Regional moss mat-sediment geochemical survey in the Porcher Island, Grenville Channel, and Dundas Island area, central British Columbia coast

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Front cover: Typical moss mat sediment. Photo courtesy of W. Jackaman, Noble Exploration Services Ltd., Jordan River, British Columbia.

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Regional moss mat-sediment geochemical survey in the Porcher Island, Grenville Channel, and Dundas Island area, central British Columbia coast

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[1]Emeritus Geoscientist, British Columbia Geological Survey, Ministry of Energy, Mines and Petroleum Resources, Victoria, B.C., V8W 9N3
[a]Ray.lett@gov.bc.ca

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Abstract

Geofile 2018-5 describes a reconnaissance-scale moss mat-sediment geochemical survey carried out in 2000, in the Porcher Island, Grenville Channel, and Dundas Island area of coastal British Columbia (NTS 103G, 103H, 103J). Seventy five moss mat-sediment samples were analyzed by a combination of a HNO_3-HCl-H_2O (modified aqua regia) dissolution - inductively coupled plasma emission/mass spectrometry and instrumental neutron activation, resulting in a total of 65 analytes. They were also analyzed for F and loss on ignition. Water samples were analyzed for pH, SO_4, F, and U. The moss mat-sediment analyses reveal scattered Au anomalies that may reflect Cu-Mo sulphide mineralization on Porcher Island. Stronger Cu-Ag-V-Fe and Ba-Mo-Zn anomalies in streams draining the northeast part of Porcher Island, the central part of Porcher Island and along Grenville Channel can be explained by northeast-trending, metavolcanic-hosted, exhalative style magnetite and sphalerite-chalcopyrite mineralization. Only background Au, Cu, Pb and Zn values were found in the moss mat sediments collected from Dundas, Dunira and Melville islands.

Keywords: Porcher Island, Grenville Channel, Dundas Island, geochemical survey, moss mat sediment, exhalite

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1. Introduction

Analytical results and field observations compiled by the Regional Geochemical Survey (RGS) program in British Columbia provide a database for mineral exploration, resource assessment, geological mapping, and environmental studies. In 2000, the British Columbia Geological Survey conducted a reconnaissance-scale moss mat-sediment, stream-sediment and stream water geochemical survey in an area along the central coast of the province. The moss mat-sediment samples were collected at 11 sites on Dundas Island, 26 sites on Porcher Island, and 34 sites along the Inside Passage (Grenville Channel; Figs. 1, 2),extending across an area of 1800 km^2 at an average density of 1 site per 7 km^2. The moss mat-sediment samples (Fig. 3) were analyzed for: 1) 37 elements by a $1HNO_3$:1HCl:$1H_2O$ dissolution (modified aqua regia) followed by inductively coupled plasma emission/mass spectrometry (ICP-ES/MS); 2) 35 elements by instrumental neutron activation (INAA); 3) F by ion specific electrode; and 4) LOI (loss on ignition) at 550°C. The stream waters were analysed for pH, U, F and SO_4 (Jackaman et al., 2001).

Immediate release of the analyses was delayed because of concerns about the reliability of the geochemical data. However, an examination of the quality control data reveals that most elements fall within guidelines for acceptable precision and accuracy established by the National Geochemical

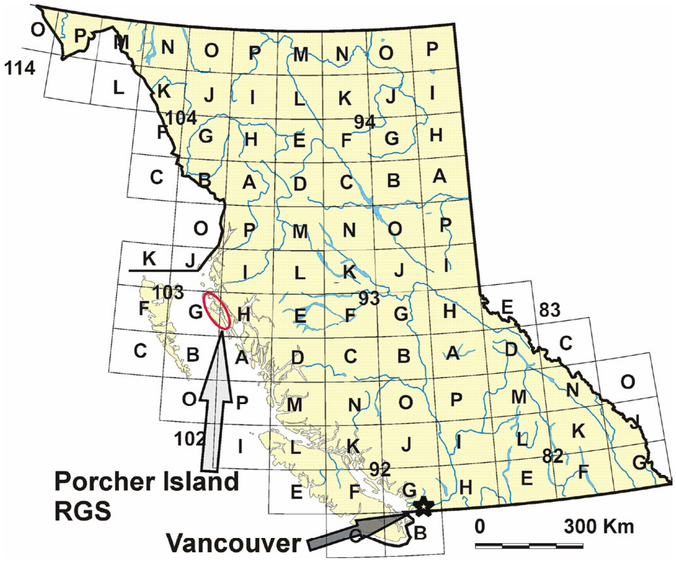

Fig. 1. Survey location.

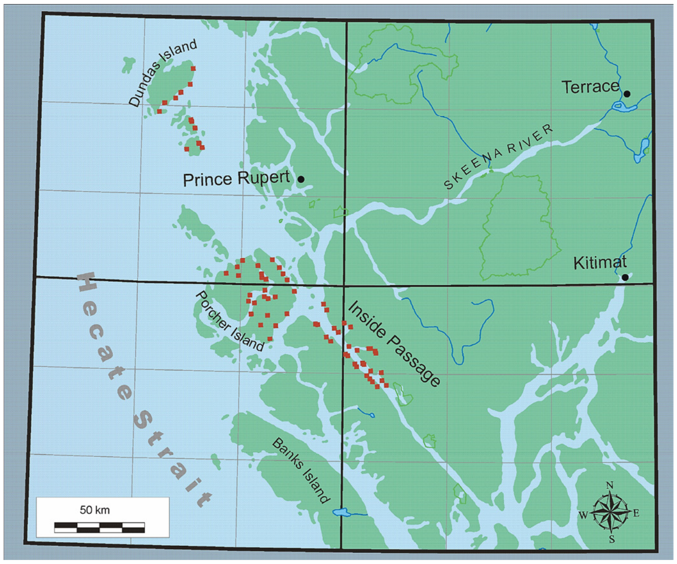

Fig. 2. Area detail and sample locations.

Fig. 3. Typical moss mat sediment. Photo courtesy of W. Jackaman.

Reconnaissance (NGR) program (Ballantyne, 1991). This GeoFile summarizes the geology of the area and its base and precious metals mineralization, documents sample collection, preparation, and analytical methods, releases the raw data as readily usable spreadsheets (Appendices A-D), and provides maps summarizing anomalies for selected commodity and pathfinder elements in the moss mat sediments.

2. Physiography, geology, and mineralization

Porcher Island, Dundas Island, and Grenville Channel are in the Hecate Depression of the British Columbia Coastal Trough (Holland, 1976). The area is mountainous, and the land surface rises steeply from sea level to elevations of greater than 500 m. Landforms such as U-shaped valleys are evidence of erosion by Pleistocene glaciers of the Cordilleran Ice Sheet, which advanced southward through the Hecate Straight.

Because Nelson et al. (2010, 2012) and Angen et al. (2012) have recently described the geology of Porcher Island and Grenville Channel in detail, only a brief summary will be given here (Fig. 4). Intrusive and metamorphic rocks predominate and, according to Nelson at al. (2010), Porcher Island, Pitt Island and Grenville Passage are "…underlain by a series of northwest-striking panels of metamorphosed supracrustal and metaplutonic rocks, intruded by late synkinematic, Cretaceous plutons". To the north, Dundas, Dunira, and Melville islands are underlain by Paleozoic volcaniclastic and rhyolitic rocks intruded by granodiorites of the Ecstall plutonic suite. The oldest rocks mapped by Nelson at al. (2010) on Porcher Island are a Neoproterozic to Cambrian succession of metasedimentary rocks, felsic metavolcanic rocks, amphibolites, schists, marbles, and pillow basalts tentatively assigned to the Wales Group. Above this succession is a sequence of limestone, andesite, dacite and volcanic pebble conglomerate tentatively assigned to the Descon Formation (Ordovician). The youngest rocks are Devonian sandstone and pillow basalt. Paleozoic to Cretaceous diorite, tonalite and granodiorite bodies have been intruded into the Neoproterozic to Paleozoic rocks. Nelson at al. (2010) suggested that the Wales Group and Descon Formation in the Porcher Island area are part of the Alexander tectonic terrane.

From mapping and MINFILE descriptions, Neoproterozic to Cretaceous rocks host several types of base and precious metal mineralization. At the Surf Point - Edye Pass (MINFILE 103J 15), past-producing gold mine on the north end of Porcher Island, gold-bearing pyritic quartz veins are confined to a northwest-trending fracture zone in a Cretaceous granodiorite-tonalite stock. The quartz vein style suggests that it is an example of an orogenic Au deposit. At the LOR occurrence (MINFILE 103G 12) in the southwest part of Porcher Island, disseminated molybdenite and pyrite in a northwest trending belt of Jurassic to Triassic metasedimentary and metavolcanic rocks that are intruded by a granitic to quartz diorite pluton suggest porphyry Mo mineralization. Several sphalerite-galena-chalcopyrite occurrences on Dunira Island, south of Dundas Island (e.g., Mineral Reef, MINFILE 103J 05, Clam Bay, MINFILE 103J 42) hosted by tuff and rhyolite suggest VMS Cu-Zn mineralization. Nelson at al. (2010) discussed the VMS potential along the east coast of Porcher Island and along Grenville Channel, based on metavolcanic-hosted magnetite and sphalerite-chalcopyrite occurrences such as the Star (MINFILE 103J 03) and the POR (MINFILE 103J 23). They suggested that "many small rhyolite and dacite volcanic centres; local premetamorphic clay sericitization and silicification of rhyolite; magnetite iron formation, and metachert with magnetite, sulphides, manganoan zoisite and axinite" represent metamorphosed exhalites and provide evidence for the existence of syngenetic submarine hot-spring systems.

3. Survey methods

3.1. Sample collection

Helicopter- and boat-supported sample collection was carried out in August, 2000. A total of 75 moss mat-sediment, and stream water samples were collected from 71 sites, providing an average sample site density of 1 site per 7 km^2. Moss mat-sediment samples (Fig. 3) weighing 1 to 2 kg were collected from active (subject to annual flooding) stream channels and placed in Kraft paper bags. Samples consisted mainly of material finer than medium sand mixed with varying

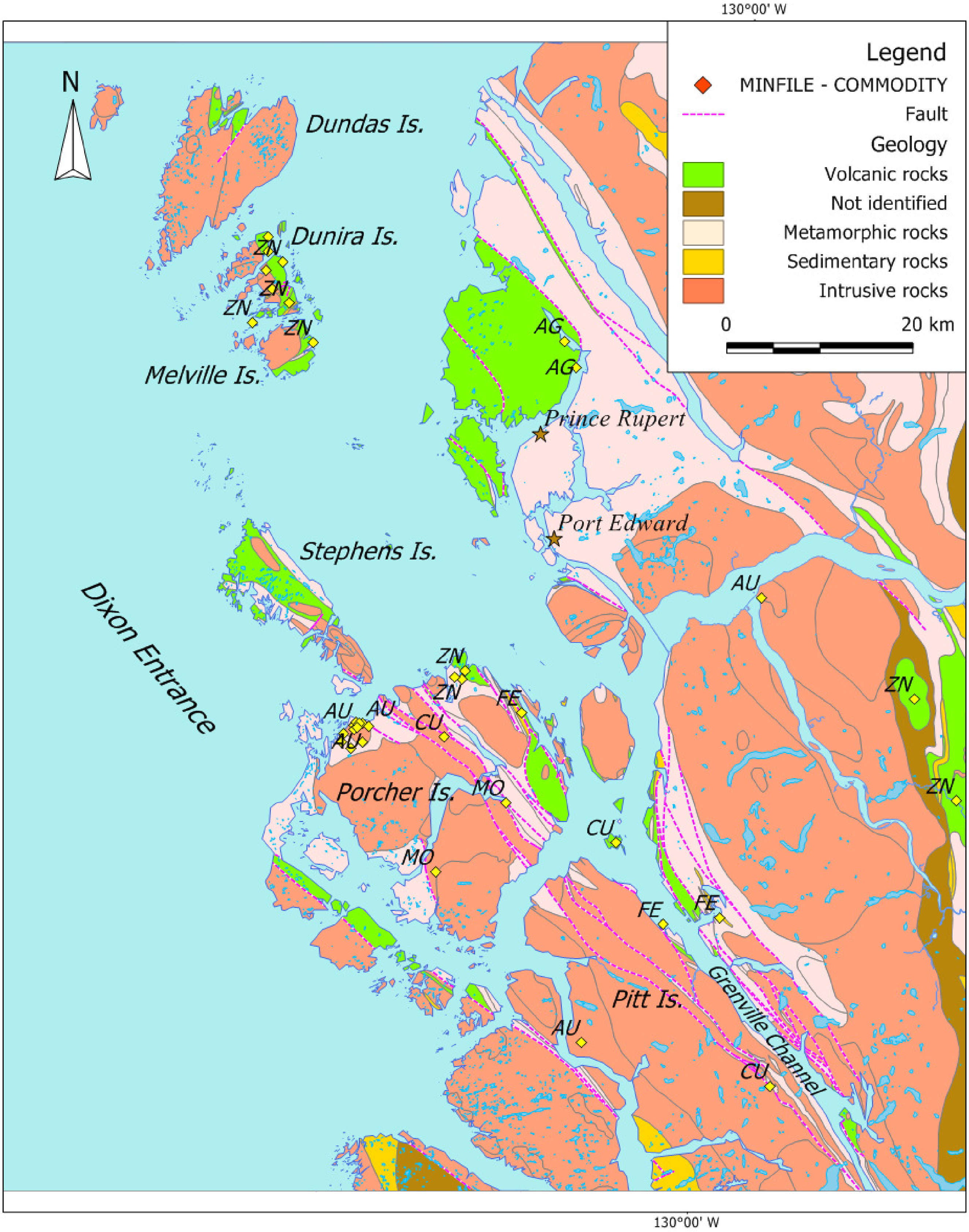

Fig. 4. Geological framework and mineral occurrences. Key to principle commodity: AU - gold; CU - Copper, FE - iron; MO - molybdenum; ZN - zinc. Geology after Cui et al. (2017) based on Gehrels (2001) and Nelson et al. (2010).

amounts of coarse sand, gravel, and organics. Contaminated or poor-quality sample sites were avoided by choosing an alternate stream or by sampling a minimum of 60 m upstream from the source of contamination. Stream water samples were collected in 250 ml bottles and precautions were taken to exclude suspended solids. Field duplicate moss mat-sediment and stream water samples were routinely collected at randomly selected sites in each analytical block of twenty samples. Observations regarding sample media, sample site, and local terrain are listed in Appendix A.

3.2. Sample preparation

Bondar and Clegg Ltd. (Vancouver, BC) prepared the moss mat-sediment samples for analysis. The samples were air dried at temperatures between 30°C and 50°C. Material finer than 1 mm was recovered by sieving each sample through a -18 mesh ASTM screen. The -80 mesh (<0.177 mm) fraction was recovered by dry sieving and was used for all subsequent analytical determinations. Control reference material and analytical duplicate samples were created by splitting one of the prepared sediment samples and were inserted into each analytical block of 20 sediment samples. Any remaining -80 mesh sediment and a representative sample of +80 to -18 mesh fraction was archived for future analyses. Quality control reference standards and analytical blanks were inserted into each analytical block of 20 water samples.

3.3. Sample analysis

Analysis of moss mat-sediment and stream water samples was conducted by commercial laboratories in accordance with established NGR analytical methods. Table 1 lists the elements, their method of analysis and their stated instrumental detection limits.

Elements in the moss mat sediments were determined by a combination of a HCl-H_2O-HNO_3 (1:1:1 v/v) dissolution (modified aqua regia) followed by inductively coupled plasma emission/mass spectroscopy (ICP-MS/ES), and by thermal instrumental neutron activation analysis (INAA). INAA is non-destructive to the sample and estimates the ‘total’ element concentration, but cannot measure key commodity elements such as Pb and Cu. These elements were determined on a separate split of the sample using HCl - H_2O - HNO_3 acid dissolution-ICP-MS. Although the acid dissolution can dissolve gold, carbonates, and sulphides it, cannot fully dissolve silicates, oxides and other refractory minerals such as barite. Hence, element concentrations determined by HCl - H_2O-HNO_3 acid dissolution are considered to be ‘partial’ rather than ‘total’. The HCl - H_2O-HNO_3 dissolution - ICP-MS/ES, INAA, F, LOI and water methods are described in more detail below and the results are listed in Appendices B to D.

3.3.1. HCl - H_2O-HNO_3 dissolution - ICP-MS/ES

A split of the recovered -80 mesh material was analyzed for Au, Ag, Al, As, Ba, Bi, B, Cd, Ca, Cr, Co, Cu, Ga, Fe, La, Mg, Mn, Hg, Mo, Ni, P, Pb, K, Sc, Se, Na, Sb, Sr, S, Te, Tl, Th, Ti, W, U, V and Zn by Acme Analytical Laboratories Ltd. (now Bureau Veritas; Vancouver, BC). One gram of the sample was digested with 6 ml of HCl, HNO_3 and distilled, deionized H_2O (2:2:2 v/v) at 95^{o}C for one hour. The solution was then diluted to 20 ml and analysed for major elements (e.g., Al, Ca) by ICP-

Table 1. Detection limits and analytical methods. ICP-ES/MS - HNO_3-HCl-H_2O dissolution, inductively coupled plasma emission/mass spectrometry; INAA - Instrumental neutron activation; ISE specific electrode; TURB - turbidimetry; LIF - laser induced ion fluorescence; GCE - Glass-combination electrode. GRAV - loss on ignition at 550^{o}C.

Element	Symbol	Detection limit	Units	Method
Aluminum	Al	0.01	pct	ICP-ES
Antimony	Sb	0.02/0.1	ppm	ICP-MS / INAA
Arsenic	As	0.1/0.5	ppm	ICP-MS / INAA
Barium	Ba	0.5/50	ppm	ICP-MS / INAA
Bismuth	Bi	0.02	ppm	ICP-MS
Boron	B	1	ppm	ICP-MS
Bromine	Br	0.5	ppm	INAA
Cadmium	Cd	0.01	ppm	ICP-MS
Calcium	Ca	0.01/1	pct	ICP-ES / INAA
Cerium	Ce	3	ppm	INAA
Cesium	Cs	1	ppm	INAA
Chromium	Cr	0.5/5	ppm	ICP-MS/ INAA
Cobalt	Co	0.1/1	ppm	ICP-MS / INAA
Copper	Cu	0.01	ppm	ICP-MS
Europium	Eu	0.2	ppm	INAA
Gallium	Ga	0.2	ppm	ICP-MS
Gold	Au	0.2	ppb	ICP-MS
Hafnium	Hf	1	ppm	INAA
Iron	Fe	0.01/0.01	pct	ICP-ES / INAA
Lanthanum	La	0.5/0.5	ppm	ICP-MS / INAA
Lead	Pb	0.01	ppm	ICP-MS
Lutetium	Lu	0.05	ppm	INAA
Magnesium	Mg	0.01	pct	ICP-ES
Manganese	Mn	1	ppm	ICP-MS
Mercury	Hg	5	ppb	ICP-MS
Molybdenum	Mo	0.01	ppm	ICP-MS
Neodymium	Nd	5	ppm	INAA
Nickel	Ni	0.1	ppm	ICP-MS
Phosphorus	P	0.001	pct	ICP-ES
Potassium	K	0.01	pct	ICP-ES
Rubidium	Rb	15	ppm	INAA
Samarium	Sm	0.1	ppm	INAA
Scandium	Sc	0.1/0.1	ppm	ICP-MS / INAA
Selenium	Se	0.1/3	ppm	ICP-MS / INAA
Silver	Ag	2	ppb	ICP-MS
Sodium	Na	0.001/0.01	pct	ICP-ES / INAA
Strontium	Sr	0.5/0.05	ppm / pct	ICP-MS / INAA
Sulphur	S	0.02	pct	ICP-MS
Tantalum	Ta	0.5	ppm	INAA
Tellurium	Te	0.02	ppm	ICP-MS
Terbium	Tb	0.5	ppm	INAA
Thallium	Tl	0.02	ppm	ICP-MS
Thorium	Th	0.1/0.2	ppm	ICP-MS / INAA
Titanium	Ti	0.001	pct	ICP-ES
Tungsten	W	0.2/1	ppm	ICP-MS / INAA
Uranium	U	0.1/0.5	ppm	ICP-MS / INAA
Vanadium	V	2	ppm	ICP-MS
Ytterbium	Yb	0.2	ppm	INAA
Zinc	Zn	0.1/50	ppm	ICP-MS / INAA
Fluorine	F	10	ppm	ION
Loss on Ignition	LOI	0.1	pct	GRAV
Fluoride (waters)	FW	20	ppb	ION
Sulphate (waters)	SO_4	1	ppm	TURB
Uranium (waters)	UW	0.05	ppb	LIF
pH (waters)	PH			GCE

ES on a Jarell Ash instrument, and for trace lements (e.g., Cu) by ICP-MS on a Perkin Elmer Elan 6000 instrument. Analyses are listed in Appendix B.

3.3.2. Instrumental Neutron Activation (INAA)

A second split (12 to 42 g; average weight 31 g), of each sample was analyzed by INAA for Au, Ag, As, Ba, Br, Ca, Ce, Cs, Cr, Co, Eu, Hf, Ir, Fe, La, Lu, Hg, Mo, Nd, Na, Ni, Rb, Sm, Sc, Se, Sr, Ta, Tb, Th, Sb, Sn, W, U, Yb and Zn at Activation Laboratories Ltd. (Ancaster, ON). Samples were irradiated for 30 minutes in a neutron flux of $7x10^{11}$ neutrons/cm^2/second. After a decay period of approximately 1 week, gamma-ray emissions for the elements were measured using a gamma-ray spectrometer with a high-resolution, coaxial germanium detector. Counting time was approximately 15 minutes per sample and the results were compiled on a computer and converted to concentrations. The INAA data are listed in Appendix C. Silver, Hg, Ni, Ir, Se and Sn are not reported because all determinations are below detection limit or have poor precision.

3.3.3. Fluoride and loss on ignition (LOI)

The samples were analyzed for F and LOI by Acme Analytical Laboratories Ltd. (now Bureau Veritas; Vancouver, BC). Fluoride was measured by ion-specific electrode (ISE, Ficklin, 1970). A 250 mg sample was sintered with 1 g of flux consisting of two parts by weight Na_2CO_3 and 1 part by weight KNO_3 and the residue was leached with H_2O. The Na_2CO_3 was neutralized with 10 ml of $C_6H_8O_7$ (citric acid), and the resulting solution diluted with water to 100 ml. Fluoride was then measured with a F ion electrode (ION) and a reference electrode. The results of the F analysis are listed in Appendix B.

Loss on ignition (LOI) was determined by weighing a 0.5 g sample into a 30 ml beaker, placing the beaker in a cold muffle furnace and heating the furnace to 500°C for 2 to 3 hours. The sample was maintained at this temperature for 4 hours, then allowed to cool to room temperature before weighing (GRAV). The results of the LOI analysis are listed in Appendix B.

3.3.4. Water: pH, uranium, and sulphate

The unfiltered stream water samples were analyzed for pH, U, F and SO_4 at CanTech Laboratories Inc. (Calgary AB). Hydrogen ion activity (pH) was measured on a separate sample aliquot with a Fisher Accumet pH meter with glass-calomel combination electrode (GCE).

Uranium was determined by laser-induced fluorescence (LIF) using a Scintrex UA-3 uranium analyzer. A complexing agent, known commercially as Fluran and composed of sodium pyrophosphate and sodium monophosphate (Hall, 1979), was added to produce a uranyl pyrophosphate species that fluoresces when exposed to the laser. Because organic matter in the sample can cause unpredictable behaviour to the U-Fluran reaction, standard addition is used to compensate for potential interference. A total of 500 µl of Fluran solution was added to a 5 ml water sample to allow for a slow reaction of the U with the complexing agent. After 24 hours, fluorescence readings were made with the addition of 0.0, 0.2 and 0.4 ppb U. All readings were compared to a sample blank.

Fluoride was determined by ion-specific electrode (ISE). A 20 ml aliquot of the sample was mixed with 20 ml of TISAB II (total ionic strength adjustment buffer) buffer solution. Fluoride was determined with an Orion fluoride electrode in conjunction with a Corning ion meter.

Sulphate was determined by a turbidimetric method (TURB). A 50 ml aliquot was mixed with BaCl and an isopropyl alcohol-HCl-NaCl reagent, and turbidity of the resulting $BaSO_4$ suspension measured with a spectrophotometer at 420 nanometres. Results of the water sample analysis are listed in Appendix D.

3.4. Quality control measures

Reliable interpretations of geochemical data cannot be made unless the variability introduced by the sampling method and the sample analysis is known. The accuracy and precision of the moss mat-sediment and water geochemistry were determined by a statistical analysis of the element, LOI, SO_4 and pH analyses of duplicate samples collected at field sites, randomly inserted standard reference materials, and analytical duplicate samples. The Ecstall-North Coast RGS survey (Jackaman, 2001) and Porcher Island project quality control data have been assessed together since the samples were analyzed as a single batch and the results therefore provide a more meaningful statistical analysis of a larger group of quality control samples.

3.4.1. Moss mat sediment and stream water accuracy and precision

The survey quality control is based on the National Geochemical Reconnaissance - Regional Geochemical Survey scheme whereby a field duplicate sample, an analytical duplicate sample, and a geochemical standard are randomly inserted in each block of 20 samples. An average coefficient of variation per analyte, or CV_{AVR} (%), calculated from a formula proposed by Abzalov (2008) provides a numerical precision value from the field and analytical duplicate data. In the formula, the terms a_i and b_i represent the analyses of first and second of the *i*th duplicate sample pair and N is the number of duplicate pairs. Values can range from 0%, where duplicate pairs have identical concentrations, to an upper value above 141.42% (i.e., the square root of 2) where duplicate results exhibit maximum differences.

$$CV_{AVR}(\%) = 100 \times \sqrt{\frac{2}{N}\sum_{i=1}^{N}\left(\frac{(a_i - b_i)^2}{(a_i + b_i)^2}\right)}$$

In Table 2, the CV_{AVR} (%) values for each element in the 18 field and 19 analytical field duplicate sample pairs analyzed by HNO_3-HCl-H_2O - ICP-MS/ES are sorted in order of their increasing field duplicate CV_{AVG} (%) value (i.e. good to poor precision). For the moss mat sediments, values of below CV_{AVG} (%)=15% (green) indicate good data quality, values between 15 and 30% (blue) acceptable quality, those greater than 30% (red) marginal to poor quality (see Heberlein et al., 2017). Seventy seven percent of the elements by HNO_3-HCl-H_2O - ICP-MS have good sampling precision. For most elements, precision for the analytical duplicate samples (i.e., inserted after sample preparation) is better (i.e., a smaller value) than the sampling precision. This would be expected because the

Table 2. The average coefficient of variation, or CV_{AVR} (%) calculated from element analyses from 18 field duplicate and 19 analytical duplicate samples by HNO_3-HCl-H_2O - ICP-MS/ES, F by ion specific electrode and loss on ignition (LOI). Green indicates good precision, blue indicates acceptable precision and red indicates marginal to poor precision.

Element	CV_{AVR} (%) 19 Analytical duplicate samples	CV_{AVR} (%) 18 Field duplicate samples
Fe pct	**2.89**	**4.21**
V ppm	**2.91**	**4.42**
Na pct	**6.48**	**4.52**
Sr ppm	**5.53**	**5.16**
Ga ppm	**5.15**	**5.45**
Al pct	**3.56**	**5.53**
Ti pct ppm	**6.35**	**5.53**
Sc ppm	**6.25**	**5.61**
Mn ppm	**3.77**	**5.67**
Ca pct	**4.67**	**5.70**
Ni ppm	**5.25**	**6.29**
Zn ppm	**4.45**	**6.35**
Ba ppm	**5.11**	**6.53**
Mg pct	**4.73**	**6.59**
Co ppm	**4.66**	**6.78**
P pct	**7.84**	**7.49**
K pct	**6.54**	**7.93**
Cr ppm	**5.15**	**8.37**
La ppm	**7.92**	**8.61**
F ppm	**20.25**	**10.11**
Bi ppm	**22.00**	**10.49**
Tl ppm	**7.05**	**10.69**
Ag ppb	**10.58**	**11.07**
Pb ppm	**9.24**	**12.63**
Mo ppm	**10.37**	**13.62**
U ppm	**30.72**	**15.15**
Cd ppm	**25.87**	**15.58**
Cu ppm	**7.07**	**16.01**
LOI pct	**6.75**	**17.02**
As ppm	**19.31**	**19.89**
Sb ppm	**20.34**	**23.68**
Th ppm	**19.32**	**27.66**
Te ppm	30.33	32.00
B ppm	38.22	32.68
W ppm	36.05	35.20
S pct	29.94	40.18
Hg pb	35.73	41.28
Se ppm	30.48	42.75
Au ppb	48.26	52.82

Table 3. The average coefficient of variation, or CV_{AVR} (%) calculated from 18 analytical duplicate and 18 field duplicate samples by INAA. Green indicates good precision, blue indicates acceptable precision and red, marginal to poor precision.

Element	CV_{AVR} (%) 18 analytical duplicate samples by INAA	CV_{AVR} (%) 18 Field duplicate samples by INAA
Na pct	**3.1**	**3.2**
Fe pct	**3.2**	**3.8**
Lu ppm	**5.6**	**5.6**
La ppm	**4.2**	**5.8**
Sm ppm	**2.8**	**6.0**
Yb ppm	**5.9**	**6.0**
Sc ppm	**3.1**	**6.2**
Ce ppm	**5.1**	**6.5**
Co ppm	**5.3**	**6.9**
Cr ppm	**4.4**	**7.6**
Eu ppm	**8.0**	**8.5**
Ba ppm	**11.7**	**11.1**
Th ppm	**7.3**	**11.3**
Hf ppm	**11.1**	**13.7**
Nd ppm	**16.0**	**14.5**
Ca pct	**16.2**	**19.3**
Sr ppm	**68.2**	**25.4**
W ppm	**40.4**	**28.9**
Ta ppm	**47.4**	**33.6**
Br ppm	**71.9**	**40.7**
Cs ppm	**42.1**	**41.9**
Zn ppm	**37.4**	**45.9**
U ppm	**28.8**	**46.9**
Sb ppm	**69.9**	**48.9**
Rb ppm	**60.8**	**48.9**
Tb ppm	**37.8**	**49.3**
Au ppb	**68.3**	**58.7**
Mo ppm	**72.3**	**62.3**
As ppm	**62.1**	**62.5**

Table 4. The average coefficient of variation, or CV_{AVR} (%) calculated from 18 field replicate samples pH, U, SO_4 and F in water. Green indicates good precision, blue indicates acceptable precision and red, marginal to poor precision. The poor F and SO_4 in water precision reflects low values close to detection limit.

Analyte	CV_{AVG} (%)
U	**7.96**
pH	**11.91**
F	**35.70**
SO_4	**64.84**

sampling variability as measured here combines the analytical uncertainty and site-specific sample media heterogeneity such as size fraction, organic content, and nugget effect. For some elements the analytical precision is larger than the sampling precision and this may be the results of heterogeneity in the sediment split to create the analytical duplicate.

In Table 3 the CV_{AVR} (%) values for each element in 18 field duplicate sample pairs analyzed by INAA are sorted in order of their increasing field duplicate CV_{AVG} (%) value (i.e. good to poor precision). Fifty five percent of the INAA-determined elements have good sampling precision (Table 4).

Accuracy and precision can also be determined from the repeat analysis of standard reference materials and a comparison of the result with recommended or certified values for the materials. A CANMET stream-sediment standard STSD 1 and a British Columbia Geological Survey RD sediment (-80 mesh) reference material were analyzed with the samples. Table 5 lists precision expressed as percent relative standard deviation (%RSD) for 8 replicate HNO_3-HCl-H_2O - ICP-MS/ES, ion-specific electrode F and LOI analyses of the RD material and duplicate HNO_3-HCl-H_2O - ICP-MS/ES, ion-specific electrode F and LOI analyses analyses of STSD 1. The table also shows the percent difference of the element mean

Table 5. Mean ($\bar{x}$) Relative standard deviation (%RSD) from 8 replicate HNO_3-HCl-H_2O - ICP-MS/ES, specific ion electrode F and LOI analyses of the BCGS RD material and duplicate HNO_3-HCl-H_2O - ICP-MS/ES, ion-specific electrode F and LOI analyses of CANMET STSD 1. Highlighted in red are RSD>15%.

Element	$\bar{x}$ RD	% RSD RD	RD-GSB	% RSD RD (GSB)	% Diff GSB RD	$\bar{x}$ STSD 1	% RSD STSD 1	CANMET - STSD 1	% Diff. CANMET
Ag	77.4	6.5	85.0	26.0	-9.0	277.5	4.3	300	**-7.8**
Al	2.0	4.1	1.9	5.4	8.6	1.1	2.0		
As	6.4	6.8	5.2	10.6	23.3	18.4	3.8	17	7.9
Au	27.8	28.9	33.0	39.0	-15.8	3.6	55.0	8	-75.9
B	0.9	52.9	0.1	1632.5	1071.9	8.0	0.0		
Ba	56.8	3.9	50.7	5.2	12.1	291.7	0.1		
Bi	0.5	4.7	0.5	5.0	2.5	0.5	10.6		
Ca	0.7	5.5	0.7	5.6	4.1	1.5	1.9		
Cd	0.2	8.2	0.2	12.1	-3.1	0.8	10.2	0.8	3.7
Co	11.8	4.8	11.3	4.6	4.4	14.3	1.5	14	1.8
Cr	21.1	4.4	21.9	3.9	-3.3	28.8	7.4		
Cu	169.6	2.9	164.9	4.4	2.8	35.3	3.0	36	-1.9
F	387.5	9.7				990.0	2.9	950	4.1
Fe	4.0	3.7	4.3	5.2	-6.2	3.0	2.1	3.5	-15.9
Ga	5.9	3.8	5.6	4.7	5.1	3.8	1.9		
Hg	23.3	17.2	22.0	14.0	5.7	113.0	3.8	110	2.7
K	0.04	9.1	0.03	15.0	29.2	0.1	0.0		
La	4.5	6.6	4.6	5.9	-2.3	21.9	1.0		
LOI	5.8	5.9				31.2	0.9	29.7	4.9
Mg	0.7	4.0	0.7	5.1	7.5	0.7	1.0		
Mn	450.0	3.9	438.0	4.0	2.7	3619.0	4.1	3740	-3.3
Mo	13.9	1.8	13.9	6.2	-0.1	0.9	11.2	2	-71.6
Na	0.02	5.4	0.02	8.0	4.4	0.0	7.4		
Ni	13.0	3.6	12.4	4.7	4.9	20.7	5.5	18	14.0
P	0.1	5.3	0.1	3.6	5.8	0.1	0.5		
Pb	7.4	5.6	6.9	5.5	7.8	35.1	5.4	34	3.1
S	0.5	8.6	0.7	5.4	-17.4	0.2	0.0		
Sb	0.2	10.5	0.2	15.9	21.5	2.2	4.8	2	9.3
Sc	3.8	4.4	4.8	5.3	-20.5	2.4	0.0		
Se	3.4	7.1	3.3	5.7	1.9	1.9	3.8		
Sr	48.7	7.1	48.6	5.3	0.1	28.1	7.3		
Te	0.5	8.3	0.4	11.8	27.5	0.1	70.7		
Th	1.1	7.5	1.1	8.6	3.0	0.7	10.9		
Ti	0.1	5.2	0.1	6.9	1.4	0.0	2.5		
Tl	0.02	21.8	0.03	9.5	-20.8	0.2	7.9		
U	0.4	9.1	0.4	6.8	-5.5	6.1	3.5	8	-27.8
V	98.8	4.1	97.3	4.4	1.5	44.5	4.8	47	-5.5
W	0.1	0.0	-0.1	0.0	-200.0	0.2	0.0		
Zn	52.3	4.5	49.7	6.0	5.2	152.5	2.3	165	-7.9

value in the standard and a recommended value for the element and LOI in the standard.

Table 5 reveals that Au, B, Hg and Tl have %RSD values greater than 15% in the RD material and Au and Te %RSD values are greater than 15% in the CANMET STSD 1 standard. Seventy percent of element and LOI mean values are within 15% of the recommended values for RD and CANMET values.

Table 6 reveals that Au, Rb, Ta, U and Zn have % RSD values greater than 15% in the RD material and Ca, Cs, Mo, Ta and Tb % RSD values are greater than 15% in the CANMET STSD 1 standard by INAA. Although the reported Au value (27 ppb) in CANMET STSD 1 is 100% higher than the recommended values (8 ppb), the Au value determined in the RD material is only 17% higher than the recommended value. This suggests a positive bias by INAA to the Au values.

Table 6. Mean ($\bar{x}$) Relative standard deviation (%RSD) from 8 replicate INAA analyses of the BCGS RD material and duplicate INAA analyses of CANMET STSD 1. Highlighted in red are RSD>15%.

Element	$\bar{x}$ RD	% RSD RD	RD-GSB	% RSD RD (GSB)	% Diff GSB RD	$\bar{x}$ STSD 1	% RSD STSD 1	CANMET - STSD 1	% Diff. CANMET
Au ppb	48.0	16.2	41.0	15.0	17.1	27.5	2.6	8	109.9
As ppm	8.8	4.7	8.0	6.0	10.0	24.1	2.9	23	4.7
Ba ppm	465.0	12.2	478.0	8.0	-2.7	575.0	13.5	630	-9.1
Br ppm	7.5	7.7	6.3	6.5	18.3	45.5	0.5	40	12.8
Ca pct	2.9	12.3				2.5	28.3		
Co ppm	15.3	4.6	16.0	8.0	-4.7	18.5	3.8	17	8.5
Cr ppm	55.5	8.8	56.0	15.0	-0.9	60.5	8.2	67	-10.2
Cs ppm	0.5	0.0	0.5	98.2	0.0	1.5	47.1	1.8	-18.2
Fe pct	6.3	4.8	5.9	3.4	7.6	5.0	0.3	4.7	5.8
Hf ppm	3.3	14.2	4.0	12.0	-18.8	6.5	10.9	6.1	6.3
Mo ppm	17.0	12.2	16.0	7.0	6.3	2.0	212.1		
Na pct	1.9	3.4	1.7	5.6	9.9	1.5	0.9		
Rb ppm	18.3	67.8	24.0	13.0	-24.0	40.0	10.6	30	28.6
Sb ppm	0.7	12.4	0.8	6.5	-7.8	2.8	2.6	3.3	-18.2
Sc ppm	22.8	3.4	21.7	7.4	4.8	13.9	1.5	14	-1.1
Ta ppm	0.4	48.2	0.5	-18.5	-20.0	0.1	848.5	0.4	-120.0
Th ppm	2.6	5.9	2.4	8.1	6.3	3.8	3.7	3.7	2.7
U ppm	1.5	18.0	1.5	6.5	2.5	8.7	13.9	8	7.8
W ppm	0.5	0.0	-0.8	-69.3		-1.0	0.0		
Zn ppm	87.8	66.5	-100.0	0.0		181.5	11.3	178	1.9
La ppm	17.3	1.9	16.0	8.0	8.0	31.2	3.0	30	3.8
Ce ppm	31.1	7.8	30.0	10.0	3.8	50.5	1.4	51	-1.0
Nd ppm	15.6	5.9				26.5	8.0	28	-5.5
Sm ppm	4.0	7.5	3.6	3.4	11.5	7.5	0.0	6	22.2
Eu ppm	1.2	6.0	2.0	39.0	-38.1	1.7	8.3	1.6	6.1
Tb ppm	0.6	39.2	0.7	15.1	-17.9	0.7	20.2	1.2	-52.6
Yb ppm	2.5	5.2	-1.0	-181.0		4.2	3.4	4	4.9
Lu ppm	0.4	5.2	0.4	22.8	-4.4	0.6	2.3	0.8	-25.4

4. Results

4. 1. Porcher Island and Grenville Channel

Summary statistics for elements in 71 moss mat-sediment samples taken from sites on Porcher Island and Grenville Channel (Fig. 5) are listed in Table 7. Figures 6 to 18 are symbol plots for Au, Ag, Cu, Mo, Ni, Pb, V and Zn by HNO_3-HCl-H_2O - ICP-MS; As, Ba, and Fe by INAA, F by ion-specific electrode and stream water pH. For most of the maps the symbol sizes and colours represent element and pH concentration intervals at the 80, 90, and 95th percentile.

Moss mat sediment from a stream in the southwest part of Porcher Island has the highest Au values (to 12.9 ppb) detected; anomalous Au values are also from streams on the east side of the entrance to the Grenville Channel (Fig. 6). Moss mat sediment from streams along the northeast shore of Porcher Island and on the east side of Granville Channel have anomalous Ag, with values to 111 ppb (Fig. 7). Only one sample from a stream on the east side of Grenville Channel has more than 4.2 ppm As (INAA) and it lacks an Au-As pathfinder association (Figs. 6, 8). However, there is a concomitant Ag and Cu increase in moss mat sediment from streams along the northeast shore of Porcher Island (Figs. 7, 9). Moss mat sediment with anomalous Mo, Pb and Zn (Figs. 10-12) was sampled from streams along the south end of Grenville Channel. Samples from streams draining the area of the LOT Mo prospect on Porcher Island have only background Mo levels.

Most moss mat sediment with anomalous Ni are from streams that cluster in the center of Porcher Island in an area underlain by faulted dacite and metasedimentary rocks (Fig. 13). These samples also have anomalous Fe (INAA), V and F (Figs. 14, 15, 17). Samples from a cluster of streams draining the northeast part of Porcher Island yielded anomalous Ag, Cu, Fe (INAA) and V. The area is underlain by Ordovician andesite, dacite, and limestone that host the magnetite mineralization. Moss mat sediment from streams along south end of the Grenville Channel have anomalous Ba (INAA), with anomalous Zn, Pb, F and Mo in some samples (Figs.10,11, 12,16,17).

Several streams draining different areas of Porcher Island have a pH below 5 (Fig. 18) suggesting a suphide mineral source. However, water sulphate values are less than 20 ppm and the lower pH may reflect higher levels of natural dissolved organic matter.

Table 7. Statistical summary for analyzed elements in the 71 moss mat-sediment samples. Min. - minimum value; Std. Dev. - standard deviation; 3Q - 3rd quartile; 80 % ile - 80th percentile; 90 % ile - 90th percentile; 95 % ile - 95th percentile; Max. - maximum value.

Analyte	Min.	Mean	Median	Std. Dev.	3 Q	80 % tile	90 % ile	95 % ile	Max.
Ag ppb ICP	7	28	22	19	33	38	53	57	111
Al PCT ICP	0.27	0.92	0.95	0.32	1.18	1.23	1.31	1.45	1.55
As ppm ICP	0.1	1.0	0.7	1.2	1.1	1.3	1.9	2.3	7.3
As ppm INAA	0.3	1.4	0.9	1.6	2.0	2.2	2.9	4.2	9.3
Au ppb ICP	0.1	1.2	0.7	1.8	1.2	1.2	1.6	2.7	12.9
Ba ppm ICP	13.6	67.8	48.7	54.8	82.5	94.8	110.1	187.0	274.9
Ba ppm INAA	25	454	420	193	570	620	730	805	950
Bi ppm ICP	0.01	0.05	0.03	0.06	0.05	0.06	0.09	0.11	0.45
Br ppm INAA	5.4	30.8	21.9	28.1	33.1	44.0	59.2	81.9	158.0
Ca PCT ICP	0.07	0.44	0.40	0.27	0.54	0.57	0.76	0.86	1.95
Ca pct INAA	2	4	4	1	5	5	6	6	7
Cd ppm ICP	0.01	0.06	0.03	0.08	0.07	0.08	0.17	0.21	0.45
Ce ppm INAA	23	64	59	27	71	73	100	122	168
Co ppm ICP	0.8	7.3	6.5	3.9	9.1	9.4	12.7	15.2	18.8
Co ppm INAA	3	15	15	6	21	21	24	26	28
Cr ppm ICP	1.6	13.3	13.0	6.3	16.9	17.2	19.7	24.9	35.2
Cr ppm INAA	16	55	52	22	70	76	82	92	113
Cs ppm INAA	0.5	0.8	0.5	0.6	1.0	1.0	2.0	2.0	3.0
Cu ppm ICP	2.0	14.2	11.7	12.3	16.0	16.8	26.1	35.0	70.3
Eu ppm INAA	0.9	1.8	1.8	0.6	2.2	2.2	2.5	3.0	4.1
F ppm ISE	130	398	330	210	460	560	630	820	1230
F ppb water	10	15	10	6	20	22	22	23	26
Fe PCT ICP	0.43	2.06	1.91	0.82	2.46	2.49	3.22	3.63	5.06
Fe pct INAA	1.68	5.51	5.33	1.92	6.72	6.98	8.43	8.67	11.10
Ga ppm ICP	1.4	3.7	3.7	1.1	4.6	4.6	5.1	5.4	5.6
Hf ppm INAA	3	8	7	4	10	10	13	15	22
Hg ppb ICP	3	30	24	19	36	42	54	64	105
K PCT ICP	0.03	0.15	0.12	0.09	0.18	0.21	0.27	0.35	0.49
La ppm ICP	1.8	6.2	5.1	3.6	6.7	7.0	11.8	13.2	24.6
La ppm INAA	12.5	32.9	30.5	14.3	36.1	39.6	53.3	61.6	87.2
LOI PCT GRAV	2.3	8.4	7.2	5.1	10.3	11.2	14.0	17.7	31.5
Lu ppm INAA	0.26	0.55	0.48	0.24	0.60	0.62	0.73	0.96	1.60
Mg PCT ICP	0.14	0.51	0.48	0.23	0.69	0.72	0.78	0.95	1.12

Table 7. Continued.
Min. - minimum value; Std. Dev. - standard deviation; 3Q - 3rd quartile; 80 % ile - 80th percentile; 90 % ile - 90th percentile; 95 % ile - 95th percentile; Max. - maximum value.

Analyte	Min.	Mean	Median	Std. Dev.	3 Q	80 % tile	90 % ile	95 % ile	Max.
Mn ppm ICP	57	406	362	281	449	465	590	898	1686
Mo ppm ICP	0.2	1.1	0.6	1.2	1.1	1.5	2.8	3.4	7.9
Mo ppm INAA	0.5	2.7	0.5	3.0	5.0	5.0	7.0	8.0	13.0
Na PCT ICP	0.007	0.025	0.023	0.012	0.032	0.033	0.037	0.046	0.074
Na pct INAA	1.33	2.33	2.27	0.43	2.50	2.61	2.81	2.91	4.44
Nd ppm INAA	11	28	27	11	32	33	38	50	67
Ni ppm ICP	1.0	7.6	7.3	3.4	9.7	9.9	11.5	13.2	21.2
P PCT ICP	0.011	0.092	0.067	0.101	0.104	0.119	0.165	0.204	0.749
Pb ppm ICP	1.15	3.35	2.66	1.89	4.36	4.74	6.17	6.92	8.98
pH	4.6	5.6	5.7	0.6	6.2	6.2	6.4	6.6	7.2
Rb ppm INAA	0.55	16.24	17.00	17.45	28.00	31.00	39.00	47.50	65.00
S PCT ICP	0.005	0.040	0.030	0.032	0.060	0.060	0.080	0.095	0.140
Sb ppm ICP	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.2	0.3
Sb ppm INAA	0.05	0.20	0.05	0.20	0.30	0.40	0.40	0.55	0.80
Sc ppm ICP	0.5	1.5	1.5	0.6	1.8	2.0	2.6	2.7	3.2
Sc ppm INAA	8.5	20.2	19.5	6.7	24.9	26.4	29.0	30.3	43.0
Se ppm ICP	0.1	0.5	0.4	0.3	0.7	0.7	1.0	1.2	1.6
Sm ppm INAA	2.8	6.4	6.0	2.3	7.0	7.5	9.6	11.6	15.8
SO_4 ppm water	1	5	5	3	8	8	9	11	13
Sr ppm ICP	8.3	34.0	28.1	21.2	43.6	51.3	60.0	73.1	103.8
Ta ppm INAA	0.3	1.0	0.7	1.0	1.4	1.5	2.3	2.8	5.4
Tb ppm INAA	0.3	0.7	0.6	0.4	0.9	0.9	1.2	1.4	1.9
Te ppm ICP	0.01	0.02	0.01	0.01	0.02	0.03	0.04	0.05	0.06
Th ppm ICP	0.2	1.5	1.2	1.3	1.7	1.9	2.4	3.5	8.9
Th ppm INAA	2.1	5.2	4.6	2.6	5.4	5.9	7.8	10.6	18.1
Ti PCT ICP	0.034	0.090	0.089	0.030	0.113	0.121	0.131	0.138	0.142
Tl ppm ICP	0.01	0.05	0.04	0.04	0.06	0.06	0.10	0.12	0.20
U ppm ICP	0.10	0.63	0.40	0.54	0.70	0.80	1.20	1.80	2.70
U ppb water	0.03	0.03	0.03	0.01	0.03	0.03	0.03	0.03	0.08
U ppm INAA	0.3	2.7	2.5	1.4	3.2	3.5	4.2	5.3	7.0
W ppm INAA	0.5	0.7	0.5	1.0	0.5	0.5	0.5	2.0	7.0
V ppm ICP	13	55	49	27	63	74	86	98	148
W ppm ICP	0.1	0.2	0.1	0.2	0.2	0.3	0.5	0.7	1.3
Yb ppm INAA	1.6	3.6	3.1	1.7	3.9	4.1	5.2	6.2	11.0
Zn ppm INAA	25	88	89	42	120	130	141	155	171
Zn ppm ICP	9.7	37.3	33.1	17.8	46.0	50.2	61.3	72.4	92.0

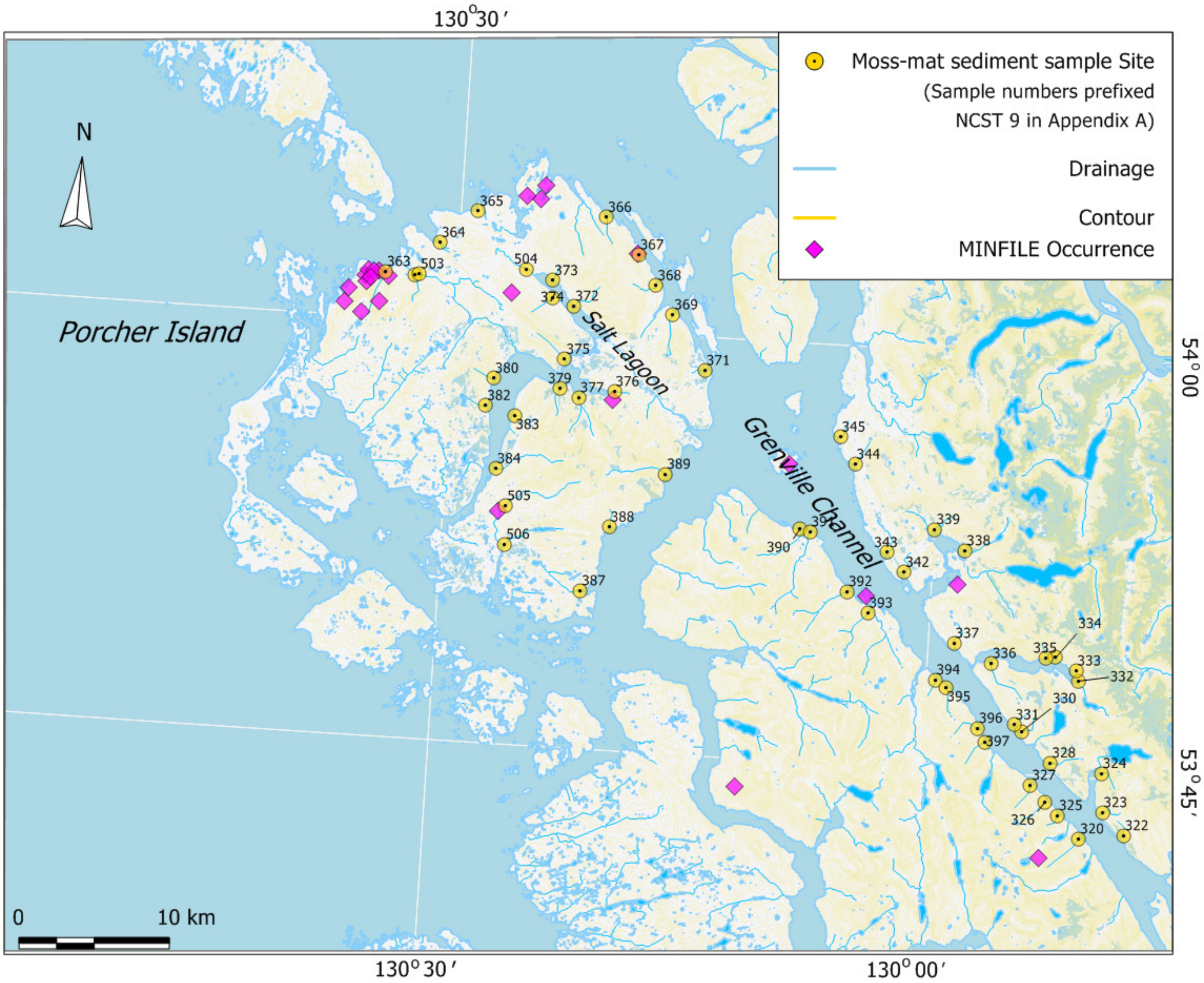

Fig. 5. Porcher Island and Grenville Channel moss mat-sediment sample and MINFILE locations. On the map sample numbers are prefixed byNCST 9 in the Master ID column of Appendix A.

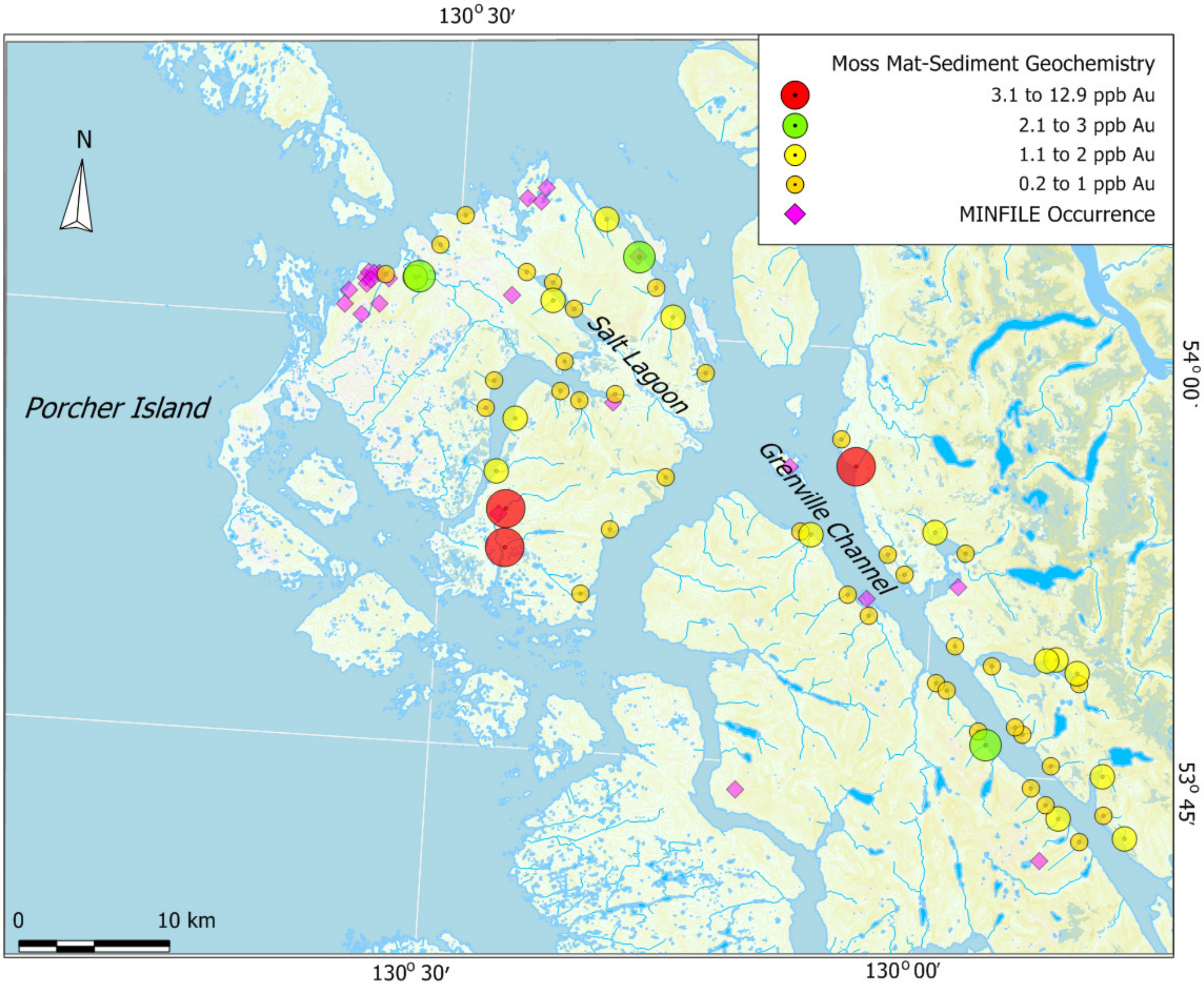

Fig 6. Porcher Island Grenville Channel, moss mat-sediment Au geochemistry.

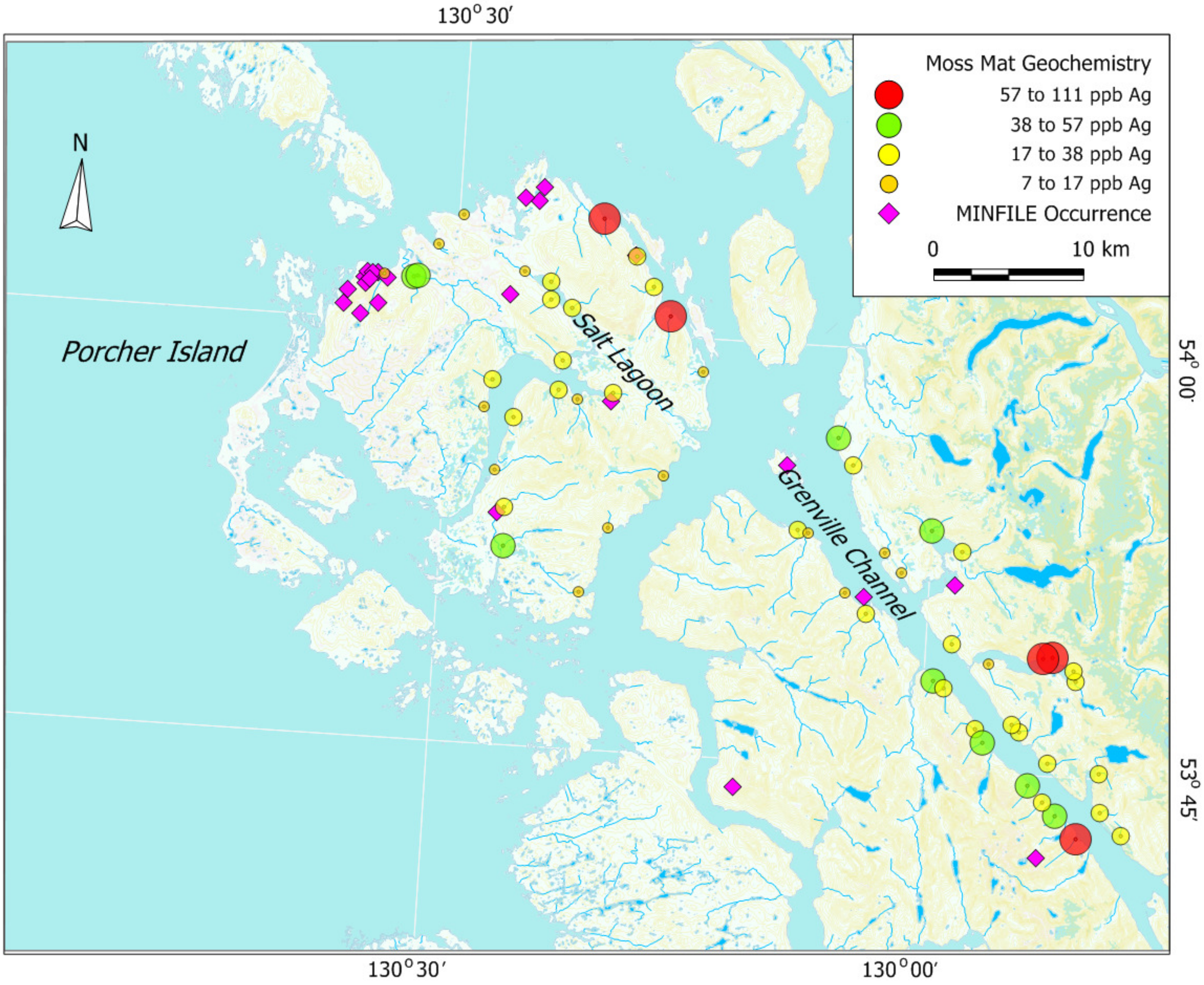

Fig 7. Porcher Island and Grenville Channel, moss mat-sediment Ag geochemistry.

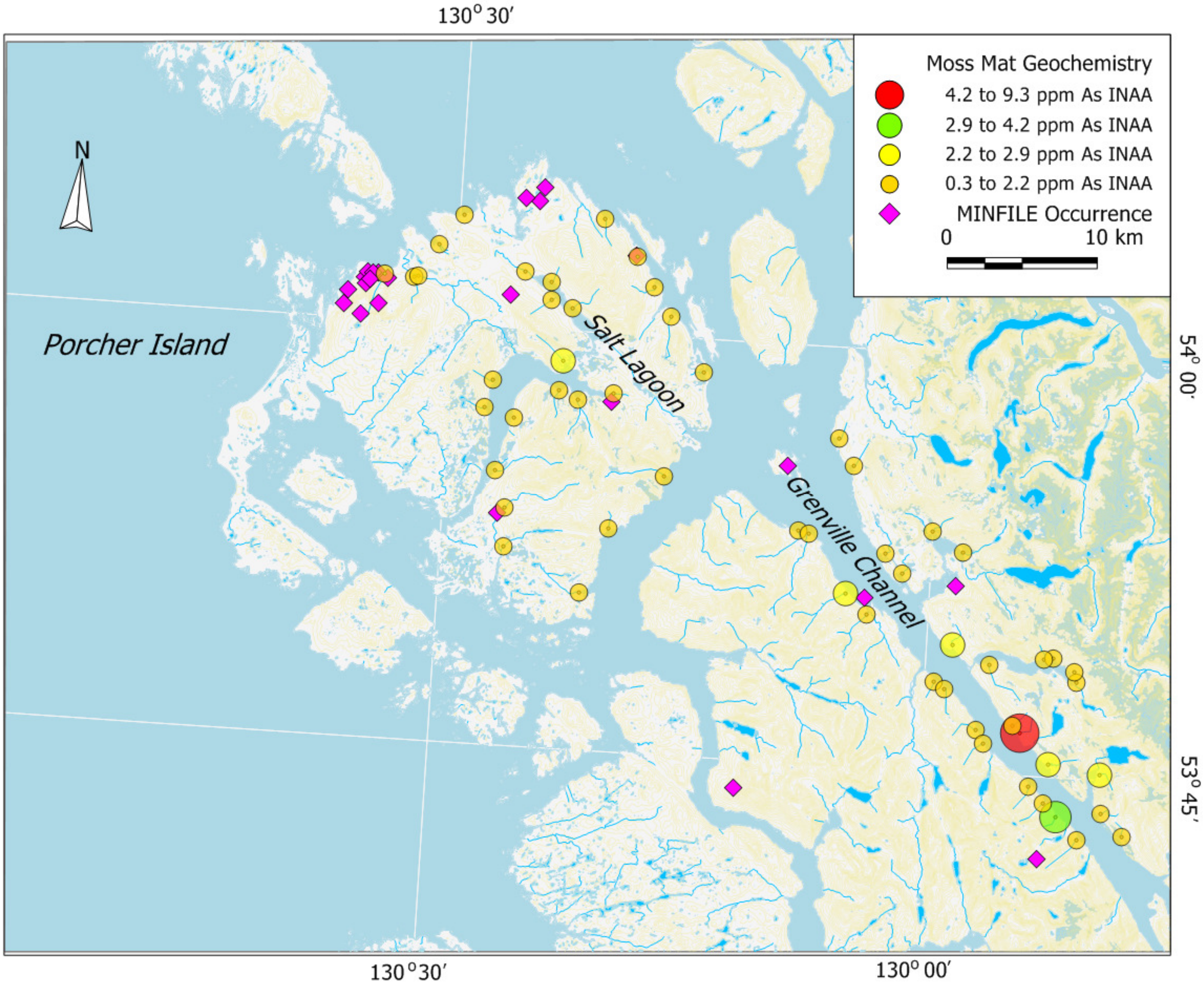

Fig. 8. Porcher Island and Grenville Channel, moss mat-sediment As (INAA) geochemistry.

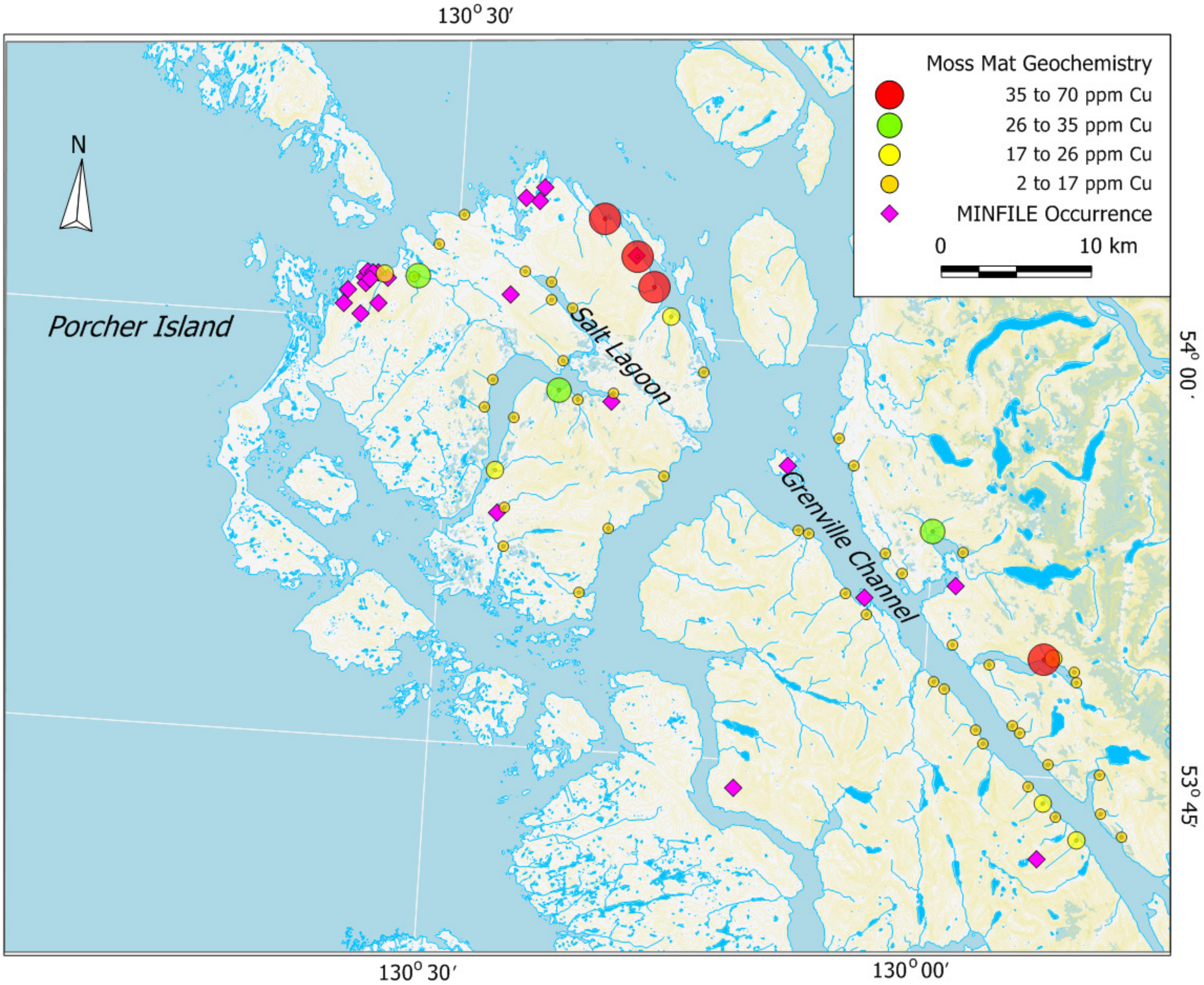

Fig. 9. Porcher Island and Grenville Channel, moss mat-sediment Cu geochemistry.

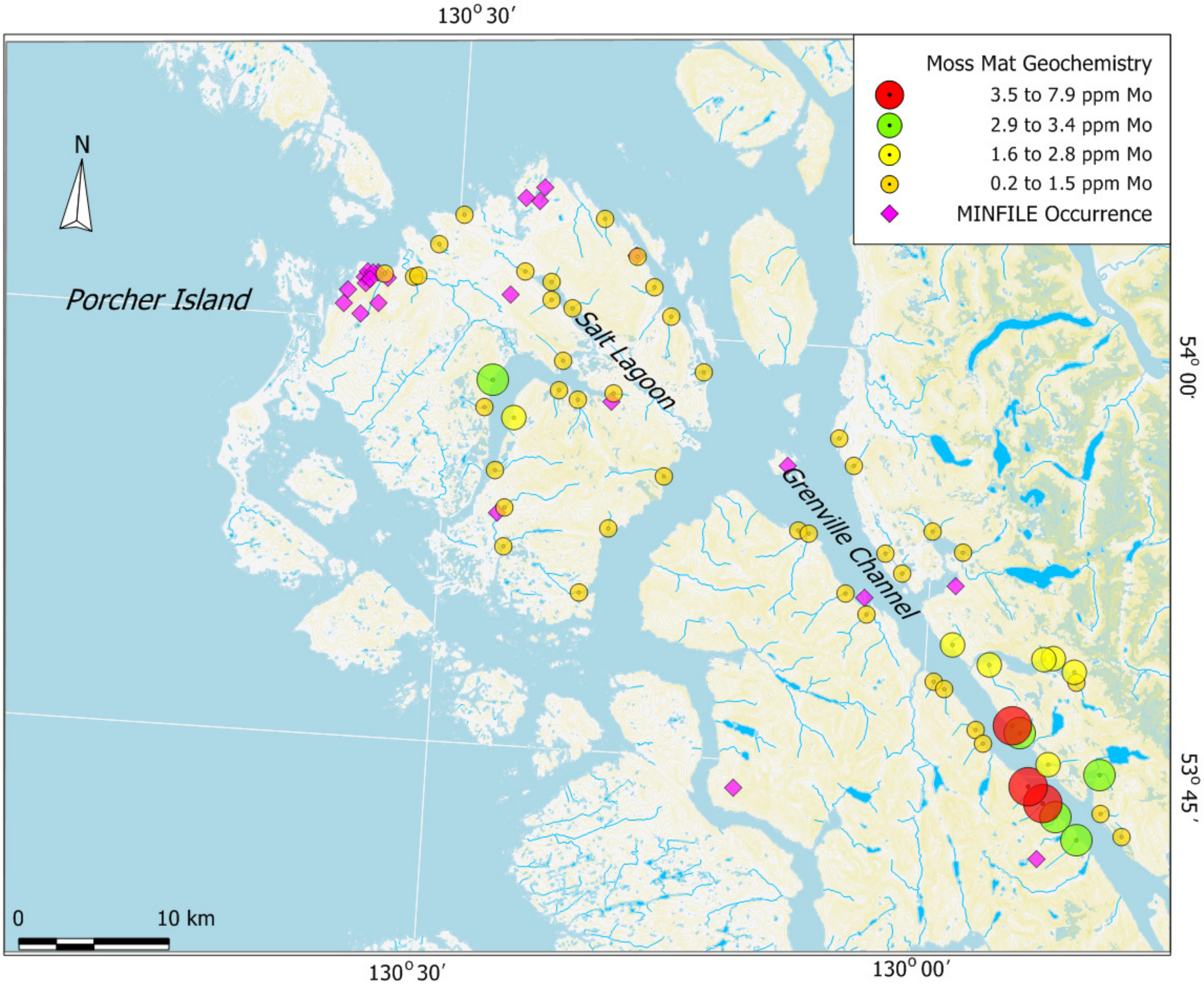

Fig 10. Porcher Island and Grenville Channel, moss mat-sediment Mo geochemistry.

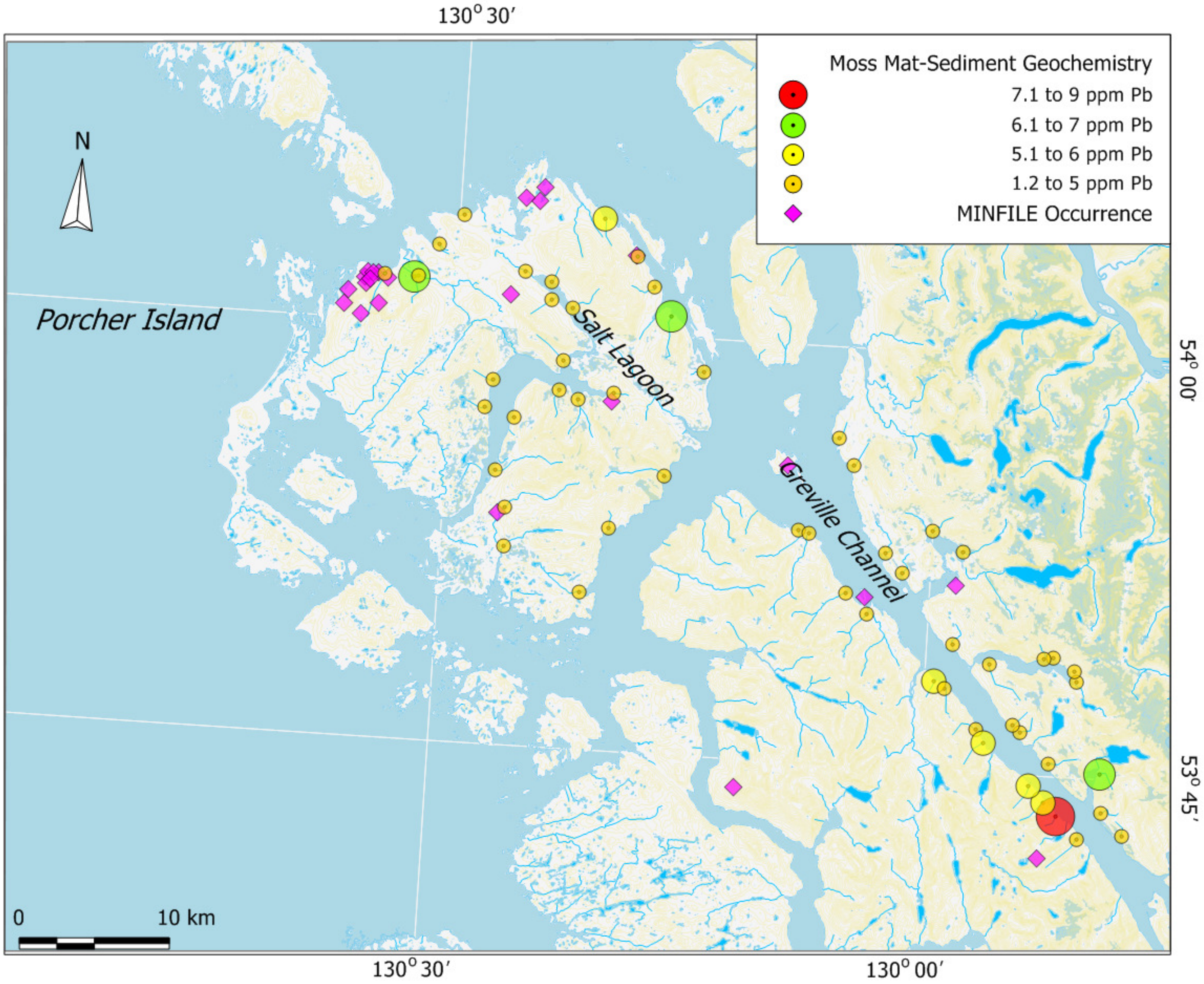

Fig 11. Porcher Island and Grenville Channel, moss mat-sediment Pb geochemistry.

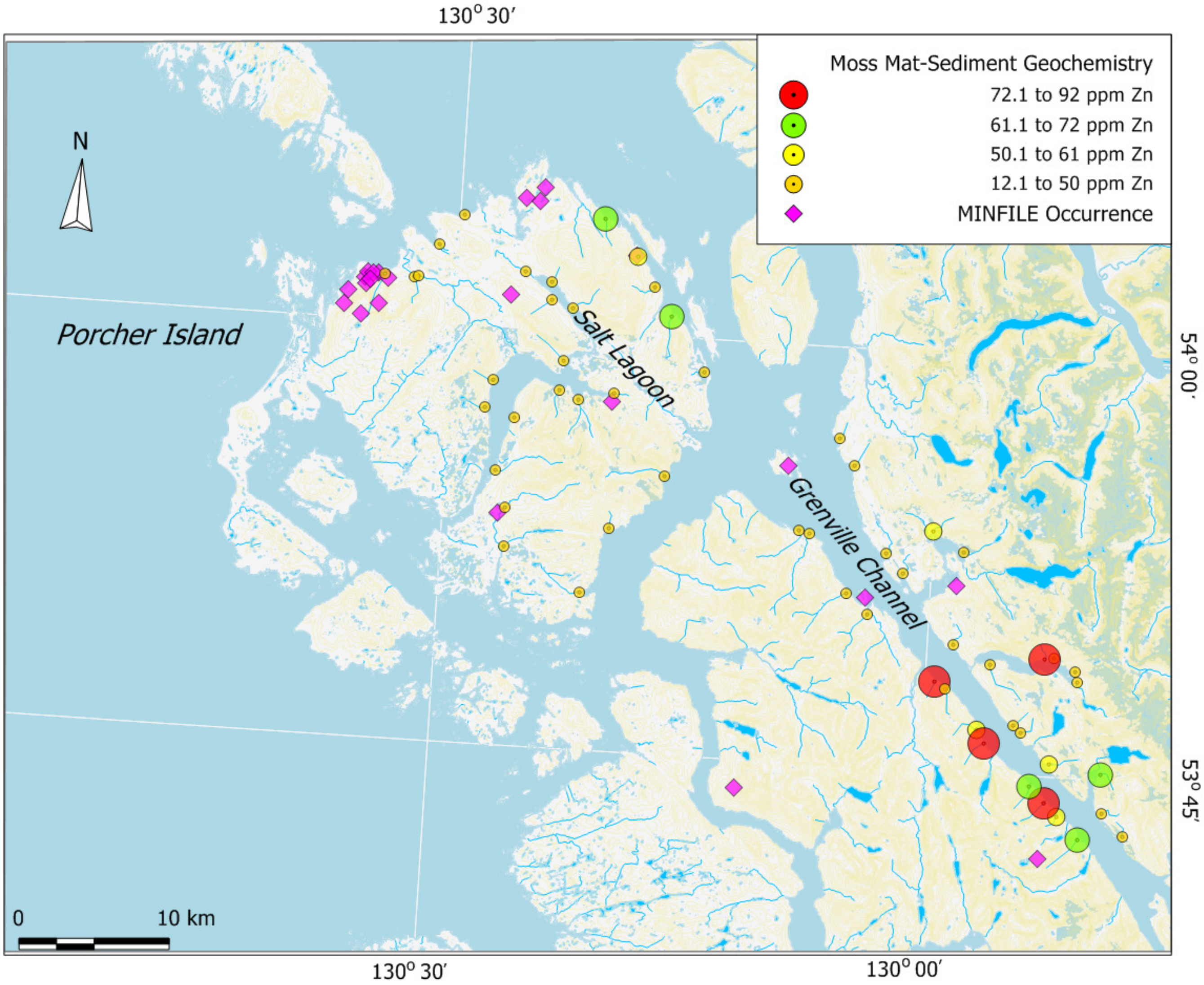

Fig 12. Porcher Island and Grenville Channel, moss mat-sediment Zn geochemistry.

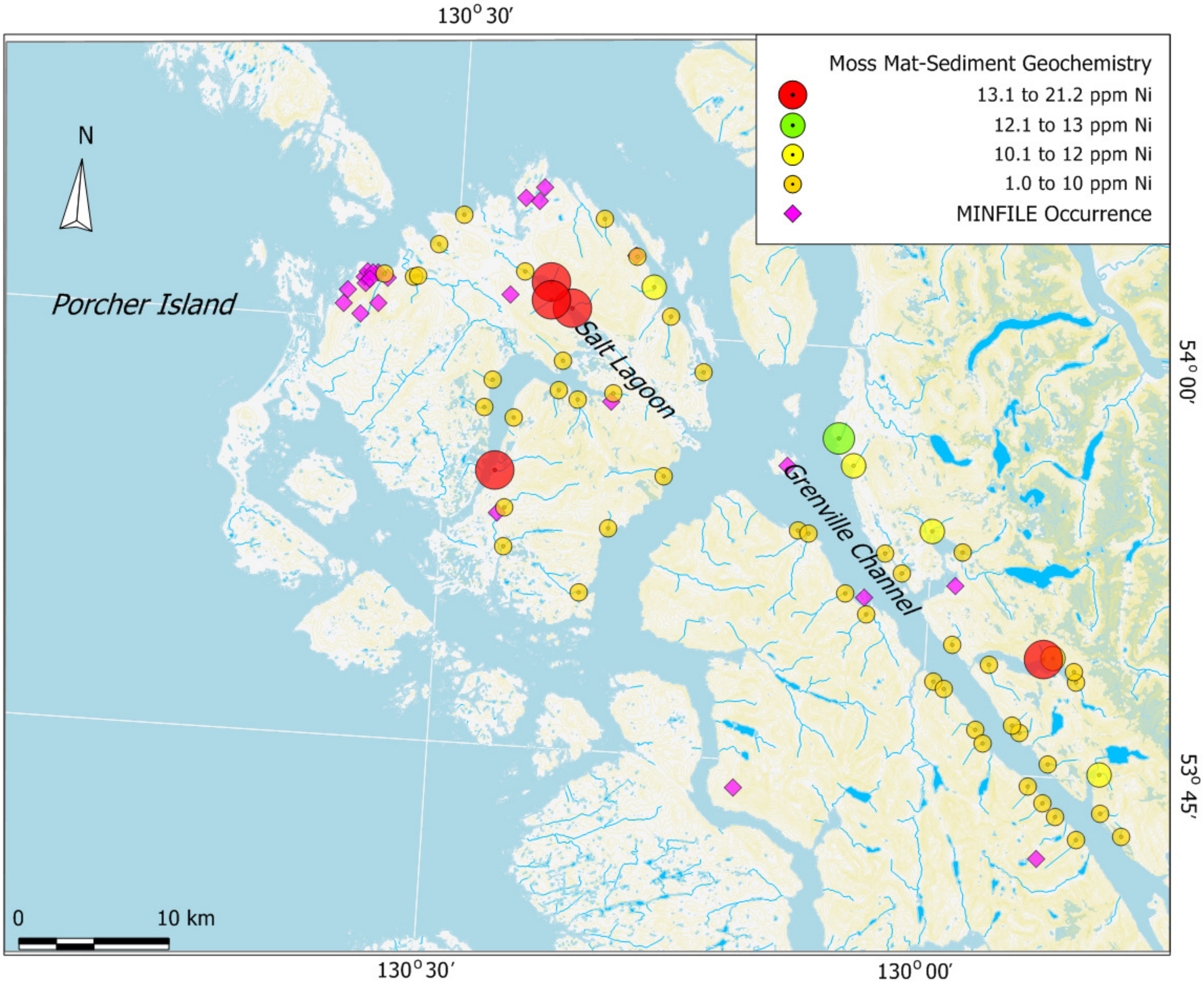

Fig 13. Porcher Island and Grenville Channel, moss mat-sediment Ni geochemistry.

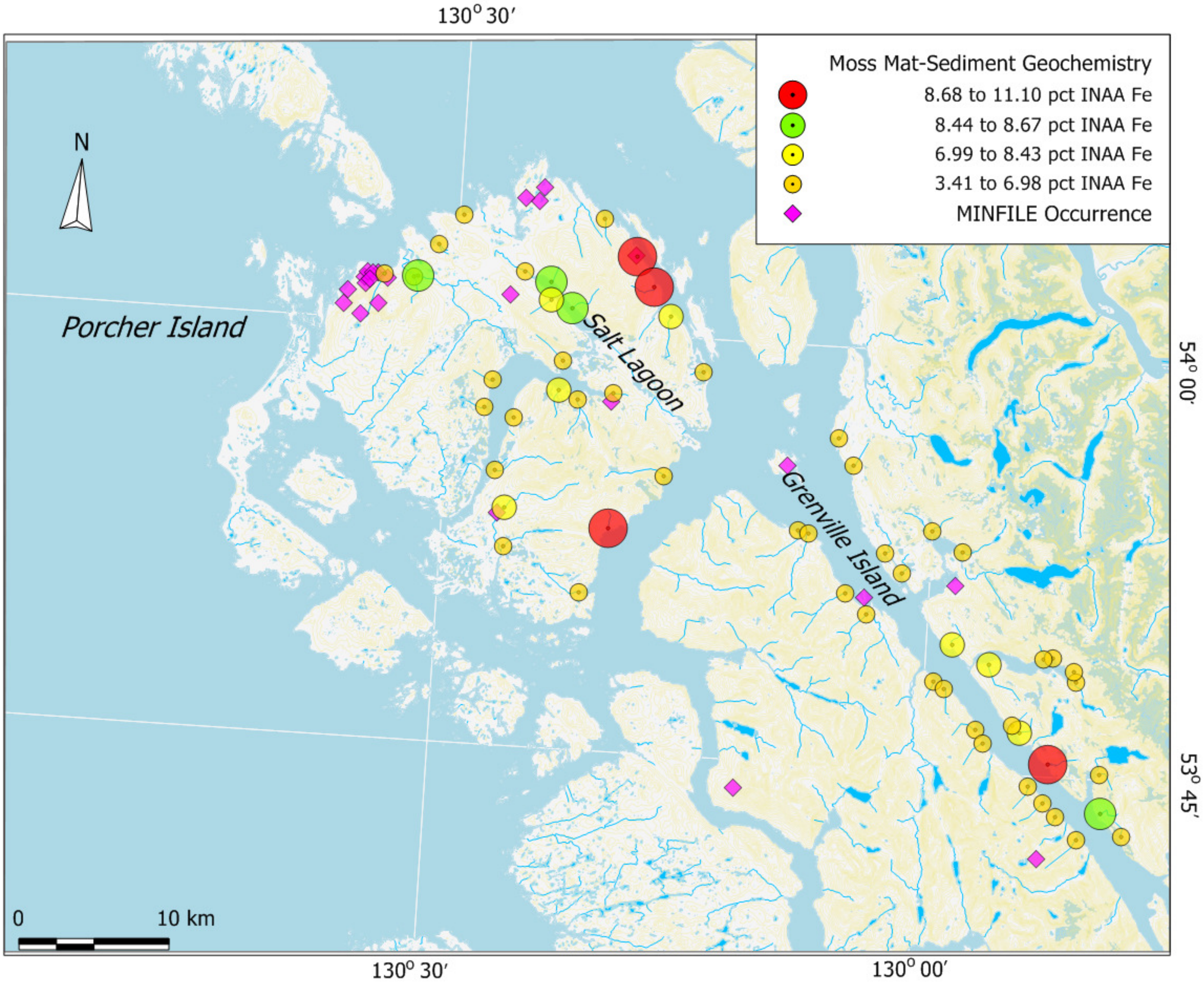

Fig. 14. Porcher Island and Grenville Channel moss mat-sediment Fe (INAA) geochemistry.

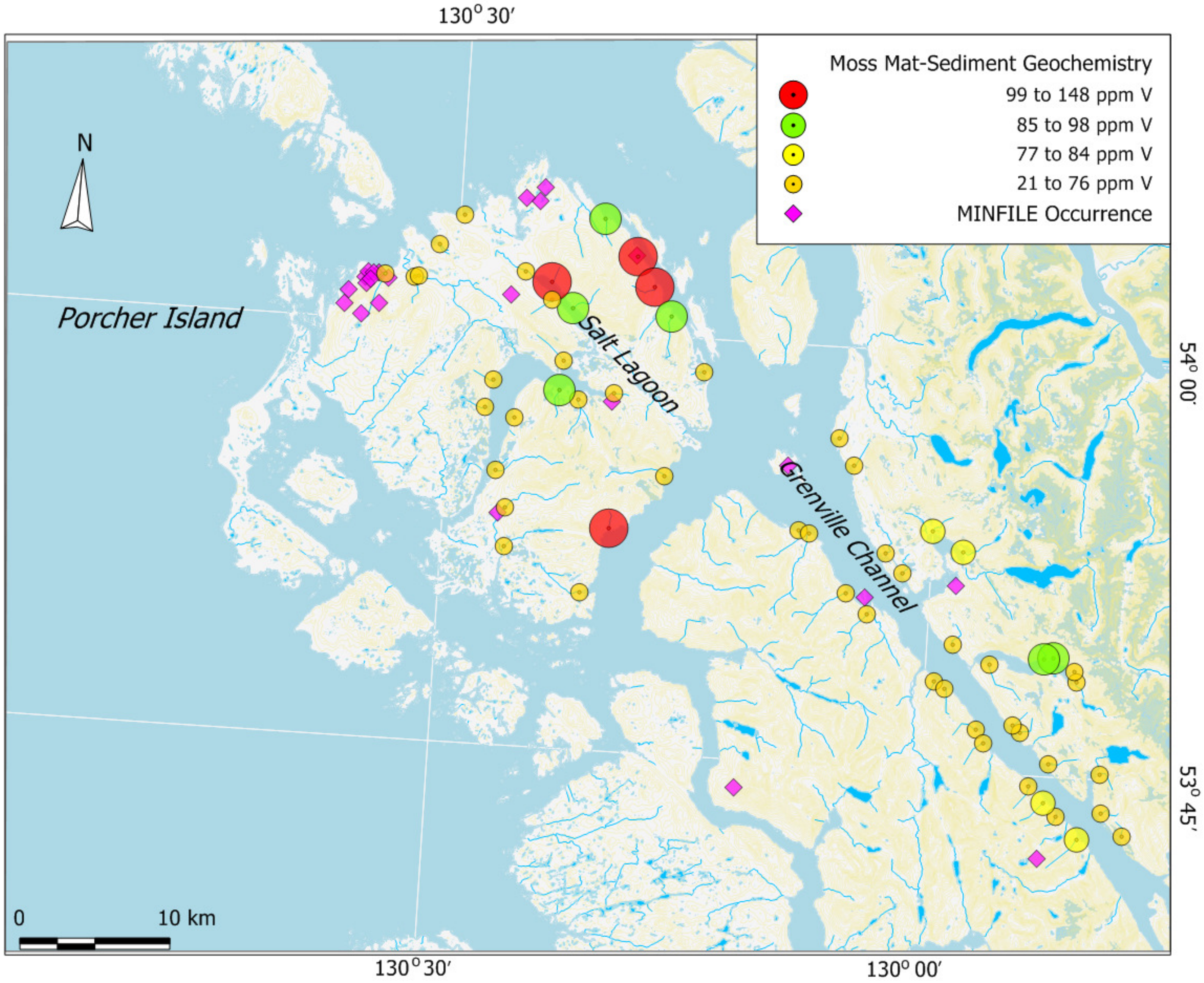

Fig. 15. Porcher Island and Grenville Channel, moss mat-sediment V geochemistry.

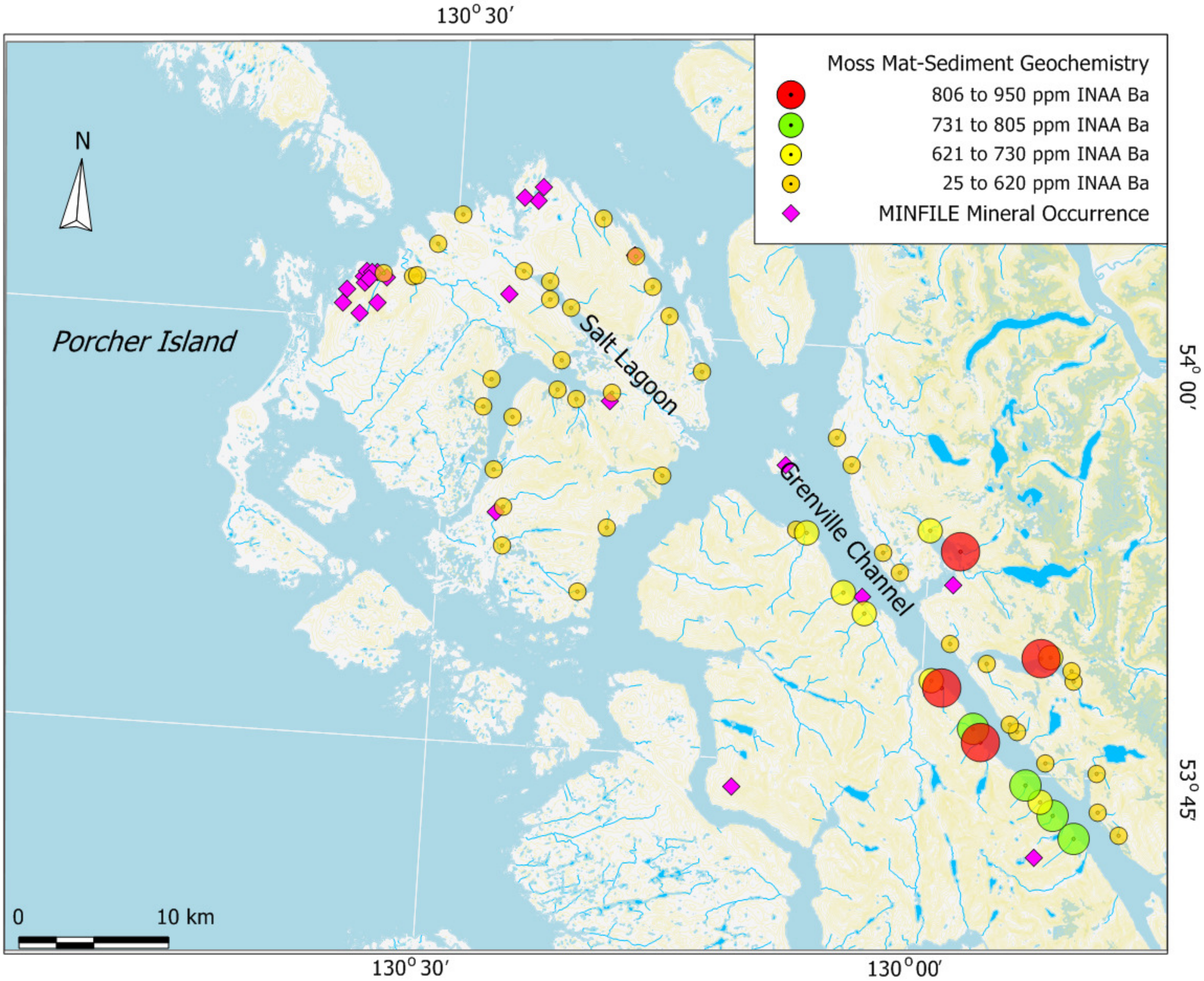

Fig. 16. Porcher Island and Grenville Channel, moss mat-sediment Ba (INAA) geochemistry.

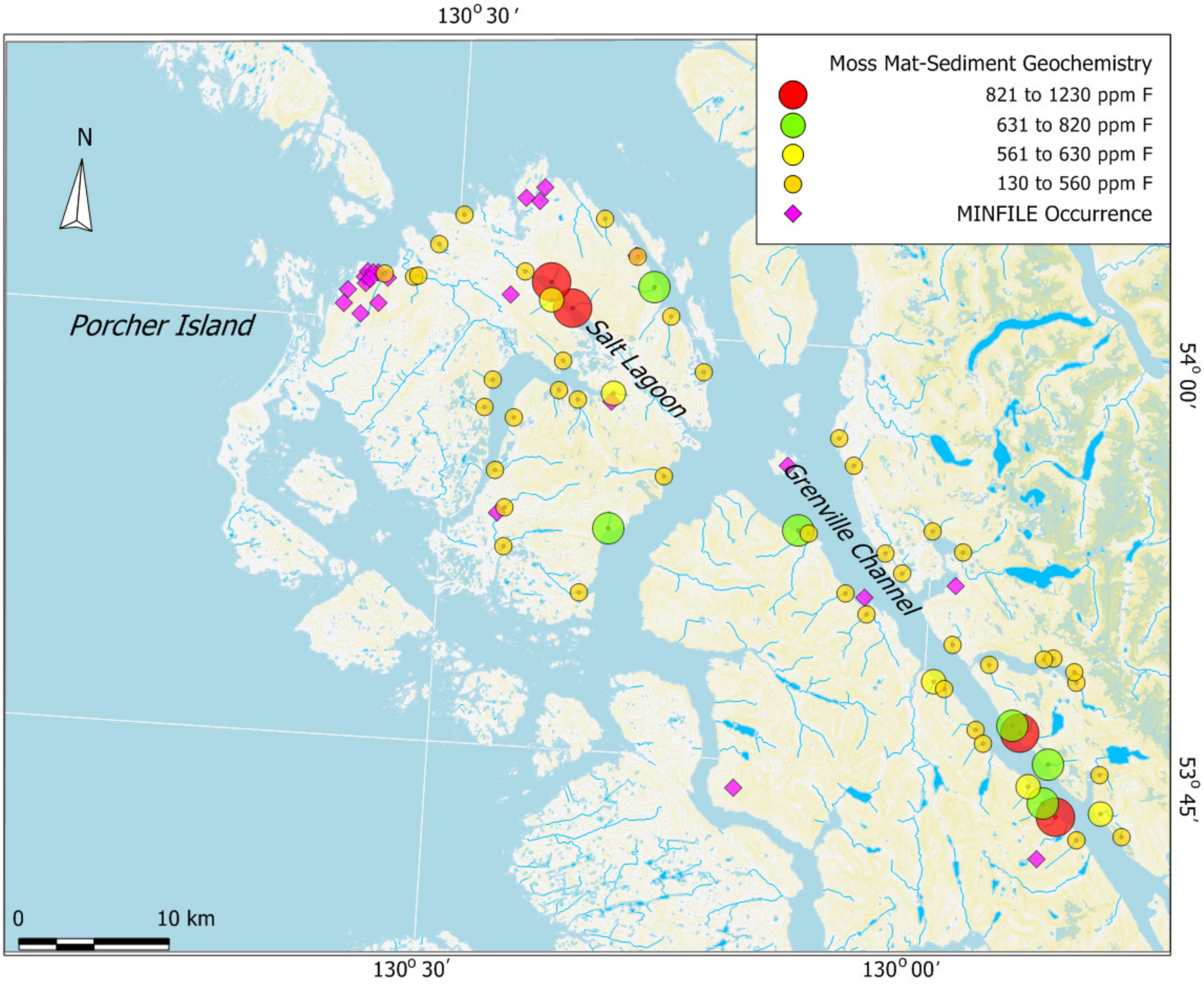

Fig. 17. Porcher Island and Grenville Channel, moss mat-sediment F geochemistry.

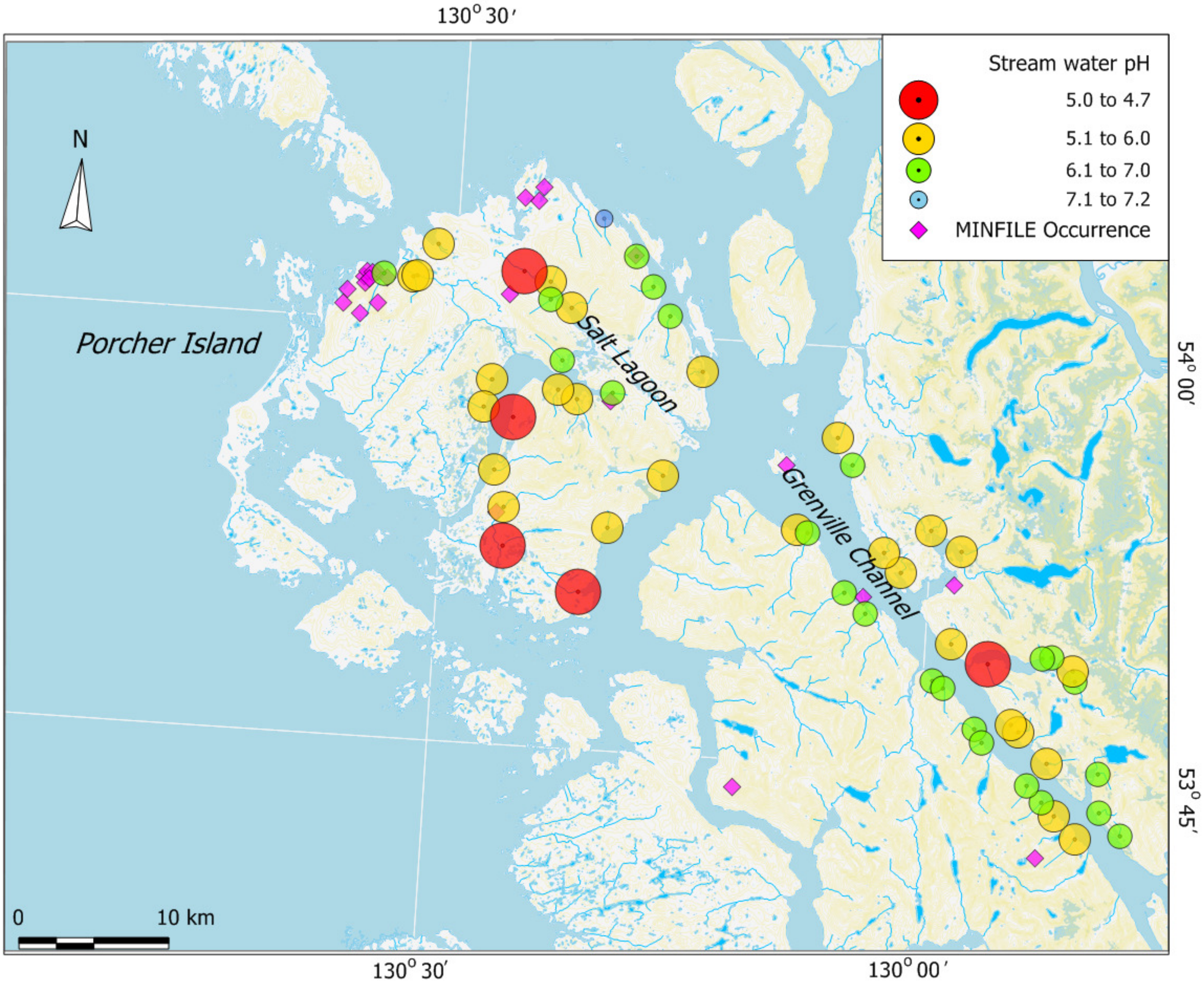

Fig. 18. Porcher Island and Grenville Channel, stream water pH.

4.2. Dundas, Dunira, and Melville islands

Figure 19 identifies moss mat-sediment sample locations on Dundas, Dunira, and Melville islands and Figures 20 to 24 display symbol plots for Au, Cu, Zn, Ni, and V by HNO_3-HCl-H_2O - ICP-MS. The symbol sizes and colours represents concentration intervals at the 80 and 90th percentiles. The element concentrations detected in the moss mat sediment from these northern islands are lower than those found in the streams draining Porcher Island and Grenville Channel. For example, the highest Au detected is 2.1 ppb and the highest Zn 50 ppm. Furthermore, the several Zn occurrences on Dunira Island appear to lack an expression in the moss mat sediment geochemistry.

Fig. 19. Dundas, Dunira, and Melville islands, moss mat sediment sample locations. Sample numbers are prefixed by NCST in the Master ID column of Appendix A.

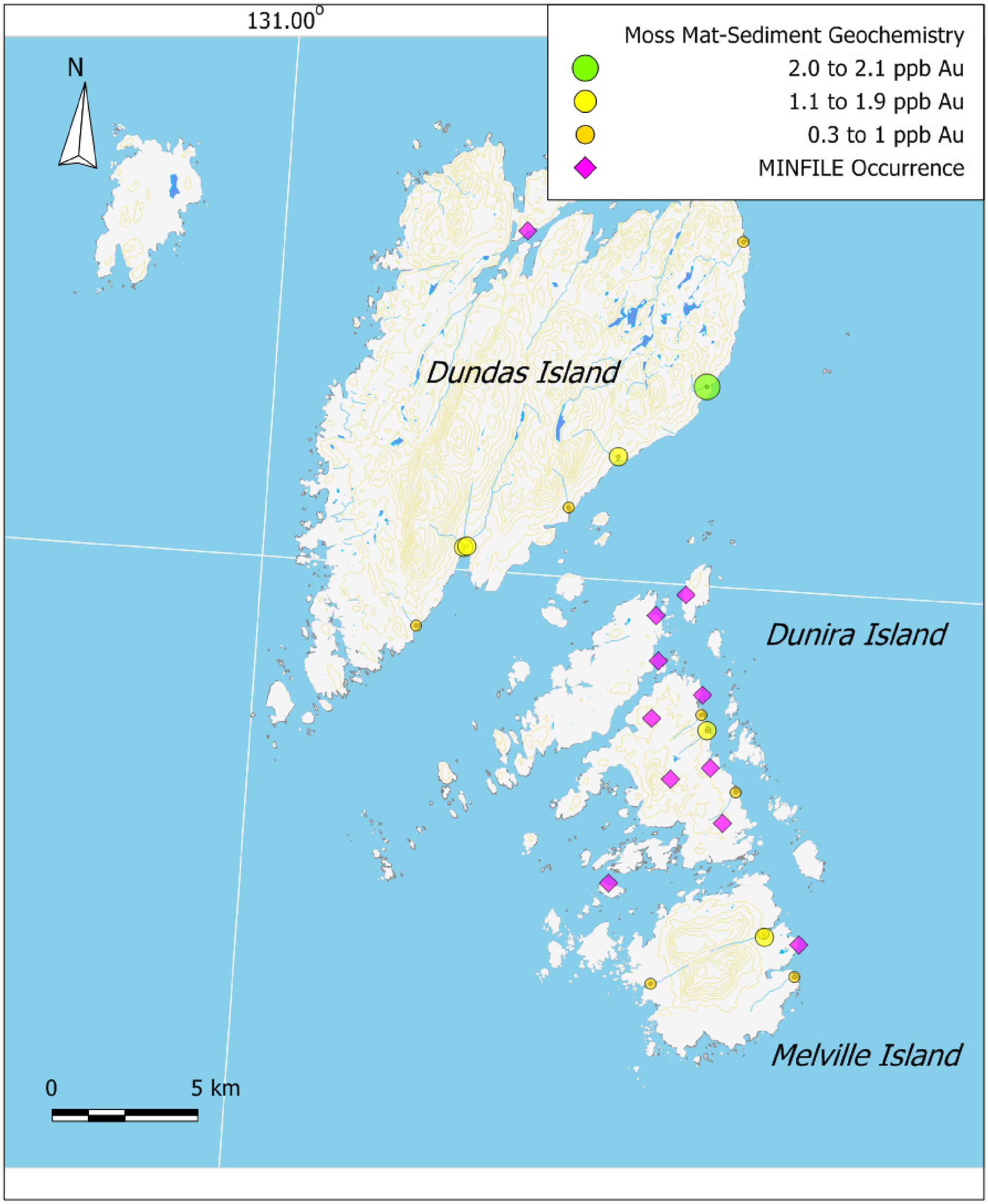

Fig. 20. Dundas, Dunira, and Melville islands moss mat-sediment Au geochemistry.

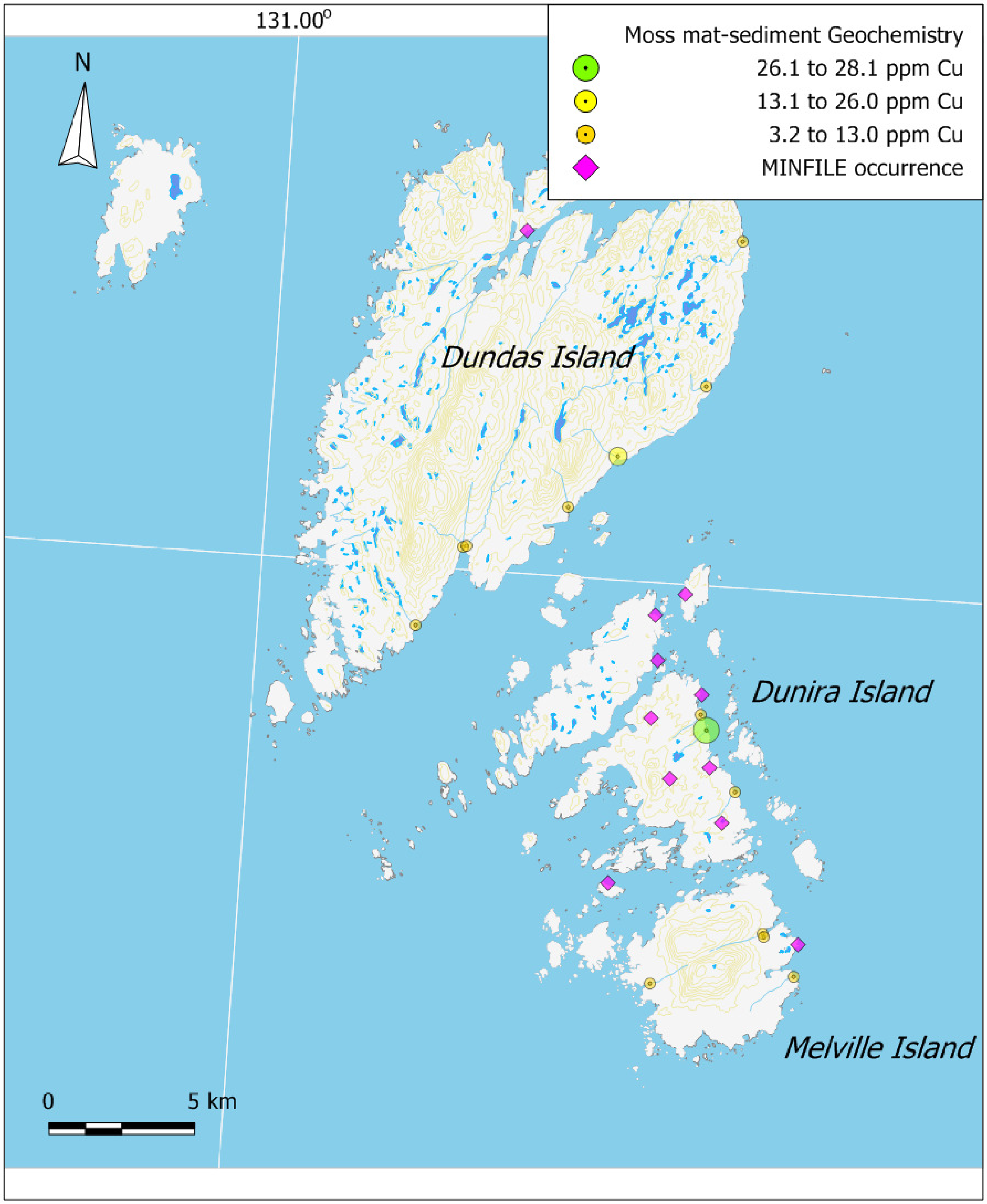

Fig. 21. Dundas, Dunira,and Melville islands, moss mat-sediment Cu geochemistry.

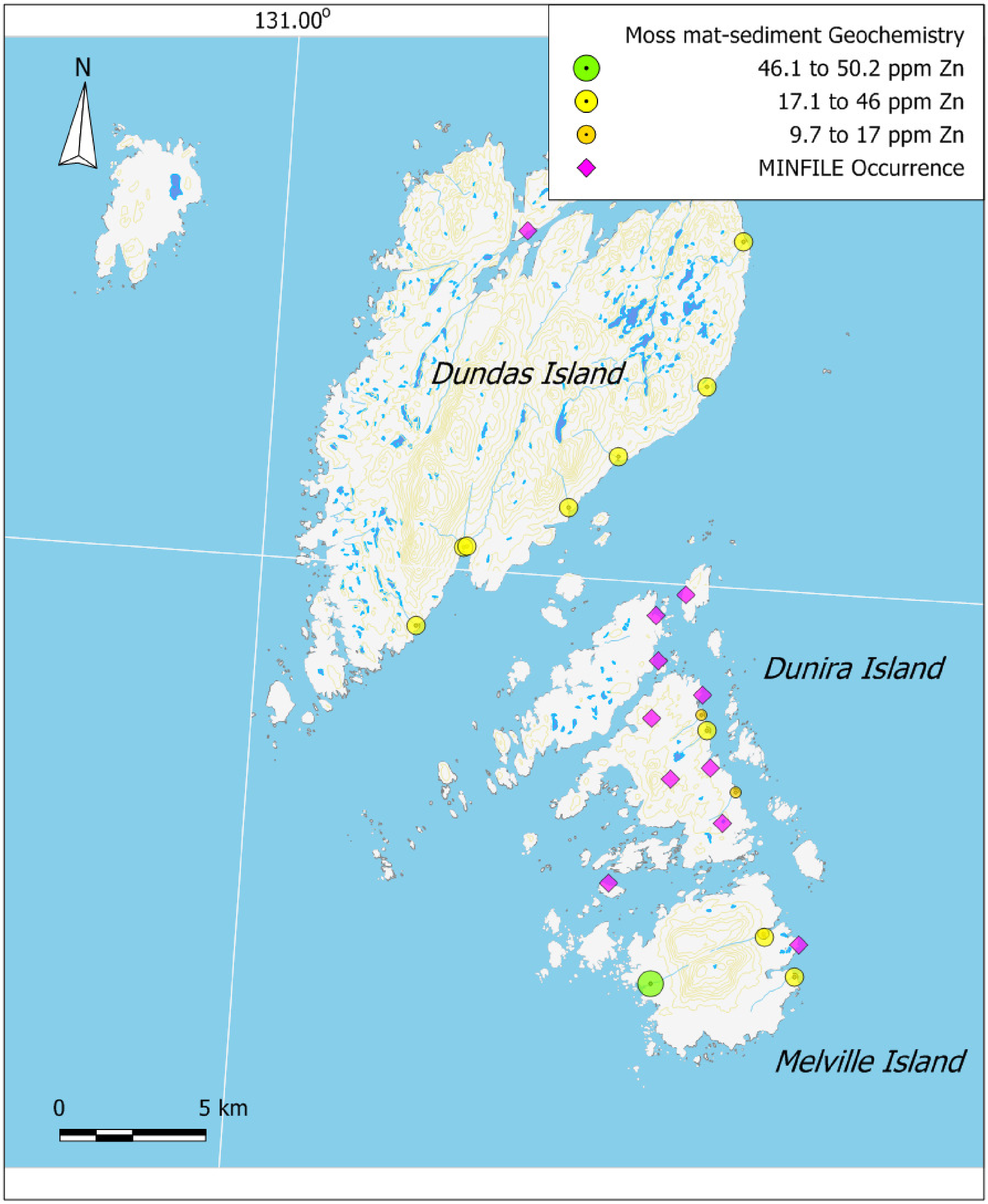

Fig. 22. Dundas, Dunira, and Melville islands, moss mat-sediment Zn geochemistry.

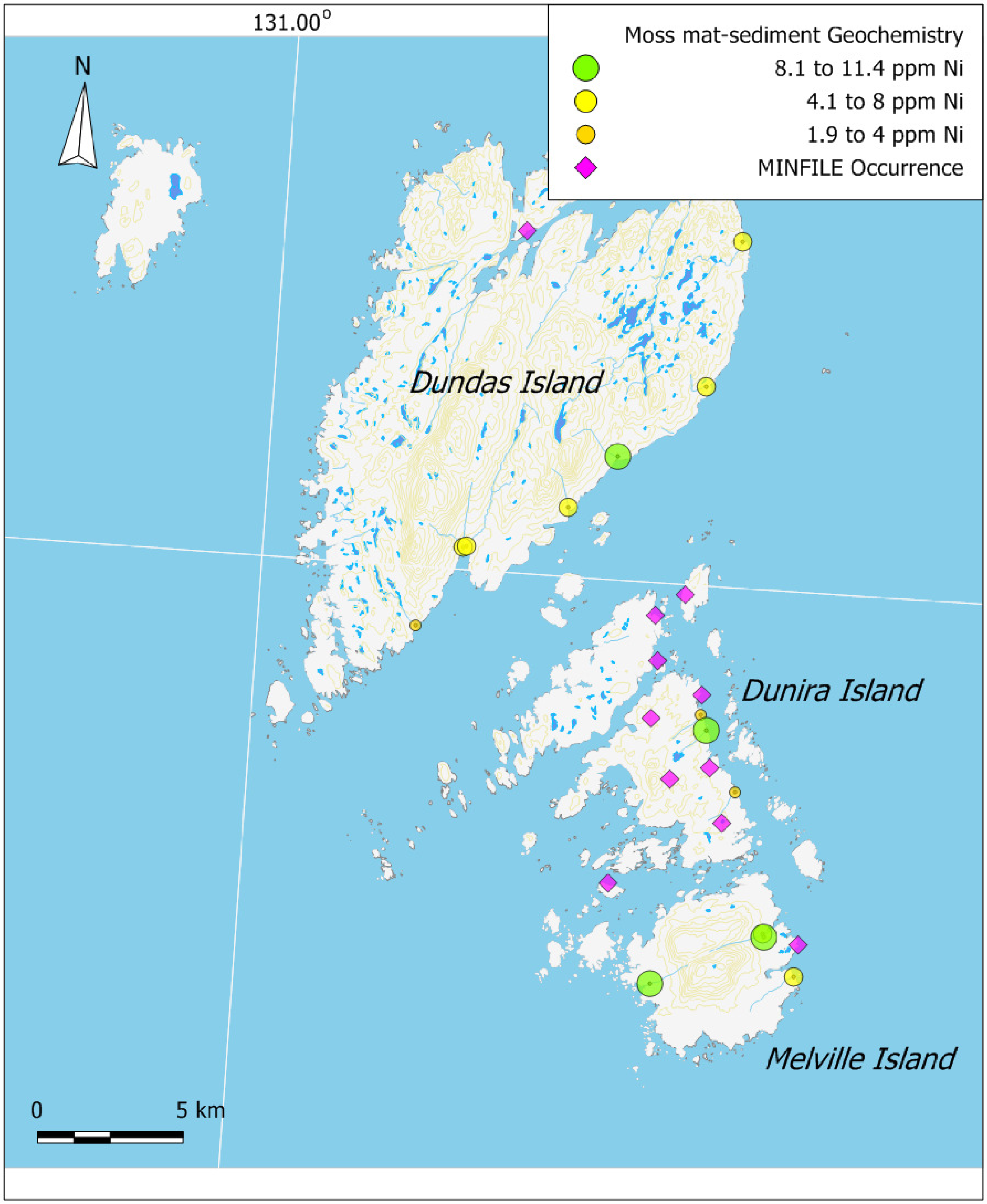

Fig. 23. Dundas, Dunira, and Melville islands, moss mat-sediment Ni geochemistry.

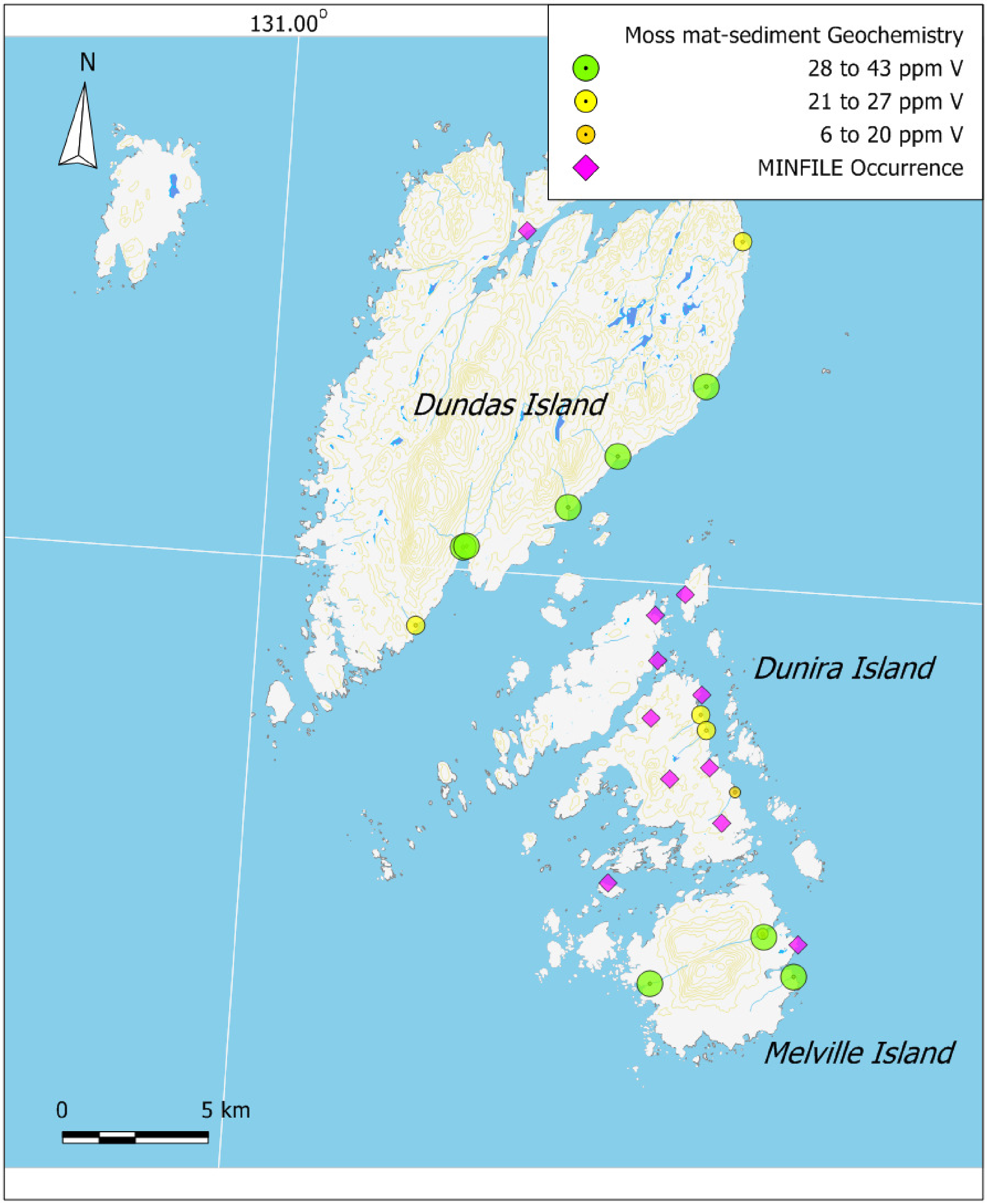

Fig. 24. Dundas, Dunira, and Melville islands, moss mat-sediment V geochemistry.

5. Discussion

Stream sediments are the preferred medium for Cordilleran regional geochemical surveys in areas where drainage systems are well developed because sediment is generally abundant. However, in mountainous areas, stream sediment sampling can be more challenging because of fewer streams and less fine-grained sediment. Matysek and Day (1988) and Matysek et al. (1988) found that in the fast-flowing Vancouver Island mountain streams, moss attached to the surface of logs and boulders captures the finer grained sediment that would normally remain in suspension. They found the Au anomaly contrast was greater in the <177µm fraction of moss mat sediment compared to the Au anomaly contrast in stream bedload sediment collected at the same site. Unlike Au, concentrations of other elements (e.g., Cu) are generally similar in moss mat and bedload sediment. The small Au anomalies (maximum 12.9 ppb) in the survey area, despite the existence of a past Au mine on Porcher Island, could reflect that streams are not draining Au mineralized areas and/or the Au-bearing suspended sediment is not being captured by the moss. Also to be considered is the large Au sampling variation (>50%) revealed by the quality control data analysis. The dynamics of suspended sediment capture are not well known and the energy of a stream combined with stream bed morphology may be factors responsible for the development of Au anomalies in moss mat sediments. The value of 12.9 ppb Au in the moss mat-sediment sample from a stream in the southwest part of Porcher Island may reflect the Mo-Cu mineralization reported at the LOR occurrence, although there are only background Mo values in the sample. The absence of anomalous Mo may also be caused by the acid stream water which would suppress Mo mobility and limit the length of the detectable dispersion pattern in drainages.

The concomitant increase in Ag, Cu, Fe, Ba, Zn and V in moss mat sediment from streams draining the northeast part of Porcher Island and along Grenville Channel likely reflect elements weathered from the metavolcanic-hosted magnetite and sphalerite-chalcopyrite occurrences reported at Star (MINFILE 103J 03) and POR (MINFILE 103J 23). The northwest orientation of anomalies parallel to the stratigraphy and the elevated total Ba (INAA) would suggest the presence of exhalites including barite. A similar pattern of northwest-trending Ni, V, Fe (INAA) and F anomalies in moss mat sediment from a stream draining in the Salt Lagoon on Porcher Island may also be related to an exhalite in metavolcanic rocks that are flanked by granite plutons.

Background element levels in moss mat sediment from streams on Dundas, Dunira, and Melville islands could reflect an absence of base metal mineralization in the drainage basins because the Zn mineral occurrences appear to be on the west side of Dunira and Melville islands whereas the streams samples drain to the east.

6. Conclusions

Moss mat sediments sampled in the Porcher Island, Grenville Channel, and Dundas Island geochemical survey area reveal that

- scattered, low contrast Au anomalies on Porcher Island and Grenville Channel may reflect Au associated with Cu-Mo sulphide mineralization
- linear Ag, Cu, Fe, Ba, Zn and V anomalies in moss mat-sediment samples collected from streams draining the northeast part of Porcher Island, the central part of Porcher Island, and along Grenville Channel can be explained by elements weathered from northeast-trending, metavolcanic-hosted, exhalitive style magnetite and sphalerite-chalcopyrite mineralization.

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References cited

Abzalov, M.Z., 2008. Quality control of assay data: A review of procedures for measuring and monitoring precision and accuracy. Exploration and Mining Geology, 17, 1-14.

Angen, J.J., van Staal, C., and Lin, S. , 2012. Structural geology of the Alexander Terrane in the vicinity of Porcher Island, northwestern British Columbia. In: Geological Fieldwork 2011, British Columbia Ministry of Energy and Mines, British Columbia Geological Survey Paper 2012-1, pp. 135-148.

Ballantyne, S.B., 1991. Stream geochemistry in the Canadian Cordillera: Conventional and future applications for exploration. In: Exploration Geochemistry Workshop, Geological Survey of Canada, Open File 2390, pp. 6.1-6.74.

Cui, Y., Miller, D., Schiarizza, P., and Diakow, L.J. 2017. British Columbia digital geology. British Columbia Ministry of Energy and Mines and British Columbia Geological Survey, Open File 2017 - 8, 9 p.

Ficklin, W.H., 1970. A rapid method for the determination of fluoride in rocks and soils, using an ion-selective electrode. United States Geological Survey, Professional Paper 700C, pp. 186-188.

Gehrels, G.E., 2001. Geology of the Chatham Sound region, southeast Alaska and coastal British Columbia. Canadian Journal of Earth Sciences, 38, 1579-1599.

Hall, G.E.M., 1979. A study of the stability of uranium in waters collected from various geological environments in Canada. In: Current Research, Part A, Geological Survey of Canada, Paper 79-1A, pp. 361-365.

Heberlein, D.R., Dunn, C.E., and Rice, S., 2017. An assessment of the use of halogens and volatile compounds in vegetation, soil and snow in the exploration for concealed deposits: case histories from Lara and Mount Washington, Vancouver Island (NTS 092B/13 and 092F/14). Geoscience BC Report, 2017-11, 50 p.

Holland, S.S., 1976. Landforms of British Columbia, a physiographic outline. British Columbia Department of Mines and Petroleum Resources, Bulletin 48, 138 p.

Jackaman, W. 2001. Stream sediment and water geochemistry of the Ecstall Greenstone Belt. British Columbia Ministry of Energy and Mines, British Columbia Geological Survey

Open File 2001-13, 17 p.

Jackaman, W., Lett, R., and Friske, P, 2001. BC Regional Geochemical Survey: 2000 Field Programs. In: Geological Fieldwork 2000, British Columbia Ministry of Energy and Mines, British Columbia Geological Survey Paper 2001-1, pp. 379-381.

Matysek, P.F. and Day, S.J., 1988. Geochemical orientation surveys: northern Vancouver Island, fieldwork and preliminary results. In: Geological Fieldwork 1987, British Columbia Ministry of Energy, Mines and Petroleum Resources, British Columbia Geological Survey, Paper 1988-1, pp. 493-502.

Matysek, P.F, Day, S.J., and Gravel, J.L., 1988. Gold in moss-mat sediments and stream sediments. Association of Exploration Geochemists Newsletter Explore, 62, February, p.1 and p.4.

Nelson, J.L., Mahoney, J.B., Gehrels, J.E., van Staal, C, and Potter, J.J., 2010. Geology and mineral potential of Porcher Island, Northern Grenville Channel, and vicinity, northwestern British Columbia. In: Geological Fieldwork 2009, British Columbia Ministry of Energy and Mines, British Columbia Geological Survey, Paper 2010-1, pp. 19-41.

Nelson, J.L., Diakow, L.J., Mahoney, J.B., van Staal, C., Pecha, M., Angen, J.J., Gehrels, G., and Lau, T. 2012. North Coast Project: Tectonics and metallogeny of the Alexander terrane, and Cretaceous sinistral shearing of the Western Coast Belt. In: Geological Fieldwork 2011, British Columbia Ministry of Energy and Mines, British Columbia Geological Survey Paper 2012-1, pp. 157-180.

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