lenses are individually discontinuous and have a wavy subparallel alignment. Smaller masses of sphalerite and calcispar are irregular in shape and display no preferred orientation.

A polished thin section of this sample reveals that the breccia clasts are composed of carbonate mudrock and coarsely recrystallized calcite some of which displays strain-related twinning and deformation bands (Plate 3c). Deformation features have a preferred orientation within clasts but are variable between clasts suggesting post-tectonic brecciation. Deformation fabrics are overgrown by scattered rhombohedral calcites. The calcite euhedra contain fine-grained inclusions of early stage pyrite (Plate 3a). Most of the pyrite forms coarse subhedral masses. The sphalerite is pale yellowish brown in plain light and weakly fluorescent orange or entirely non-fluorescent. It is a late stage phase forming irregular masses and fracture-fillings on and within earlier growth pyrite (Plate 2f).

C-322766-2 (Plate 2d): Massive sulphide. Major constituents include pyrite (48.2%), very dark brown sphalerite (5.3%), galena (0.6%), white and vitreous calcispar. The fabric of the rock is defined by randomly-oriented centimetre scale lenses or cavities filled with finely crystalline sphalerite. These lenses are enveloped by massive finely crystalline and colloform-textured pyrite with finely divided carbonates, sphalerite and probable minor galena as indicated by ICP analysis.

C-322766-3: Massive sulphide. Major constituents include pyrite (47.7%), very dark brown sphalerite (8.8%), galena (0.7%), white and vitreous calcispar. The fabric of the rock is defined by randomly-oriented centimetre scale lenses or cavities filled with finely crystalline sphalerite and white calcispar. These lenses are enveloped by massive finely crystalline and colloform-textured pyrite with finely divided carbonates, sphalerite and probable minor galena.

C-322766-4 (Plate 2e): Pyrite-impregnated calcispar-cemented mosaic packbreccia.

Breccia clasts feature laminated lime mudstone clasts, each up to several centimetres. Replacement textures are prominent with finely crystalline pyrite disseminated throughout the mudstone clasts and more-or-less massive concentrations of pyrite and lesser sulphides forming diffuse-bordered haloes on the margins of clasts. The calcispar appears to envelop both sulphides and clasts and is therefore probably a late void fill phase. Although there is significant obvious pyrite (31.5%), the concentration of sphalerite is low (0.3%).

C-322767-1: Pyrite-impregnated calcispar-cemented mosaic packbreccia. Breccia clasts feature dark grey lime mudstone clasts, each up to about one centimetre. Replacement textures are prominent with finely crystalline pyrite disseminated throughout the mudstone clasts and more-or-less massive concentrations of pyrite and lesser sulphides forming diffuse bordered haloes on the margins of clasts. The calcispar appears to envelop both sulphides and clasts and is therefore probably a late void fill phase. There is significant obvious pyrite (31.5%) but indicated concentration of sphalerite is low (0.3%).

A thin section of this sample contains coarsely crystalline masses of sphalerite that have overgrown and replaced both strained early carbonate and pyrite (Plate 3b). The sphalerite ranges from very-weakly fluorescent orange to non-fluorescent. Sphalerite within fissures and cavities in pyrite is more noticeably fluorescent.

C-322767-2: Massive sulphide. Major constituents include pyrite (45.3%), very dark brown sphalerite (4.1%), galena (0.4%), white and vitreous calcispar. The fabric of the rock is defined by randomly-oriented centimetre scale lenses or cavities filled with finely crystalline dark sphalerite and coarse white calcispar. These lenses are enveloped by massive finely crystalline and colloform-textured pyrite with finely divided carbonates, sphalerite and probable minor galena.

Results: Table 4 and Appendices

Table 4. Selected geochemical values for subdivisions D and E of the Hazen Formation.
* Results marked with an asterix have been confirmed by wet chemical assay.

Ag ppm	Al %	Ca %	Cd ppm*	Cu ppm	Fe %	Mg %	Pb ppm, %*	Zn ppm, %*	C-number	Station number
1.3	0.22	4.13	80*	13	24.1	0.45	2.02%*	5.75%*	C-322766-1	HBB-99-200
1.8	0.59	5.13	50*	13	22.4	1.03	0.54%*	3.55%*	C-322766-2	HBB-99-200
1.4	0.23	5.74	80*	12	22.2	0.39	0.61%*	5.90%*	C-322766-3	HBB-99-200
1.9	0.30	13.7	10*	13	14.6	2.24	851	0.22%*	C-322766-4	HBB-99-200
3.1	0.26	23.8	20*	14	7.55	0.37	716	1.74%*	C-322767-1	HBB-99-200
1.5	0.29	6.61	40*	13	21.1	1.79	0.34%*	2.72%*	C-322767-2	HBB-99-200
2.0	1.84	14.9	0.6	39	0.94	8.69	16	62	C-322768	HBB-99-202
2.1	0.11	18.1	2.0	14	5.23	9.88	260	836	C-322770	HBB-99-204
1.2	0.08	4.29	5.6	14	22.0	0.01	0.92%*	1,630	C-322771	HBB-99-204
1.4	0.18	10.6	0.5	6,977	1.02	0.23	26	55	C-322775	HBB-99-214

Hazen Formation - Subdivision E

Locality: *Cape Baird area gossan and sulphide occurrence*: Stn. HBB-99-204
Air photo: A16680-87 (Fig. 7)
Location: NTS: 120C (Lady Franklin Bay): 81°30.52'N, 065° 08.12'W Stream bank exposure located 10.0 km southwest of Cape Baird on an eastward-flowing tributary of the lower Pavy River (Plate 3e). Outcrop was examined 10 km upstream from the sea level outlet near Cape Baird and 1.5 km southeast of the nearest part of Lady Franklin Bay.

Description: The sampled outcrop is located low in subdivision "E" of the Hazen Formation (est. 70 m above the base) in a talus and patchy outcrop section that includes a lower contact with subdivision D and an upper contact with the Danish River Formation. The sampled outcrop is 100 m in length with contained strata striking parallel to the long dimension of the outcrop and to the adjacent stream bed (bedding attitude: N77°E/32°NW). Dominant rock type is a dark grey weathering flat-laminated lime mudstone, minor lime mudstone clast particulate rubble packbreccia and calcite veins. Podiform gossan and discontinuous massive sulphides occur in a stratigraphic interval located 3 to 6 m above stream level that runs the length of the outcrop (Plate 3e). The maximum development of iron oxide staining and gossan is about 5 m thick with much of this concentrated within fractures in the host lime mudstone. Outcrop observations indicate no apparent laminae-parallel or synsedimentary sulphide; rather fracture-fill and replacement textures are dominant. The top of the outcrop is a talus-covered bench. This talus presents a 4 to 9 m thick covered interval below a ledge-forming outcrop of particulate rubble float breccia containing a dolomitic and coarsely arenaceous matrix. Analyzed samples were collected from the zone of gossanous mudstone and disintegrated massive sulphide.

An additional zone of *in situ* massive goethitic gossan (not sampled) was located at the same stratigraphic level 400 m to the northeast of station HBB-99-204 (Fig. 7). This exposure lies on the flat upland surface surrounded by colluvium. The exposed gossan is 6 to 8 m, wide measured across strike and 4 m long, parallel to strike. The goethitic cap is at least 30 cm thick with no underlying bedrock exposed. Pieces of dark grey lime mudstone, without pyrite or iron oxide alteration, are present in the surrounding colluvium.

Analyzed specimen: C-322770 (Plate 3d): Mosaic packbreccia containing dark grey lime mudstone clasts. Clast matrix is flesh coloured and limonite-stained dolospar. The dolospar has also apparently been brecciated and transected by limonite fracture-fill. Unoxidized pyrite is present as thin vein-fill cutting dolospar, and as centimetre-scale masses and aggregates that appear to have overgrown and replaced the dolospar. ICP analysis indicates 11.2% pyrite.

C-322771: Disintegrated massive iron sulphide. The rock has been reduced by weathering and mechanical breakdown to a coarse pyrite sand. ICP analysis indicates 47.7% pyrite.

Results: Table 4 and Appendices

Locality: *Cape Baird area pyrite occurrence*: Stn. HBB-99-202

Air photo: A16680-87 (Fig. 7)

Location: NTS: 120C (Lady Franklin Bay): 81°30.59'N, 065° 08.98'W. Stream bank exposure located 11.5 km southwest of Cape Baird on a northeastward-flowing tributary of the lower Pavy River. Outcrop was examined 11 km upstream from the sea level outlet near Cape Baird and 1.2 km southeast of the nearest part of Lady Franklin Bay.

Description: The sampled outcrop, mostly surrounded by extensive talus slopes, is located in the lowest beds of Subdivision E or potentially in the highest part of Subdivision D, of the Hazen Formation. Seventy-five metres downstream is a ten metre thick tectonic breccia zone lying in the footwall of a southeastward-dipping normal fault that places Danish River Formation (to the south) in tectonic contact with Hazen Formation.

Analyzed specimen: C-322768: Moderate to dark grey indistinctly flat-laminated non-fissile argillaceous and dolomitic mudstone. Sampled pieces contain scattered pyrite cubes, patchy aggregates of pyrite (to 1 cm) and finely disseminated pyrite (total 2.0% based on ICP iron content).

Results: Table 4 and Appendices

Locality: *Twin Glacier area copper occurrence*: Stn. HBB-99-214

Air photo: A16680-21 (Fig. 8)

Location: NTS: 120C (Lady Franklin Bay): 81°17.49'N, 067° 29.05'W. Southeast-facing hillside talus slopes and felsenmeer located near the local height of land 3.6 km north of the closest part of Twin Glacier and 5.1 km southeast of the closest part of Archer Fiord.

Description: Talus and felsenmeer consists of flat-laminated dark grey slaty lime mudstone in the lower part of subdivision "E" 50 to 75 m above the lower contact. Talus pieces of pale brown coarsely crystalline calcispar and white quartz are locally scattered through the talus in individual pieces up to 30 cm thick. Several dozen pieces of this material contain large grains and grain clusters of pyrite and a grey copper sulphide (chalcocite?). These occurrences are interpreted as frost-shattered quartz-calcispar-sulphide veins broken from local bedrock.

Analyzed specimen: C-322775 Coarsely-crystalline quartz-calcispar-sulphide vein material containing 5 to 10% gun metal grey sulphide (chalcocite?) with lesser pyrite. The grey sulphide has a bright green malachite alteration admixed with dark brown goethite. Individual mineral grains of sulphide, carbonate and quartz are up to 6 mm. Sulphide aggregates range up to 2 cm. Finer mineral grains are concentrated in a 5 mm thick layer adjacent to the flat margin of individual pieces; what may have been a vein wall. Slaty mudstone host rock is not found adhering to the collected samples.

Results: Table 4 and Appendices

Cape Clay Formation

Locality: *Great Plains Ltd. Zn-Pb prospect*
Airphoto: A16608-29 (Fig. 9)
Location: NTS: 120C (Lady Franklin Bay): 81°23.28'N, 066° 03.6'W at a fork on an unnamed, steep-sided creek that drains north into the north fork of the Pavy River. The slopes of the creek valley are largely covered in scree so outcrop is limited in the area of the showing. The north side of the creek has an outcrop about 80 m long and 10 m high. Outcrop on the south side of the creek has been exposed in four trenches, each about 100 m apart. There is no rusty alteration or gossan that might allow the showing to be recognized from a distance.

Previous work: Five trenches were excavated on the showing by Great Plains Ltd. Channel samples of these trenches were reported to contain "zinc-equivalent" values of: 3.22% over 0.9 m, 6.05% over 1.2 m, 3.21% over 2.1 m, and 9.09% over 0.6 m. A gravity survey showed five anomalies, the largest of which is 500 (150 m) to 1500 feet (460 m) north of the trenches. Electromagnetic and induced polarization surveys revealed no anomalies. Three additional trenches were dug about 1.5 miles (2.4 km) northeast of the showings. These contained trace amounts of olive green sphalerite.

Geochemical anomalies (zinc greater than 155 ppm; lead greater than 122 ppm) were reported by Great Plains Ltd. from three streams in the vicinity of the showings (Fig. 9). The stream cutting the showing has three adjacent silt samples directly below the showing that are anomalous in zinc. Four silt samples from the same stream near its confluence with the Daly River are anomalous in either zinc or lead, or both. The first stream southwest of the showings has three samples that are anomalous in lead, and the stream south of the showings (across the water shed) has two silt samples that are anomalous in zinc. In both these streams, anomalous samples are separated by barren samples.

Description: The prospect lies within a northeast-trending range of high hills between the Daly River and the north fork of the Pavy River. Strata throughout much of the range are mostly outer shelf carbonates of Ordovician age. Units exposed in the valley and surrounding high hills are more-or-less flat-lying and include the Cape Clay Formation at the showing (dip 5° to the northeast) with overlying Ninnis Glacier, Eleanor River and Bay Fiord formations on the slopes and hill tops to the east and south (dip 6° south). There are at least eight planar near-vertical faults identified on air photographs within a 3 km radius of the showing, each with displacements ranging from a few tens of metres to potentially several hundred metres. Five of these strike northeastward; the others strike northwest and west.

The mineralization lies in a 2.0 to 2.5 m thick interval in the upper part of the Cape Clay Formation and is present in each of the four test trenches (Plate 4a,b). Mineralized boulders are visible in scree between the trenches implying continuity of the mineralization for at least 300 m. The host rock is a 2.6 m thick interval of dolostone, light to moderate grey weathered, moderate grey on fresh, medium bedded, medium to coarsely crystalline, structureless, or with bedding parallel dissolution clay seams to 0.5 mm (Plate 4b). This is overlain by 4.4 m of coarsely crystalline dolostone, sandy dolostone, and white, medium crystalline limestone in 40 to 75 cm thick beds. The host dolostone bed contains abundant pseudobreccia and minor collapse breccia. Pseudobreccia is parallel to bedding, up to 5 cm across and possibly follows original fenestrae. Breccia cement is white dolospar locally with sphalerite, chalcopyrite, galena, and quartz (Plate

4c,d,e). Porosity is negligible. Rare zones of collapse breccia contain rotated blocks of dolostone to 5 cm. Blocks have irregular or embayed margins. Sphalerite is light brown to yellowish brown, resinous and crystalline in masses ranging from 1 mm to 6 cm. Rare galena, intergrown with sphalerite and pyrite, occurs in patches up to 8 cm across and in these circumstances can form up to 20% of the rock. Galena crystals are up to 1 cm across. Visual estimate of grades over 25 cm squares range between 1 and 25% combined lead-zinc, with sphalerite forming at least 80% of the mineralization. Pyrite is anhedral to euhedral in masses to 3 cm across. Dolospar, chalcopyrite, sphalerite, and galena are intergrown. Quartz appears to be a later, void-filling phase. A vertical vein of white dolospar and minor sphalerite, 5 cm wide and trending N85°E, is exposed in the creek bed 80 m northeast of the southwest-most trench. This may be part of a conduit system that fed the mineralized bed.

Analyzed specimens: C-412160, C-412161 (Plate 4c,d,e)

Results: Table 5 and Appendices

Table 5. Selected geochemical values for the Cape Clay Formation.
* Results marked with an asterix have been confirmed by wet chemical assay.

Ag ppm	Al %	Ca %	Cd ppm*	Cu ppm	Fe %	Mg %	Pb ppm, %*	Zn ppm, %*	C-number	Station number
1.0	0.52	0.09	5.0	17	8.73	0.23	128	4,148	C-322739	HBB-99-162
			0.8*				23*	1100*	C-322739-1	HBB-99-162
			0.7*				44*	1600*	C-322739-2	HBB-99-162
			0.7*				18*	530*	C-322739-3	HBB-99-162
			0.8*				47*	1900*	C-322739-4	HBB-99-162
			2.4*				145*	0.57%*	C-322739-5	HBB-99-162
			0.9*				118*	2900*	C-322739-6	HBB-99-162
4.5	0.05	30.3	5.6	16	1.46	4.96	39	1,966	C-322746	HBB-99-168
1.6	0.20	1.58	180*	34	2.66	0.15	499	13.8%*	C-322748	HBB-99-168
			80*				30*	4.40%*	C-322748-1	HBB-99-168
			260*				43*	16.6%*	C-322748-2	HBB-99-168
			405*				56*	23.2%*	C-322748-3	HBB-99-168
			0.8*				20*	465*	C-322748-4	HBB-99-168
			0.7*				13*	453*	C-322748-5	HBB-99-168
2.4	0.66	14.7	20*	15	0.59	6.95	2,886	0.93%*	C-322779-1	HBB-99-220
1.4	0.11	15.1	1.4	3	0.24	7.40	1.01%*	136	C-322779-2	HBB-99-220
2.8	0.41	19.7	6.5	21	1.30	10.1	1,222	4,050	C-322779-3	HBB-99-220
3.6	0.16	17.4	390*	36	2.02	9.97	322	8.30%*	C-412160	99-DTA-49
3.6	0.26	20.3	120*	21	0.47	11.1	206	4.00%*	C-412161	99-DTA-49

Locality: *Twin Glacier area Zn-Pb occurrence 1*: Stn. HBB-99-168

Air photo: A16680-21 (Fig. 8)

Location: NTS: 120C (Lady Franklin Bay): 81°17.79'N, 066° 57.30'W. Gossanous outcrops were located by Geological Survey of Canada staff on both sides of a talus-choked gully and ephemeral stream draining southward into a significant tributary, 2.4 km above its confluence with the Daly River. This confluence is located 18 km, straight line distance, northwest of the mouth of the Daly River and 9 km northeast of the closest part of Twin Glacier.

Previous work: Great Plains Ltd. have reported anomalous zinc values in nine stream silt samples collected downstream from station HBB-99-168 (seven sample sites located on Fig. 8) as a consequence of their reconnaissance sampling program conducted on Judge Daly Promontory in 1974. Ten samples collected on a stream to the north, which is over a local divide from Stn HBB-99-168, were not anomalous. Results of their follow-up prospecting (if any) were not reported.

Description: Gossan is most obviously developed on the southwest stream bank within a 10 m long outcrop of pale grey and pale yellowish brown mosaic packbreccia and moderately crystalline dolomitized pseudobreccia. Breccia clasts are moderately crystalline dolostones of the Cape Clay Formation. Matrix consists of calcispar, particulate dolostone and goethite-replaced iron sulphides. The goethite is massively developed in several irregular pods, each of two metres, maximum dimension. Pyrite cubes, to several mm each, are scattered throughout the host rock. Breccia and gossan are situated within an eight metre thick stratigraphic interval of the upper Cape Clay Formation immediately below the exposed contact with the overlying Ninnis Glacier Formation. Bedding is absent in the breccia. However the attitude of the Ninnis Glacier Formation, measured 110 m downstream, is N87°E/51°S. Pieces of gossanous breccia were collected from various parts of the outcrop (C-322746).

Additional sulphides, secondary dolospar and patchy goethitic alteration are present in the Cape Clay Formation twenty five to thirty metres up the gully to the northwest on the opposite (northeast) stream bank. This material, mostly located in large talus blocks and felsenmeer, contains much less iron oxide surface alteration and when viewed at a little distance is less impressive than the previous outcrop. There are two dominant lithofacies (C-322748): pale and moderate grey moderately crystalline dolostone pseudobreccia with disseminated pyrite and; pale yellow coarse grained quartz arenite containing disseminated pyrite (with surface limonite alteration) and very pale brown varieties of disseminated sphalerite. While the extent of this mineralization would appear to be limited, sphalerite is plentiful in some samples containing only minor pyrite and related surface alteration.

Analyzed specimens: C-322746 A general selection of gossanous breccia fragments was collected from all parts of the outcrop and submitted for analysis.

C-322748 A selection of sulphide-rich quartz arenites was collected from the general area of gossanous felsenmeer blocks. ICP analyses and confirmation assay results indicate 5.7% pyrite and approximately 20% sphalerite. Specific pieces were subsequently re-assayed to determine variability of zinc content and associated metals.

C-322748-1 (Plate 5a) Goethite-stained moderate grey, mottled with white, fine grained quartz arenite. Estimated 5% scattered cubes and cube clusters (to 2 mm each) of pyrite and approximately 6.5% finely disseminated pale reddish brown sphalerite. Individual sphalerite grains and grain clusters range to about 1 mm.

Thin section analysis indicates that the host rock is a texturally and compositionally mature quartz sandstone. Quartz grains are well rounded and have well developed quartz overgrowths or, even more commonly, a clear quartz cement. Both quartz phases are relatively unstrained and only rarely fractured. Interstitial porosity is less than 0.1% and is recognized by the presence of crystal terminations formed on secondary quartz overgrowth. Larger vugs are occupied by calcispar that overgrows vug-lining pyrite and quartz euhedra (Plate 5d). Phases related to sulphide mineralization include sphalerite, pyrite, gypsum, smithsonite and various iron oxides. The sphalerite is yellowish brown in plain light and normally forms equant grains; each grain tending to be centred in the space formerly occupied by the quartz cement between detrital quartz grains. Pyrite, which is relatively rare in the prepared thin section, forms partly corroded subhedral grains and grain clusters with sphalerite overgrowth. A late mineral phase is a finely crystalline variety of calcium sulphate, likely gypsum (Plate 5d). Normally occurring in the host rock matrix or as an alteration product, this material forms a mosaic of compact low-relief, low birefringent booklets that have invaded and overgrown both calcispar, quartz, and sulphide grains. The calcium sulphate is often finely divided with the smithsonite and iron oxides in diffusely-bounded fractures within the sandstone and sulphides. This material is clearly later than the other phases and is likely the result of recent surface weathering processes.

C-322748-2 (Plate 5c) Goethite-stained pale grey, mottled with white, fine grained quartz arenite. Estimated 5 to 10% pyrite and approximately 25% finely disseminated pale yellowish brown sphalerite. Individual sphalerite grains and grain clusters range to about 1 mm. However the distribution of grains ranges from 10% to more than 50% across a 10 cm slab surface. Similarly concentration of disseminated pyrite tends to range from less than 5% to patches of 40%.

C-322748-3 (Plate 5b,e) Goethite-stained pale grey, mottled with white, fine grained quartz arenite. Estimated 5% pyrite and approximately 35% finely disseminated pale yellowish brown sphalerite. Individual sphalerite grains and grain clusters range to about 1 mm. However the distribution of grains ranges from 15% to more than 50% across a 5 cm slab surface. A thin section prepared for this sample is mineralogically and paragenetically uncomplicated. Well rounded and unstrained quartz grains carry well developed quartz overgrowths and clear quartz cement. Relict porosity is less than 0.1%. Equant sphalerite grains are situated in the spaces between detrital quartz grains but have also grown and replaced both the detrital grain boundaries and their silica overgrowths. Both quartz phases display corrosional pits and other irregularities against late stage sphalerite.

C-322748-4 Unevenly goethite-stained, mottled pale and moderate grey, mediumly crystalline dolostone pseudobreccia with scattered pyrite clusters and replacement masses to 2 cm each. Significant finely disseminated pyrite is implied by the surface weathering pattern of goethite. No obvious sphalerite.

C-322748-5 Unevenly goethite-stained, mottled pale and moderate grey, mediumly crystalline dolostone pseudobreccia with scattered pyrite clusters and replacement masses to 5 mm each. Significant finely disseminated pyrite is implied by the surface weathering pattern of goethite. No obvious sphalerite.

Results: Table 5 and Appendices

Locality: *Twin Glacier area Zn-Pb occurrence 2*: Stn. HBB-99-220

Air photo: A16680-21 (Fig. 8)

Location: NTS: 120C (Lady Franklin Bay): 81°16.88'N, 067° 12.74'W An extensive blocky talus slope with some shifted outcrop occurs on the northeast bank of a major tributary of the Daly River. Most river runoff is derived from the northeastern terminus of Twin Glacier which is located 5.5 km to the southwest. The talus slope at this station is 4.4 km, straight line distance, northwest of the tributary confluence with the Daly River and this confluence is located 19.5 km, straight line distance, west northwest of the mouth of the Daly River. The sampled outcrops lie 4.2 km along strike to the southwest but somewhat below the stratigraphic level of locality HBB-99-168.

Previous work: Great Plains Ltd. have reported anomalous zinc, lead and cadmium in two stream silt samples collected on an adjacent tributary (Fig. 8). A third sample, with anomalous lead only, is reported in the next drainage to the south. At least 26 samples collected upstream were not anomalous. A curious gap in sampling is present directly opposite and downstream from Stn HBB-99-220. Indeed, there were no results reported by Great Plains Ltd over a distance of 5 km on any of the local streams draining favourable strata between this area and the showing located near Stn HBB-99-168. Results of their follow-up prospecting (if any) were not reported.

Description: Most of the talus slope at Stn HBB-99-220 is pyrite-bearing quartz arenite, correlated with either the Kap Coppinger Member or a sandstone interval within the Cape Clay Formation. A small proportion of the talus blocks are dolomitized particulate rubble packbreccia. These contain patchy and disseminated pyrite, a little sphalerite and galena. Several sulphide-bearing pieces were submitted for ICP and follow-up assay.

Analyzed specimens: C-322779-1 (Plate 5f) Dolomitized rubble packbreccia with disseminated pyrite and several replacement pyrite aggregates to 2 cm each. Clast compositions range from pale grey moderately crystalline dolostone to dark grey finely crystalline dolomitic mudstone. Some clasts are fractured with fractures containing white calcispar. Transecting fractures and some irregular openings are also filled with spar calcite. Pyrite, as single grains and small aggregates to 2 mm each, is finely disseminated through the matrix. Larger masses have partly replaced the margins of some clasts. A few galena cubes are present. No obvious sphalerite.

C-322779-2 Mottled light grade and dark grey coarsely crystalline dolostone. Lighter coloured dolospar is coarsest and appears to have partly replaced darker coloured varieties. Scattered white calcispar void-fill, disseminated galena cubes to 3 mm each, and a little pyrite evident as oxidized spots and patches on weathered surfaces.

C-322779-3 Dolomitized rubble packbreccia with disseminated pyrite and several replacement pyrite aggregates to 1 cm each. Clast compositions range from pale grey moderately crystalline dolostone to dark grey finely crystalline dolomitic mudstone. Clasts are fractured with fractures containing white calcispar. Transecting fractures and some irregular openings are also filled with spar calcite. Pyrite, as single grains and small aggregates to 2 mm each, occurs through the matrix.

Results: Table 5 and Appendices

Locality: *Daly River area gossan*: Stn. HBB-99-162

Air photo: A16609-170 (Fig. 6)

Location: NTS: 120C (Lady Franklin Bay): 81°19.06'N, 066° 41.23'W. Obvious gossan located in the uppermost part of the Cape Clay Formation on the northwest side and immediately adjacent to a regional fault trace, and a west southwest flowing tributary stream 3.8 km northeast of its confluence with the Daly River. This confluence lies 16 km, straight line distance, northwest of the mouth of the Daly River. The sampled outcrops lie 5.2 km along strike to the northeast and at the same stratigraphic level as locality HBB-99-168.

Description: The Cape Clay Formation, which in this area overlies the Kap Coppinger Member and subdivision D of the Hazen Formation, strikes N65°E and dips 22°SE. Strata immediately adjacent to the fault trace are locally rotated to vertical, presumably as a result of dextral slip and drag of beds along the fault plane. Large calcispar veins in subdivision D are also consistent with dextral slip motion along the fault. The fault cuts across the Hazen, Cape Clay and overlying Ninnis Glacier and Bulleys Lump formations such that these strata are now in tectonic contact with Danish River Formation and an outlier of Paleocene Eureka Sound Group to the southwest.

The gossanous outcrop is exposed above stream level and amongst talus over a distance of 25 m parallel to the adjacent stream course. The host rock is a limonite- and goethite-stained quartz- and goethite-cemented rubble packbreccia (tectonic breccia?) and pseudobreccia with local calcispar. Fractures have locally widened to accommodate pods of massive goethite and goethitic crusts each up to about 1 m, maximum dimension. Clasts in the breccia include, fine grained quartz arenite, lesser pale grey dolostone and arenaceous dolostone. Similar breccias with only scattered pyrite cubes are common throughout the Cape Clay Formation and Kap Coppinger member near the fault trace.

Analyzed specimens: C-322739 A general selection of gossanous breccia fragments was collected from all parts of the outcrop and submitted for analysis. Specific pieces were subsequently assayed to determine variability of zinc content and associated metals.

C-322739-1 Goethite-stained fine grained quartz sandstone Estimate 5% porosity associated with quartz-lined vugs and the weathering out of disseminated oxidized fine grained iron sulphides.

C-322739-2 Goethite-stained fine grained quartz sandstone Estimate 10% porosity associated with quartz-lined vugs and the weathering out of disseminated and fracture-fill iron sulphides.

C-322739-3 Fine grained quartz sandstone pseudobreccia. Estimated 10% porosity associated with quartz-lined vugs and the weathering out of disseminated oxidized fine grained iron sulphides.

C-322739-4 Fine grained quartz sandstone pseudobreccia. Estimated 10% porosity associated with quartz-lined vugs and the weathering out of disseminated oxidized fine grained iron sulphides.

C-322739-5 Packbreccia with clasts of fine grained sandstone and goethite. Particulate matrix of goethite and comminuted sandstone fragments.

C-322739-6 Packbreccia with clasts of fine grained sandstone. Particulate matrix of goethite and comminuted sandstone fragments.

Results: Table 5 and Appendices

Discussion

Field activities on Judge Daly Promontory in 1999 were directed toward bedrock mapping, measurement of selected stratigraphic sections and evaluation of resource potential along the lower Paleozoic shelf margin. This work has resulted in the clarification of the stratigraphic position of a known sphalerite and galena prospect, the discovery of three new sphalerite and galena occurrences and two of copper, and the geochemical detection of zinc, lead and cadmium in three additional localities (Figure 10).

Two of the new zinc and lead occurrences, both located northeast of Twin Glacier (stns. HBB-99-168, 220), a gossan near the Daly River containing geochemical indications of these metals (Stn. HBB-99-162) and the prospect previously discovered and explored by J.C. Sproule and Associates for Great Plains Ltd are all situated in the Cape Clay Formation close to the facies transition of this formation into correlative basin slope deposits of the Hazen Formation. Cadmium is an important accessory metal in the collected samples with concentration appearing to correlate with abundance of zinc. Anomalous concentration of antimony, molybdenum, arsenic and phosphorus but not silver is also indicated by ICP results. Replacement textures of sulphide minerals involving carbonate packbreccia, pseudobreccia, secondary dolospar and even quartz-cemented quartz arenite are all suggestive of transport of metal-bearing brines and related fluids through and into previously consolidated host rocks and the transformation of these host rocks as part of the mineralizing event. The common stratigraphic position of these mineral occurrences points to the suitability of the Cape Clay Formation as both an aquifer and host rock, and of the overlying Ninnis Glacier Formation as an effective aquitard (or stratigraphic barrier to upward migration of fluids). Proximity of the known showings to the lower Paleozoic shelf margin may be significant. However, migration of metal-bearing brines through the Cape Clay Formation to more distant portions of the Lower Ordovician shelf should not be discounted. Any or all of the three sets of steep faults in the vicinity of the Great Plains prospect may have provided transecting channel ways for migrating fluids if these faults were active at the time of fluid migration and mineral deposition. Alternatively, early fault activity may have produced suitable local conditions for entrapment of metallogenic fluids.

One additional new occurrence of sphalerite and galena is associated with podiform massive sulphides in the medial part of subdivision D of the Hazen Formation near Cape Baird (Stn. HBB-99-200) and geochemical indication of zinc, lead and cadmium is present in a pyrite gossan of subdivision "E" in the same area (Stn, HBB-99-204). As well as significant zinc, lead, and cadmium, ICP results point to anomalous values for arsenic, antimony, molybdenum and phosphorus but not silver. Copper sulphides (chalcocite?) are also sparingly present in felsenmeer quartz-calcispar veins of subdivision "E" northeast of Twin Glacier (Stn. HBB-99-214). The host rocks for all these occurrences are slope facies rocks including lime mudstone and packbreccia and, for the subdivision "E" occurrences, may lie at more-or-less the same stratigraphic level as the Citronen Fjord sedimentary-exhalative mineral deposits of the Amundsen Land Group of eastern North Greenland (van der Stijl and Mosher, 1998). However, sulphide replacement textures are dominant in two of the new occurrences in the Hazen Formation (both near Cape Baird) and thin section evidence indicates a post-kinematic timing for mineralization. This provides compelling indication that metal-bearing fluids have moved through and been deposited within the sediment pile. Rather than detracting from economic

potential, these conditions may have promoted a concentration of metals, coarser overall grain size as a consequence of slow subsurface crystallization, and the absence of standard sedimentary-exhalative diluting factors such as non-sulphide interbeds. The common association of cadmium, arsenic, antimony, molybenum and phosphorus without silver in all of the Cape Clay and Hazen sphalerite and galena occurrences suggests a common but unidentified metallogenic source and potentially a single ancestral aquifer that once connected the promising localities in the upper Hazen to the showings nearby in the Cape Clay.

An occurrence of malachite and azurite in the Scoresby Bay Formation near Carl Ritter Bay provides an indication of copper and related sulphide mineral potential in these rocks. Common occurrence of secondary dolospar and zebra-textured dolomite, both at the showing and regionally throughout the Scoresby Bay Formation, provides an indication of the effectiveness of these strata as a former aquifer. Indeed the correlative units of the inner shelf (Cape Leiper, Cape Ingersoll, Police Post and Cape Kent formations) and of the basin slope (Subdivision B of the Hazen Formation) are also similarly dolomitized. Considered collectively these strata were likely an interconnected plumbing system in the Arctic Cambrian; a system capped by an equally extensive aquitard represented by Subdivision C of the Hazen Formation on the basin slope and by the Parrish Glacier and Cass Fjord formations on the shelf.

Additional occurrences of iron sulphides are reported from a pyritic mudrock unit in the medial Ella Bay Formation and from Subdivision C of the Hazen Formation. These occurrences are associated with laminated black mudrocks and lime mudstones that are free of bioturbation and associated biogenic activity. The accumulation of pyrite-rich sedimentary layers and laminae point to conditions of anoxia and extreme sediment starvation in relatively undisturbed (deep water?) portions of the outer shelf in the Lower Cambrian and of the adjacent ocean basin throughout the Middle Cambrian. While these conditions could also have been favourable for the preservation of sedimentary-exhalative mineral deposits, the geochemistry of collected samples do not provide encouragement for economic mineral deposits near the sampled localities. Not to be ignored, however, is the geological favourability of the host rocks and the somewhat elevated level of zinc in the analyzed specimen of the Ella Bay Formation in Unit 8 of section 99-DTA-10, and of zinc with cadmium in a bed of dolomitic mudrock in Unit 1, Subdivision C of the Hazen Formation near Cape Baird (Stn. HBB-99-185).

Summary and recommendations

Significant sphalerite, galena and related geochemical indications of lead, zinc, cadmium and other metals are here reported from three recently discovered localities in the Cape Clay Formation and two localities in subdivisions D and "E" of the Hazen Formation. Exploration to assess the economic significance of these showings is warranted including prospecting of the host strata, property-scale geological mapping, geochemistry and geophysical surveys (IP, EM, magnetometer and gravity). Special attention should be given to favourable host rocks, such as those of the Cape Clay Formation, which are known to contain significant sphalerite and galena with little or no pyrite, iron oxide alteration or gossan. Reconnaissance exploration for carbonate-hosted sphalerite and galena is warranted throughout the exposure belt containing the Cape Clay Formation. Similarly, subdivisions D and "E" of the Hazen Formation are also worthy of exploration. Methods should include ground traverses and prospecting of the favourable host

units, aerial reconnaissance for and sampling of gossans within these strata, and careful examination of rocks in the immediate vicinity but beyond the obvious limit of any discovered gossans. Reconnaissance geochemical techniques, with special attention to minor tributaries, are recommended including stream silt and heavy mineral sampling. Promising associated elements include Pb, Zn, Cd, Cu, As, Sb, Mo and P but not Ag.

Areas close to the Cambrian and Ordovician shelf edge on Judge Daly Promontory appear to be especially worthy of reconnaissance exploration. This study indicates that the Cape Clay and Scoresby Bay formations may each have been a regionally significant aquifer; each enclosed by an effective aquitard. For this reason, the entire exposure belt for these formations throughout the Arctic Islands should be consideration for long term exploration planning. The Cape Clay Formation is known throughout the eastern Arctic Islands including all of eastern and southern Ellesmere Island and all of Devon Island (Okulitch,1991). Correlative strata occur in the upper part of the Turner Cliffs Formation (de Freitas et al., 1997). The latter unit is extensively preserved throughout the southern Arctic including Boothia Peninsula, Baffin and Somerset islands and is likely to be found on Victoria Island and the adjacent small islands of the Arctic Platform (Okulitch,1991). The Scoresby Bay Formation, while it also carries significant evidence of promising secondary dolomite and related aquifer fluid flow, has not yet proven to contain mineral occurrences of any great economic significance. Nevertheless, copper bloom is now reported to occur in the upper part of this formation in one locality near Carl Ritter Bay and as the overlying strata appear to have sealing properties, the upper contact of the Scoresby Bay Formation is considered to be a promising level for prospecting, strategic stream sediment sampling, and reconnaissance exploration for gossans.

Geological conditions appear to have been favourable for sedimentary-exhalative deposits in various slope and basin facies rocks of the Hazen Formation. Especially noted are flat-laminated pyrite-rich mudrocks in Subdivision C on Judge Daly Promontory. Although the depositional setting and general composition of these rocks is attractive, all samples but one (C-322757-2) contain neither significant nor anomalous base metal concentrations (apart from iron) and the potential for nearby mineral deposits within these strata would appear to be slight. Other geologically favourable deep water mudrocks with mineral potential include the Kennedy Channel Formation (Lower Cambrian), a pyritic mudrock unit in the medial Ella Bay Formation (also Lower Cambrian) and the Cape Phillips Formation (Silurian). The Cambrian mudrocks are exposed throughout northeastern Ellesmere Island from north of Bache Peninsula to the top end of Judge Daly Promontory. The Cape Phillips Formation is known throughout the Arctic Islands from northern Ellesmere Island to western Melville Island.

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Plates

Plate 1: A: Anticline hinge exposures near Stns HBB-99-38, 39 featuring the upper part of the Kennedy Channel Formation and three members of the Ella Bay Formation including the pyritic mudrock middle member (see Fig. 3 for location); B: Sample C-311572 of medial Ella Bay Formation (Stn. HBB-98-39); C: Sample C-311577 of medial Ella Bay Formation (Stn. HBB-98-44); D, E: Stn. HBB-99-185; pyritic mudrock of Unit 5, Subdivision C of Hazen Formation (samples C-322761, 762);

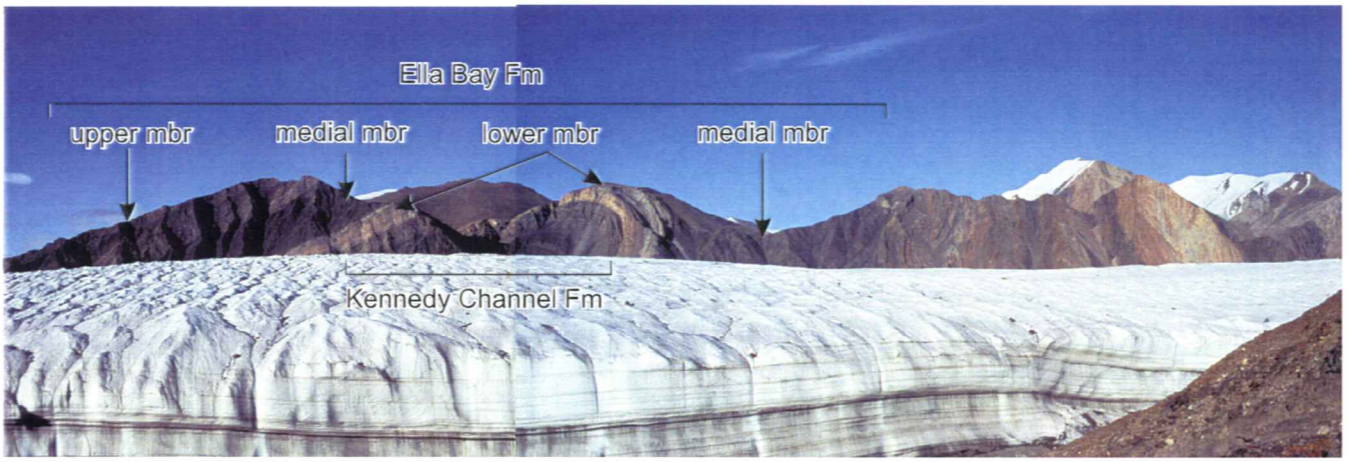
Plate 2: A, B: Dolomitized Scoresby Bay Formation at Stn 99-DTA-37 near Carl Ritter Bay; C: Outcrop of gossan and podiform massive sulphides (with sphalerite and galena) in lime mudstone of subdivision D of Hazen Formation (Stn. HBB-99-200); D: Samples C-322766-1 (upper left; 5.75% Zn; 2.02% Pb; 80 ppm Cd) and C-322766-2 (lower right; 3.55% Zn; 0.54% Pb; 50 ppm Cd) both collected from Stn. HBB-99-200; E: Sample C-322766-4 collected from Stn. HBB-99-200; F: photomicrograph of sample C-322766-1 containing fractured high relief pyrite enveloped by variably fluorescent sphalerite:

Plate 3: A: photomicrograph of C-322766-1 in plain light with host mudrock containing scattered pyrite grains overgrown by secondary calcispar rhombs; B: photomicrograph of C-322767-1 in plain light showing strained early carbonate, calcispar fracture-fill (bright), and post-kinematic sulphides (opaque pyrite; yellowish high-relief enveloping sphalerite); C: photomicrograph of C-322766-1 in plain light with strained early carbonate and post-kinematic sulphides (opaque pyrite; high-relief sphalerite); D: Sample C-322770 collected from Stn. HBB-99-204; E: Outcrop (Stn. HBB-99-204) of subdivision "E" lime mudstone of Hazen Formation near Cape Baird containing a zone of gossan (between arrows) and podiform sulphides.

Plate 4: A: Wall of trench no.4 on the Great Plains Ltd. Zn-Pb prospect of Judge Daly Promontory (Stn. 99-DTA-49); B: Wall of trench # on the Great Plains Ltd. Zn-Pb prospect; C: Sample C-412161b from Great Plains Ltd trench no.3; D: Sample C-412161a from Great Plains Ltd trench #; E: Sample C-412160 from Great Plains Ltd trench no.4.

Plate 5: A: Sample C-322748-1 (4.40% Zn; 80 ppm Cd) collected from the upper part of the Cape Clay Formation northeast of Twin Glacier (Stn. HBB-99-168); B: Photomicrograph of sample C-322748-3 with well rounded detrital quartz, quartz cement and replacement high relief sphalerite; C: Sample C-322748-2 (16.62% Zn; 260 ppm Cd) collected from the upper part of the Cape Clay Formation northeast of Twin Glacier (Stn. HBB-99-168); D: Photomicrograph of sample C-322748-1 in plain light with vug-lined pyrite euhedra (opaque) calcispar vug-fill and late-stage gypsum filling fractures in both calcite and sulphides; E: Sample C-322748-3 (23.25% Zn; 405 ppm Cd) collected from the upper part of the Cape Clay Formation northeast of Twin Glacier (Stn. HBB-99-168); F: Sample C-322779-1 (0.93% Zn; 0.37% Pb; 20 ppm Cd) collected from the Cape Clay Formation northeast of Twin Glacier (Stn. HBB-99-220).

Plate 1

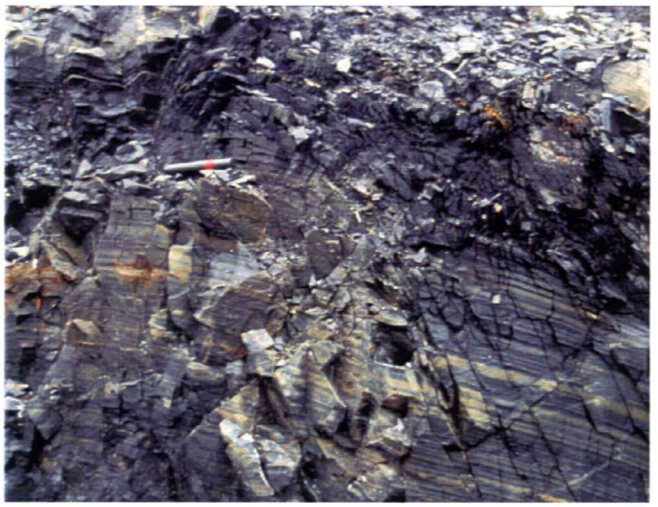


A

B

C

D



E

Plate 2

A

B

C

D

E

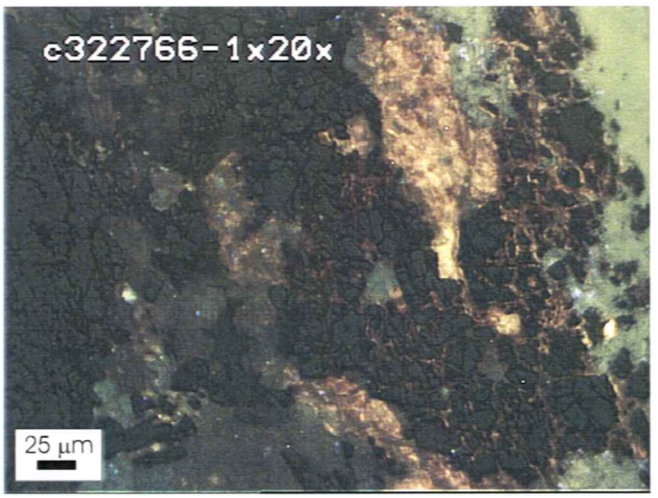


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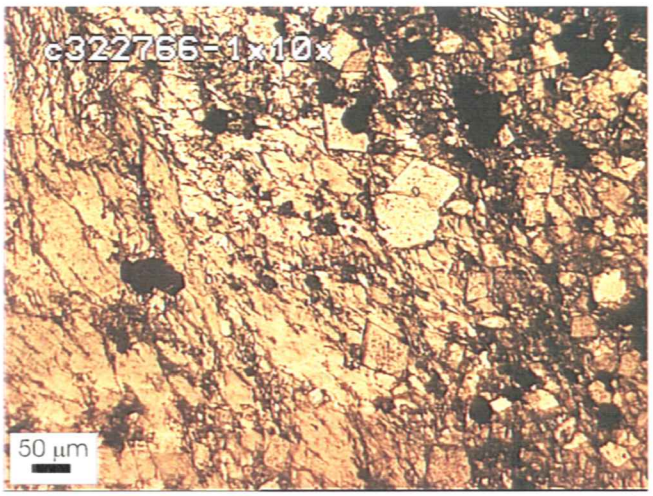
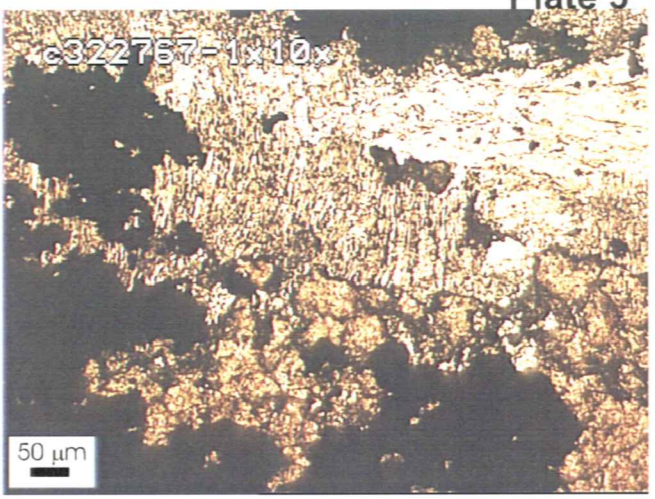
Plate 3



A



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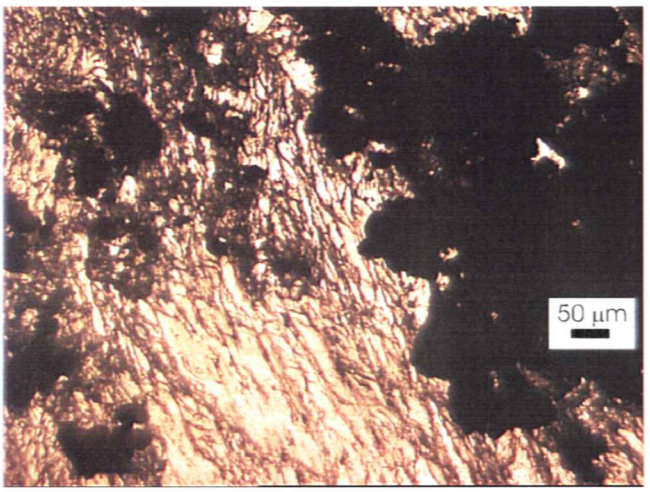

C

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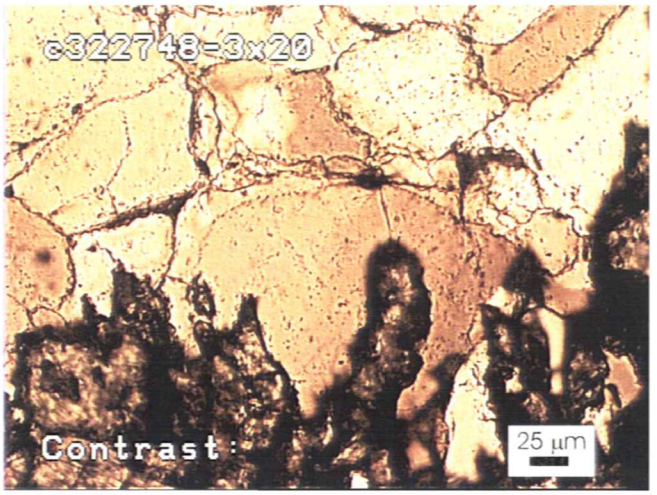
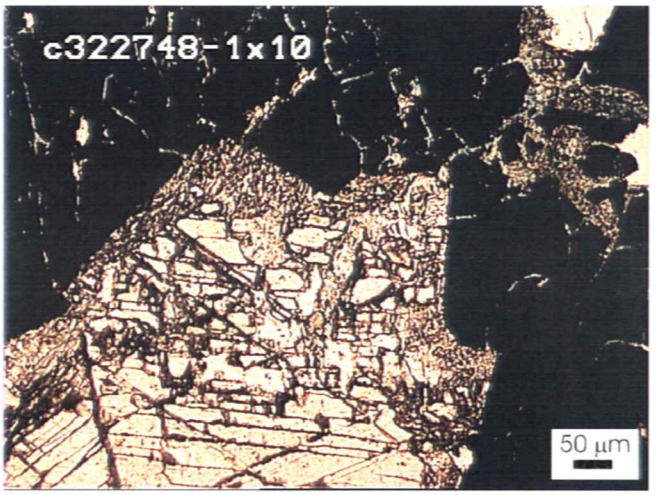
A


c322748-3x20
Contrast:
25 µm

B

C


c322748-1x10
50 µm

D


CENTIMETRES
I.S.P.G.

E

F

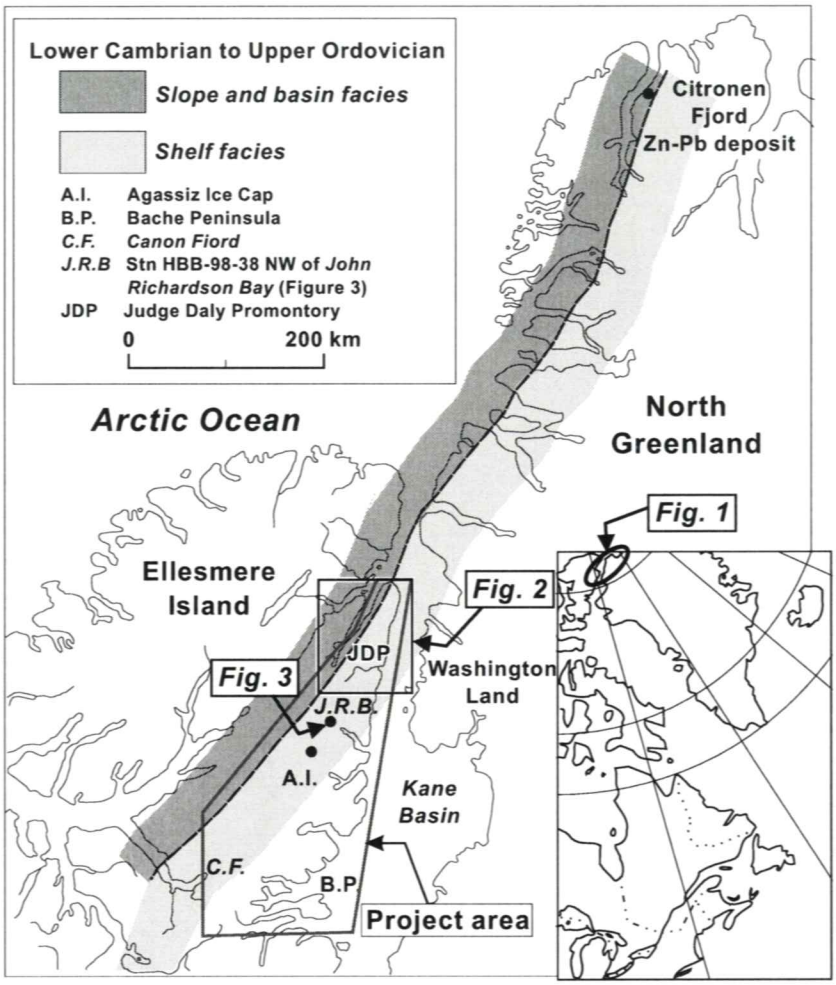


Figure 1: Project and report area locations relative to the Lower Cambrian through Upper Ordovician shelf edge and other key localities of northern Ellesmere Island and North Greenland.

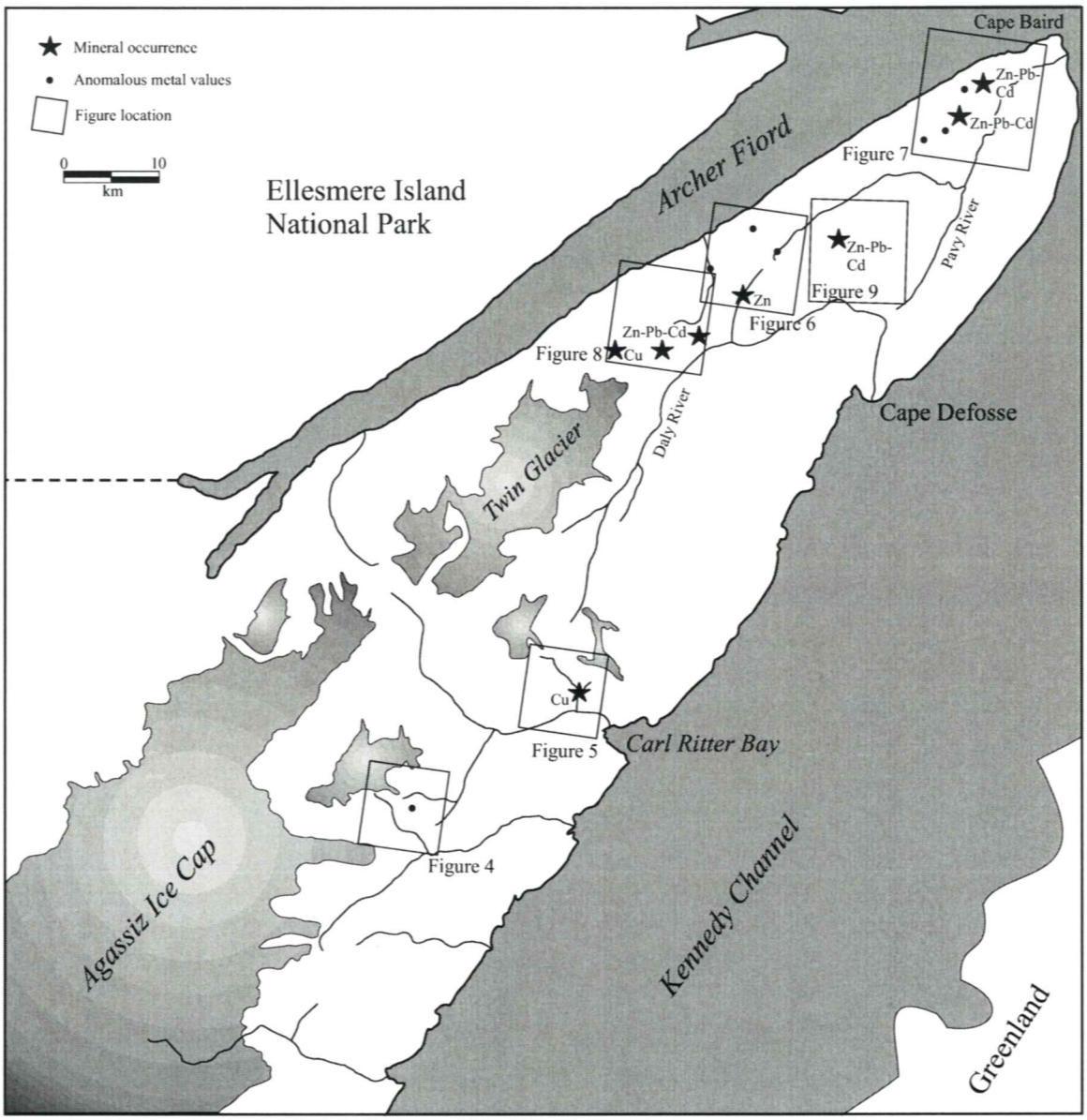


Figure 2: Location of sphalerite and galena occurrences and other mineral localities of Judge Daly Promontory, northeastern Ellesmere Island.

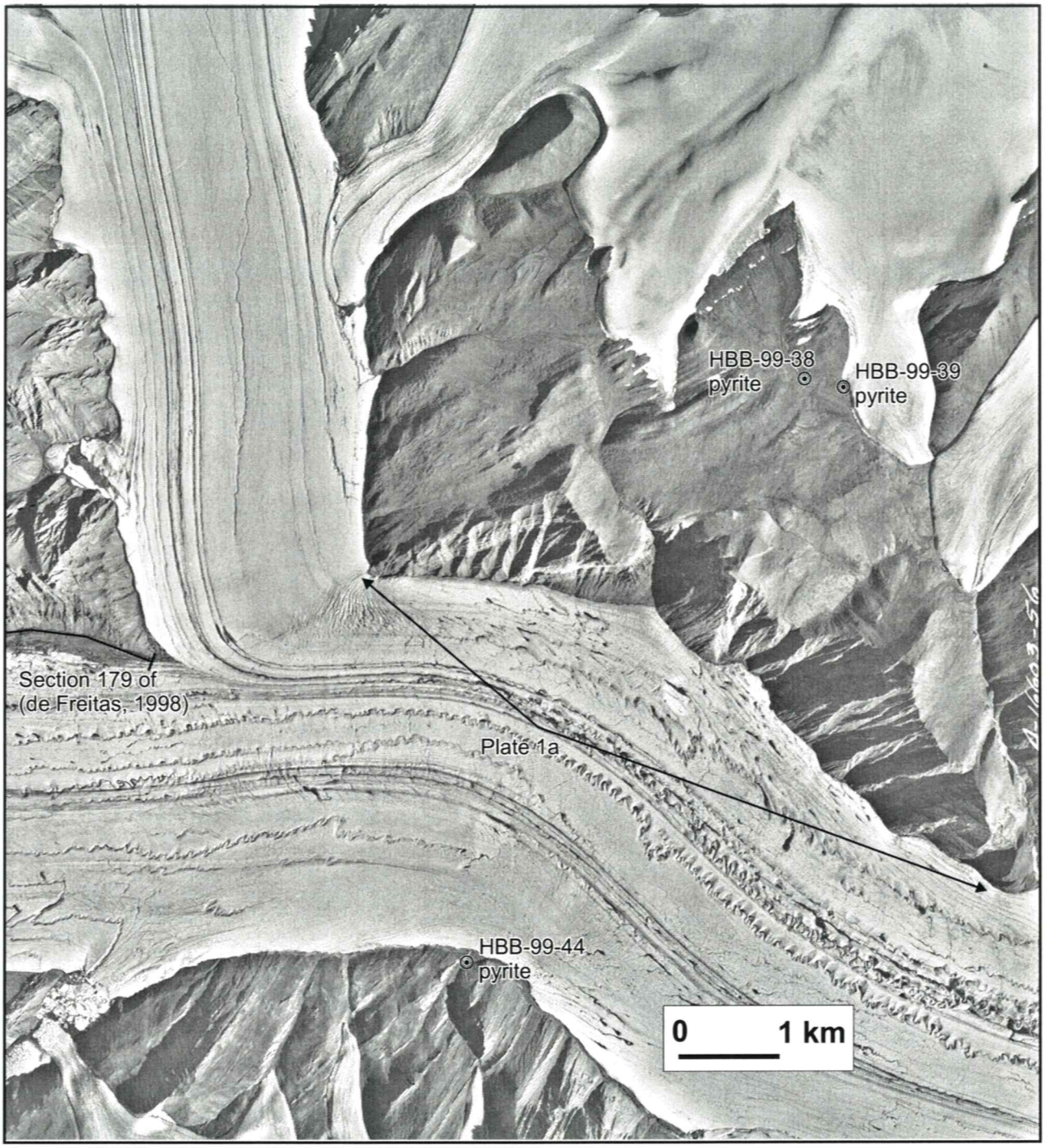


Figure 3: Portion of National Air Photo Library (NAPL) air photograph A16603-56 and position of cited mineral localities northwest of the head of John Richardson Bay (see Fig. 1 for location).

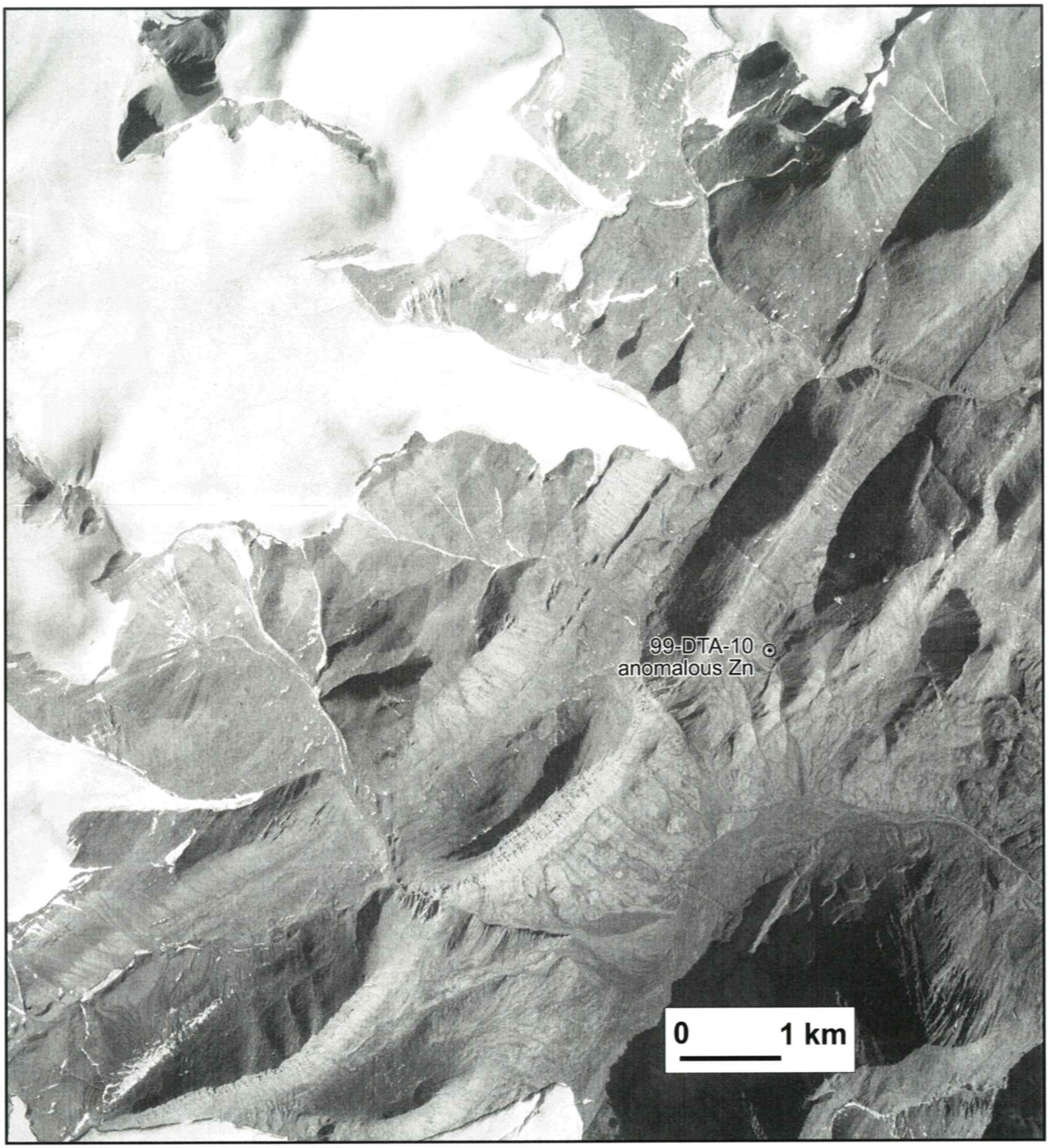


Figure 4: Portion of National Air Photo Library (NAPL) air photograph A16610-132 and position of cited mineral locality southwest of Carl Ritter Bay.

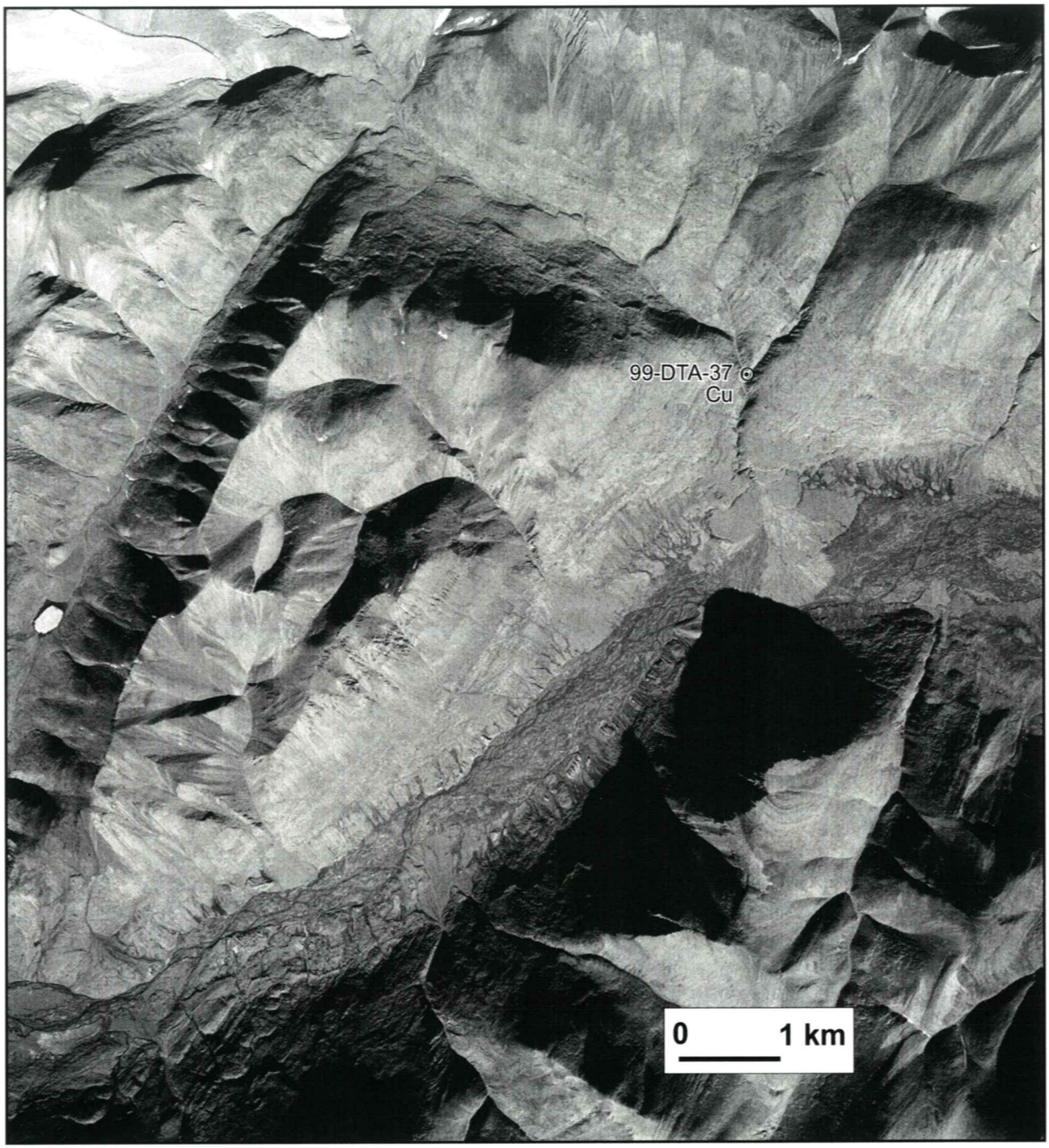


Figure 5: Portion of National Air Photo Library (NAPL) air photograph A16680-12 and position of cited mineral locality near Carl Ritter Bay.

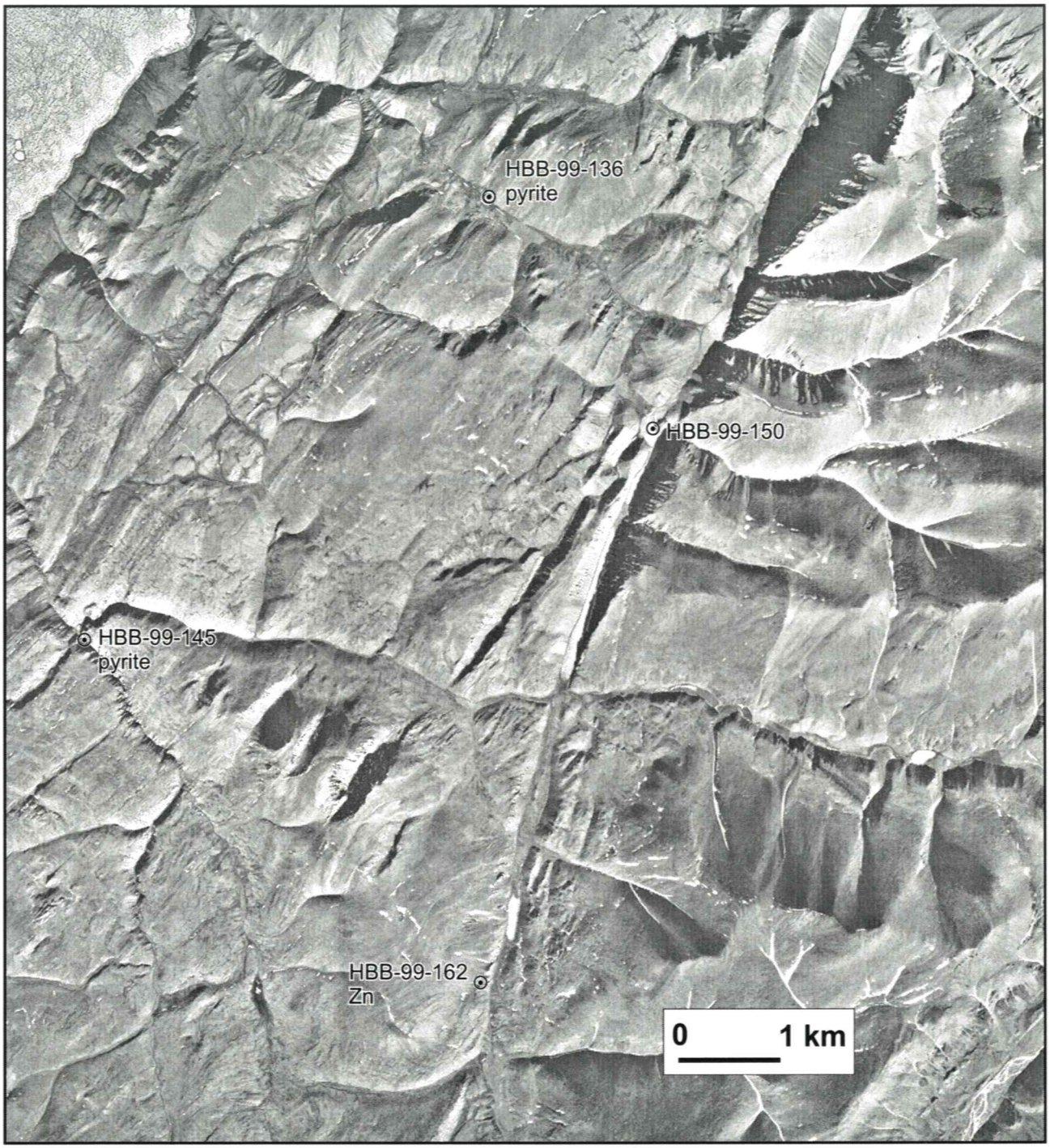


Figure 6: Portion of National Air Photo Library (NAPL) air photograph A16609-170 and position of cited mineral localities near Packdog Creek and Daly River.

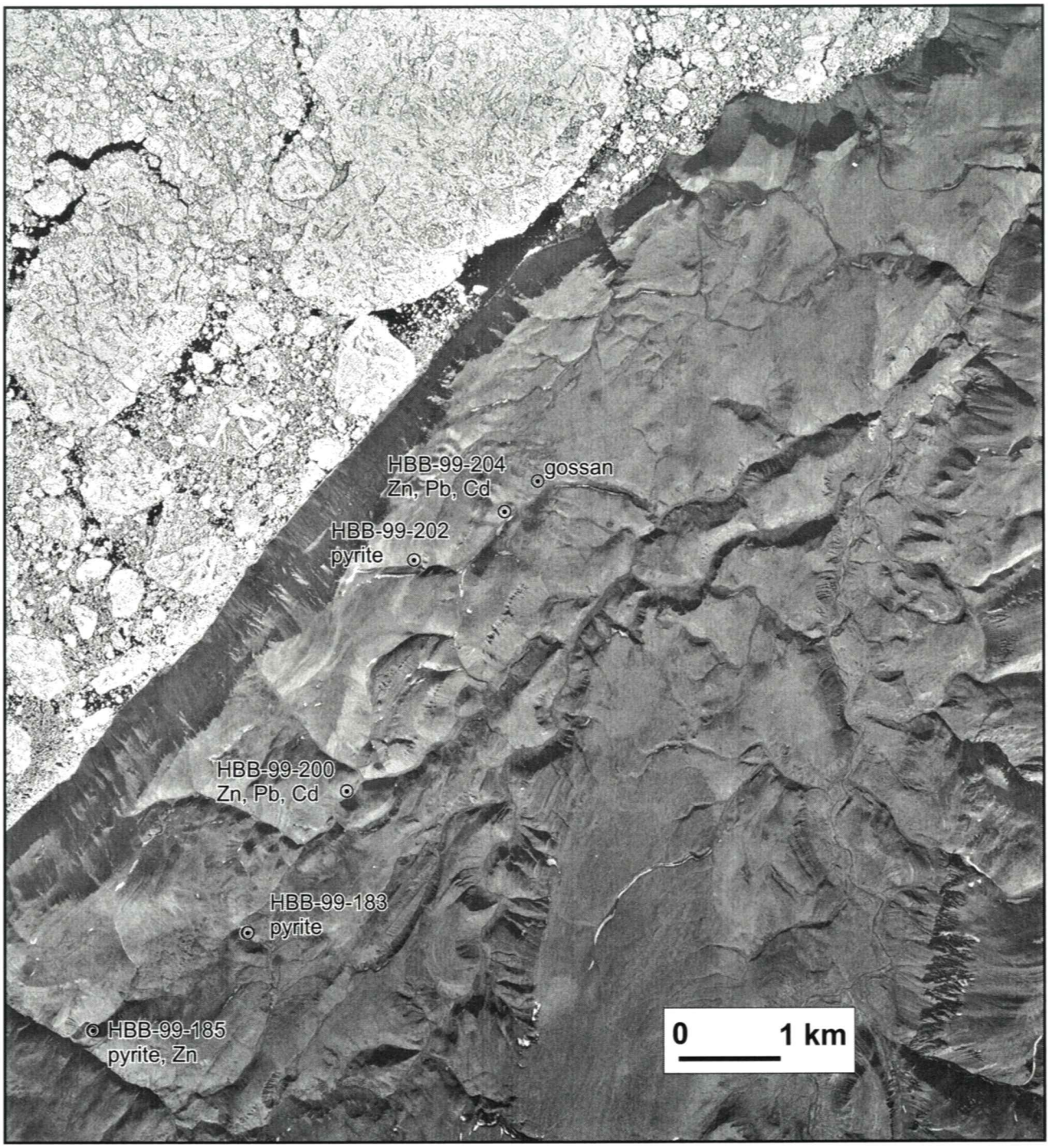


Figure 7: Portion of National Air Photo Library (NAPL) air photograph A16680-87 and position of cited mineral localities near Cape Baird.

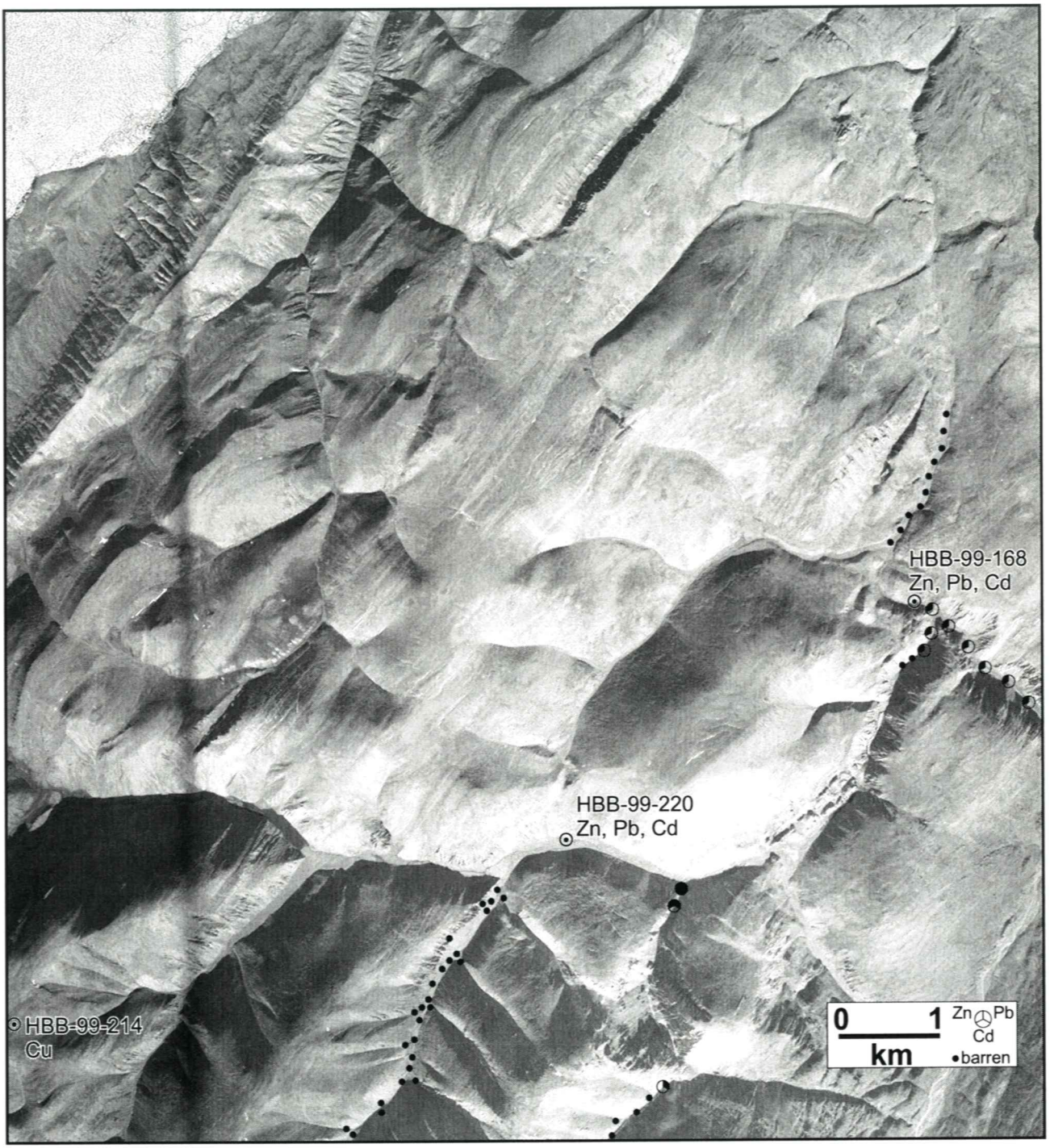


Figure 8: Portion of National Air Photo Library (NAPL) air photograph A16680-21 and position of cited mineral localities northeast of Twin Glacier. Stream geochemistry results from McLaren *et al.* (1975).

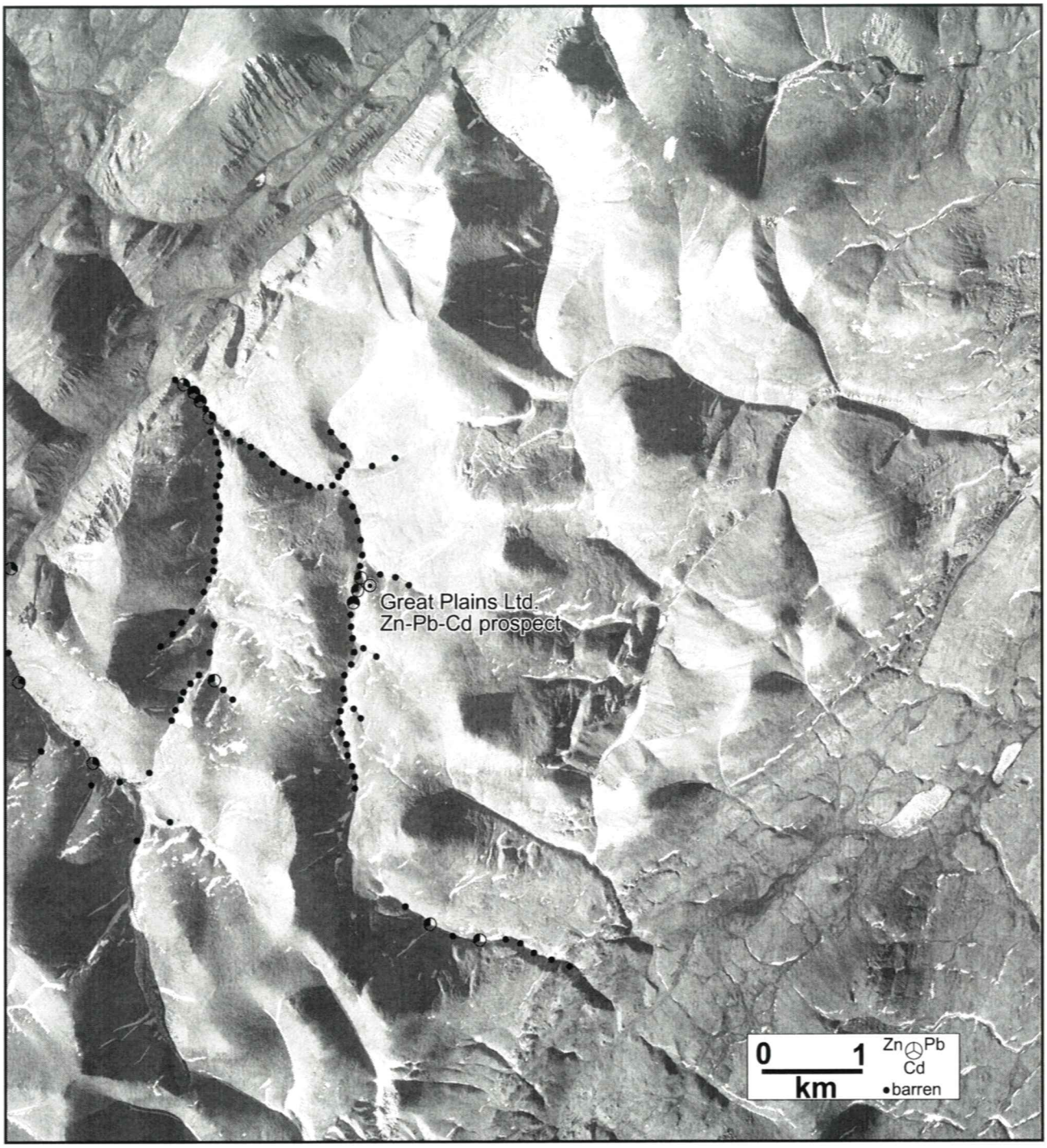


Figure 9: Portion of National Air Photo Library (NAPL) air photograph A16608-29 and position of the zinc-lead prospect explored by Great Plains Ltd. in 1973-4. Stream geochemistry results from Mclaren *et al.* (1975)

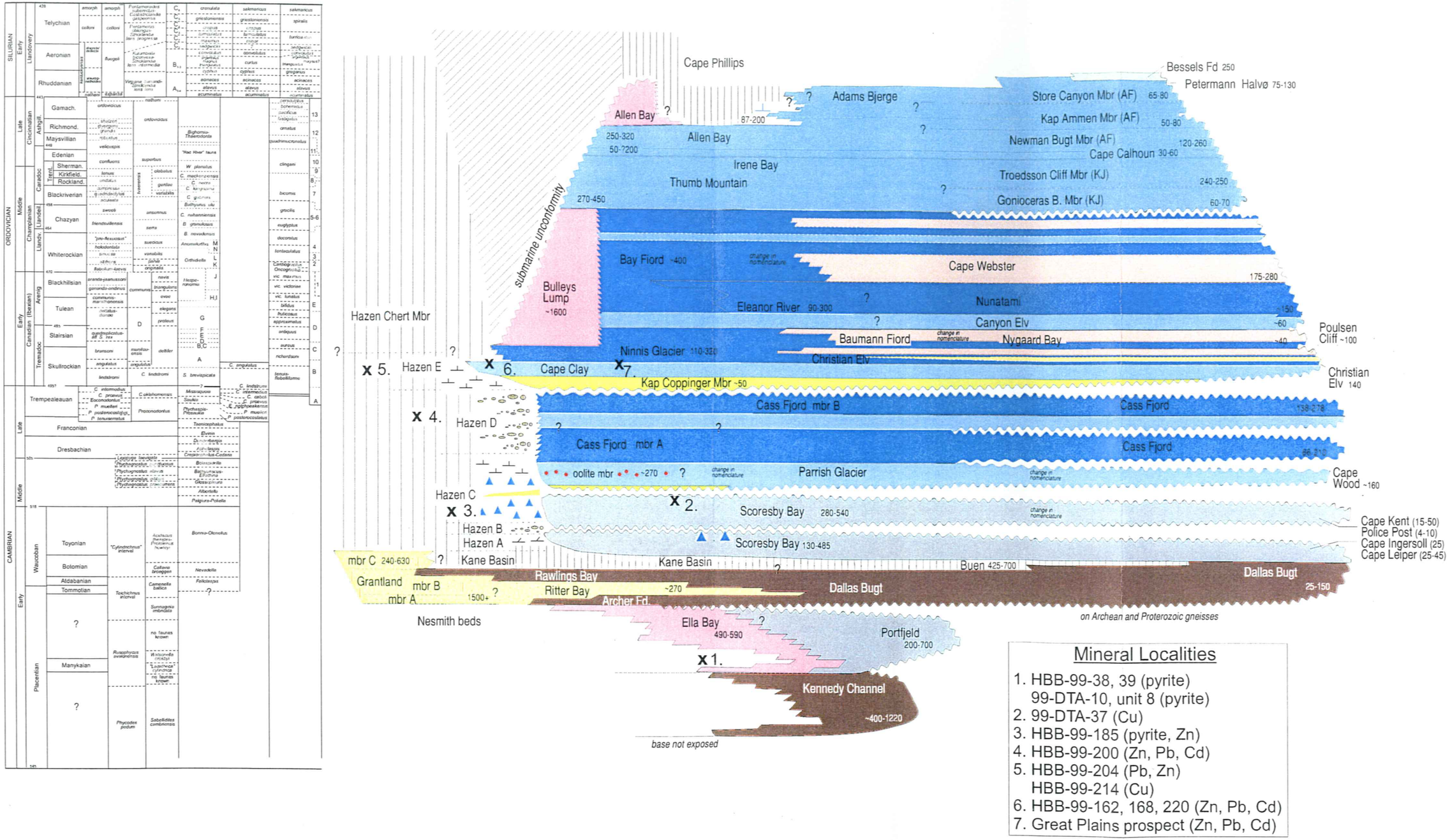


Figure 10: Stratigraphic position of base metal mineral occurrences and sequence stratigraphic relationships for the lower Palaeozoic strata of northeastern Ellesmere Island and North Greenland (modified from de Freitas *et al.*, 1997). Colours and patterns provided on the correlation charts of de Freitas *et al.*, 1997.

Appendix 1

ICP-MS results (Cantech Laboratories Ltd., Calgary)

Station	Sample	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	La	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sr	Ti	V	W	Zn	Unit
		ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	%	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	
HBB-98-38	C-311571	4.1	2.98	4	9	274	1.3	<3	24.0	1.2	3	46	25	1.33	1.67	24	0.73	207	<1	0.22	12	1,578	24	3	3845	0.11	39	<2	34	Ella Bay
HBB-98-39	C-311572	2.2	3.71	3	11	139	1.2	<3	14.0	1.7	6	98	22	3.93	0.95	47	1.27	958	<1	1.10	23	2,239	12	<2	1416	0.11	25	<2	33	Ella Bay
HBB-99-136b	C-322715-1	2.7	2.54	<2	6	345	1.2	<3	14.17	1.1	6	48	25	3.14	1.76	17	5.72	678	<1	0.05	23	129	12	<2	43	0.09	31	<2	19	Hazen c
HBB-99-136b	C-322715-2	2.8	2.58	<2	6	296	1.3	<3	19.0	1.6	5	56	34	3.67	2.25	12	5.13	1,237	<1	0.06	19	284	11	<2	203	0.11	36	<2	147	Hazen c
HBB-99-136b	C-322715-3	1.1	2.98	<2	<5	352	0.9	<3	6.86	0.6	4	62	14	2.61	1.74	18	2.42	933	<1	0.05	18	181	7	<2	78	0.14	30	<2	15	Hazen c
HBB-99-145a	C-322729	1.6	<0.01	45	<5	27	0.5	<3	14.52	1.3	<2	<1	13	1.79	<.01	<1	7.72	139	<1	0.03	5	96	57	3	253	0.01	39	<2	222	Hazen b
HBB-99-145b	C-322730-1	2.2	0.7	17	<5	632	1.3	<3	19.63	0.9	<2	54	29	0.40	0.51	9	11.36	154	21	0.05	36	330	10	<2	99	0.05	290	<2	20	Hazen c
HBB-99-145b	C-322730-2	0.7	6.97	9	8	148	1.7	<3	0.93	<.5	17	258	31	4.45	4.30	44	0.71	121	11	0.23	45	517	31	14	82	0.33	61	<2	43	Hazen c
HBB-99-145b	C-322730-3	0.6	7.48	<2	<5	284	1.0	<3	0.30	<.5	8	342	28	2.21	4.44	61	0.25	63	13	0.33	44	287	25	<2	73	0.30	58	<2	14	Hazen c
HBB-99-145b	C-322730-4	<.3	5.28	20	10	59	1.0	<3	0.16	0.6	193	306	59	16.28	5.29	19	0.24	130	11	0.16	563	465	52	<2	41	0.20	40	<2	58	Hazen c
HBB-99-150a	C-322731	2.8	0.66	7	5	197	0.8	<3	17.79	<.5	11	233	47	1.22	0.51	19	0.17	129	9	0.05	81	298	25	<2	155	0.04	695	<2	83	Hazen c
HBB-99-162	C-322739	1.0	0.52	70	<5	63	0.5	<3	0.09	5.0	<2	406	17	8.73	0.18	<1	0.23	69	46	<.01	19	363	128	9	<1	0.02	<1	<2	4,148	Cape Clay
HBB-99-168a	C-322746	4.5	0.05	4	7	21	0.8	<3	30.33	5.6	<2	3	16	1.46	0.05	<1	4.96	286	<1	0.05	4	<10	39	18	79	0.01	9	<2	1,966	Cape Clay
HBB-99-168c	C-322748	1.6	0.20	71	<5	32	0.2	12	1.58	241.8	<2	442	34	2.66	0.14	<1	0.15	62	210	0.03	13	7,666	499	572	7	0.02	<1	<2	100,562	Cape Clay
HBB-99-183	C-322756	1.5	0.96	9	7	733	1.1	<3	0.44	<.5	<2	439	22	0.57	1.02	5	0.15	60	36	0.03	25	348	40	<2	42	0.06	125	<2	2,753	Hazen c
HBB-99-185a	C-322757	1.7	0.40	18	6	257	0.6	<3	5.30	6.5	<2	325	33	0.47	0.27	1	2.53	60	31	0.03	46	444	104	13	46	0.03	409	<2	2,957	Hazen c
HBB-99-185c	C-322759	2.3	2.33	4	<5	251	1.0	<3	14.67	<.5	6	120	25	1.05	2.44	16	1.14	155	4	0.05	19	1,528	31	<2	188	0.10	48	<2	55	Hazen c
HBB-99-185d	C-322760	2.2	2.91	<2	<5	405	1.2	<3	15.06	1.0	5	46	22	1.97	2.77	32	6.79	554	<1	0.06	13	429	12	9	165	0.11	27	<2	78	Hazen c
HBB-99-185e	C-322761	1.7	7.47	7	<5	255	2.1	<3	2.39	1.4	15	131	41	2.40	4.85	31	1.45	117	1	0.13	50	141	68	<2	57	0.33	68	<2	195	Hazen c
HBB-99-185f	C-322762	1.9	4.74	12	<5	592	1.9	<3	8.08	<.5	8	92	26	1.62	2.94	25	3.98	270	1	0.07	33	697	26	9	134	0.20	71	<2	56	Hazen c
HBB-99-200a	C-322766-1	1.3	0.22	60	11	4	0.4	16	4.13	100.2	<2	132	13	24.06	0.25	<1	0.45	198	100	0.03	84	4,547	11,850	274	31	0.02	<1	<2	52,942	Hazen d
HBB-99-200a	C-322766-2	1.8	0.59	65	11	19	0.5	21	5.13	69.4	<2	133	13	22.41	0.73	<1	1.03	316	69	0.04	112	3,539	5,762	206	32	0.03	<1	<2	36,305	Hazen d
HBB-99-200a	C-322766-3	1.4	0.23	59	10	15	0.4	14	5.74	98.4	<2	103	12	22.2	0.28	<1	0.39	196	93	0.03	113	4,429	6,280	278	34	0.02	<1	<2	51,948	Hazen d
HBB-99-200a	C-322766-4	1.9	0.30	12	8	63	0.6	4	13.74	10.8	<2	41	13	14.63	0.36	<1	2.24	300	8	0.07	23	1,177	851	28	59	0.02	<1	<2	6,234	Hazen d
HBB-99-200b	C-322767-1	3.1	0.26	9	6	57	0.6	<3	23.75	24.8	<2	16	14	7.55	0.32	<1	0.37	277	31	0.04	16	1,762	716	87	108	0.02	5	<2	18,933	Hazen d
HBB-99-200b	C-322767-2	1.5	0.29	42	9	16	0.5	16	6.61	49.4	<2	64	13	21.13	0.37	<1	1.79	274	51	0.03	76	2,692	3,425	160	35	0.02	<1	<2	28,061	Hazen d
HBB-99-202	C-322768	2.0	1.84	<2	<5	183	1.2	<3	14.88	0.6	5	35	39	0.94	1.76	2	8.69	136	<1	0.06	16	960	16	2	68	0.09	51	<2	62	Hazen c
HBB-99-204a	C-322770	2.1	0.11	8	<5	45	0.6	<3	18.11	2.0	<2	45	14	5.23	0.14	<1	9.88	201	<1	0.05	<1	289	260	<2	71	0.02	3	<2	836	Hazen e
HBB-99-204b	C-322771	1.2	0.08	29	9	9	0.3	5	4.29	5.6	<2	165	14	22.0	0.10	<1	<.01	244	8	0.03	8	363	8,983	4	70	0.01	<1	<2	1,630	Hazen e
HBB-99-214	C-322775	1.4	0.18	<2	9	35	0.4	<3	10.57	<.5	2	304	6,977	1.02	0.07	<1	0.23	67	10	0.04	11	146	26	<2	277	0.02	<1	<2	55	Hazen e
HBB-99-220a	C-322779-1	2.4	0.66	<2	<5	87	0.7	<3	14.71	12.7	<2	14	15	0.59	0.78	<1	6.95	177	10	0.04	1	786	2,886	40	44	0.04	2	<2	7,964	Cape Clay
HBB-99-220a	C-322779-2	1.4	0.11	<2	<5	25	0.6	<3	15.05	1.4	<2	5	3	0.24	0.14	<1	7.40	175	<1	0.04	<1	<10	7,108	<2	41	0.01	<1	<2	136	Cape Clay
HBB-99-220a	C-322779-3	2.8	0.41	<2	<5	69	0.8	<3	19.66	6.5	<2	39	21	1.30	0.54	<1	10.13	242	5	0.06	1	313	1,222	23	70	0.03	6	<2	4,050	Cape Clay
99-DTA-10	C-412018	2.2	2.64	11	<5	111	1.2	<3	1.88	1.0	7	257	23	2.64	0.78	33	0.66	1,053	10	0.41	34	312	64	<2	151	0.11	15	<2	213	Ella Bay
99-DTA-37	C-412151	2.5	0.02	37	<5	16	0.6	<3	22.78	1.1	<2	12	517	0.09	0.04	<1	13.75	115	<1	0.05	<1	<10	13	4	47	0.01	<1	<2	69	Scoresby
99-DTA-49	C-412160	3.6	0.16	40	<5	23	0.6	10	17.38	399.8	<2	13	36	2.02	0.13	7	9.97	357	116	0.04	8	5,277	322	360	44	0.01	<1	<2	67,561	Cape Clay
99-DTA-49	C-412161	3.6	0.26	22	<5	31	1.1	5	20.31	145.8	<2	17	21	0.47	0.23	2	11.05	355	65	0.05	<1	3,103	206	228	58	0.02	2	<2	40,344	Cape Clay

Appendix 2

Confirmation assay results (Cantech Laboratories Ltd.,Calgary)

Station	Sample		Cd		Pb		Zn			
			ppm		%		%			
HBB-99-162	C-322739-1		0.8		23	ppm	0.11			
	C-322739-2		0.7		44	ppm	0.16			
	C-322739-3		0.7		18	ppm	530	ppm		
	C-322739-4		0.8		47	ppm	0.19			
	C-322739-5		2.4		145	ppm	0.57			
	C-322739-6		0.9		118	ppm	0.29			
HBB-99-168	C-322748		180				13.75			
	C-322748-1		80		30	ppm	4.4			
	C-322748-2		260		43	ppm	16.62			
	C-322748-3		405		56	ppm	23.25			
	C-322748-4		0.8		20	ppm	465	ppm		
	C-322748-5		0.7		13	ppm	453	ppm		
HBB-99-183	C-322756						90	ppm		
HBB-99-185	C-322757						0.276			
	C-322757-1		1.2		8	ppm	478	ppm		
	C-322757-2		18		50	ppm	1.03			
HBB-99-200	C-322766-1		80		2.02		5.75			
	C-322766-2		50		0.54		3.55			
	C-322766-3		80		0.61		5.90			
	C-322766-4		10				0.220			
	C-322767-1		20				1.74			
	C-322767-2		40		0.34		2.72			
HBB-99-204	C-322771				0.92					
HBB-99-220	C-322779-1		20		0.37		0.93			
	C-322779-2				1.01					
Gt. Plains Ltd.	C-412160		390				8.30			
(99-DTA-49)	C-412161		120				4.00			