Newfoundland Labrador

Natural Resources

Mines

STREAM-SEDIMENT, SOIL AND ROCK GEOCHEMICAL SURVEYS OVER GRANITIC ROCKS IN SOUTHERN NEWFOUNDLAND
(NTS MAP AREAS 12A/2, 11P/10, 15, 16 AND 1M/10, 11, 13 TO 15)

J.W. McConnell

Open File NFLD/3260

St. John's, Newfoundland
July, 2015

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Cover: Pitching camp at Sage Pond, Ackley Granite survey area, July 1982. Looking southwest.

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ABSTRACT

Rocks, stream-sediment and/or soil surveys and sampling were conducted in seven areas of granitic terrane in southern Newfoundland between 1982 and 1984.

The Granite Lake area (NTS map area 12A/2) is underlain by two Silurian–Devonian granitic intrusions of the North Bay Granite Suite; several occurrences of tungsten and molybdenum are found in the area. Stream sediments and reconnaissance- and grid-soil samples were collected.

The Dolland Brook and Dolland Brook North areas (NTS map area 11P/15) are underlain by four granitic intrusions of the North Bay Granite Suite. One occurrence of tungsten mineralization is known in each area. Stream sediments were collected from each area, and reconnaissance- and grid-soil samples were collected only in the Dolland Brook area.

The Bottom Brook area (NTS map area 11P/16) is underlain by the Ordovician siliciclastic Riches Island Formation and by four intrusions of the North Bay Granite Suite. No granophile mineralization is known in the area. Stream sediments and reconnaissance-soil samples were collected.

The East Bay area (NTS map areas 1M/13 and 11P/16) is underlain by the Riches Island Formation and by the East Bay Granite of the North Bay Granite Suite. A few minor occurrences of molybdenum are known in the area. Only stream-sediment samples were collected.

The François Granite area (NTS map area 11P/10) is underlain by four units of the northeast lobe of the Devonian François Granite. Granophile mineralization is not known to be present. Only stream-sediment samples were collected in the area, but the scarcity of surficial cover material prevented the sampling of soils.

The Ackley Granite area (NTS map areas 1M/10, 11, 14 and 15) is underlain by two siliciclastic and volcanic units of the Ediacaran Long Harbour Group, two felsic and mafic intrusive units of the Devonian Cross Hills Plutonic Suite and two granites of the Devonian Ackley Granite. Several occurrences of tin, molybdenum and tungsten are known in the area. Stream sediments and reconnaissance- and grid-scale soil samples were collected.

Using ten different methods, stream-sediment samples were analyzed for up to 39 unique elements and loss-on-ignition. Soil samples were analyzed for up to 15 unique elements and loss-on-ignition, using 9 different methods, and rock samples were analyzed for up to 34 unique elements and loss-on-ignition, using 9 different methods.

The report provides summary statistics of the geochemical data, correlation analyses of selected data, histograms, cumulative frequency plots, sample-location maps and symbol maps showing the distribution of most elements and variables for sediment and soil samples. The symbols are overlain on maps showing drainage features and detailed-scale geology.

The study demonstrates that stream-sediment and soil sampling are effective methods of delineating most known granophile mineral occurrences in these areas. As well, several areas with anomalous stream-sediment and soil samples are identified, which suggest the presence of potential mineralization.

INTRODUCTION

The principal aims of this project are to determine which surficial exploration methods were effective in delineating known mineralization, and to identify prospective areas for further exploration. Target commodities were tin, tungsten and molybdenum occurring in granitic environments.

Field work was carried out during the summers of 1982 to 1984, in seven areas of granitic terrane, across the south coast and southern part of Newfoundland. Field operations were conducted from tent camps located in the survey areas. Crew sizes varied from five to seven, and sampling was completed on foot traverses; helicopters were used in some instances to position the camps. Sampling methods included the collection of active stream-sediment samples, regional soil samples and detailed grid soil-samples in areas of known or suspected mineralization; the B horizon was preferentially sampled. Rock samples of mineralization as well as samples of local unmineralized bedrock and float were also collected.

Some results of this work have been published previously (*see* below), but much has not been released. All stream-sediment samples were analyzed using instrumental neutron activation analysis (INAA), thus greatly increasing the geochemical data available for interpretation.

LOCATION AND ACCESS

The seven areas surveyed are located in south-central Newfoundland (Figure 1). The Granite Lake area (NTS map area 12A/2) is accessible by vehicle using forest-access roads. The Dolland Brook and Dolland Brook North (NTS map area 11P/15), Bottom Brook (NTS map area 11P/16), François Granite (NTS map area 11P/10) and East Bay areas (NTS map areas 1M/13 and 11P/16) are most easily accessed by helicopter. The last area can be reached by boat but the steep slopes from the sea to the plateau are formidable. The eastern parts of the Ackley Granite area (NTS map areas 1M/10) are accessible by a walk over rugged terrain, and the western parts (NTS map areas 1M/11 and/14) can be accessed by boat or helicopter.

PREVIOUS GEOCHEMICAL SURVEYS AND REPORTS

Prior to conducting the stream, soil and rock surveys, lake-sediment surveys were conducted that included the current survey areas. Butler and Davenport (1978a) presented initial data for a survey that included the Granite Lake, Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite

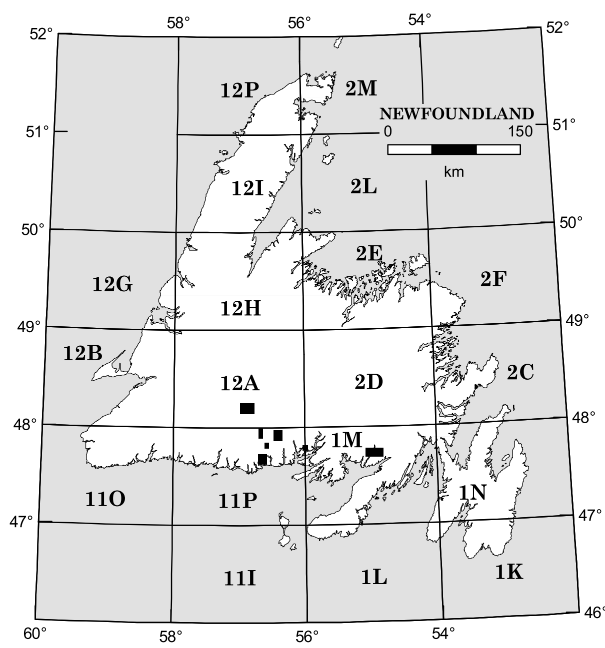

Figure 1. *Location of survey area.*

areas. Two subsequent reports released fluoride and tungsten data for these samples (Davenport and Butler, 1981, 1982).

The Ackley Granite area was reported on, in three separate lake-sediment survey reports. The first two reports included the common suite of trace elements and the third included fluorine analyses (Butler and Davenport, 1978b, 1979a). Some of the lake samples were re-analyzed for tin (Davenport, 1981).

The release of data from the reconnaissance lake-sediment survey, which included the Granite Lake area, generated claim-staking by several exploration companies. In comparison to sediment samples collected elsewhere in Newfoundland, the sediments are enriched in several elements including Ag, F, Mo and U and, to a lesser extent, Cu, Pb and Zn. Follow-up exploration in the region led to the discovery of molybdenite and tungsten (wolframite) mineralization in pyritiferous quartz veins. Exploration has relied largely on soil sampling to delineate targets for trenching.

The Dolland Brook, Dolland Brook North, Bottom Brook and East Bay areas all have elevated levels of W in lake sediment. The Bottom Brook and Dolland Brook North areas have some elevated U values and the East Bay area has moderately elevated Ag and Cu values. The eastern lobe of the François Granite has a multi-element anomaly including F, Pb and U, and moderate enrichment in Ag.

The lake surveys over the Ackley Granite area revealed multi-element anomalies in Ag, F, Mo, Pb and U. The Ag, F and Pb anomalies are focused on the southern margin of the granite. Fifty-six samples of lake sediment, selected primarily from sites near the southern margin of the granite, were analyzed for Sn (Davenport, 1981). All but three were below the 2 ppm detection limit. The remaining three samples had values of 2 or 3 ppm. The lack of useful Sn data in the lake sediments may be due the relative insolubility of cassiterite in the surficial environment.

A description of 1982 field work and laboratory procedures for surveys conducted in the Granite Lake area, and the 1982 work done in the François Granite and the Ackley Granite areas was released by McConnell (1983). A similar report of field and laboratory procedures for surveys conducted in 1983 in the Dolland Brook, East Bay and François Granite areas was released the following year (McConnell, 1984a). A detailed description of sampling, laboratory methods and preliminary analytical results from the 1982 surveys in the Granite Lake and François Granite areas was reported by McConnell (1984b). A description of the field work conducted, and analyses performed, for the final surveys completed in 1984 in the two Dolland Brook, the François Granite and the Ackley Granite areas was released by McConnell (1985).

Subsequent to conducting the stream, soil and rock surveys, the regional lake sediments were analyzed by instrumental neutron activation analysis for many elements. Together with the previous data, the neutron activation data were released in CD format by Davenport *et al.* (1994). These additional data comprise several granophile-associated elements including U, rare earth elements, W, Th and Ta. The François Granite stands out strongly in Ta and Th and, to a lesser extent, Tb. The Ackley Granite, particularly near the southern contact, is anomalous in Tb and Th. The data released on CD are now available for download online from the Geoscience Atlas at: http://www.nr.gov.nl.ca/nr/mines/geoscience_online.html.

BEDROCK GEOLOGY AND MINERALIZATION OF THE SURVEY AREAS

All survey areas have been mapped at 1:50 000 scale, with the exception of the Ackley Granite area which is mapped at various scales from 1:17 000 to 1:100 000. The Granite Lake area (NTS map area 12A/2) was first mapped by Dickson and Gibbons (1982) and subsequently republished by Dickson (1990a). The Dolland Brook and Dolland Brook North areas (NTS map area 11P/15) were also mapped by Dickson (1990b). The Bottom Brook area and the western part of the East Bay area (NTS map area 11P/16) were mapped by Dickson (1990c). The eastern part of the East Bay area (NTS map area 1M/13) was mapped by Colman-Sadd (1976). The François Granite area (NTS map area 11P/10) was mapped by Dickson *et al.* (1996). The Ackley Granite area (NTS areas 1M/10, 11 and 14) was mapped by Dickson (1983). The eastern part of the Ackley Granite area (NTS map area 1M/10) was later remapped by O'Brien *et al.* (1984). A portion of the area, including parts sampled and discussed in this report (NTS map area 1M/10 near Sage Pond) was mapped at 1:17 000 scale and the mineralization described by Tuach (1991).

The bedrock geology of the survey areas, except that of the Ackley Granite, is shown in Figure 2. The geology of the Ackley Granite area is shown in Figure 3. Molybdenum, tin and tungsten mineral occurrences are shown and identified with their National Mineral Inventory Number (NMINO) from the Mineral Occurrence Data System (MODS). Some molybdenum occurrences that are near but outside the East Bay survey area are omitted because of space limitations. The geological legend (Figure 4) includes units that fall within the survey areas. The geology is simplified and based on units as described by Crisby-Whittle (2012).

The following descriptions are taken largely from the aforementioned references.

GRANITE LAKE AREA

The Granite Lake area is underlain by the Cambrian to Early Ordovician Spruce Brook Formation which consists of migmatitic to siliciclastic rocks (Unit 5). Two Silurian–Devonian granitic units, the Meelpaeg Lake Granite (Unit 15) and the Wolf Mountain Granite (Unit 18) of the North Bay Granite Suite underlie the remainder of the area (Dickson and Gibbons, 1982). The Meelpaeg Lake Granite is a buff to white, medium-grained, equigranular, weakly foliated biotite ± muscovite granite, locally cut by garnetiferrous pegmatites. The Wolf Mountain Granite is a pink to red and buff, massive to weakly foliated, coarse-grained, K-feldspar porphyritic, muscovite–biotite granite.

Tungsten and molybdenum mineralization are the principal elements of economic interest in the Granite Lake area. There are 15 occurrences of tungsten mineralization reported within the surveyed area (GSNL, MODS 2013). Of these, 10 are classified as 'showings' and 5 are 'indications'. Most of the mineralization is wolframite, although some occurrences are reported to consist of scheelite. Generally mineralization is found in quartz veins or greisens within the Wolf Mountain Granite. The mineralization also commonly contains chalcopyrite, molybdenite, silver and fluorite.

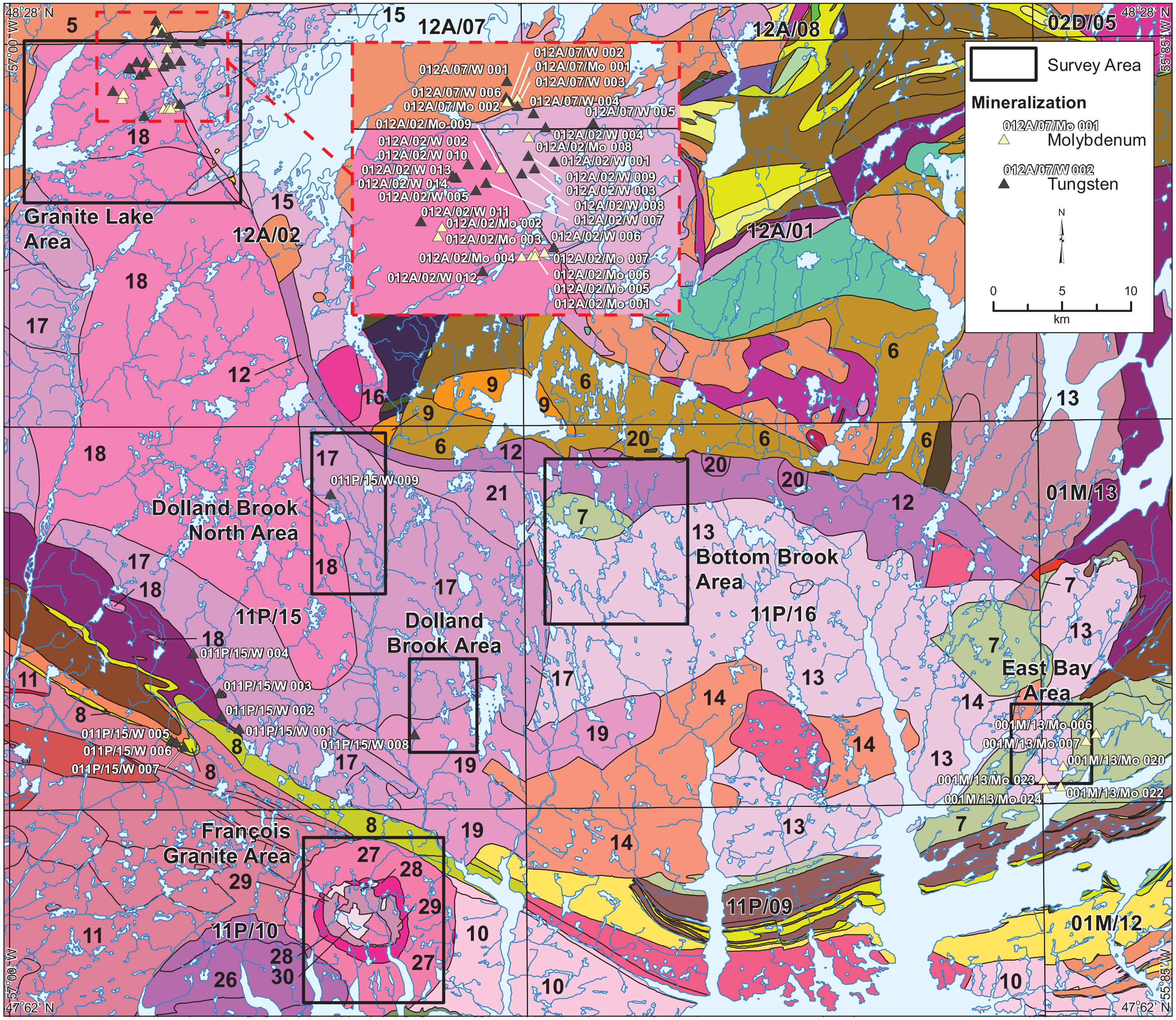

Figure 2. *Detailed geology map of Granite Lake, Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite survey areas.*

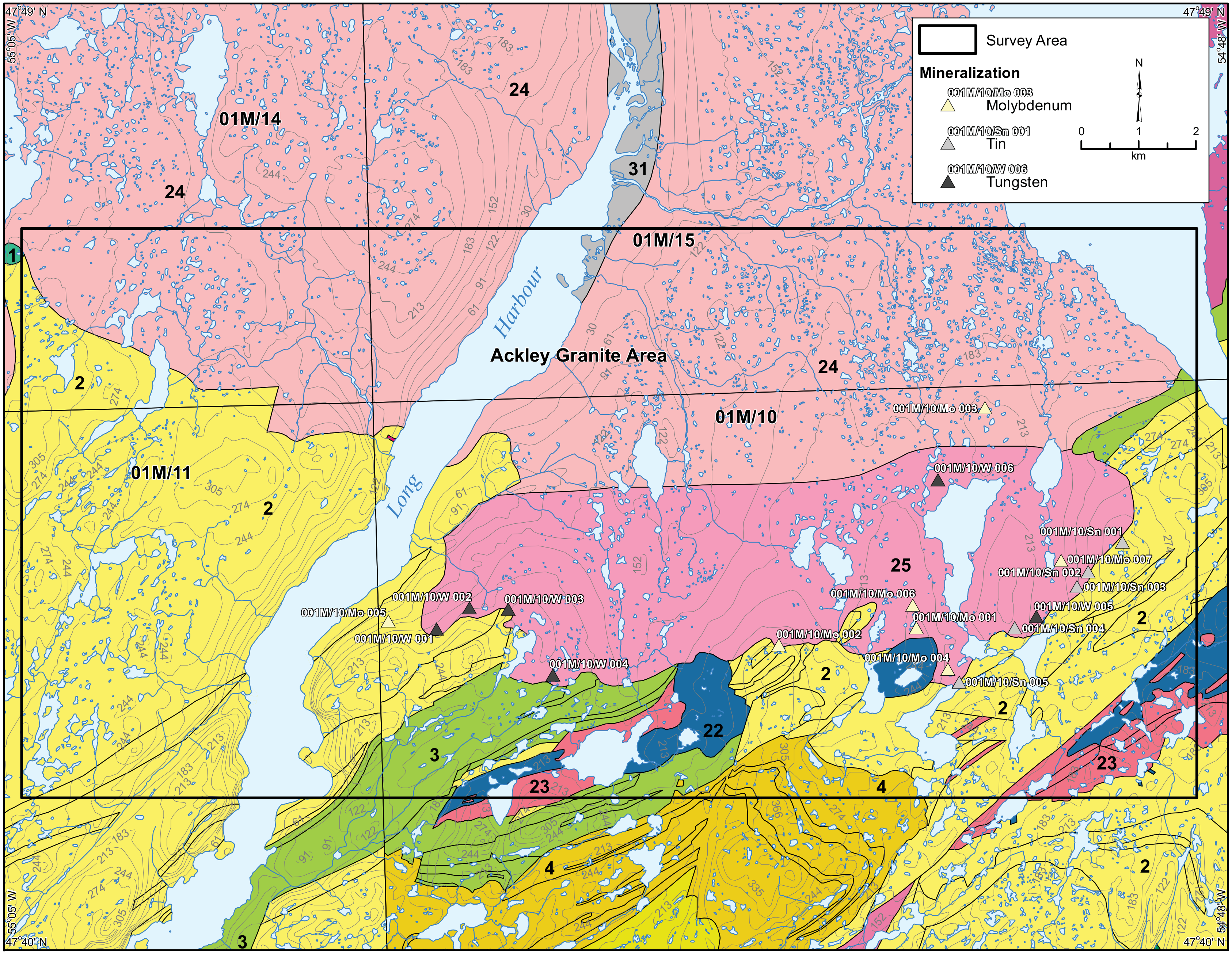

Figure 3. *Detailed geology map of Ackley Granite survey area.*

QUATERNARY

31 — Unconsolidated sediments

DEVONIAN

FRANCOIS GRANITE

Northeast Lobe

30 — Pink, fine- to medium-grained, quartz and K-feldspar porphyritic, biotite granite

29 — Buff to grey, medium-grained, quartz and plagioclase porphyritic, biotite granodiorite

28 — Dominantly pink, fine-, medium- and coarse-grained, quartz and K-feldspar porphyritic, biotite granite

27 — Pink, coarse-grained, quartz and K-feldspar porphyritic, biotite granite

Southwest Lobe

26 — Dominantly massive, feldspar-porphyritic, biotite granite

ACKLEY GRANITE SUITE

Hungry Grove-Rencontre Lake Granites

25 — Fine-grained, pink granite and aplite

24 — Pink, massive, coarse-grained and locally medium-grained, K-feldspar porphyritic or equigranular, biotite granite

CROSS HILLS PLUTONIC SUITE

23 — Granodiorite, biotite granite and peralkaline granite

22 — Gabbro, diabase and diorite

SILURIAN-DEVONIAN

NORTH BAY GRANITE SUITE

Dolland Pond Granite and related granites

21 — Dominantly pink, massive to weakly-foliated, medium-grained, K-feldspar porphyritic, muscovite-biotite ± garnet granite

20 — Pink to buff, strongly foliated, coarse-grained, microcline porphyritic, biotite granite

Morgan Brook Granite

19 — Pink, massive to weakly-foliated, medium-grained, K-feldspar porphyritic, muscovite-biotite ± garnet granite

Wolf Mountain Granite

18 — Pink to red and buff, massive to weakly-foliated, coarse-grained, K-feldspar porphyritic,muscovite-biotite granite

Dolland Brook Granite

17 — Massive, medium- to coarse-grained, K-feldspar porphyritic, biotite granite

Wolf Lake Granite

16 — White to buff, massive, coarse-grained, equigranular, garnet-biotite-muscovite granite

Meelpaeg Lake Granite

15 — Weakly-deformed, medium-grained, feldspar porphyritic, muscovite-biotite granite

Bottom Brook Granite

14 — Weakly foliated, medium-grained, feldspar porphyritic, muscovite-biotite granite

East Bay Granite

13 — Medium-grained, equigranular, weakly foliated, muscovite-biotite granite

D'Espoir Brook Granite

12 — Strongly deformed, medium-grained, muscovite-biotite-garnet granite

BURGEO INTRUSIVE SUITE

11 — Dominantly foliated, granodiorite, tonalite and granite

SILURIAN

Gaultois Granite

10 — Strongly foliated, coarse-grained, K-feldspar and plagioclase-porphyritic, biotite-rich granite and hornblende-biotite-rich granodiorite

Dolland Pond Formation

9 — Interbedded sandstone, siltstone and slate

ORDOVICIAN

BAY DU NORD GROUP

8 — Extensively-migmatized, metasedimentary rocks

BAIE D'ESPOIR GROUP

Riches Island Formation

7 — Migmatite to highly-deformed pelitic to psammitic schist

Salmon River Dam Formation

6 — Psammite; pelite

CAMBRIAN TO EARLY ORDOVICIAN

Spruce Brook Formation

5 — Migmatitic to siliclastic rocks

EDIACARAN

LONG HARBOUR GROUP

Mooring Cove Formation

4 — Rhyolitic flows and ash-flow tuffs; minor basaltic flows and sills

Andersons Cove Formation

3 — Slate, siltstone, sandstone and conglomerate; minor rhyolite.

Belle Bay Formation

2 — Dominantly felsic, non-marine volcanic and volcanic-dervived epiclastic rocks

EDIACARAN-NEOPROTEROZOIC

SIMMONS BROOK INTRUSIVE SUITE

1 — Dark-grey to green, fine- to medium-grained diorite, medium- to coarse-grained gabbro, and minor diabase

MINERALIZATION

△ Tin (Sn)

▲ Tungsten (W)

△ Molybdenum (Mo)

Figure 4. *Geology legend for survey areas.*

There are eleven occurrences of molybdenum mineralization; of these, two are prospects, one is a showing, and eight are indications. Most occurrences consist of molybdenite in quartz veins cutting biotite–muscovite granite or as smears on joints within the granite. Chalcopyrite and pyrite are commonly associated. The most thoroughly explored prospect is the Moly Hill deposit. Playfair Mining Limited (2008) reported results of over 30 diamond-drill cores. The longest intersection (249 m) averaged 0.018% Mo. The highest-grade intersection (15.8 m) was 0.087% Mo.

DOLLAND BROOK AREA

Most of Dolland Brook is underlain by the Morgan Brook Granite (Unit 19) which consists of pink, massive to weakly foliated, medium-grained, K-feldspar porphyritic, muscovite–biotite granite. Portions of the north-central survey are underlain by the Dolland Brook Granite (Dickson, 1990b), from where 11 stream-sediment samples were collected. The Dolland Brook Granite (Unit 17) consists of pink to buff, massive to weakly foliated, medium-grained, K-feldspar porphyritic, (muscovite)–biotite granite. The only known mineralization is a tungsten occurrence. It was discovered during follow-up work of a tungsten anomaly in stream sediment (McConnell, 1984a). The occurrence consists of quartz–tourmaline–pyrite–scheelite veins outcropping in a brook and is classified as NMINO 011P/15/W/ 008 (MODS 2013); a rock sample from the discovery occurrence (sample 4140081) analyzed 0.39% tungsten

DOLLAND BROOK NORTH AREA

Dolland Brook North is underlain by the D'Espoir Brook Granite (Unit 12; strongly deformed, medium-grained, muscovite–biotite–garnet granite), the Dolland Brook Granite (Unit 17) and the Wolf Mountain Granite (Unit 18; Dickson, 1990b). The only tungsten mineralization known was discovered during the geochemical survey. There are two occurrences and two styles of mineralization. The first occurrence has little or no pyrite and is located in moderately fresh, pinkish brown medium grained, feldspar porphyritic biotite granite. Rock samples 4140503, 4140504 and 4140505 have tungsten values ranging from 248 to 402 ppm and were collected from two sites 30 m apart. It is classified as NMINO 011P/15/W 009 in the MODS records and is described as an indication. The second tungsten occurrence consists of vuggy quartz-(epidote) veins in the granite. No scheelite or wolframite ware identified in hand sample. The tungsten analysis from this outcrop, rock sample 4140506, was 856 ppm. It is not classified in the MODS database. The two occurrences are separated by about 200 m and are only exposed in stream beds.

BOTTOM BROOK AREA

The geology was mapped by Dickson (1990b); the area is underlain by the Riches Island Formation (Unit 7) of the Ordovician Baie D'Espoir Group composed of migmatite to highly deformed pelitic to psammitic schist, and by four units of the North Bay Granite Suite. The latter comprise the D'Espoir Brook Granite (Unit 12), the East Bay Granite (Unit 13), the Dolland Brook Granite (Unit 17, a medium-grained, equigranular, weakly foliated, muscovite–biotite granite), and the Dolland Pond Granite (Unit 21, a dominantly pink, massive to weakly-foliated, medium-grained, K-feldspar porphyritic, muscovite–biotite ± garnet granite). No mineralization is known in the area.

EAST BAY AREA

The western part of East Bay (NTS map area 11P/16) was mapped by Dickson (1990b) and the eastern part (NTS map area 1M/13) was mapped by Colman-Sadd (1976). The survey area is underlain by the Ordovician Riches Island Formation (Unit 7), which is intruded by numerous dykes of the East Bay Granite (Unit 13). There is no known mineralization within the stream-sediment survey area although there are several occurrences of molybdenum mineralization to the south and east.

FRANÇOIS GRANITE AREA

A few stream-sediment samples are from locations underlain by rocks of the Burgeo Intrusive Suite (Unit 11), consisting dominantly of foliated, granodiorite, tonalite and granite. Most of the sampled area is underlain by the northeast lobe of the bilobal Devonian François Granite (Dickson *et al.*, 1996) and most of the sample sites are underlain by Unit 27, a pink, coarse-grained, quartz and K-feldspar porphyritic biotite granite. This unit forms a concentric shell around the outer half of the lobe. Units 28, 29 and 30 (as well as Unit 27) are found within the core of the shell, themselves also forming somewhat concentric contact patterns. Unit 28 forms an irregular shell inside Unit 27. The lithology of Unit 28 is highly variable ranging from fine-grained, quartz-feldspar porphyritic biotite granite to fine- to coarse-grained, slightly porphyritic to equigranular granite. Unit 29 forms a shell within Unit 28. It is a buff to grey, medium-grained, quartz-plagioclase porphyritic biotite granodiorite. Unit 30 forms the innermost body. It is a pink, fine- to medium-grained, quartz-K-feldspar porphyritic biotite granite. There is no mineralization known in the northeast lobe of the François Granite.

ACKLEY GRANITE AREA

The entire area was mapped at 1:100 000 scale by Dickson (1983). The area within NTS map area 1M/10 was mapped by O'Brien *et al.* (1984) at 1:50 000 and includes most of the known mineralized area. A geological map of the area is shown in Figure 3 and the geological legend for units underlying sampled areas is included in Figure 4; the units are simplified from Crisby-Whittle (2012). The area to the south of the margin of the Ackley Granite is underlain primarily by mid to late Neoproterozoic rocks. The following descriptions are of the principal units underlying the sampled areas from oldest to youngest. The Simmons Brook Intrusive suite (Unit 1) has the oldest rocks in any of the survey areas and outcrops in NTS area 1M/14. The Ediacaran Belle Bay Formation (Unit 2) consists dominantly of felsic, non-marine volcanic and volcanic-derived epiclastic rocks. The Snooks Tolt member of the Belle Bay Formation, which underlies much of the sampled area, is described by O'Brien *et al.* (1984) as dominantly felsic and mafic pyroclastic rocks. The overlying Anderson's Cove Formation (Unit 3) consists of undifferentiated, grey, green and minor red, fine- to coarse-grained sandstone, slate and siltstone with granule to local boulder conglomerate. The Mooring Cove Formation (Unit 4) consists of rhyolitic flows and ash-flow tuffs, minor basaltic flows and sills. The Devonian or earlier Cross Hills Plutonic Suite is bimodal and is represented by gabbro, diabase and diorite in Unit 22, and by granodiorite, biotite granite and peralkaline granite in Unit 23. The Ackley Granite Suite is represented by two units. Unit 24 is a pink, massive, coarse-grained and locally medium-grained, K-feldspar-porphyritic or equigranular, biotite granite, and Unit 25 is a fine-grained pink granite and aplite.

There are five occurrences of tin mineralization in the surveyed portion of Unit 25 of the Ackley Granite. Three are described as showings and two as prospects. Typically, the mineralization occurs in topazite greisens and quartzolite dykes in the Ackley Granite, which are thought to represent late-stage fractionation products of the granite melt. Ore minerals are cassiterite and commonly wolframite; topaz and fluorite are frequent accessories (Tuach, 1991). All the occurrences are within the Ackley Granite and very close to the contact with the Snooks Tolt member of the Belle Bay Formation (Unit 2), described as "ash-flow: massive welded and layered ash-flow tuff, breccia, and massive non-welded tuff" (Tuach, 1991).

There are six occurrences of tungsten mineralization in the Ackley Granite. Five are described as indications and one is a showing. The tungsten occurrences are similar in nature to the tin occurrences being topazite greisen veins. Indeed cassiterite is commonly found along with wolframite and molybdenite.

There are six instances of molybdenum mineralization; these consist of one prospect, one showing and four indications. They belong to the same family of mineralization style as do the tin and tungsten mineralization described above. Typically, they are topazite greisens or quartzolites with molybdenite and commonly containing minor cassiterite, wolframite, pyrite, topaz or fluorite. The prospect (NMIN 001M/10/Mo 001) is by far the largest and was described in 1954 as a 120-m-long silicified zone extending from the granite to the contact with the volcanic rocks.

SURFICIAL GEOLOGY OF THE SURVEY AREAS

A map of the regional surficial geology of the region (GSNL, 2014; http://www.nr.gov.nl.ca/nr/mines/geoscience_online.html) with the locations of the stream and soil samples of the seven areas is shown in Figure 5. Individual areas are discussed below.

GRANITE LAKE AREA

McConnell (1984b) described the surficial deposits as extensively till-covered with little outcrop. Angular cobbles and boulders of local bedrock are common, whereas rounded cobbles and boulders of metasedimentary and metavolcanic rocks, similar to those mapped several kilometres to the north, are widespread but form a minor constituent of the till. Consequently, most of the till is believed to have been derived locally. Podzolic soil profiles are generally well developed. Typically, a leached grey or buff Ae-horizon and a reddish orange B-horizon overlie a sandy yellow till classified as C-horizon. The presence of metasedimentary boulders in an area underlain by granite extending for a few kilometres to the south of the sediment/granite contact indicates a southward direction of till transport. The few glacial striae shown on the surficial geological map (Figure 5) also show a generally southward ice-flow. Subsequent to the survey described in this report, the area was mapped by Liverman and Taylor (1994c).

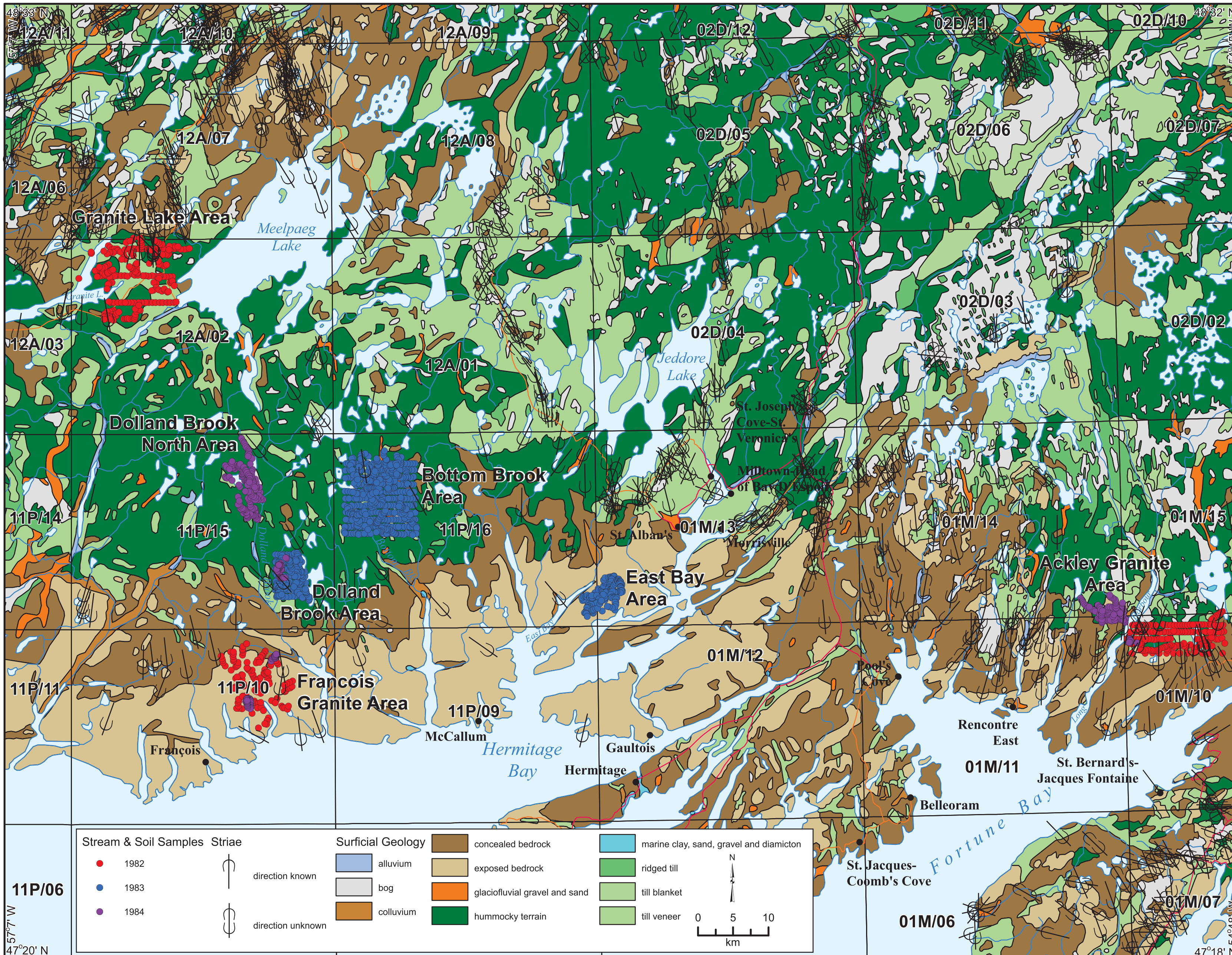

Figure 5. *Surficial geology map with sample sites for reference.*

DOLLAND BROOK AND DOLLAND BROOK NORTH AREAS

These areas were described (McConnell, 1985) as having near-continuous till cover with little bedrock exposure except along stream beds. The surficial geology was mapped at 1:250 000 scale primarily using air-photo interpretation and most of the area is described as, "hummocky terrain: a blanket of diamicton or sand and gravel, 1.5 to 15 m thick having irregular hummocky topography and relief of 2 to 10 m"(Liverman and Taylor, 1994b). No sand or gravel deposits were noted during the course of the stream and soil surveys. The two striae in the Dolland Brook area and the single striation in the Dolland Brook North area show a southeastward glacial movement.

BOTTOM BROOK AREA

Bottom Brook was described by McConnell (1984a) as having low relief and being covered by a moderate thickness of sandy till. Several ice-contact drift deposits and south-southeast-trending eskers were noted. Direction of ice movement is considered to have been generally southward to southeastward, based on two striae. Typically, the ground is mantled by large angular boulders of granite similar in composition to that observed in outcrop. However, the compositions of the small lithic fragments contained within the soil profile, as noted during soil sampling, were predominantly meta-clastic and meta-igneous suggesting a considerable distance (5–10 km) of transport. This observation suggests that a significant component of the soil material sampled may also be derived from a source several kilometres to the north. More recent surficial mapping shows most of the survey area to be underlain by hummocky terrain (Liverman and Taylor, 1994b).

EAST BAY AND FRANÇOIS GRANITE AREAS

These areas are typical of the broad strip along the south-central coast of Newfoundland which consist largely exposed bedrock with very little surficial material. Surficial mapping of the East Bay area was included in maps by Liverman and Taylor (1994a, b), and the François Granite area by Liverman and Taylor (1994b). Striae indicate a generally southward movement of ice in the François Granite area. None are shown in the immediate East Bay area.

ACKLEY GRANITE AREA

The surficial geology is described briefly by McConnell (1983). Most of the area is covered by a thin mantle of glacial till. The till is generally composed of poorly sorted sand and pebbles, with a few areas underlain by well-sorted, presumably waterlain, sands. Soil profiles are generally poorly developed and B horizons are commonly not clearly distinguishable. North–south-trending glacial striae were observed on one outcrop of polished quartzolite. Several striae are shown on the surficial geological map and directions range from south-southeastward to south-southwestward. The area is included in the 1:250 000-scale surficial map of Liverman and Taylor (1994a).

SAMPLE COLLECTION PROCEDURES

Three types of sample were collected – stream sediment, soil, and rock. The type of surficial sample collected varied by terrain and purpose. Stream sediments sample larger catchment areas than do soil or rock and are best used as a semi-reconnaissance survey mthod, for example between lake-sediment and soil surveys. The sediment is derived from both bedrock and till. Stream sediment in the François Granite area is an exception. There is very little surficial cover present and the sediment is derived from local bedrock. In the François Granite area there was too little soil cover to sample. In all cases, as the work was conducted prior to the development of portable GPS devices, UTM coordinates were determined in the field by reference to a 1:50 000-scale topographic map or to an aerial photograph. Generally, observations are considered accurate to within 25–100 m. In some cases, where locations were determined by pacing between stations over fairly featureless terrain, accuracy may be somewhat less.

Stream sediment was collected using a spade or by scooping up active sediment by hand. Generally, a sample was composited from two or three locations within a few metres of one another. The samples were stored in numbered, waterproof, Kraft-paper bags. In some areas, two bags were collected to ensure there was sufficient -180 µm material for analyses. Observations recorded on-site included UTM coordinates, stream width and depth, water colour, vegetation along stream, flow rate, sediment colour, presence or absence of mineral precipitation on stream bed or rocks, the colour of any mineral precipitation, and the nature of any possible contaminants present. Samples were returned to camp and air-dried prior to being sent to the departmental laboratory for processing.

Samples of B-horizon soil were preferentially collected using a spade and stored in numbered, waterproof, Kraft-paper bags. Generally the soils were podzolic and sample depths were 25–35 cm. Observations recorded onsite included UTM coordinates, local bedrock outcrop type, slope angle, relief, vegetation, depth, texture, soil horizon, material classification, colour, moisture, drainage and possible contamination. Samples were returned to camp and air-dried prior to being sent to the departmental laboratory for processing.

Rock samples were generally collected either to characterize the local bedrock or to sample suspected mineralization. Where possible, samples were obtained of fresh, unweathered rock. In some instances, samples of locally derived float were sampled if mineralized. Field observations noted included UTM coordinates, nature of outcrop/float, size of outcrop, degree of outcrop fracturing and veining, type of veining, outcrop homogeneity, rock type, metamorphic grade, texture, IUGS rock classification, foliation, weathering, colour, amounts of quartz, K-feldspar, plagioclase, Fe–Mg minerals and others, notes on economic mineralization if present and alteration.

SAMPLE PREPARATION, ANALYSIS AND DATA QUALITY

PREPARATION

Stream-sediment and soil samples underwent similar preparations. After being air-dried in the field, they were shipped to the departmental laboratory and oven-dried at 40°C. They were then hand-sieved through -180 µm stainless-steel sieves.

Rock samples were progressively reduced to a -100 µm pulp by passing through a jaw crusher and pulverizing in a disc-mill with alumina plates.

ANALYSIS

Stream sediment was analyzed for up to 39 unique elements and loss-on-ignition, using ten different methods. The analytical methods are summarized in Table 1. Analyses by instrumental neutron activation analysis (INAA) were problematic due to spectral interference for samples that have high uranium contents. Elements including samarium, europium and molybdenum were most affected and commonly yielded high detection limits for samples with uranium values greater than about 1000 ppm. Tungsten was analyzed by three different methods. Nearly all samples were analyzed by INAA (W1_ppm), some were analyzed by ICP-ES (W11_ppm) and some were analyzed by visible spectrometer (W13_ppm). There is not complete overlap of samples analyzed by at least two methods. For example, there are 30 samples analyzed only by INAA, 84 samples analyzed only by colorimetric and 5 samples analyzed only by ICP-ES. For this reason, symbol plots of all three analytical methods are provided. In addition, none of the 74 stream-sediment samples from the Ackley Granite have sufficient fine material to perform complete analytical suites. In particular, there are 71 analyses of fluoride, 60 analyses of tin, 37 analyses of silver, 35 analyses of elements in the AA suite and only 17 analyses by INAA. There were no analyses performed for loss-on-ignition.

Soil was analyzed for up to 15 unique elements and loss-on-ignition using 9 different methods. The analytical methods are summarized in Table 2. Note that two methods of analyses were employed for tungsten. Samples that were analyzed by both methods replicated quite well, so in areas that have analyses by the two methods, symbol plots include both types of analyses. Statistics were calculated on a merged data file that included both sets of data.

Rock was analyzed for up to 34 unique elements and loss-on-ignition using 9 different methods. The analytical methods are summarized in Table 3.

DATA QUALITY

To ensure and measure the reliability of the trace-element data, two methods were employed. At the analytical stage, a sample split, or laboratory duplicate, was inserted within every batch of 20 samples to measure precision. An international reference standard was also included in every 20 samples to monitor accuracy.

STATISTICAL ANALYSIS

SUMMARY STATISTICS

To quantify the range and distribution characteristics of the element populations, summary statistics have been calculated for the stream-sediment and soil data. Statistics tabulated include the median, arithmetic mean, geometric mean, arithmetic standard deviation, logarithmic standard deviation, minimum and maximum. The geometric means as well as arithmetic means are provided because the distributions of most element populations are more log-normal than normal. The frequency distributions of loss-on-ignition are an exception and tend to conform more closely to a normal distribution.

Table 1. Analytical methods for stream-sediment samples

Numeric Suffix	Elements/ Variables	Method	Preparation/ Digestion	External Laboratory
1 (*e.g.*, Au1_ppb)	As, Au, Ba, Br, Ce, Co, Cr, Cs, Eu, Fe, Hf, La, Lu, Mo, Na, Rb, Sb, Sc, Sm, Ta, Tb, Th, U, W, Yb, Zr	Instrumental Neutron Activation Analysis (INAA)	5 to 10 g in shrink-wrapped vial	Becquerel Laboratories
4 (*e.g.*, Cu4_ppm)	Cd, Co, Cu, Fe, Mn, Ni, Pb, Zn	Atomic Absorption Spectroscopy (AAS)[1]	HNO_3-HC1 (partial digestion)	
5 (Mo5_ppm)	Mo	Atomic Absorption Spectroscopy (AAS)	HNO_3/HC1/$A1^{3+}$	
6 (Ag6_ppm)	Ag	Atomic Absorption Spectroscopy (AAS)	HNO_3	
8 (U8_ppm)	U	Delayed Nuclear Activation	5 to 10 g in shrink-wrapped vial	Nuclear Activation Services
9 (F9_ppm)	F	Ion-selective electrode		
11 (W11_ppm)	W	Inductively coupled emission spectroscopy (ICP-ES)	HF-$HC1O_4$-HC1 (total digestion)	Acme Analytical Laboratories
12 (Sn12_ppm)	Sn	NH_4I sublimate		Chemex Laboratories
13 (W13_ppm)	W	Visible spectrometer	Lithium metaborate fusion followed by reaction with zinc dithiol	
	Loss-on-ignition (LOI_pct)	Gravimetric using muffle furnace raised to 500°C		

[1] Wagenbauer *et al.*, 1983

Table 2. Analytical methods for soil samples

Numeric Suffix	Elements/ Variables	Method	Preparation/ Digestion	External Laboratory
4 (*e.g.*, Cu4_ppm)	Cd, Co, Cu, Fe, Mn, Ni, Pb, Zn	Atomic Absorption Spectroscopy (AAS)[1]	HNO_3-HC1 (partial digestion)	
5 (Mo5_ppm)	Mo	Atomic Absorption Spectroscopy (AAS)	HNO_3/HC1/$A1^{3+}$	
6 (Ag6_ppm)	Ag	Atomic Absorption Spectroscopy (AAS)	HNO_3	
8 (U8_ppm)	U	Delayed Nuclear Activation	5 to 10 g in shrink-wrapped vial	Nuclear Activation Services
9 (F9_ppm)	F	Ion-selective electrode		
11 (W11_ppm)	W	Inductively coupled emission spectroscopy (ICP-ES)	HF-$HC1O_4$-HC1 (total digestion)	Acme Analytical Laboratories
12 (Sn12_ppm)	Sn	NH_4I sublimate		Chemex Laboratories
13 (W13_ppm)	W	Visible spectrometer	Lithium metaborate fusion followed by reaction with zinc dithiol	
	Loss-on-ignition (LOI_pct)	Gravimetric using muffle furnace raised to 500°C		

[1] Wagenbauer *et al.*, 1983

Table 3. Analytical methods for rock samples

Numeric Suffix	Elements/ Variables	Method	Preparation/ Digestion	External Laboratory
1 (*e.g.*, U1_ppm)	U, W	Delayed Nuclear Activation	5 to 10 g in shrink-wrapped vial	Nuclear Activation Services
2 (*e.g.*, Be2_ppm)	Be, Cu, Li, Mo, Ni Pb, Zn	Atomic Absorption Spectroscopy (AAS)[1]	HF-$HC1O_4$-HC1 (total digestion)	
6 (Ag6_ppm)	Ag	Atomic Absorption Spectroscopy (AAS)	HNO_3	
9 (F9_ppm)	F	Ion-selective electrode		
10 (*e.g.*, Ba10_ppm)	Ba, Ce, Cr, Ga, La Nb, Rb, Sr, Th, V, Y, Zr	X-ray fluorescence spectroscopy		Memorial University
11 (W11_ppm)	W	Inductively coupled emission spectroscopy (ICP-ES)	HF-$HC1O_4$-HC1 (total digestion)	Acme Analytical Laboratories
12 (Sn12_ppm)	Sn	NH_4I sublimate		Chemex Laboratories
13 (W13_ppm)	W	Visible spectrometer	Lithium metaborate fusion followed by reaction with zinc dithiol	
(*e.g.*, SiO_2_pct)	SiO_2, Al_2O_3, Fe_2O_3 FeO, MgO, CaO, Na_2O, K_2O, TiO_2, MnO, P_2O_5, LOI	*See* Wagenbauer *et al.* (1983)		

[1] Wagenbauer *et al.*, 1983

The summary statistics for the stream sediments (Table 4) are based on the data from all seven areas. Table 5 shows the summary statistics for the reconnaissance-scale soil samples from all four areas where soils were collected – Granite Lake, Dolland Brook, Bottom Brook and Ackley Granite. Because soil samples in the areas of tungsten mineralization might be expected to have different geochemical patterns than those collected around tin mineralization, statistics on the data collected from grids located over tungsten occurrences (Table 6) are calculated separately from data from grids over tin mineralization (Table 7).

HISTOGRAMS AND CUMULATIVE FREQUENCY CURVES

Histograms of the stream-sediment and soil variables are included in the symbol-plot maps showing the areal distributions. Histograms show the shape of the population distributions and may be useful when interpreting the distribution maps of these variables. Cumulative frequency curves are also incorporated into these maps. The curves show the percentage of samples whose values fall below a progressive range of variable values.

CORRELATION ANALYSIS OF SEDIMENT DATA

Spearman correlation coefficients were calculated for stream-sediment geochemical data from three different populations and are shown in Tables 8, 9 and 10. The first and largest group consists of the samples from areas having, or being close to, known tungsten mineralization. These include the Granite Lake, Dolland Brook, Dolland Brook North, Bottom Brook and East Bay survey areas. The second set of samples comes from the François Granite area, which is typified by samples with high concentrations of molybdenum, tin, tungsten and uranium, but which has no known mineralization. The Ackley Granite area provides the third set and is the only area known to have tin mineralization. It also contains some minor tungsten mineralization. In addition to the potential ore metals (tin, tungsten, molybdenum or uranium, depending on the area), the environmental parameters iron (Fe4) and loss-on-ignition (LOI) are included in all tables.

For both stream-sediment and soil correlations, the term **strong correlation** refers to correlation coefficients between the absolute values of 0.60 and 1.00. The term **moderate correlation** refers to coefficients between the absolute values of 0.30 and 0.59. Coefficients less than the absolute value of 0.30 are termed **weak correlations**.

Granite Lake, Dolland Brook, Dolland Brook North, Bottom Brook and East Bay Areas

This first set of data was selected to include only data which had Spearman correlations (r) greater than or equal to the absolute value of 0.40 between elements and one of the potentially economic metals tungsten, molybdenum or uranium. The coefficients are shown in Table 8. Elements having the strongest correlations with the ore metals are shown in bold. The elements with the strongest associations with W1 are Mo5 (r=0.70) and Zn4 (r=0.63). However, all three potentially economic metals share moderate to strong correlations with Fe4 (r= 0.42 to 0.82) suggesting that at least some of the association is due to iron (hydr)oxide scavenging.

The elements with the strongest correlations with molybdenum (Mo5), other than iron and manganese, are Zn4 (r=0.83), Co4 (r=0.77) and Cd4 (r=0.73). Except for Cd4, these elements all

Table 4. Summary statistics for stream-sediment data

Element/ Variable	N	Median	Mean Arithmetic	Mean Geometric	Standard Deviation Arithmetic	Standard Deviation Logarithmic	Minimum	Maximum
Ag6_ppm	879	<0.1	0.19	0.13	0.30	0.28	0.1	3
As1_ppm	1041	24	106	24	189	0.86	0.2	1760
Au1_ppb	1041	<1	0.8	0.6	1.27	0.26	0.5	21
Ba1_ppm	1041	250	294	219	483	0.34	25	14000
Br1_ppm	1041	35	46	34	42.2	0.34	1	525
Cd4_ppm	1139	0.2	1.6	0.3	8.20	0.64	0.1	185
Ce1_ppm	1041	96	149	104	170	0.37	2	1900
Co1_ppm	1041	4	32	6	70.2	0.79	1	719
Co4_ppm	1139	6	29	7	62.3	0.72	1	740
Cr1_ppm	1041	17	27	11	36.2	0.64	2	350
Cs1_ppm	1041	3.2	4.7	3.3	4.11	0.40	0.2	36
Cu4_ppm	1139	7	17	8	40.9	0.41	1	685
Eu1_ppm	1041	0.2	1.0	0.5	1.43	0.48	0.2	16
F9_ppm	1175	348	443	347	345	0.31	5	2782
Fe1_pct	1041	3.30	6.88	3.49	8.01	0.53	0.1	41.8
Fe4_pct	1139	2.64	6.09	2.68	7.94	0.60	0.06	42.8
Hf1_ppm	1041	7.0	7.1	5.3	4.96	0.39	0.5	39
La1_ppm	1041	39	51	42	45.4	0.26	1	670
Lu1_ppm	1041	0.25	0.4	0.1	0.62	0.71	0.02	4.8
Mn4_ppm	1139	430	11158	871	30200	1.02	4	330000
Mo1_ppm	1041	10	62.7	9.4	206	0.86	0.5	3280
Mo5_ppm	1136	12	73.7	14	259	0.74	1	3790
Na1_pct	1041	1.40	1.41	1.03	0.81	0.44	0.02	3.9
Ni4_ppm	1139	4	6	4	7.00	0.39	1	62
Pb4_ppm	1139	24	48	25	73.8	0.50	1	827
Rb1_ppm	1041	66	96	59	93.6	0.51	2	592
Sb1_ppm	1041	0.30	0.31	0.24	0.24	0.34	0.05	2.7
Sc1_ppm	1041	4.9	5.7	4.9	3.21	0.24	0.5	35
Sm1_ppm	1041	5.6	7.4	4.8	7.75	0.49	0.1	90.5
Sn12_ppm	760	<2	3.9	1.7	10.4	0.43	1	165
Ta1_ppm	1041	1.1	2.1	1.1	2.60	0.48	0.1	15
Tb1_ppm	1041	1.0	1.4	1.0	1.68	0.37	0.2	25
Th1_ppm	1041	17	25	18	23.9	0.36	0.5	253
U1_ppm	1041	24	75	25	250	0.57	1.1	3620
U8_ppm	303	54	122	55	280	0.48	3.9	2500
W1_ppm	1041	5	18.5	7.0	39.3	0.59	0.5	610
W11_ppm	522	2	11.1	4.5	39.1	0.46	2	760
W13_ppm	573	8	21.8	9.2	43.8	0.57	1	580
Yb1_ppm	1041	2.5	4.4	2.2	7.30	0.56	0.2	127
Zn4_ppm	1139	45	100	48	236	0.48	2	4550
Zr1_ppm	1041	<100	124	79	152	0.36	50	1400
LOI_pct	836	20.7	25.0	19.7	16.7	0.32	0.4	96
width_m	1192	1.5	3.1	1.7	4.70	0.45	0.1	50
depth_cm	1185	20	20	16	15.2	0.29	0	200

Table 5. Summary statistics from reconnaissance-scale soils data

Element/ Variable	N	Median	Mean Arithmetic	Mean Geometric	Standard Deviation Arithmetic	Standard Deviation Logarithmic	Minimum	Maximum
Ag6_ppm	698	<0.2	0.12	0.11	0.19	0.14	0.1	3.0
As21_ppm	179	1.0	1.4	1.1	1.16	0.26	0.5	9
Cd4_ppm	698	<0.2	0.1	0.1	0.09	0.09	0.1	2
Co4_ppm	698	1	1	1	1.13	0.18	1	17
Cu4_ppm	698	3	4	3	5.62	0.35	1	61
F9_ppm	297	144	216	157	220	0.33	20	1398
Fe4_pct	698	0.87	1.08	0.80	1.16	0.36	0.01	20.3
Mn4_ppm	698	37	98	38	759	0.34	1	14500
Mo5_ppm	698	1	3	2	18.6	0.31	1	407
Ni4_ppm	698	2	2	2	2.24	0.31	1	20
Pb4_ppm	698	8	12	8	21.8	0.30	1	370
Sn12_ppm	698	<2	10	2	218	0.34	1	5750
U8_ppm	283	6.3	10.0	6.9	25.4	0.25	2.5	312
W11_ppm	456	2	2.7	2.2	4.06	0.20	1	65
W13_ppm	250	4	19	5	84.5	0.49	1	955
W11&W13ppm	696	2	8	3	51.2	0.36	1	955
Zn4_ppm	698	8	11	8	11.0	0.33	1	109
LOI_pct	698	13.4	15.5		11.7		1	99.2
depth_cm	694	30	30	27	14.6	0.22	5	100

Table 6. Summary statistics from grid soils from tungsten mineralized zones in the Granite Lake and Dolland Brook survey areas

Element/ Variable	N	Median	Mean Arithmetic	Mean Geometric	Standard Deviation Arithmetic	Standard Deviation Logarithmic	Minimum	Maximum
Ag6_ppm	51	<0.2	0.17	0.14	0.15	0.24	0.1	0.8
As21_ppm	31	9	9.1	6.4	6.16	0.44	0.5	25
Cd4_ppm	151	<0.2	0.1	0.1	0.10	0.16	0.1	0.9
Co4_ppm	151	1	4	2	16.0	0.37	1	191
Cu4_ppm	151	4	10	6	12.0	0.45	1	83
F9_ppm	151	156	200	162	143	0.28	35	836
Fe4_pct	151	0.87	1.66	0.93	2.56	0.45	0.05	18.3
Mn4_ppm	151	56	597	67	3825	0.54	1	39500
Mo5_ppm	151	1	15	3	97.8	0.37	1	1200
Ni4_ppm	151	2	4	2	4.17	0.29	1	32
Pb4_ppm	151	7	8	6	6.1	0.00	1	61
Sn12_ppm	0	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
U8_ppm	48	3.9	4.9	4.1	3.7	0.00	1.8	21.7
W11_ppm	0	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
W13_ppm	150	4	49	9	89.9	0.83	1	575
W11&W13ppm	150	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Zn4_ppm	151	15	27	16	37.4	0.36	2	249
LOI_pct	151	12.4	14.7		11.3		0.6	50.2
depth_cm	151	40	73	46	96.1	0.36	10	500

Note: N.D. indicates no data

Table 7. Summary statistics from grid soils from tin mineralized zones in the Ackley Granite survey area

Element/ Variable	N	Median	Mean Arithmetic	Mean Geometric	Standard Deviation Arithmetic	Standard Deviation Logarithmic	Minimum	Maximum
Ag6_ppm	101	<0.2	0.12	0.11	0.13	0.14	0.1	1.3
As21_ppm	53	1	1.7	1.3	1.43	0.30	0.5	7
Cd4_ppm	101	<0.2	0.1	0.1	0.02	0.06	0.1	0.2
Co4_ppm	101	1	1	1	0.33	0.07	1	4
Cu4_ppm	101	2	3	2	3.61	0.35	1	24
F9_ppm	101	164	294	213	266	0.34	51	1540
Fe4_pct	101	0.46	0.58	0.49	0.36	0.27	0.06	2.24
Mn4_ppm	101	28	67	35	164	0.38	10	1420
Mo5_ppm	101	2	4	3	4.1	0.27	1	38
Ni4_ppm	101	1	1	1	1.14	0.19	1	8
Pb4_ppm	101	11	27	13	67.2	0.41	2	577
Sn12_ppm	101	3	6.0	3.3	8	0.45	1	37
U8_ppm	53	5.8	7.0	6.4	3.3	0.19	2.9	17.4
W11_ppm	48	2	3.2	2.4	2.73	0.33	1	14
W13_ppm	53	3	3.2	2.7	2.0	0.26	1	10
W11&W13ppm	101	3	3.2	2.6	2.3	0.29	1	14
Zn4_ppm	101	6	14.0	7.1	41.4	0.38	1	402
LOI_pct	101	7.0	9.0		6.4		0.2	36.4
depth_cm	101	40	39	36	13.9	0.18	10	70

Table 8. Spearman correlation coefficients in stream-sediment data from Granite Lake, Dolland Brook, Dolland Brook North, Bottom Brook and East Bay survey areas

Correlation Coefficients

	Ag6_ppm	As1_ppm	Cd4_ppm	Ce1_ppm	Co1_ppm	Co4_ppm	F9_ppm
W1_ppm	0.47	0.52	0.58	0.46	0.55	0.52	0.49
Mo5_ppm	0.55	0.66	**0.73**	0.60	0.73	**0.77**	0.68
U1_ppm	0.30	0.30	**0.50**	**0.56**	0.38	0.40	0.39
Fe4_pct	0.36	0.85	0.58	0.52	0.74	0.79	0.63
LOI_pct	0.47	0.04	0.56	0.21	0.19	0.12	0.08

	Fe4_pct	Mn4_ppm	Mo1_ppm	Mo5_ppm	U1_ppm	W1_ppm	Zn4_ppm
W1_ppm	0.62	0.61	0.68	**0.70**	0.41	1.00	**0.63**
Mo5_ppm	0.82	**0.81**	0.93	1.00	0.61	**0.70**	**0.83**
U1_ppm	0.42	0.43	0.51	**0.61**	1.00	0.41	0.47
Fe4_pct	1.00	0.83	0.77	**0.81**	0.42	0.62	0.83
LOI_pct	0.20	0.19	0.35	**0.43**	**0.43**	0.26	0.21

Correlations >|0.09| are significant at the 0.01 confidence level.
Correlations >|0.06| are significant at the 0.05 confidence level.
N=666 for Ag6, 851 for As1, Ce1, Co1, Fe1, Mo1 and U1 and 843 for all others.

correlate quite strongly with Fe4, so some of the apparent association is likely due to scavenging by iron and manganese (hydr)oxides.

The elements with the strongest correlations with uranium (U1) are Mo5 (r=0.61), Ce1 (r=0.56) and Cd4 (r=0.50). Uranium has only a moderate correlation with Fe4 (r=0.42), so these associations are likely real and appear to be little affected by scavenging.

François Granite Area

The data generally have stronger inter-element correlations than do those in the previous set. To focus on the strongest associations, non-ore-metal variables were selected which had a correlation coefficient (r) greater than the absolute value of 0.45 with one of the possible ore-metal variables (Mo5, Sn12, U1 and W1). The coefficients are shown in Table 9. The elements with the strongest correlations with molybdenum (Mo5), other than iron and manganese, are Zn4 (r=0.63), As1 (r=0.54), Co4 (r=0.49) and F9 (r=0.47). All of these elements have even stronger correlations with iron (Fe4) with the exception of fluoride (F9). Mo5 also has a strong correlation with Fe4 (r=0.74). Together, this suggests that much of the apparent association is due to iron and manganese (hydr)oxide scavenging.

Table 9. Spearman correlation coefficients in stream-sediment data from the François Granite survey area

Correlation Coefficients

	Ag6_ppm	As1_ppm	Cd4_ppm	Co4_ppm	Cu4_ppm	F9_ppm	Fe4_pct	Mn4_ppm	Mo1_ppm	Mo5_ppm
Mo5_ppm	0.14	**0.54**	0.20	**0.49**	0.39	**0.47**	**0.74**	0.75	0.76	1.00
Sn12_ppm	0.03	0.04	0.07	0.04	0.40	-0.11	0.06	0.17	0.05	0.12
U1_ppm	0.49	0.46	0.54	0.27	0.52	0.39	0.28	0.51	0.22	0.41
W1_ppm	0.34	0.26	0.27	0.21	**0.44**	**0.44**	0.17	0.30	0.33	0.37
Fe4_pct	0.14	0.65	0.16	0.52	0.33	0.40	1.00	0.74	0.56	**0.74**
LOI_pct	0.48	0.54	0.35	-0.01	0.33	0.10	0.19	0.13	0.19	0.09

	Ni4_ppm	Pb4_ppm	Sb1_ppm	Sn12_ppm	Tb1_ppm	U1_ppm	W1_ppm	Yb1_ppm	Zn4_ppm
Mo5_ppm	0.23	0.44	0.12	0.12	0.17	0.41	0.37	0.10	**0.63**
Sn12_ppm	**0.65**	**0.58**	0.48	1.00	0.19	0.20	0.18	0.25	0.30
U1_ppm	0.24	**0.67**	0.36	0.20	**0.64**	1.00	0.35	**0.59**	**0.59**
W1_ppm	0.10	0.35	0.05	0.18	0.17	0.35	1.00	0.33	**0.43**
Fe4_pct	0.39	0.45	0.24	0.06	0.14	0.28	0.17	-0.05	0.69
LOI_pct	0.12	0.25	0.43	0.00	0.22	**0.36**	0.08	0.14	0.23

Most correlations >|0.20| are significant at the 0.01 confidence level.
Most correlations >|0.15| are significant at the 0.05 confidence level.
N=153 for Ag6, 163 for INAA analyses (*e.g.*, Mo1), 199 for AAS analyses (*e.g.*, Cu4) and 176 for Sn12.

The elements having the strongest correlations with tin (Sn12) are Ni4 (r=0.65), Pb4 (r=0.58) and Sb1 (r=0.48). Sn12 has no significant correlation with Fe4 (r=0.06), hence the possibility of scavenging is not a concern here.

The elements having the strongest correlations with uranium (U1) are Pb4 (r=0.67), Tb1 (r=0.64), Yb1 (r=0.59) and Zn4 (r=0.59). Since U1 has a low correlation with Fe4 (r=0.28), scavenging is of little concern. Moreover Tb1 and Yb1 also have very low correlations with Fe4 (r=0.14 and -0.05, respectively).

No elements show strong correlations with tungsten (W1). Moderate correlations are displayed by Cu4 (r=0.44), F9 (r=0.44) and by Zn4 (r=0.43). Since tungsten has a low correlation with Fe4 (r=0.17), scavenging is not a concern here.

Ackley Granite Area

As described previously, no samples from the Ackley Granite area had sufficient fine material to conduct the entire suite of analyses. As a result, correlations may be less meaningful than for other areas. Because only 17 samples with INAA data (*e.g.*, As1, Ba1) share points in common with Sn12 and Mo5, these data are not included. The ore metals tin (Sn12) and molybdenum (Mo5) were selected for correlations because mineral occurrences of both of these are found in the survey area. Spearman correlation coefficients are shown in Table 10.

Table 10. Spearman correlation coefficients in stream-sediment data from the Ackley Granite survey area

	Correlation Coefficients									
	Ag6_ppm	Cd4_ppm	Co4_ppm	Cu4_ppm	F9_ppm	Mn4_ppm	Mo5_ppm	Pb4_ppm	Sn12_ppm	Zn4_ppm
Sn12_ppm	0.06	-0.13	0.07	-0.02	-0.04	-0.05	-0.08	-0.11	1.00	-0.10
Mo5_ppm	0.09	**0.82**	0.71	0.52	**0.72**	0.79	1.00	0.62	-0.08	**0.81**
Fe4_pct	-0.15	0.41	0.76	0.10	0.65	0.68	**0.73**	0.31	-0.01	0.40

N varies from N=35 for Ag6, Mo5, Cd4, Co4, Cu4, Fe4, Mn4, Pb4 and Zn4 to N=60 for F9 and Sn12.

No elements have even moderate correlations with tin (Sn12), but several elements do have strong correlations with molybdenum (Mo5). The strongest of these are Cd4 (r=0.82), Zn4 (r=0.81) and F9 (r=0.72). Mo5 and F9 have strong correlations with Fe4 (r=0.73) and (r=0.65) respectively, so some of the association of fluoride and tin may be due to iron (hydr)oxide scavenging. Cd4 and Zn4, however, have only moderate correlations with Fe4, r=0.41 and r=0.40 respectively, so the association of these metals with molybdenum is likely primary.

CORRELATION ANALYSIS OF SOIL DATA

Three populations of soil data from grid sampling (rather than from reconnaissance sampling) were selected for correlation analysis, the rationale being that element associations in the vicinity of mineralization would be of most interest from a prospecting perspective. The first population is from the Granite Lake area, which is known to host tungsten and molybdenum mineralization and also has elevated values of uranium in lake sediment. The second population is from the Dolland Brook area, which hosts a scheelite-bearing quartz–tourmaline vein. The final population includes the soil samples from the four grids on the Ackley Granite area. Two of the grids are in the vicinity of tin-bearing outcrops, one is near a tin and molybdenum showing, and one is near two fluorite-bearing greisen outcrops, one analyzing 2000 ppm W13 and a trace amount of Sn12, and the other analyzing 280 ppm Sn12 and only 13 ppm W13.

Granite Lake Area

Correlations coefficients were calculated for the analytical data with tungsten (W13), molybdenum (Mo5) and uranium (U8) and are presented in Table 11. Tungsten has no strong correlations and only a moderate one with fluoride, r=0.36.

Molybdenum has somewhat stronger correlations with three variables, copper, zinc and fluoride. These have r values of 0.66, 0.64 and 0.57, respectively. Mo5 has a moderate correlation with Fe4 (0.35) and the correlations of the other three elements with Fe4 are all less than their correlations with Mo5; thus iron (hydr)oxide scavenging does not appear to play a significant role in their associations with Mo5.

Table 11. Spearman correlation coefficients in grid-soil data from Granite Lake survey area

	Correlation Coefficients						
	Ag6_ppm	Cd4_ppm	Co4_ppm	Cu4_ppm	F9_ppm	Fe4_pct	LOI_pct
W13_ppm	0.16	-0.06	-0.07	0.04	**0.36**	-0.03	0.01
Mo5_ppm	0.15	0.35	0.39	**0.66**	**0.57**	0.35	-0.04
U8_ppm	-0.07	0.34	**0.54**	0.32	0.29	-0.24	-0.10
Fe4_pct	0.49	0.11	-0.03	0.41	-0.08	1.00	0.66
LOI_pct	0.51	-0.06	-0.27	0.16	-0.37	-0.66	1.00
	Mn4_ppm	Mo5_ppm	Ni4_ppm	Pb4_ppm	U8_ppm	W13_ppm	Zn4_ppm
W13_ppm	-0.04	0.25	-0.19	-0.04	-0.06	1.00	0.00
Mo5_ppm	0.32	1.00	0.22	0.33	0.05	0.25	**0.64**
U8_ppm	0.53	0.05	0.30	0.19	1.00	-0.06	0.36
Fe4_pct	0.17	0.35	-0.18	0.33	-0.24	-0.03	0.27
LOI_pct	-0.12	-0.04	-0.38	0.31	-0.10	0.01	-0.02

Correlations >|0.37| are significant at the 0.01 confidence level.
Correlations >|0.28| are significant at the 0.05 confidence level.
N=49.

Uranium (U8) has only one moderate correlation and it is with Co4 (r=0.54). Neither uranium nor cobalt has a positive correlation with iron in this area so it is concluded that scavenging is not a concern.

Dolland Brook Area

The analytical data were correlated with tungsten (W13) and molybdenum (Mo5) and are shown in Table 12. All correlations are low. With tungsten, only cobalt (Co4) and molybdenum (Mo5) have correlations that are significant at the 0.01% confidence levels. These have r values of 0.29 and 0.27, respectively. Moreover, they both have stronger correlations with iron (Fe4) as does molybdenum (Mo5) so that even these weak associations are not significant from a metallogenic point of view. The three strongest correlations with molybdenum are iron (r=0.46), zinc (r=0.38) and cobalt (r=0.33).

Table 12. Spearman correlation coefficients in grid-soil data from the Dolland Brook survey area

Correlation Coefficients

	Cd4_ppm	Co4_ppm	Cu4_ppm	F9_ppm	Fe4_pct	LOI_pct
W13_ppm	0.19	**0.29**	0.08	0.17	0.14	0.05
Mo5_ppm	0.31	**0.33**	0.25	0.27	**0.46**	0.31
Fe4_pct	0.08	0.39	0.31	0.25	1.00	0.30
LOI_pct	-0.06	-0.42	-0.41	-0.45	0.30	1.00

	Mn4_ppm	Mo5_ppm	Ni4_ppm	Pb4_ppm	W13_ppm	Zn4_ppm
W13_ppm	0.33	**0.27**	0.15	-0.12	1.00	0.20
Mo5_ppm	0.34	1.00	0.11	0.29	0.27	**0.38**
Fe4_pct	0.39	0.46	0.12	0.31	0.14	0.43
LOI_pct	-0.34	0.31	-0.60	0.55	0.05	-0.35

Correlations >|0.26| are significant at the 0.01 confidence level.
Correlations >|0.19| are significant at the 0.05 confidence level.
N=101.

Ackley Granite Area

Correlation coefficients for the analytical variables were calculated with tin (Sn12), molybdenum (Mo5) and tungsten (W11 and W13) in Table 13. The last variable combines 48 analyses of W11 performed on some samples with 53 analyses of W13 performed on the remaining samples.

Tin has strong to moderate correlations with F9 (r=0.70), U8 (r=0.66), W11 and W13 (r=0.53) and Mo5 (r=0.50). In all cases, these correlations are considerably stronger than the corresponding correlations of these elements with Fe4.

Table 13. Spearman correlation coefficients in grid-soil data from the Ackley Granite survey area

	Correlation Coefficients						
	Ag6_ppm	Cd4_ppm	Co4_ppm	Cu4_ppm	F9_ppm	Mn4_ppm	Mo5_ppm
Sn12_ppm	0.11	-0.04	-0.03	0.35	**0.70**	0.35	**0.50**
Mo5_ppm	0.12	-0.16	-0.07	**0.56**	**0.56**	0.35	1.00
W11&W13ppm	0.15	-0.01	0.13	0.32	**0.58**	0.43	0.31
Fe4_pct	0.21	-0.03	0.27	0.62	0.34	0.55	0.39
LOI_pct	0.20	-0.01	0.07	0.20	-0.17	-0.09	0.06

	Ni4_ppm	Pb4_ppm	Sn12_ppm	U8_ppm	W11&W13ppm	Zn4_ppm
Sn12_ppm	0.22	0.19	1.00	**0.66**	**0.53**	0.38
Mo5_ppm	0.19	0.16	0.50	**0.81**	0.31	0.28
W11&W13ppm	0.29	0.33	**0.53**	**0.69**	1.00	0.40
Fe4_pct	0.30	0.48	0.16	0.44	0.33	0.49
LOI_pct	-0.02	0.20	-0.20	-0.01	0.05	-0.09

Correlations >|0.25| are significant at the 0.01 confidence level for all variables except U8_ppm.
Correlations >|0.20| are significant at the 0.05 confidence level for all variables except U8_ppm.
N=101 for all variables except U8 for which N=53.

Molybdenum has a very strong correlation with U8 (r=0.81). It has moderate correlations (r=0.56) with both Cu4 and F9. Since it has only a correlation of r=0.39 with Fe4, it is concluded that scavenging does not affect the distribution pattern.

Tungsten, in addition to the correlation with tin noted above, correlates quite strongly with uranium (r=0.69) and moderately with fluoride (r=0.58). In both cases, the correlations with tungsten are considerably stronger than those with iron, suggesting that scavenging by iron (hydr)oxides does not significantly affect the distribution pattern.

ELEMENT DISTRIBUTION MAPS AND DISCUSSION

Symbol-plot maps of the various elements and variables were produced for most using quantile divisions. For most elements there are sufficient data points above the detection limit to group the data into six quantile divisions: less than 50th percentile, 50th–70th percentile, 70th–85th percentile, 85th–95th percentile, 95th–98th percentile and greater than 98th percentile. For elements that have too few data above the detection limit, only four or five divisions are used. The intervals for loss-on-ignition are an exception; in this instance, the range is divided into five, 20 percentile quantiles. The cumulative frequency curve for each variable is shown in its symbol-plot figure. For discussion purposes, the term 'high value' will refer to the highest interval on the associated dot-plot map shown by red dots, the term 'elevated value'will refer to the second highest interval shown by orange dots, the term 'moderate value' will refer to the third highest interval shown by green dots and the term 'low values' will refer to the lowest interval shown by black dots. For most figures, the six dot-classes were sorted sequentially in order of size so that the smallest and lowest-value symbols plot on the top, and the largest and highest-value symbols (red) plot on the bottom to ensure no symbols are obscured. This method works well where samples are spaced at a relatively low density. In the figures for stream-sediment data that encompass the Dolland Brook, Dolland Brook North, Bottom Brook and East Bay areas, the symbols are reversed in size and stacking order so that the highest-value samples are superimposed on the lower values samples. This is a result of the high density of samples and to ensure that no high-value samples are hidden. The element plots are presented as PDF files. This format permits areas of interest to be examined in detail by zooming to the most appropriate scale while still retaining high resolution.

The intervals and histograms for stream-sediment data are based on all stream data except duplicates. The intervals and histograms for both reconnaissance and grid soil sample data are based on the reconnaissance data.

Elements and variables of direct economic interest are presented as symbol-plot figures and discussed within the text. The others are presented only as figures in the appendices.

The symbols are overlaid on 1:50 000- or 1:100 000-scale bedrock geology maps (Crisby-Whittle, 2012) and 1:50 000- or 1:250 000-scale drainage features. Occurrences of tungsten, tin and molybdenum mineralization (MODS, 2013) are plotted as colour-coded triangles. A legend for the mineralization symbols is provided in Figure 4 and serves for all the sample-location and element-distribution figures.

DISTRIBUTION IN STREAM SEDIMENTS

The locations of stream-sediment sampling areas, with sites colour-coded by year of collection, are shown in Figure 6. Figures showing the locations of individual, numbered sample-sites for the Granite Lake, Dolland Brook, Dolland Brook North, Bottom Brook, East Bay, François Granite and Ackley Granite areas are shown in Figures 7 to 13, respectively. Each sample site is identified with the last 3 digits of the sample's field number. In some areas, particularly the Dolland Brook and Bottom Brook areas, many sites do not plot on streams shown on the 1:50 000 drainage layer. These sites were located by identifying streams that only appear on aerial photographs.

Symbol maps showing element and variable contents are presented for three survey areas or groups of areas, notably the Granite Lake area, a figure combining the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas, and, finally, the Ackley Granite area; a geochemical legend and histogram accompanies each figure. These are derived from the entire stream-sediment population, not just from the particular area or areas illustrated in a figure.

Elements of economic interest or that may be associated with elements of economic interest, some elements of geologic interest, and the variables iron and loss-on-ignition, which may affect the concentration of economic elements in a sample, are included and discussed in this report. All other elements except U8 are plotted and included in Appendix 1 without discussion. U8 is not plotted because only 303 samples were analyzed. It is included in the data because it has a simi-

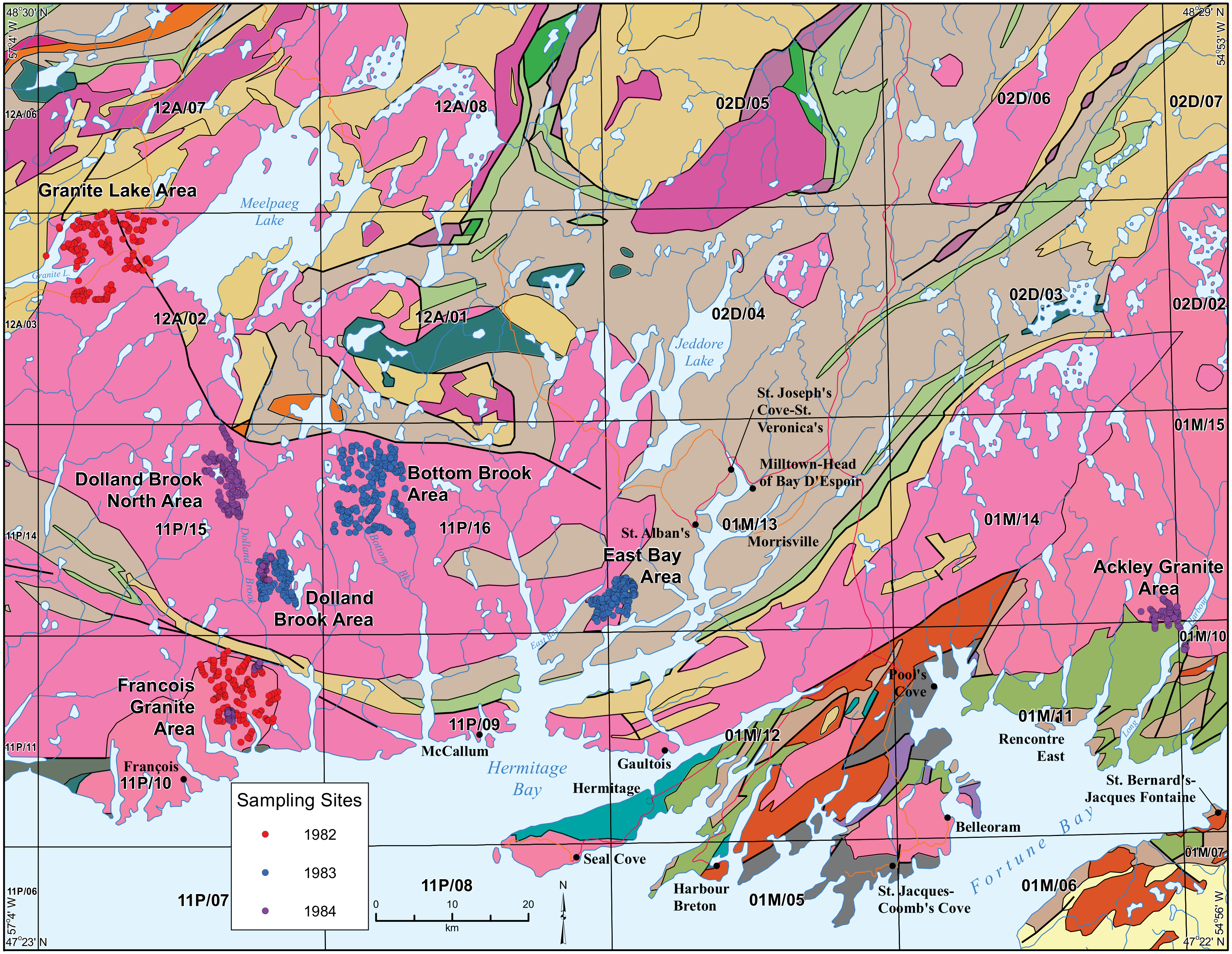

Figure 6. *Stream-sediment sampling areas.*

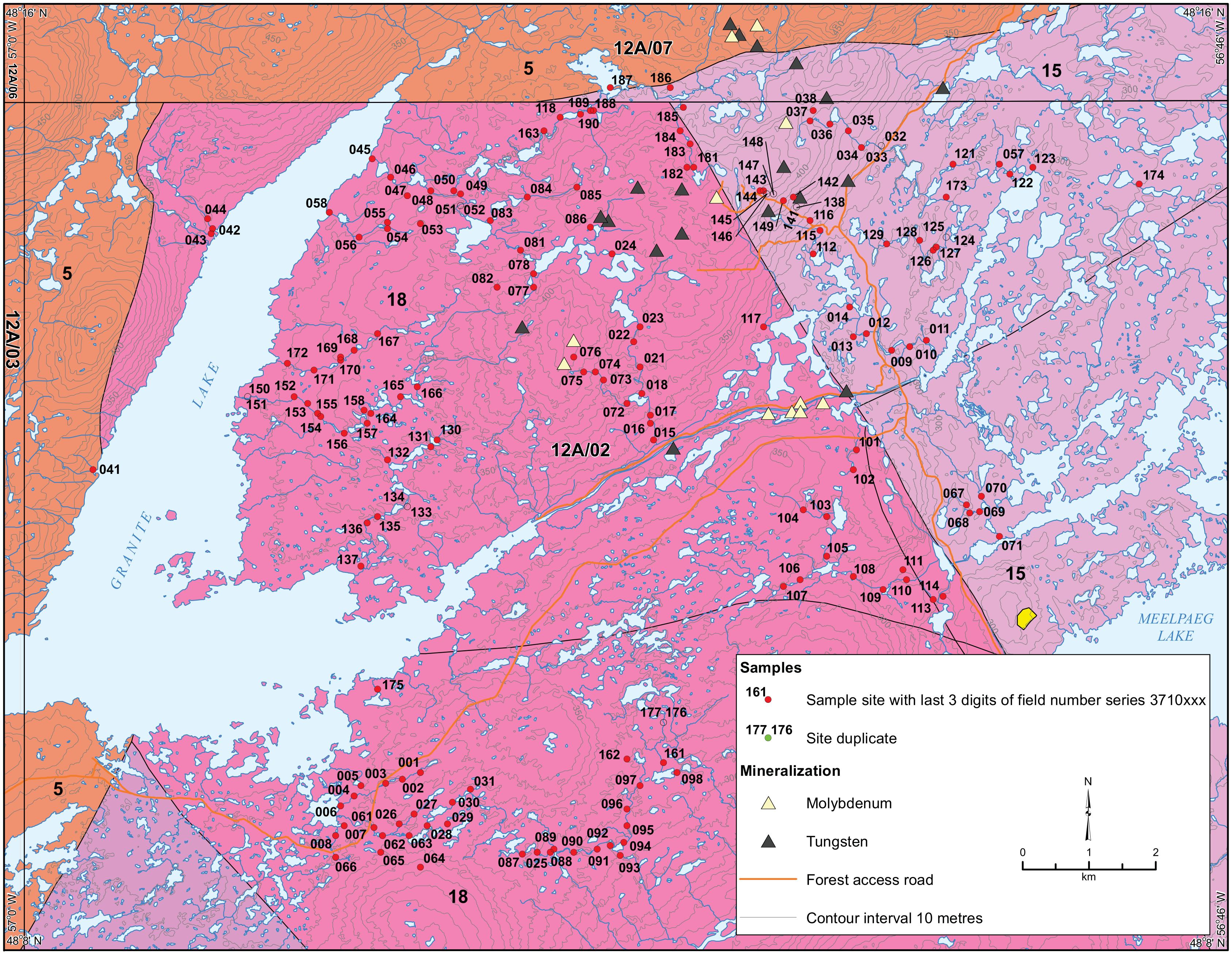

Figure 7. *Stream-sample locations with sample numbers in the Granite Lake area.*

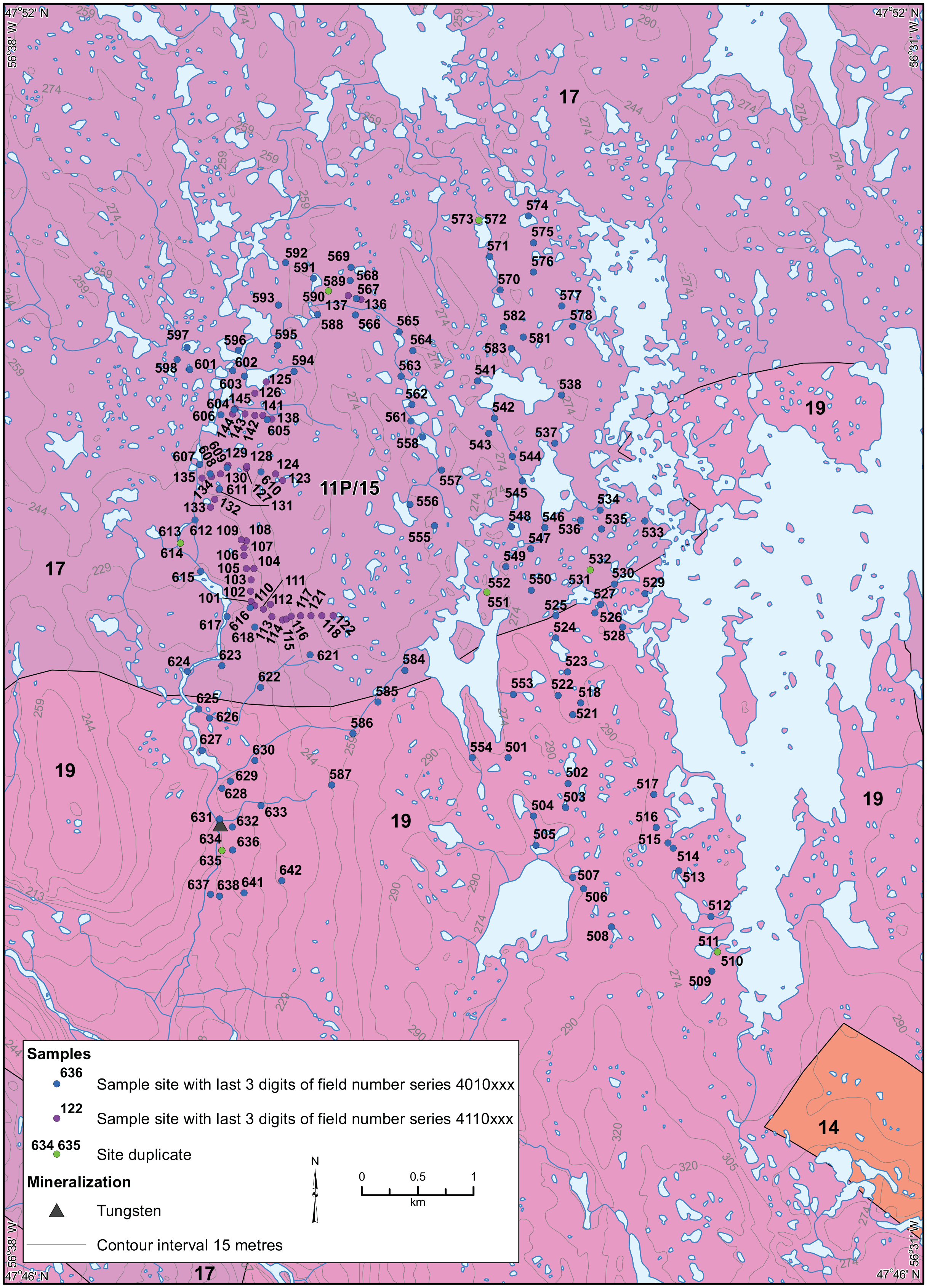

Figure 8. *Stream-sample locations with sample numbers in the Dolland Brook area.*

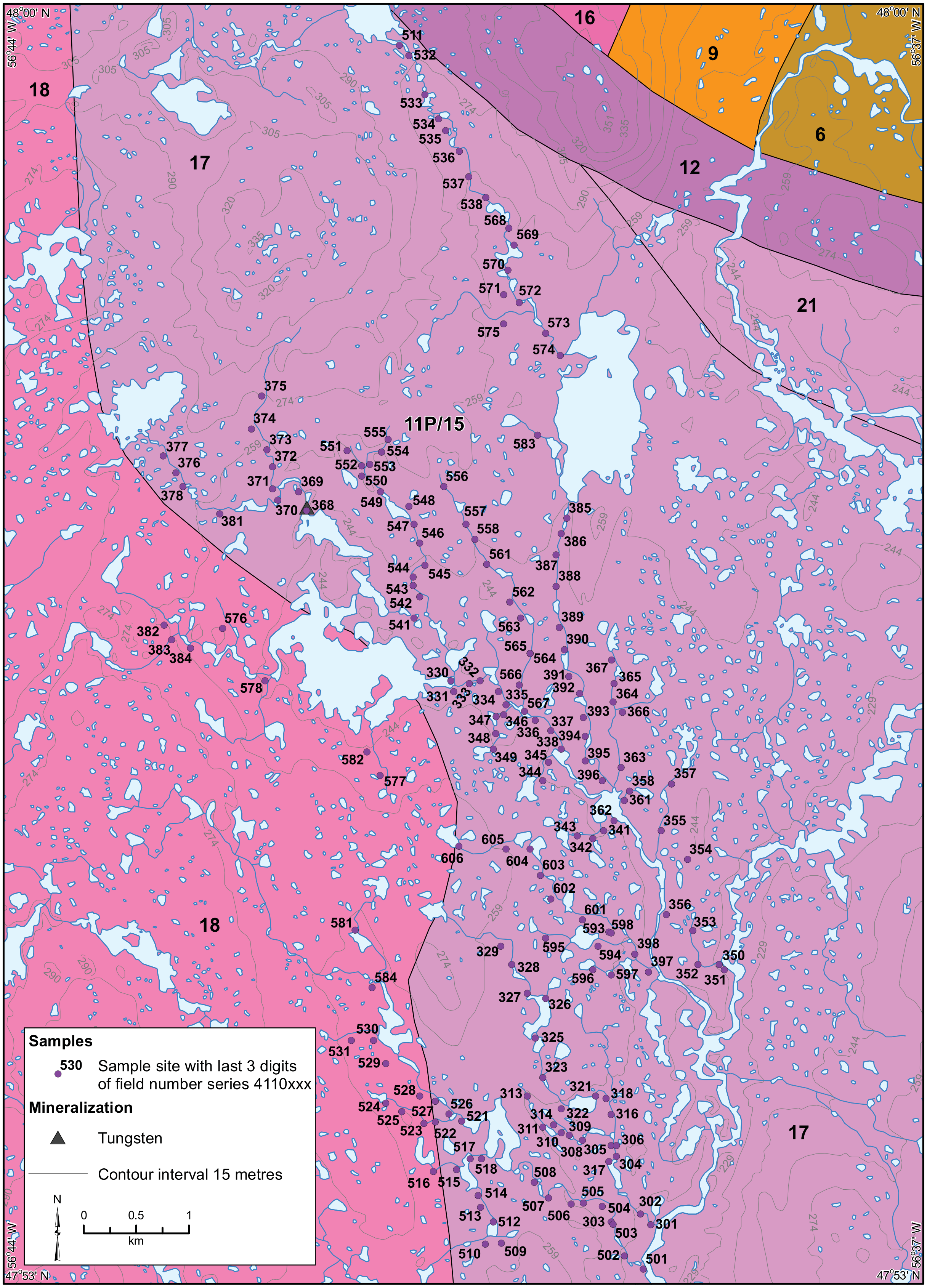

Figure 9. *Stream-sample locations with sample numbers in the Dolland Brook North area.*

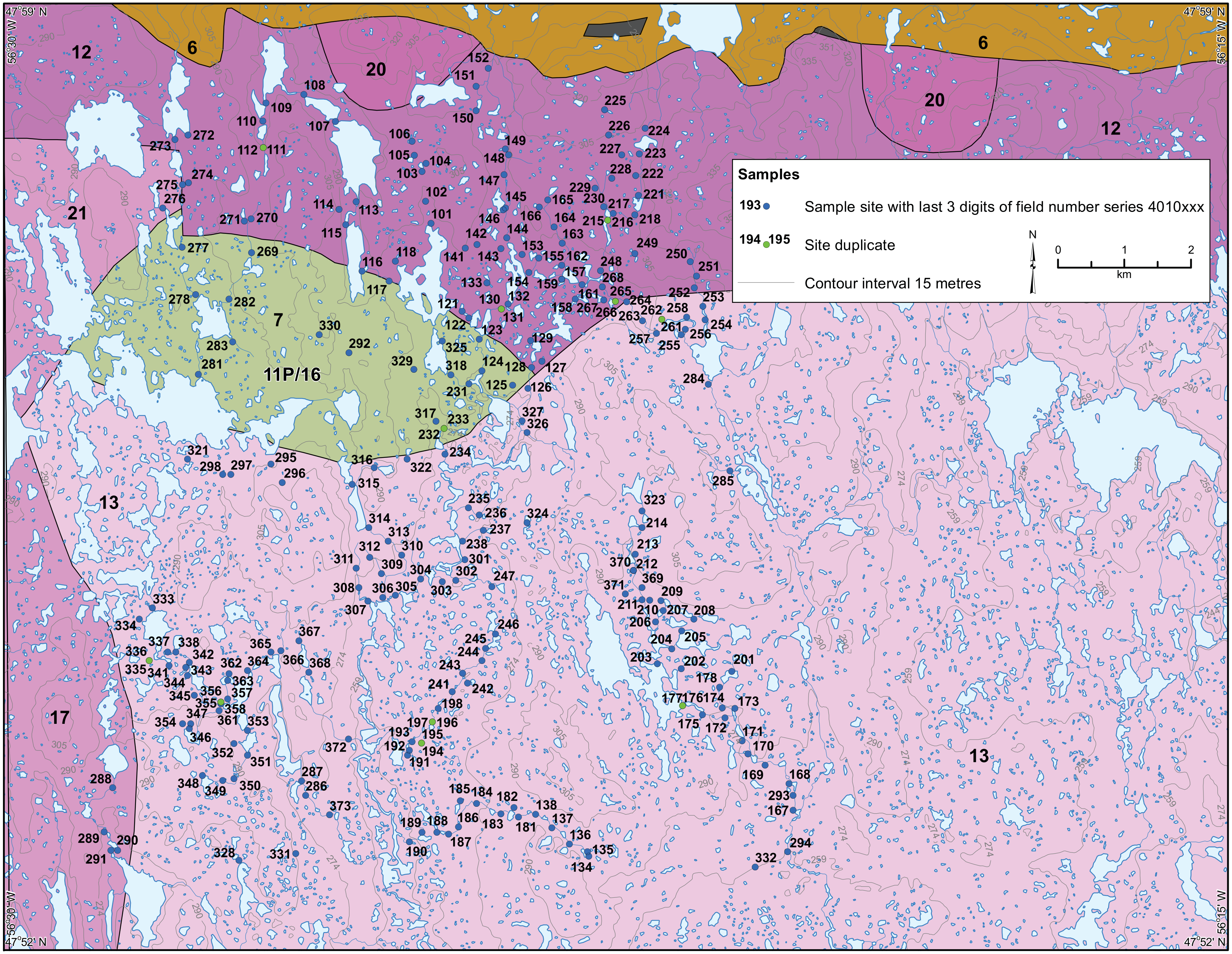

Figure 10. *Stream-sample locations with sample numbers in the Bottom Brook area.*

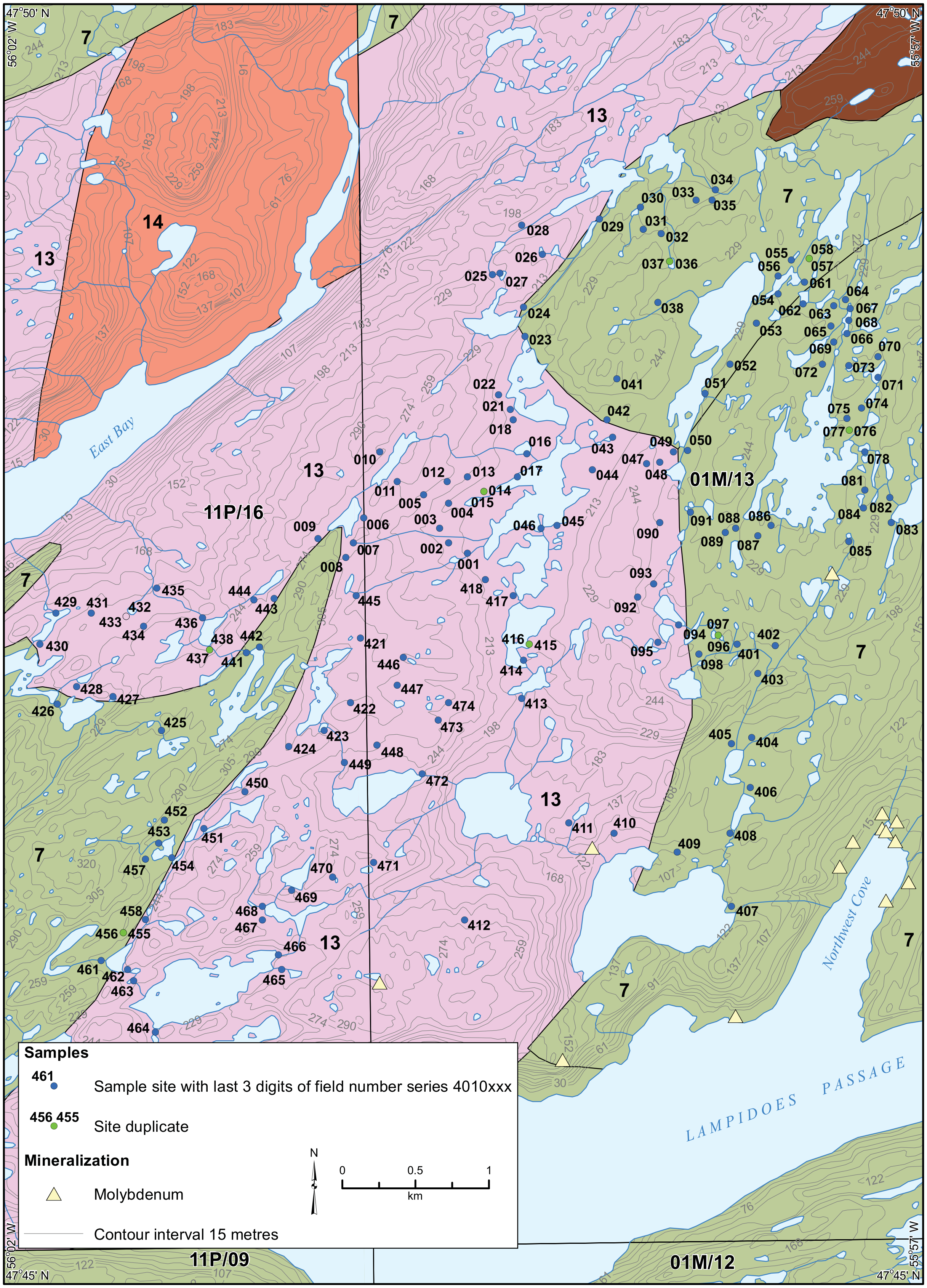

Figure 11. *Stream-sample locations with sample numbers in the East Bay area.*

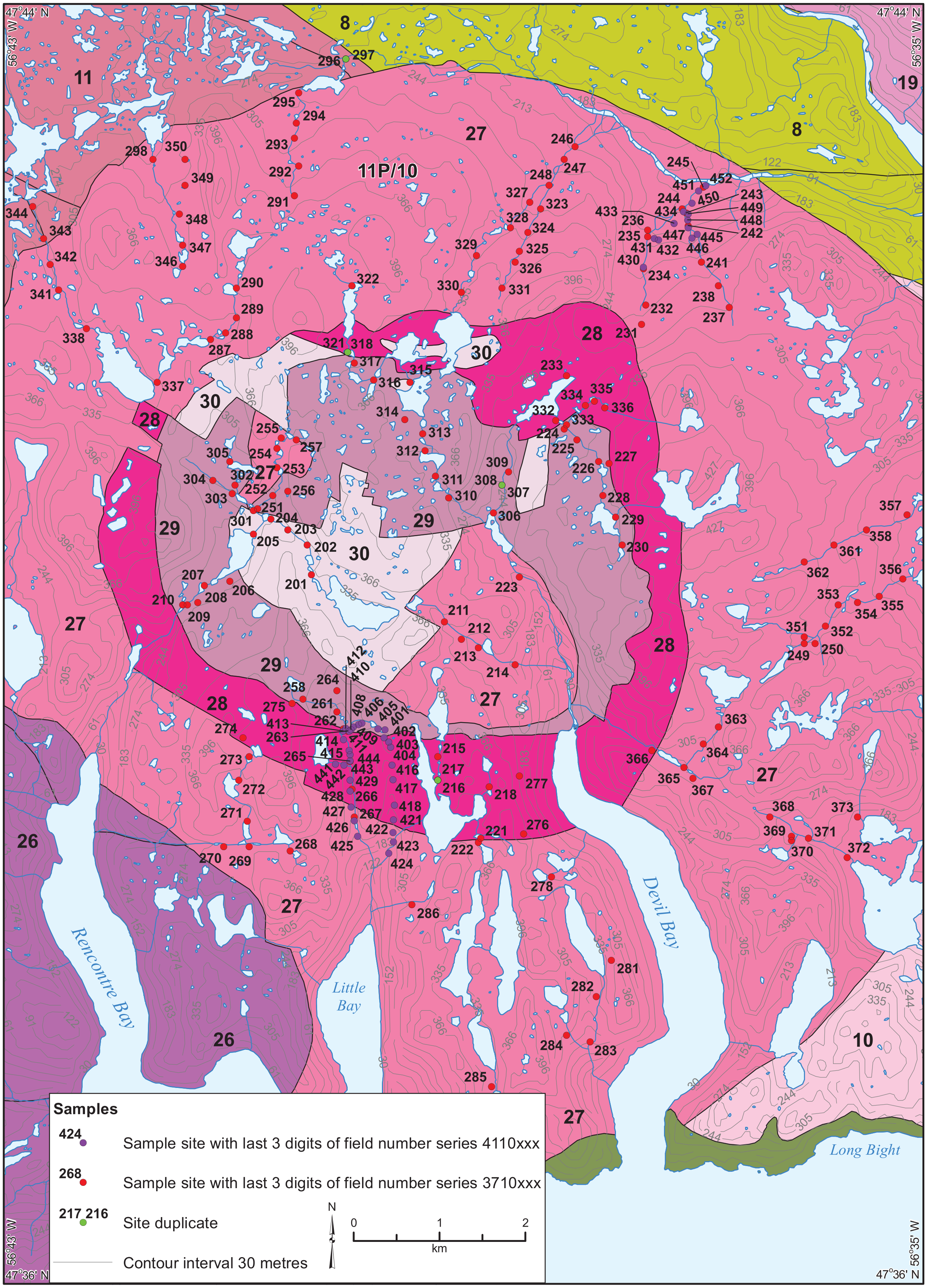

Figure 12. *Stream-sample locations with sample numbers in the François Granite area.*

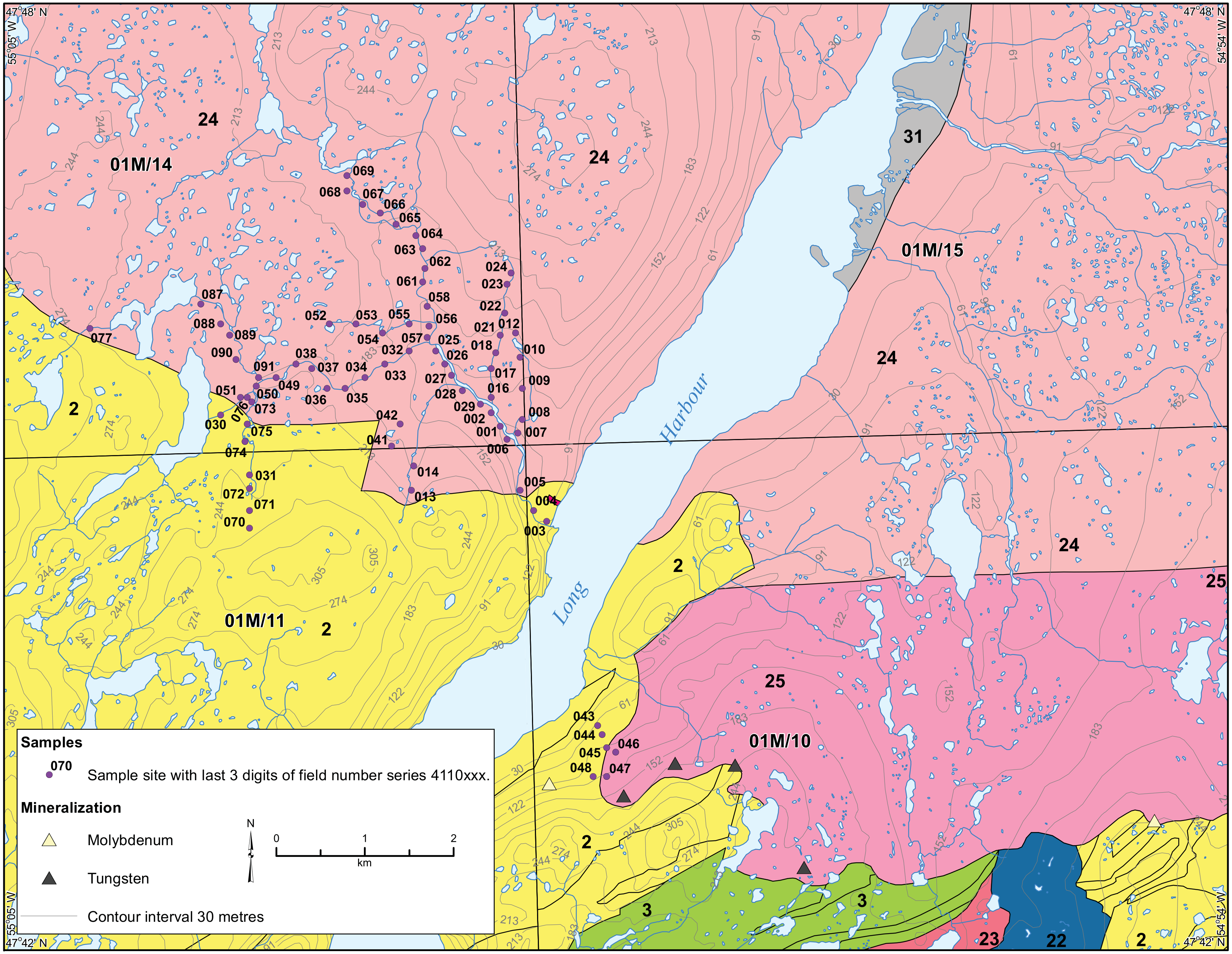

Figure 13. *Stream-sample locations with sample numbers in the Ackley Granite area.*

lar analytical method to U1 (INAA), hence provides a check on the analytical consistency for those samples analyzed by both methods and because a few samples were only analyzed by U8 and not by U1.

Stream-sediment Data from the Granite Lake Area

Fe

The distribution of iron (Fe4) in stream sediments (Figure 14) indicates that the contents are quite high, with many samples in the greater than 90th percentile range. Iron correlates with some metals due to the affinity of metals such as molybdenum, zinc, cobalt and arsenic, and to a lesser degree tungsten, to complex with iron and manganese (hydr)oxides in stream and soil environments. The possible effects of this complexing are seen in the high correlation coefficients with Fe4 in Table 8. As a result, the raw values of these metals in stream sediments may be higher than in otherwise similar areas, where such metal scavenging is less prevalent.

LOI

Loss-on-ignition (LOI), which is an estimate of a sample's organic content, is another environmental factor which may enhance or dilute an element's content. Generally, the affect is weaker than that of iron (hydr)oxide scavenging. LOI has a moderate correlation with molybdenum and uranium (Table 8; r=0.43 for both). The LOI values in the Granite Lake area are very high (Figure 15).

Ag

The distribution of silver (Ag6) is shown in Figure 16. There are numerous samples with 'high' or red values. Fifteen of the 879 samples analyzed for silver are classified as high and all but one of the fifteen is found in the Granite Lake area. Moreover, there appears to be good spatial correlation of samples having high silver values with the location of tungsten and molybdenum mineralization. The high and elevated values are confined to contiguous zones underlain by units of the Wolf Mountain Granite and Meelpaeg Lake Granite north of the Granite Lake Ditch (hydroelectric canal) joining Granite and Meelpaeg lakes.

Cu

The distribution of copper (Cu4) is shown in Figure 17. The distribution pattern of high and elevated values is similar to that of silver with a similar spatial relationship of high values to that of the tungsten and molybdenum mineralization. In the case of copper, all of the red symbols in the entire stream survey are found in the Granite Lake.

F

The distribution of fluoride (F9) is shown in Figure 18. The distribution pattern of high and elevated values is more extensive than those of silver and copper but is confined to the same granite units north of the Granite Lake Ditch.

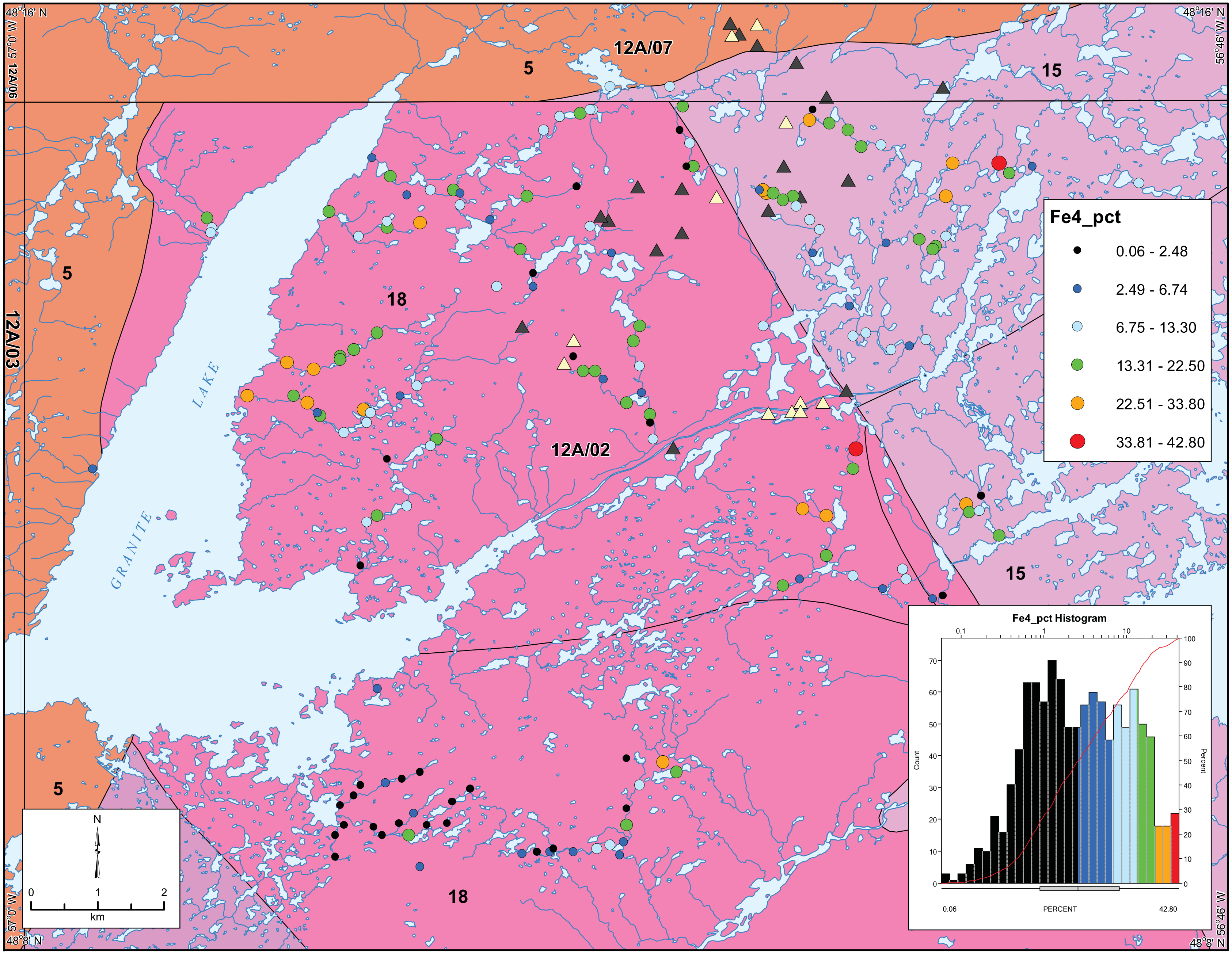

Figure 14. *Iron (Fe4) in stream sediments in the Granite Lake area.*

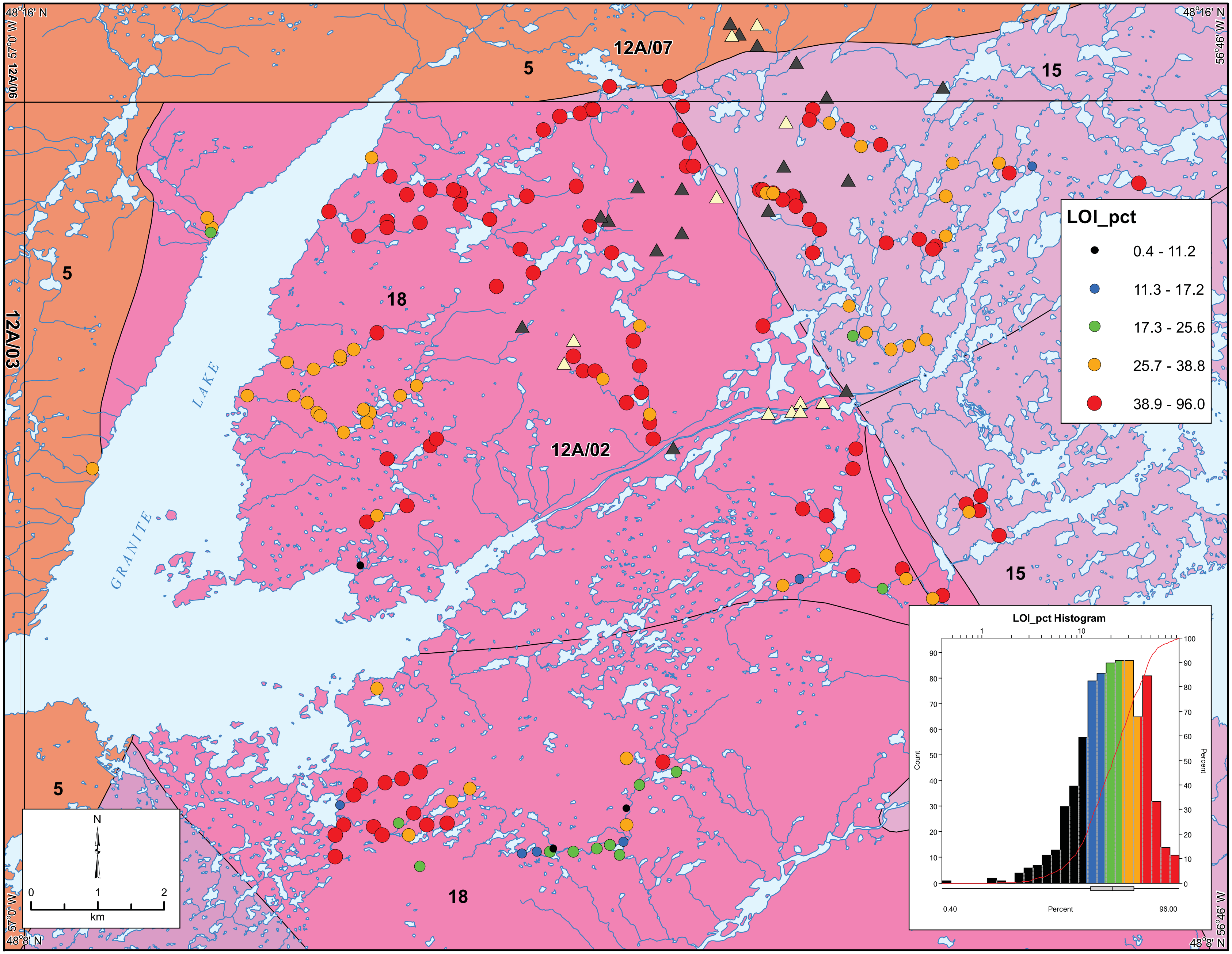

Figure 15. *Loss-on-ignition (LOI) in stream sediments in the Granite Lake area.*

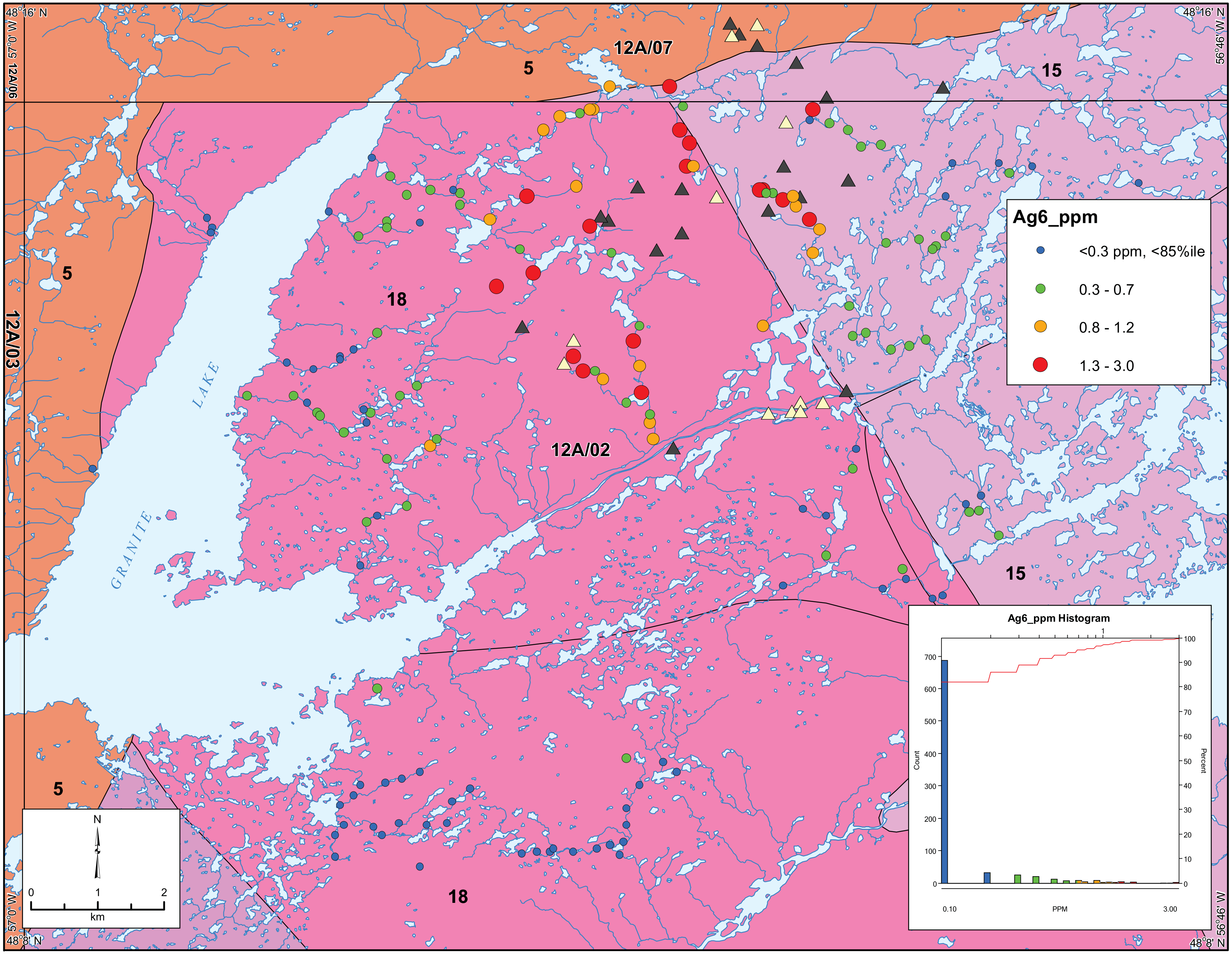

Figure 16. *Silver (Ag6) in stream sediments in the Granite Lake area.*

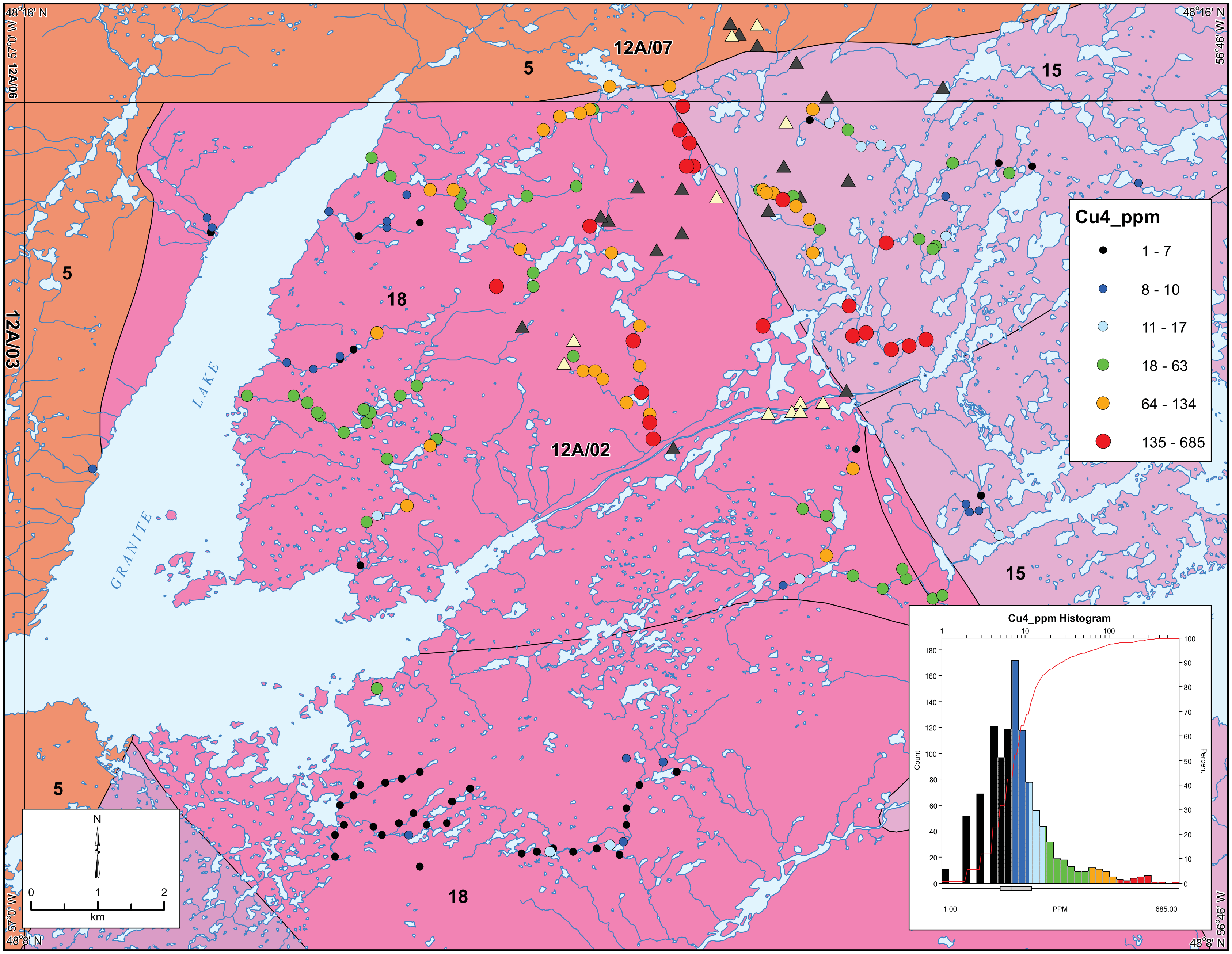

Figure 17. *Copper (Cu4) in stream sediments in the Granite Lake area.*

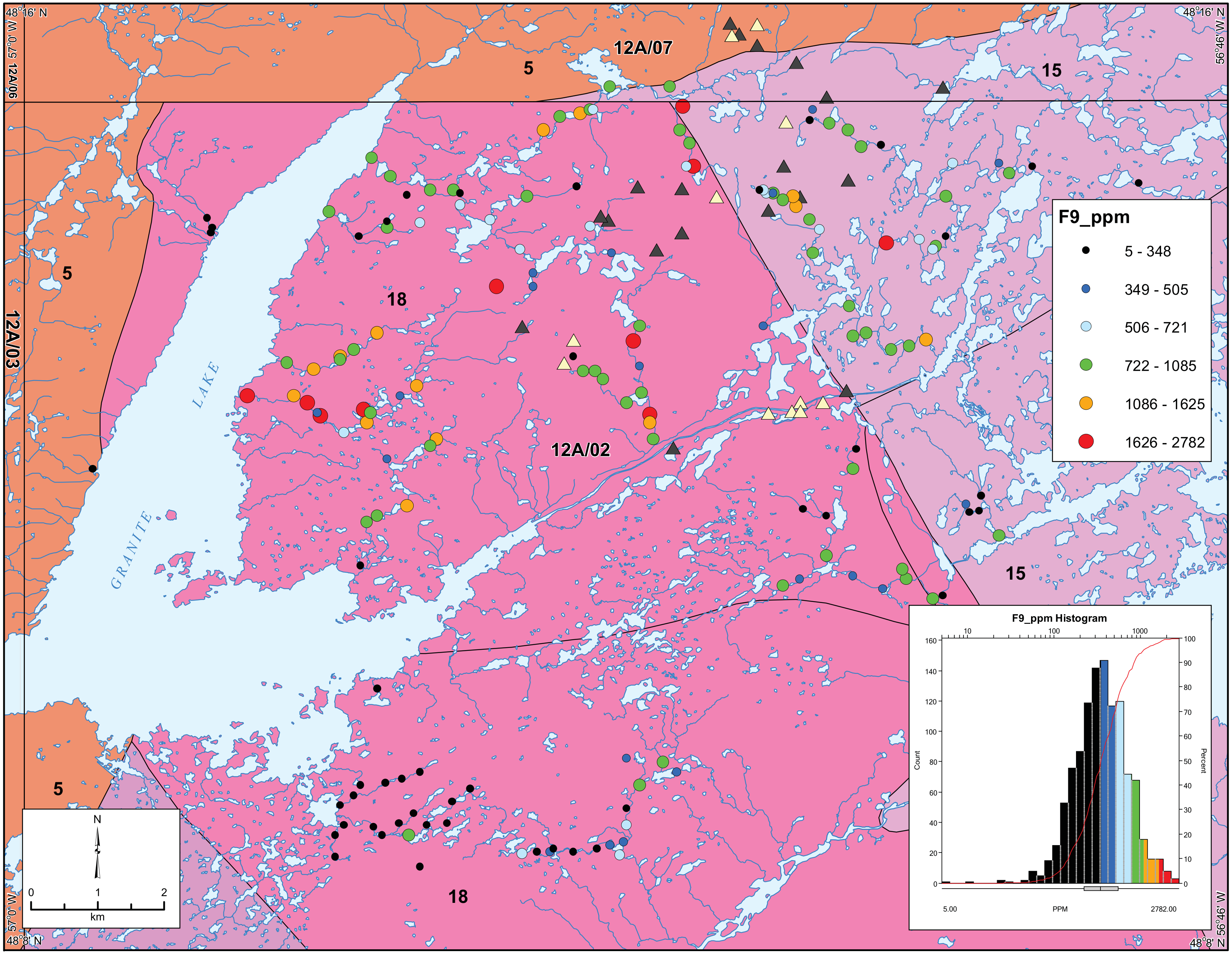

Figure 18. *Fluoride (F9) in stream sediments in the Granite Lake area.*

Hf

The distribution of hafnium (Hf1) is shown in Figure 19. It has a single high-value sample, with a hafnium content of 22 ppm. It stands out against a background of otherwise universally low values.

Mo

The distribution of molybdenum (Mo5) is shown in Figure 20. The distribution pattern is somewhat similar to those of silver and copper but with elevated values also occurring farther west and south. In the case of molybdenum, all of the samples that have high (red) and elevated (orange) levels are found only in the Granite Lake area. There are several clusters of red and orange samples in areas without known molybdenum mineralization.

U

The distribution of uranium (U1) is shown in Figure 21. There are 3, three-sample clusters of high and elevated values plus a single sample with the second highest value (3520 ppm) of any of the over 1000 samples analyzed. This sample also has high values of hafnium, lanthanum and terbium. Unfortunately, analyses of several other rare-earth elements are absent due to analytical interference affects with uranium.

W

The distribution of tungsten (W1) is shown in Figure 22. It has a pattern of high and elevated values in samples that are generally coincident with areas of known tungsten mineralization. One group of green and orange symbols is found in the northern portion of NTS map area 12A/02 underlain by the Wolf Mountain Granite. The locations of these samples are not over or down-ice from known tungsten mineralization. The distribution of colorimetric tungsten (W13) is shown in Figure 23. The patterns for the two distributions are very similar, but the analyses of W13 include a few samples that were not analyzed by INAA. Most notably, two samples in the central north/south anomaly extending north from the Granite Lake Ditch have high tungsten contents. Sample 3710022 has a W13 content of 580 ppm. The adjacent sample, 3710023, also has a W13 content of 580 ppm. Together, these two represent the highest W13 analyses encountered in the entire stream-sediment survey.

Zn

The distribution of zinc (Zn4) is shown in Figure 24. There are several samples with high and elevated values of zinc distributed across the area underlain by the Wolf Mountain and Meelpaeg Lake granites. One cluster of particularly high-value samples is found north of the Granite Lake Ditch in an area underlain by the Meelpaeg Lake Granite. One of these samples has a zinc content of 4550 ppm, the highest in the entire survey. However, these samples also have generally elevated to high manganese (Mn4) contents as well. The Spearman correlation coefficient for Mn4 and Zn4 in the Granite Lake area is 0.64, suggesting that much of the Zn content in the samples may be due to complexing with Fe–Mn (hydr)oxides.

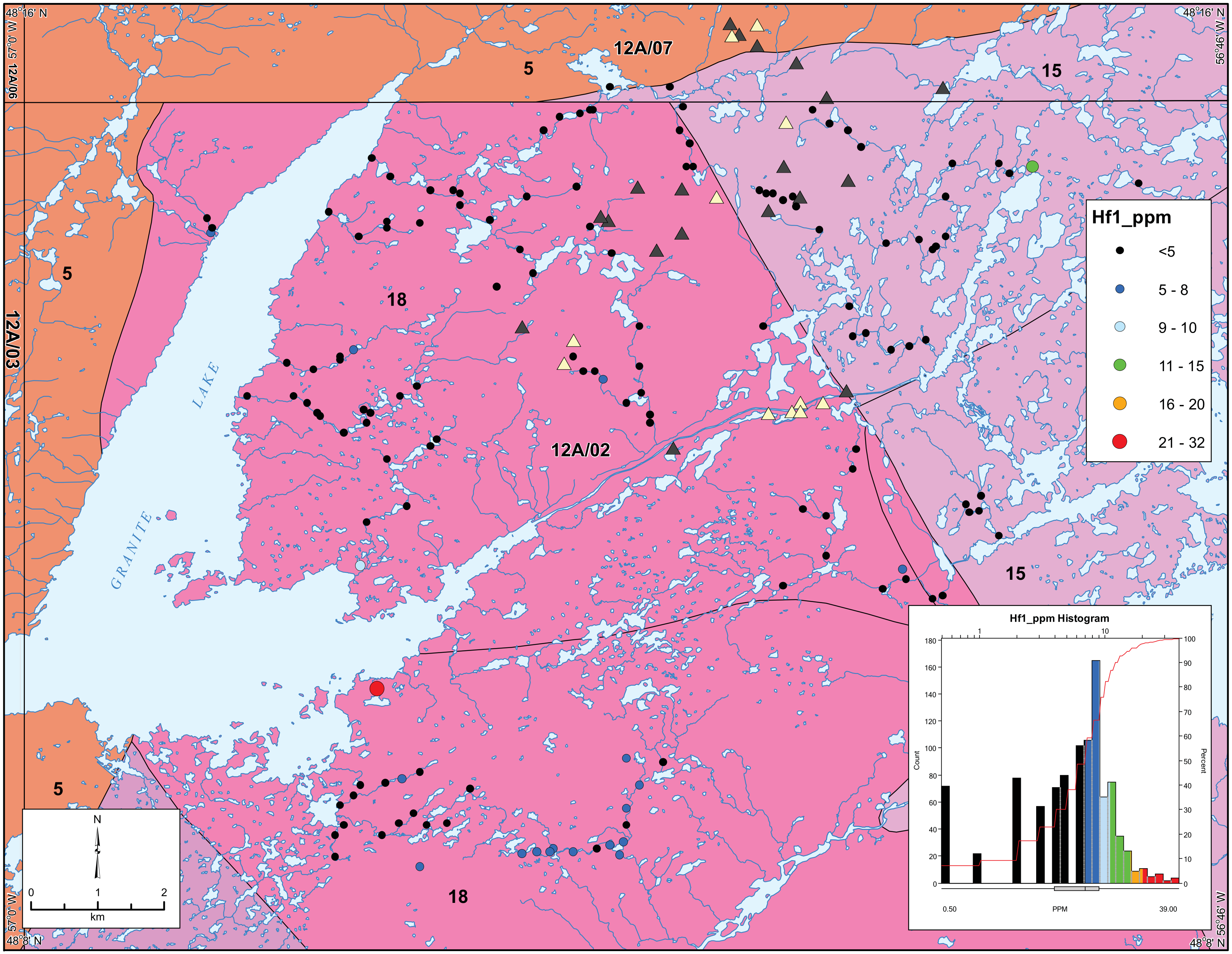

Figure 19. *Hafnium (Hf1) in stream sediments in the Granite Lake area.*

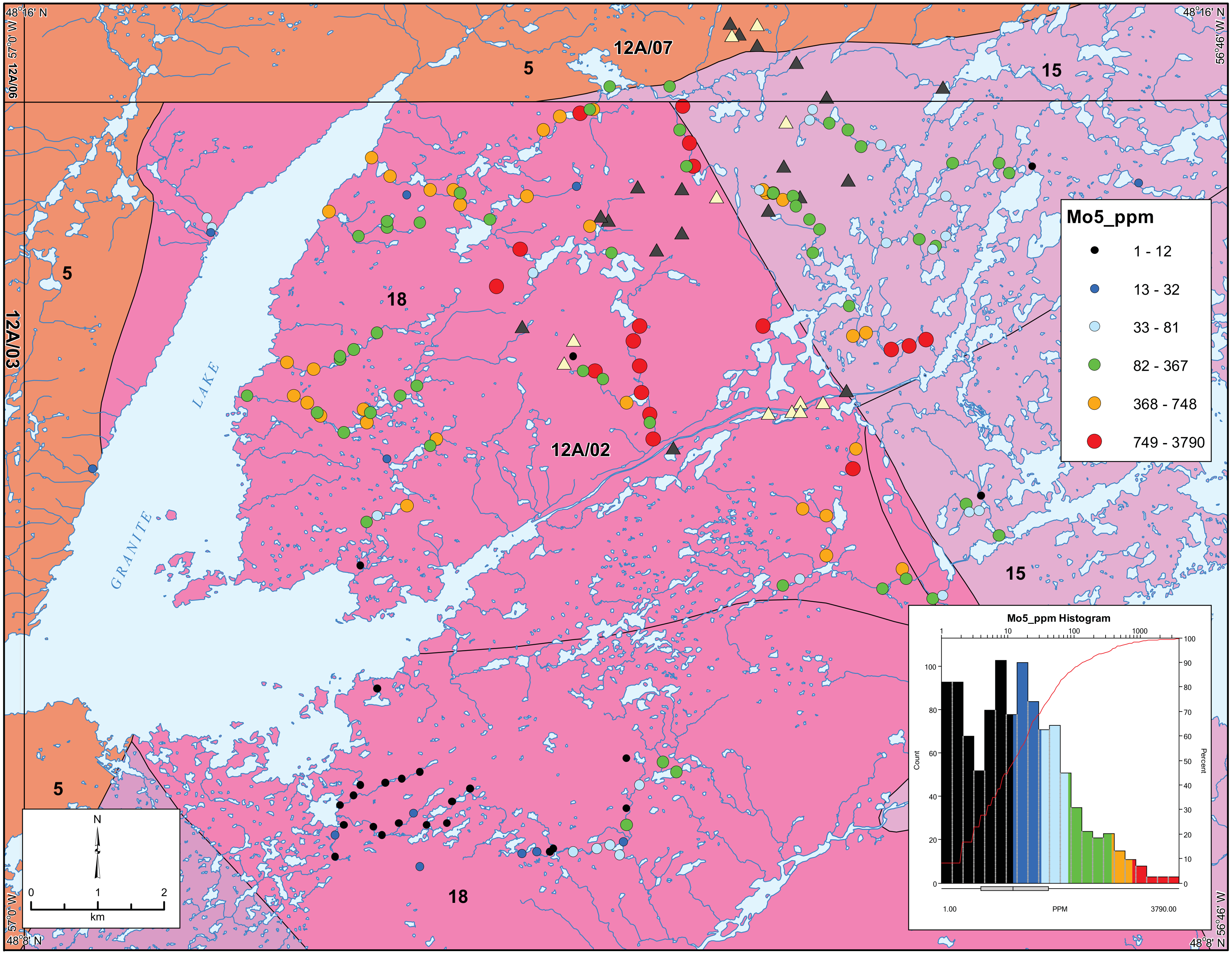

Figure 20. *Molybdenum (Mo5) in stream sediments in the Granite Lake area.*

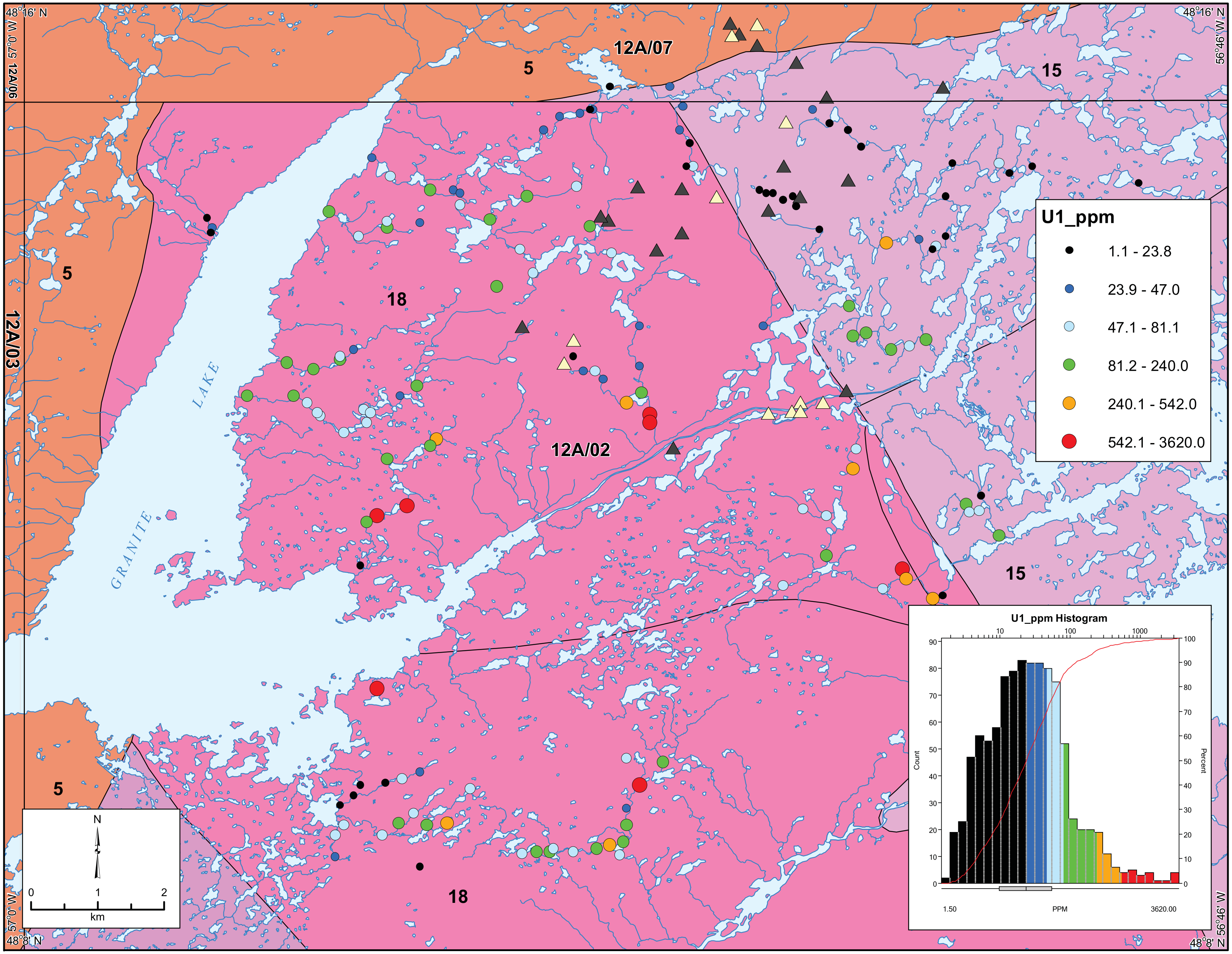

Figure 21. *Uranium (U1) in stream sediments in the Granite Lake area.*

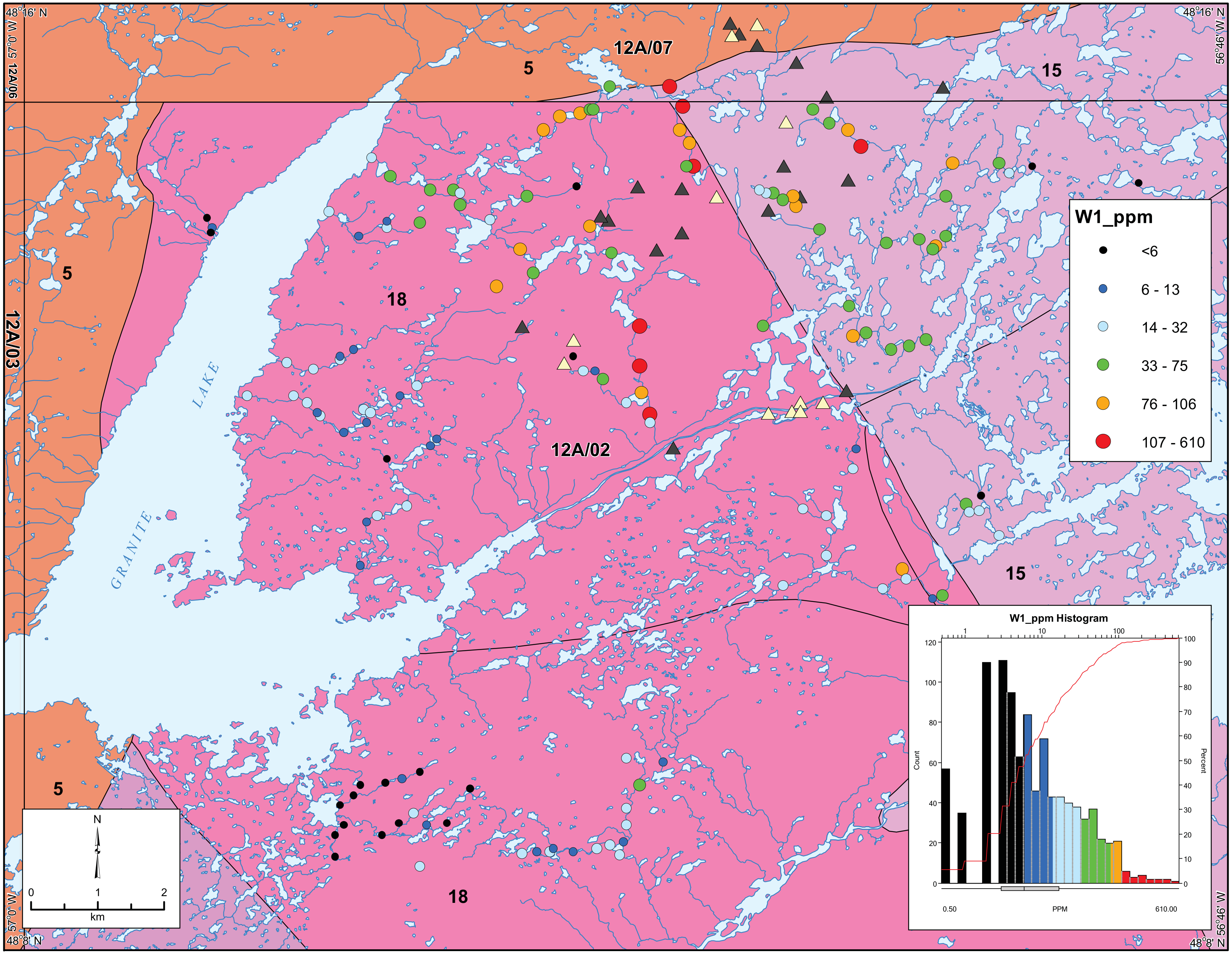

Figure 22. *Tungsten (W1) in stream sediments in the Granite Lake area.*

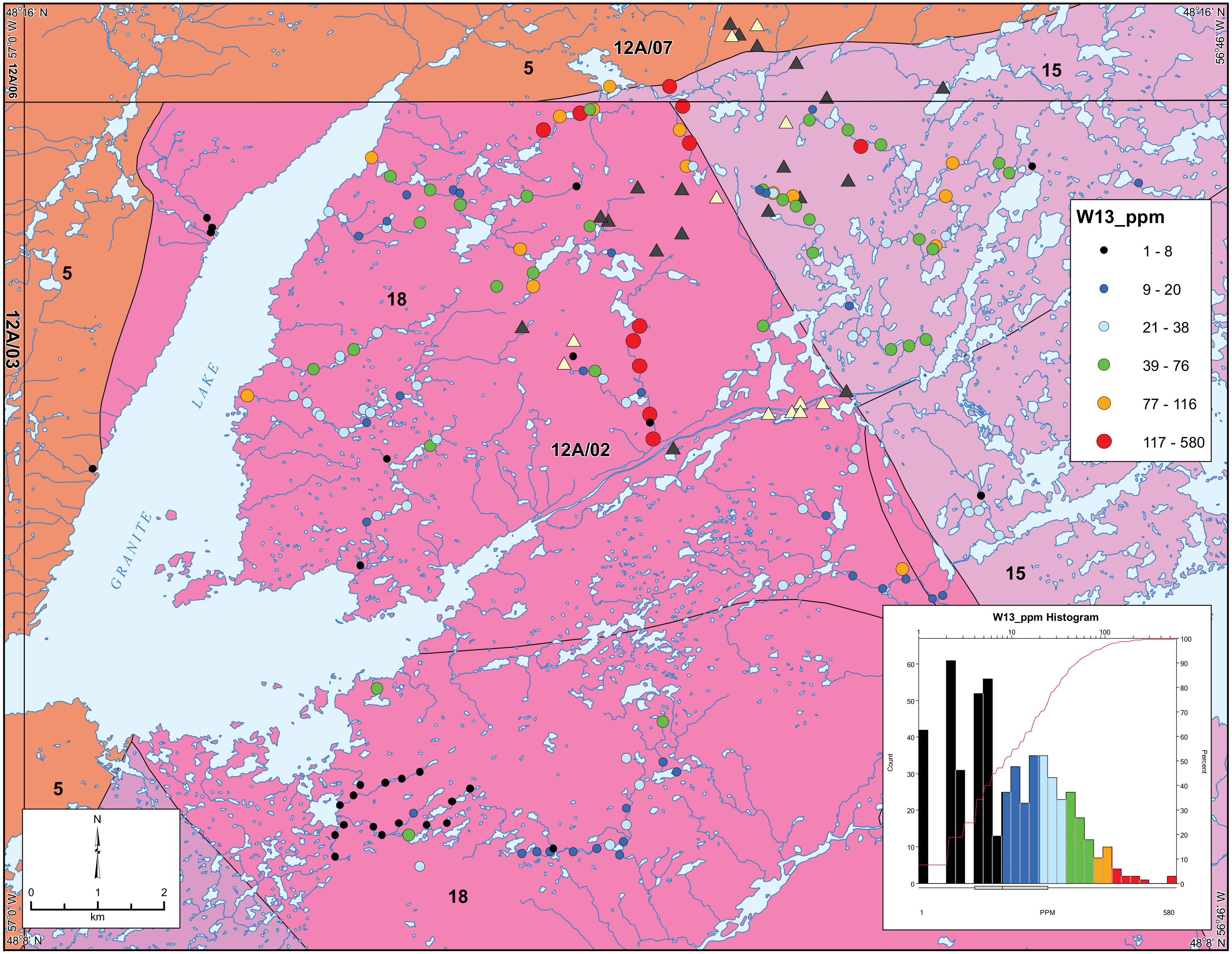

Figure 23. *Tungsten (W13) in stream sediments in the Granite Lake area.*

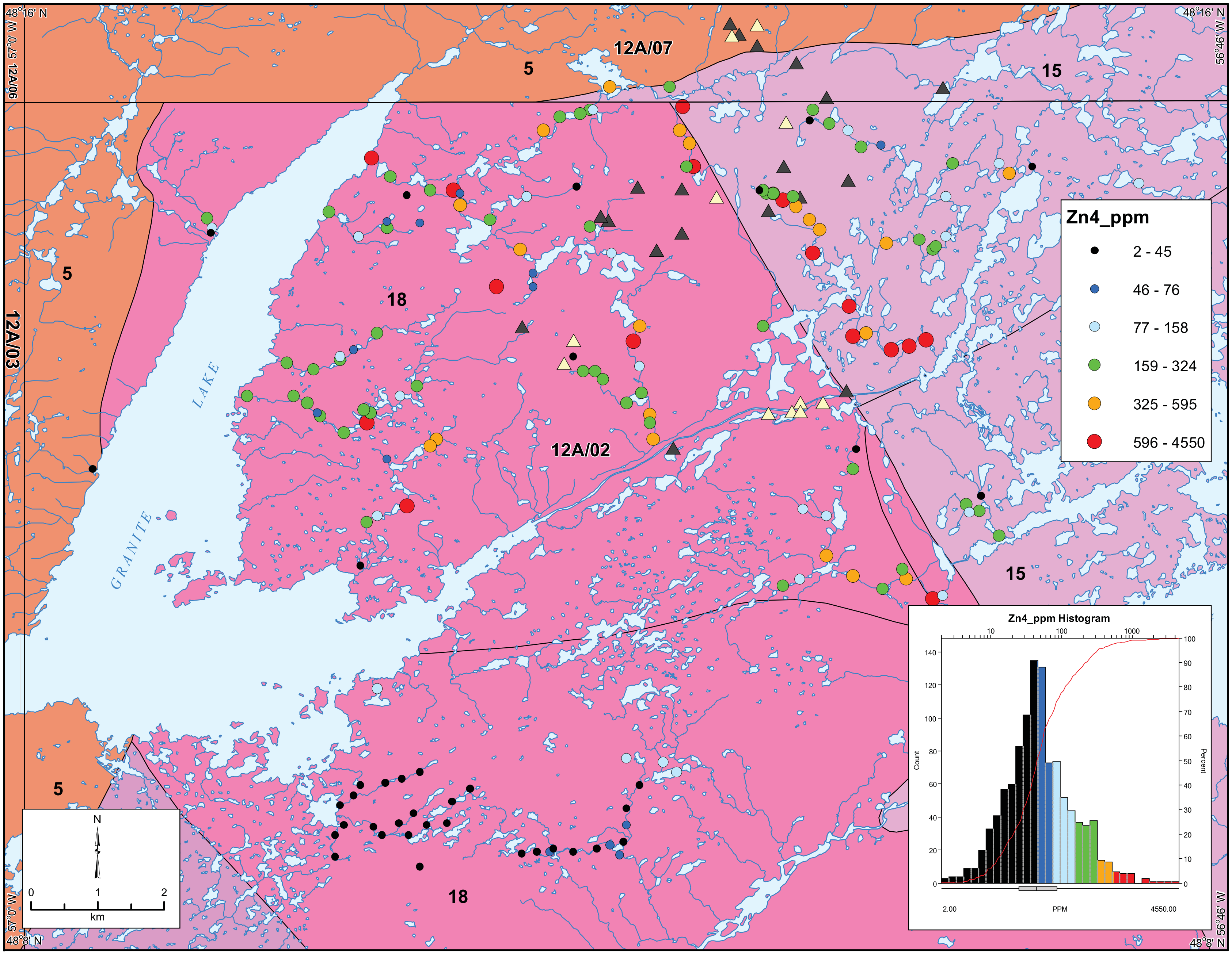

Figure 24. *Zinc (Zn4) in stream sediments in the Granite Lake area.*

Stream-sediment Data from the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite Areas

These five surveys areas are located close to one another and so all the data for a given variable are included in a single figure. As stated above, due to the higher sample density, these plots differ from those for the Granite Lake and Ackley Granite areas, in that the symbols for the higher value samples are smaller than for those of the lower value samples but are superimposed to ensure none of the samples with higher values are obscured. Some of the lowest value samples may be concealed as a result.

Fe

The distribution of iron (Fe4) is shown in Figure 25. The Dolland Brook and Dolland Brook North areas have several samples with higher than average iron contents, whereas the François Granite and East Bay areas have lower contents.

LOI

The distribution of loss-on-ignition (LOI) is shown in Figure 26. Note that, unlike other variables, the LOI distribution is presented as quantiles so that there are more symbols with high and elevated values than is the case for other variables. The François Granite area has proportionally fewer high values than do the other four areas.

Au

The distribution of gold (Au1) is shown in Figure 27. Six of the nine high-value samples are located in the Dolland Brook North area, including the sample with the highest gold content found in the entire survey, 21 ppb.

REE

Maps showing the distributions of rare-earth elements (REE) are included to show their relationship to units in the François Granite. The figures are presented in order of increasing atomic weight beginning with lanthanum (La1) in Figure 28 and continuing with cerium (Ce1) in Figure 29, samarium (Sm1) in Figure 30, europium (Eu1) in Figure 31, terbium (Tb1) in Figure 32, ytterbium in Figure 33, and ending with lutetium (Lu1) in Figure 34.

Relative to each other, values of the light REE are generally lower in sediments over the François Granite and increase with increasing atomic weight, *i.e.*, La1 and Ce1 have mostly black and dark blue symbols. Sm1 has mostly green and light blue, Tb1 has mostly green and light blue with several orange and some red symbols and so on through Yb1 and Lu1. Europium is an exception being a midweight REE, but having the lowest symbol classifications of the REE in the François Granite.

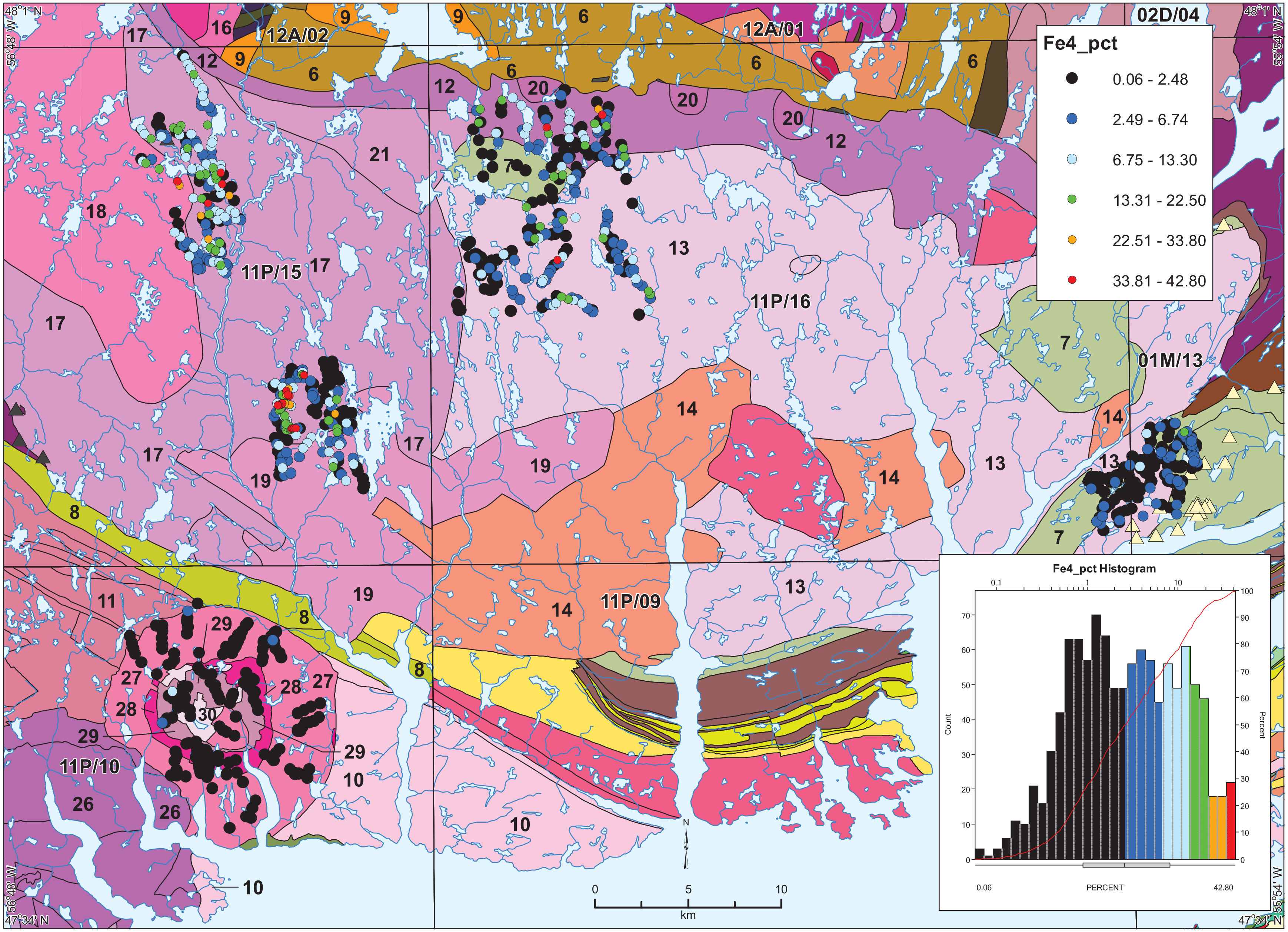

Figure 25. *Iron (Fe4) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

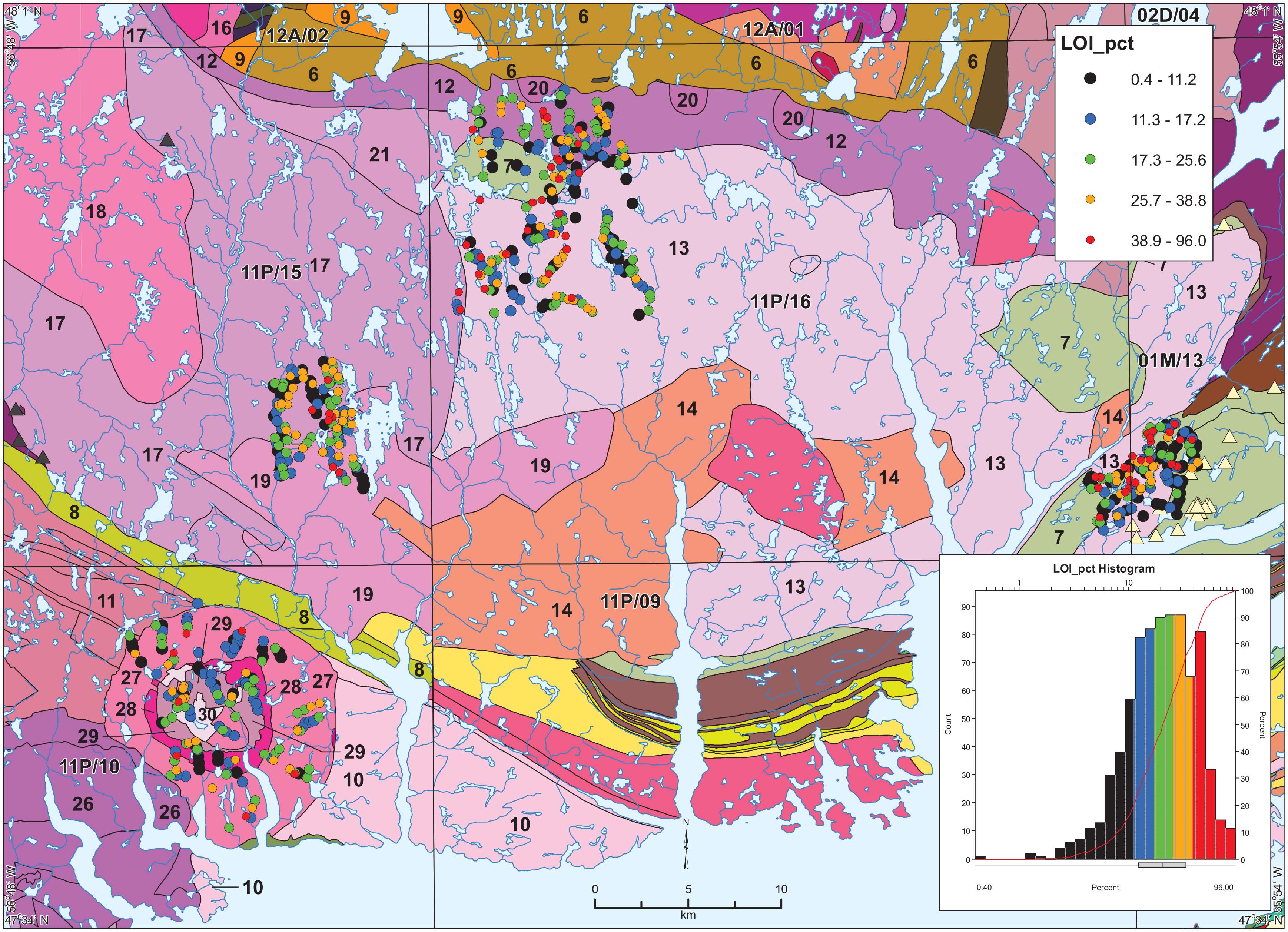

Figure 26. *Loss-on-ignition (LOI) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

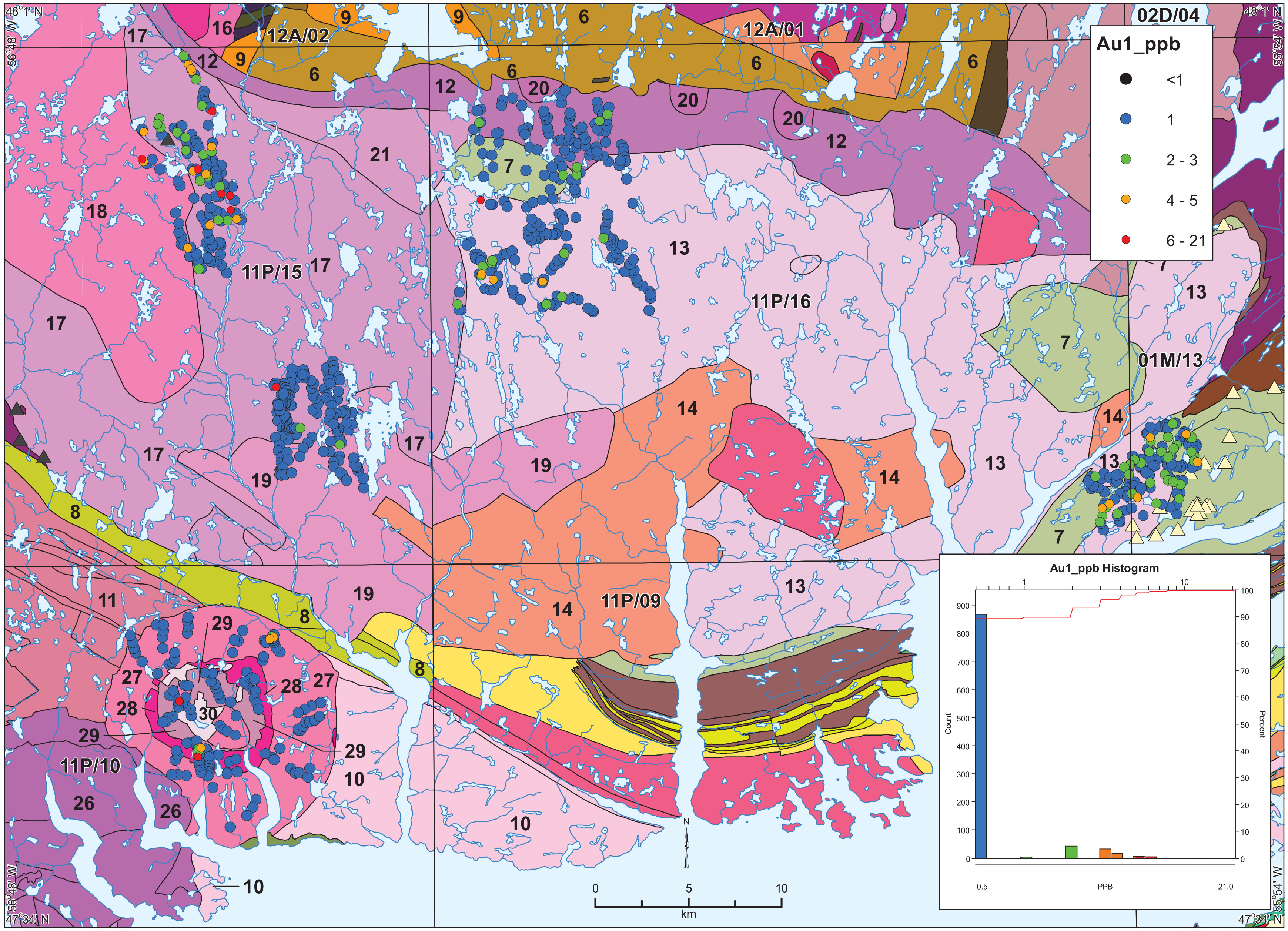

Figure 27. *Gold (Au1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

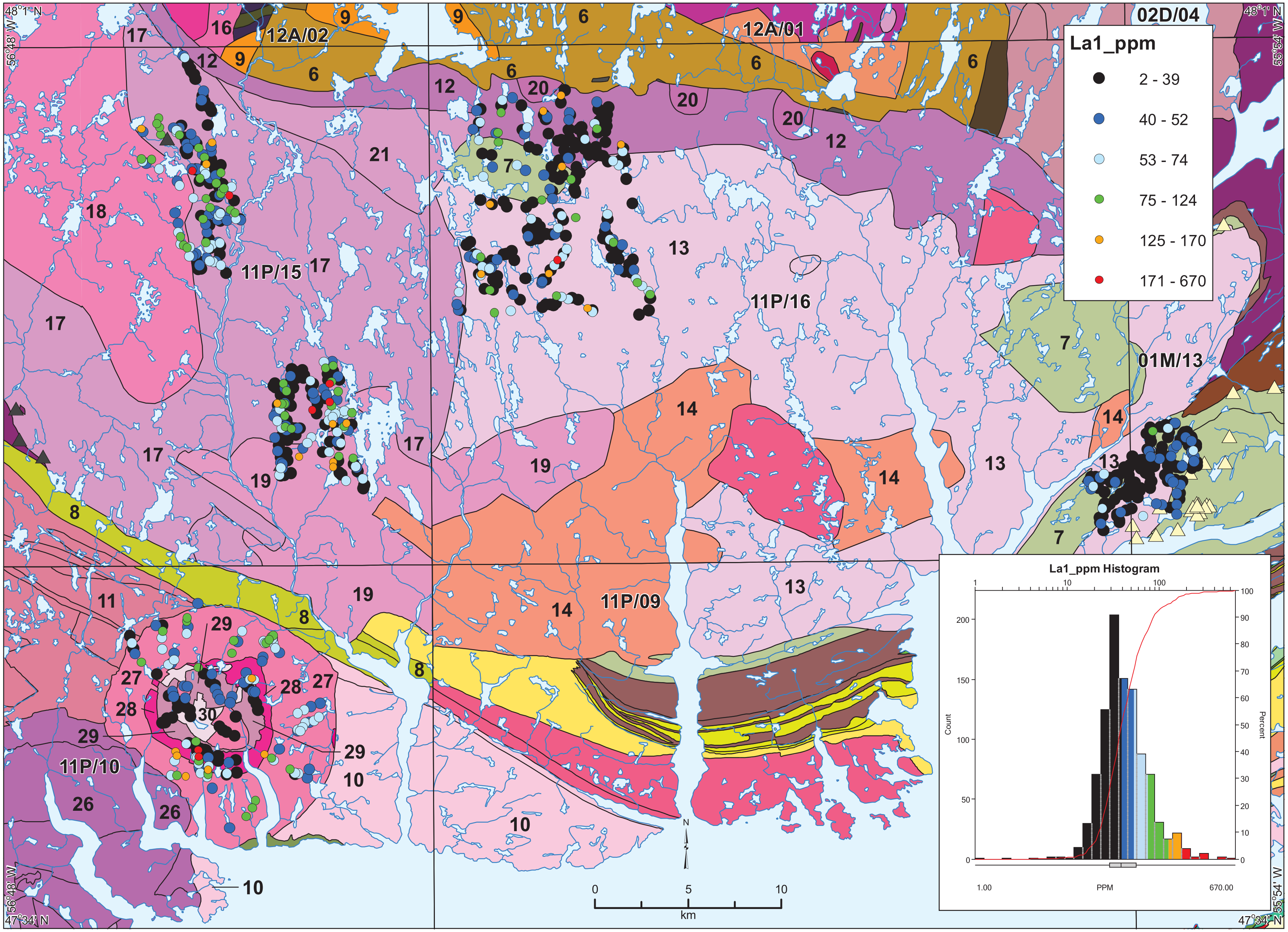

Figure 28. *Lanthanum (La1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

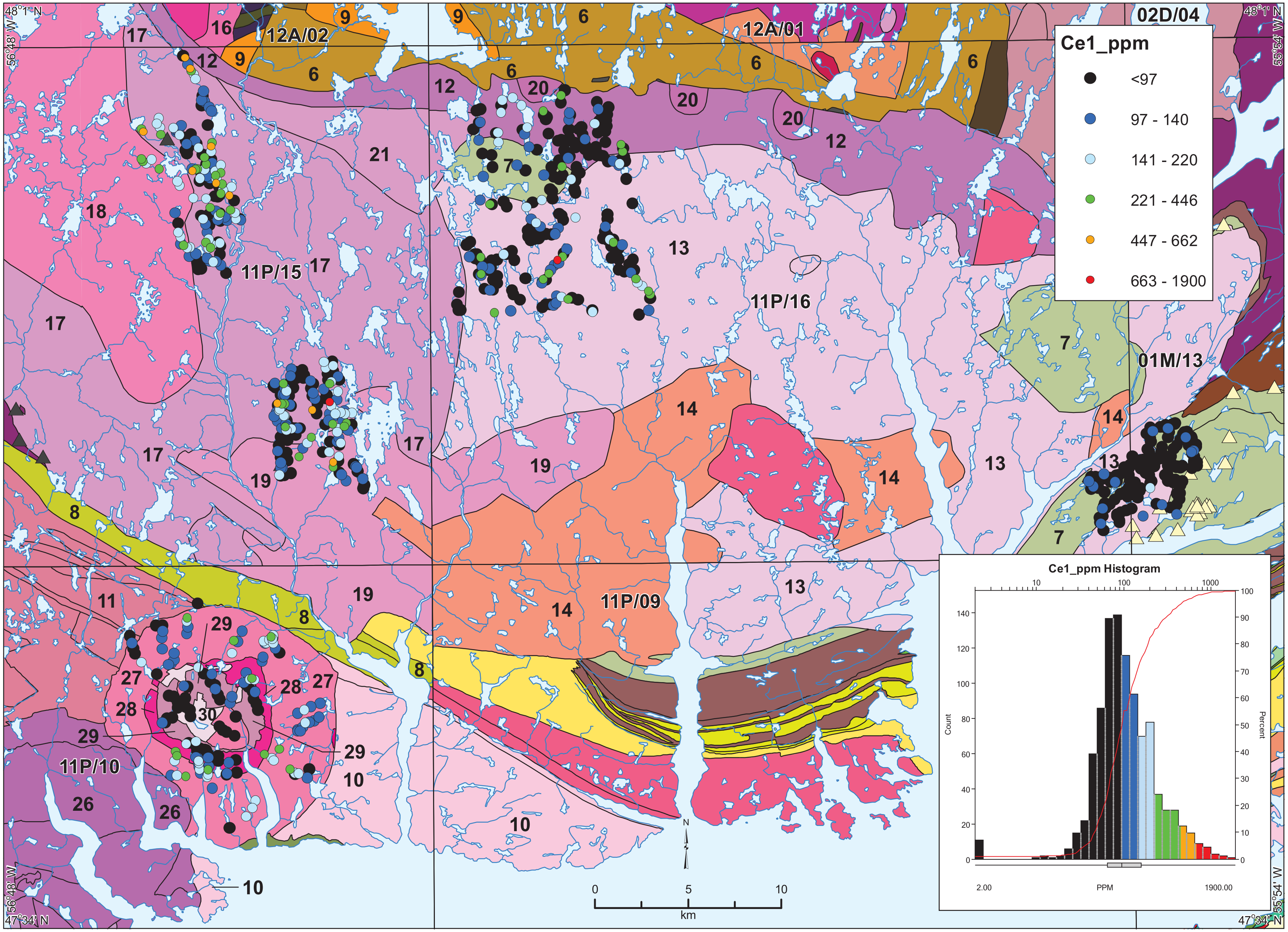

Figure 29. *Cerium (Ce1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

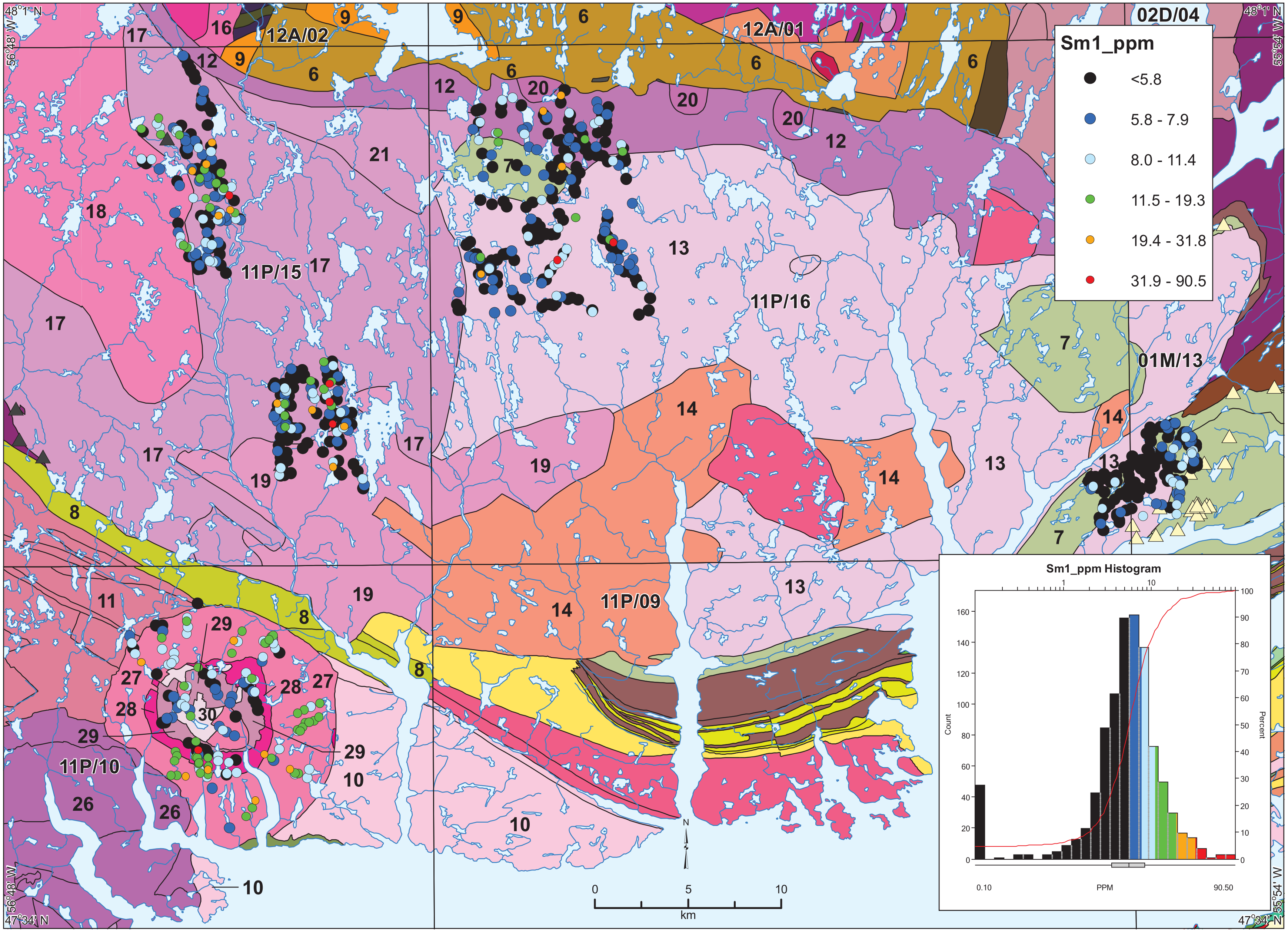

Figure 30. *Samarium (Sm1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

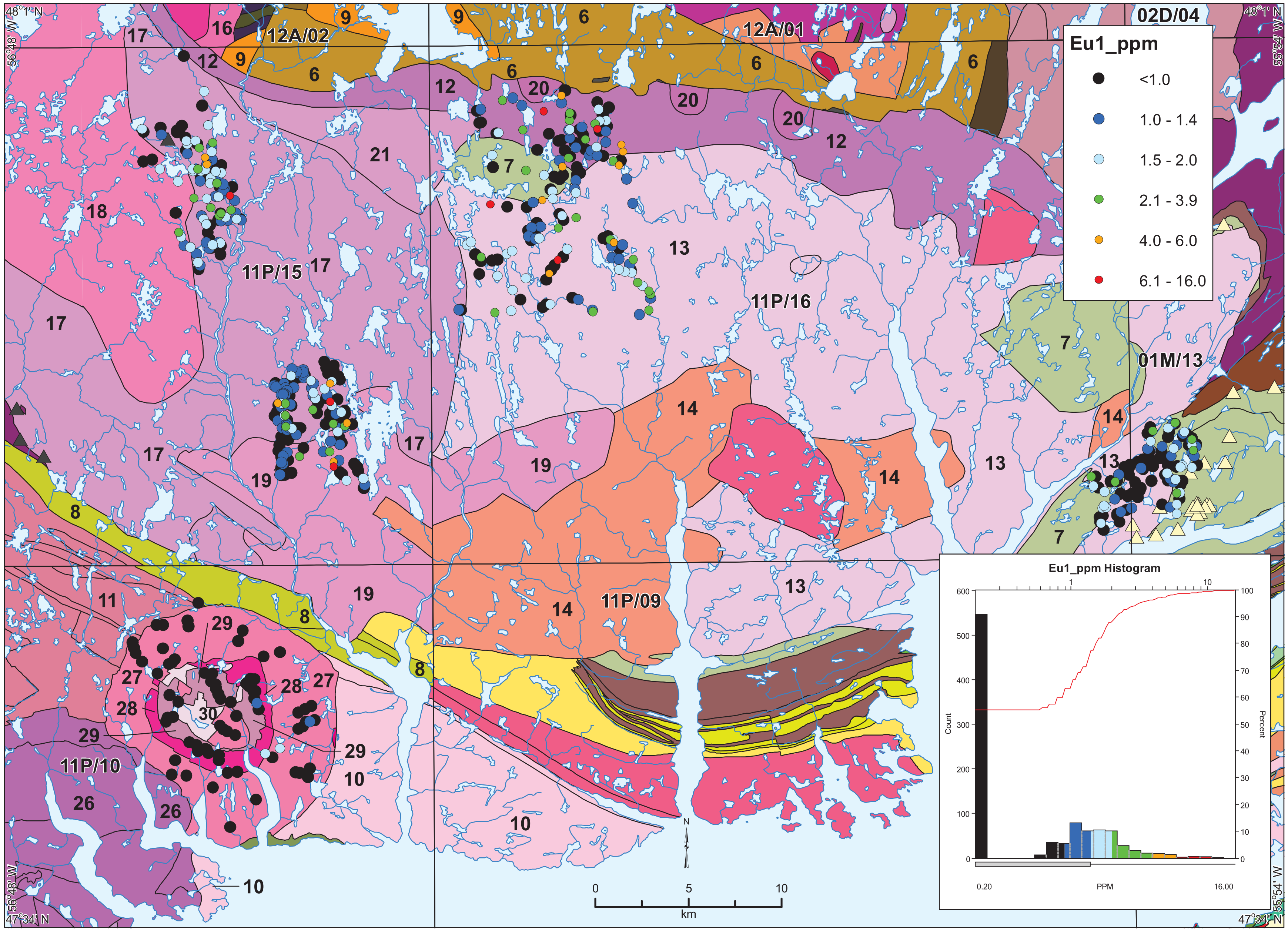

Figure 31. *Europium (Eu1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

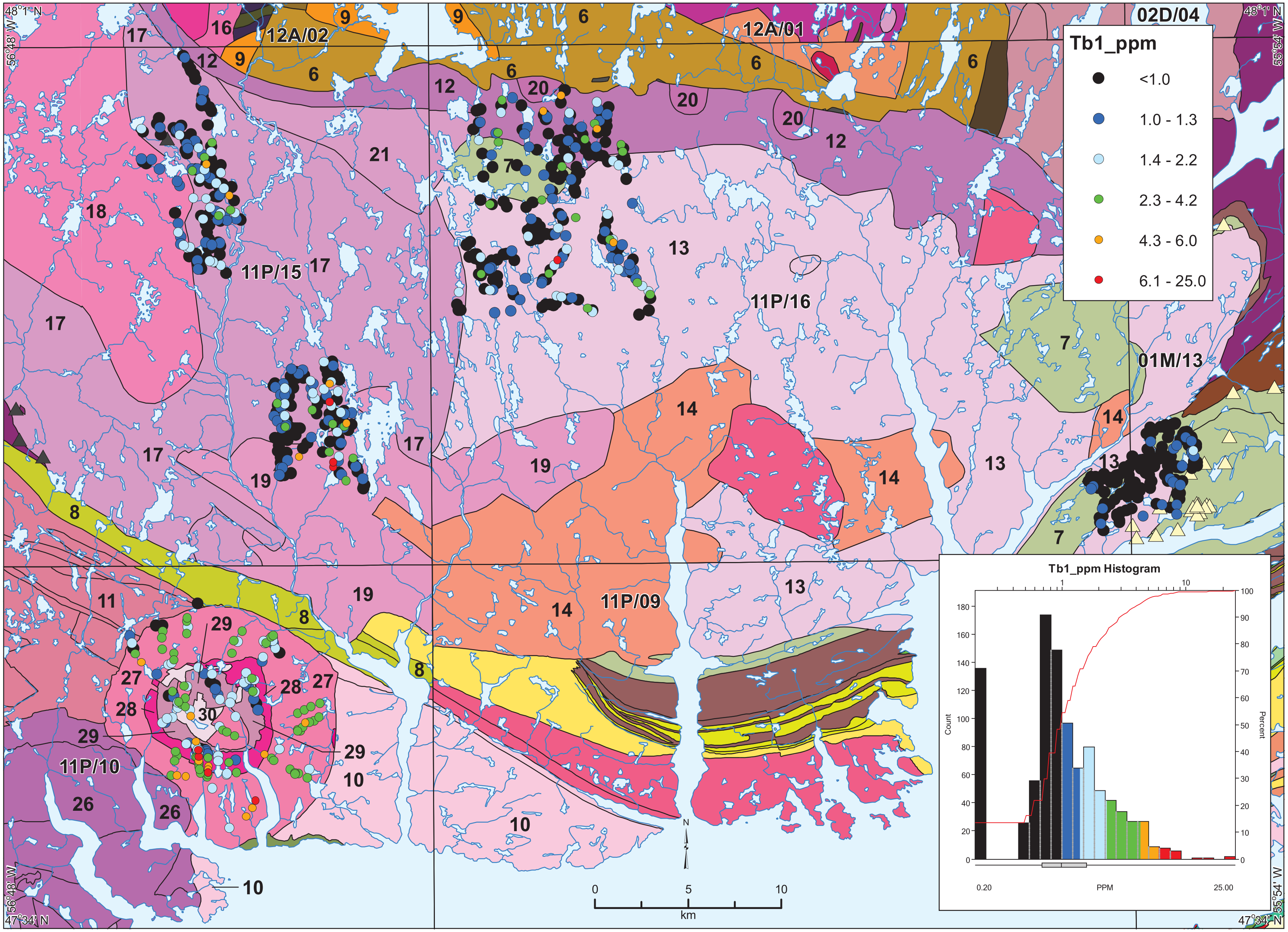

Figure 32. *Terbium (Tb1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

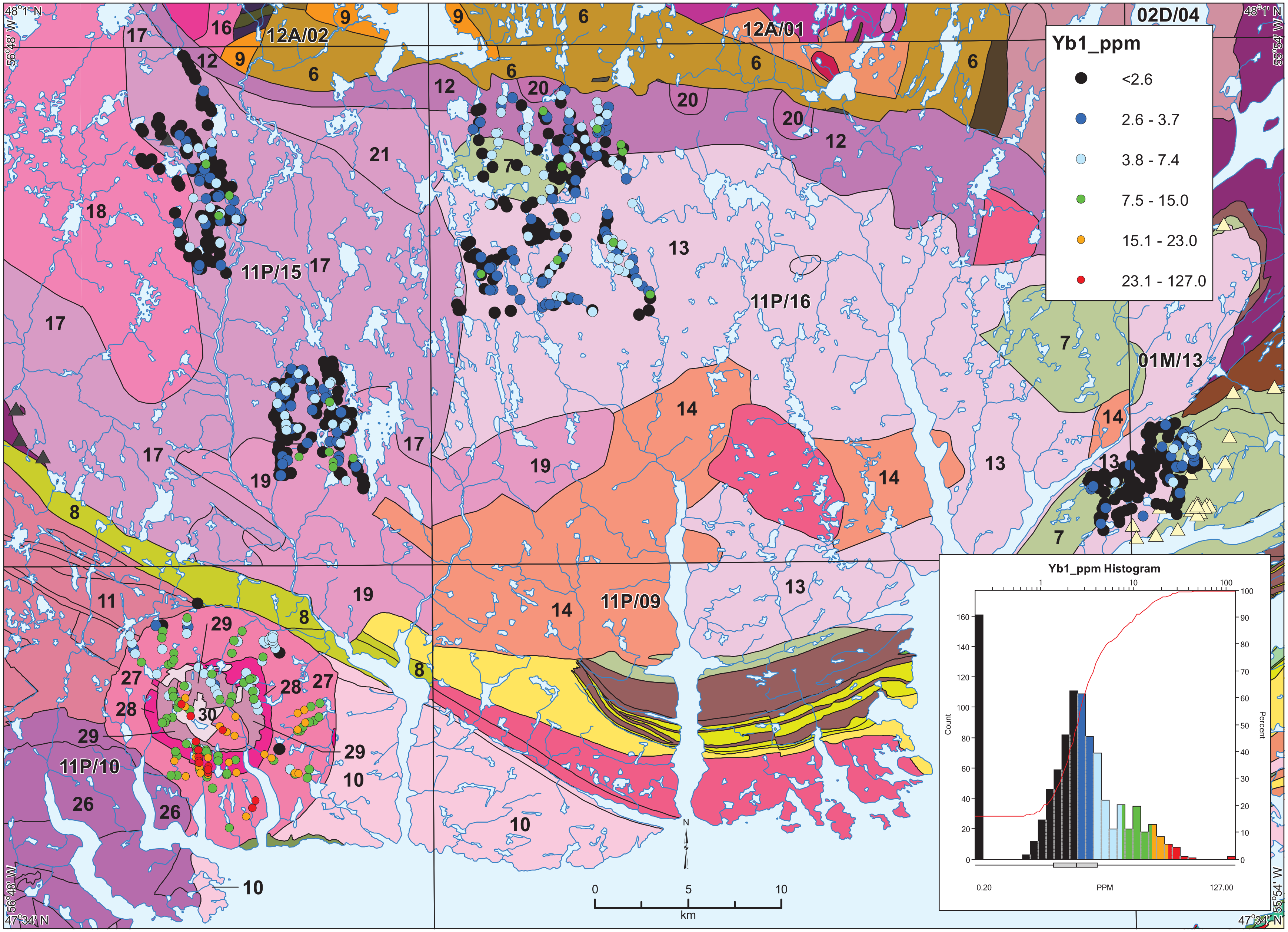

Figure 33. *Ytterbium (Yb1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

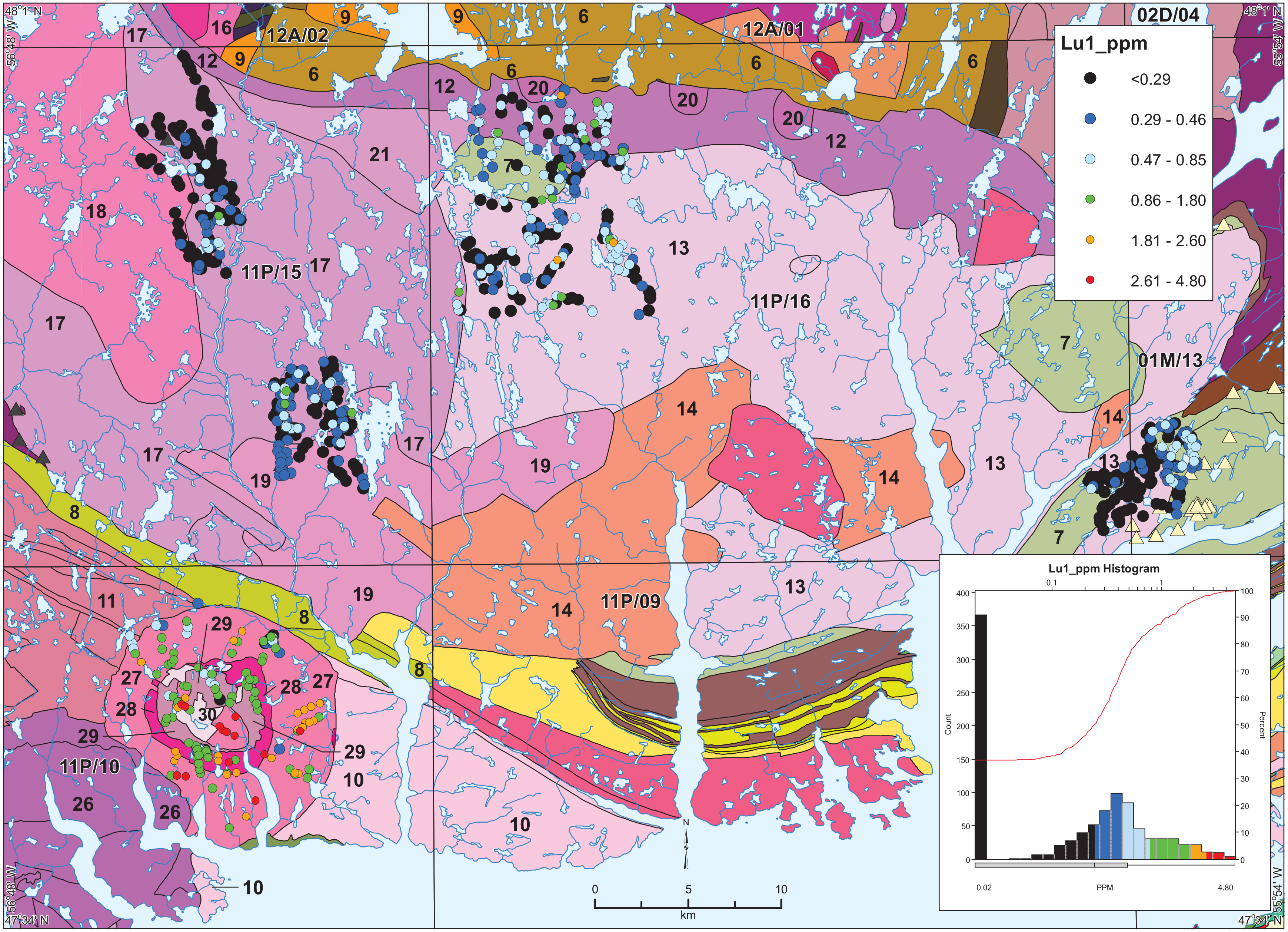

Figure 34. *Lutetium (Lu1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

Cs1, Na1, Rb1

The distribution of the three alkali metals analyzed – cesium (Cs1), sodium (Na1) and rubidium (Rb1) – are included to show patterns that likely reflect the variations in the lithologic composition of the François Granite. The distribution of Cs1 is shown in Figure 35, of Na1 in Figure 36 and of Rb1 in Figure 37. All three metals have similar distributions with the highest values clustering in the central area and do not conform to bedrock units as mapped.

Sn

The distribution of tin (Sn12) is shown in Figure 38. Tin analyses were not performed on samples from the Dolland Brook North area. Moderate to high contents of tin are found in most samples from the François Granite area. The distribution pattern of tin contents across the granite is fairly uniform. However, the highest values (105 and 165 ppm) are from two samples located about 100 m apart in the northeast part of the survey area.

Ta

The distribution of tantalum (Ta1) is shown in Figure 39. Nearly all stream-sediment samples in the François Granite area have moderate to high values. Samples with high and elevated values are strongly concentrated near the central area of the eastern lobe of the granite.

U

The distribution of uranium (U1) is shown in Figure 40. High and elevated values are found in the Bottom Brook, Dolland Brook and François Granite areas. Some of the values are very high. Of the eight highest value samples (*i.e.*, U1 >1200 ppm), only one also contains high levels of iron suggesting the presence of iron (hydr)oxide scavenging. That sample, 4010102, in the north end of the Bottom Brook area, has a Fe4 content of 39.2% and the highest uranium content in the survey at 3620 ppm. However, sample 4010136, which has the survey's third highest uranium content (2980 ppm U1), is also found in the Bottom Brook area and has an iron content of only 3.0%.

W

The distribution of tungsten in stream sediments (W1) is shown in Figure 41. Several high- and elevated-value samples are found in the Dolland Brook and Dolland Brook North areas. Moreover, each anomaly is concentrated in a relatively restricted area. These two survey areas are the only ones of the five shown in the figure that have known tungsten mineralization. However, in neither area are the occurrences reflected in the stream-sediment patterns. The presence of focused stream-sediment anomalies suggests that there may be other tungsten occurrences in the area. Perhaps the most interesting two samples are 4110563 and 4110565, located in the Dolland Brook area, which are adjacent samples from the same stream taken 350 m apart. These have W1 values of 387 and 391 ppm, respectively – the second and third highest tungsten (W1) values found in the entire survey. Samples 4110564 and 4110565 were taken at the same site. One sampled an iron-manganese hydroxide-rich layer (4110564) overlying a normal-appearing sediment (4110565). The normal sediment analyzed 6.51% Fe4 and 121 ppm Mn4 but contained 391 ppm tungsten, whereas the hydroxide-rich layer analyzed 10.5% Fe4 and 1060 ppm Mn4 but contained only 57 ppm tungsten.

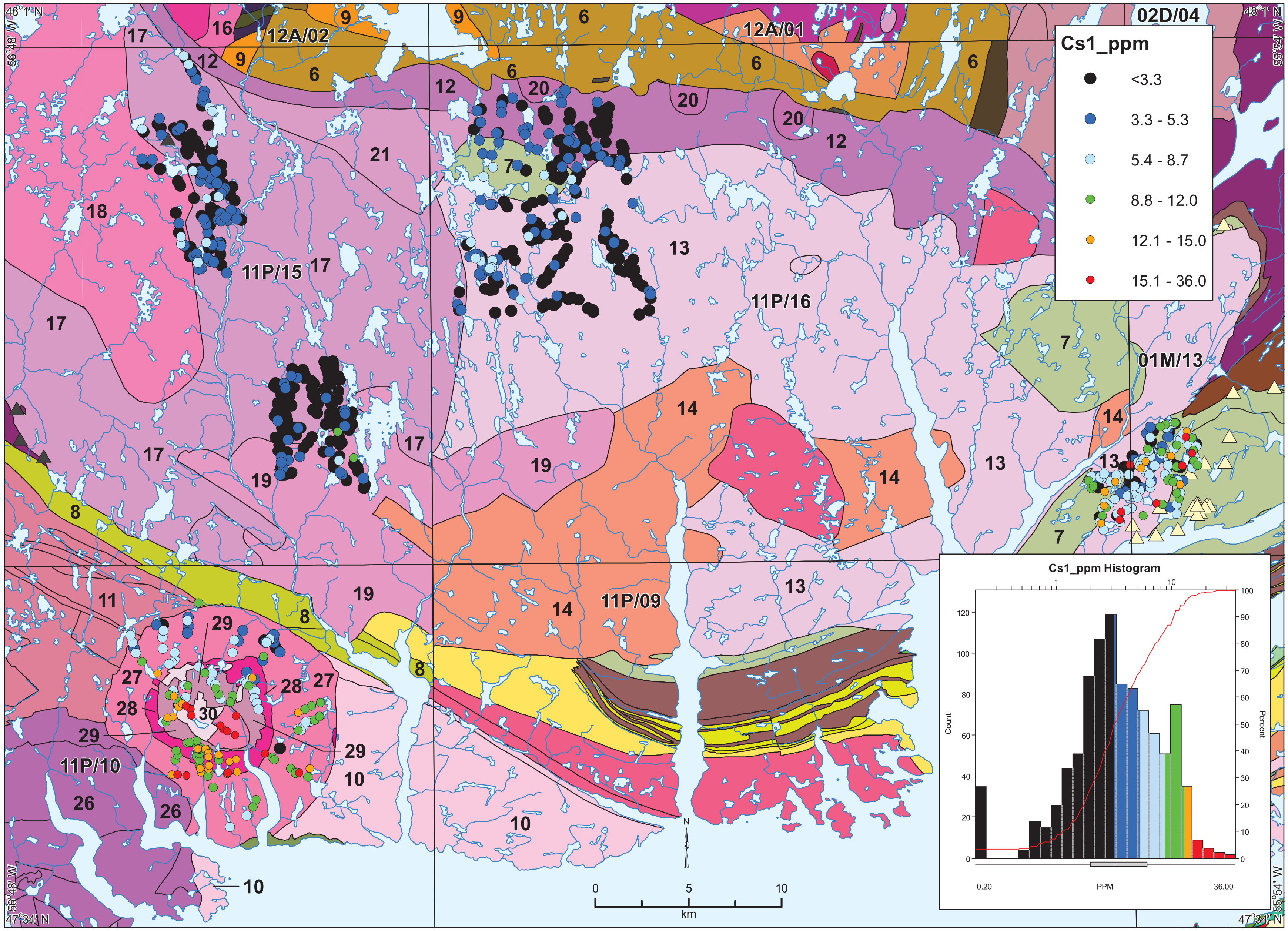

Figure 35. *Cesium (Cs1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

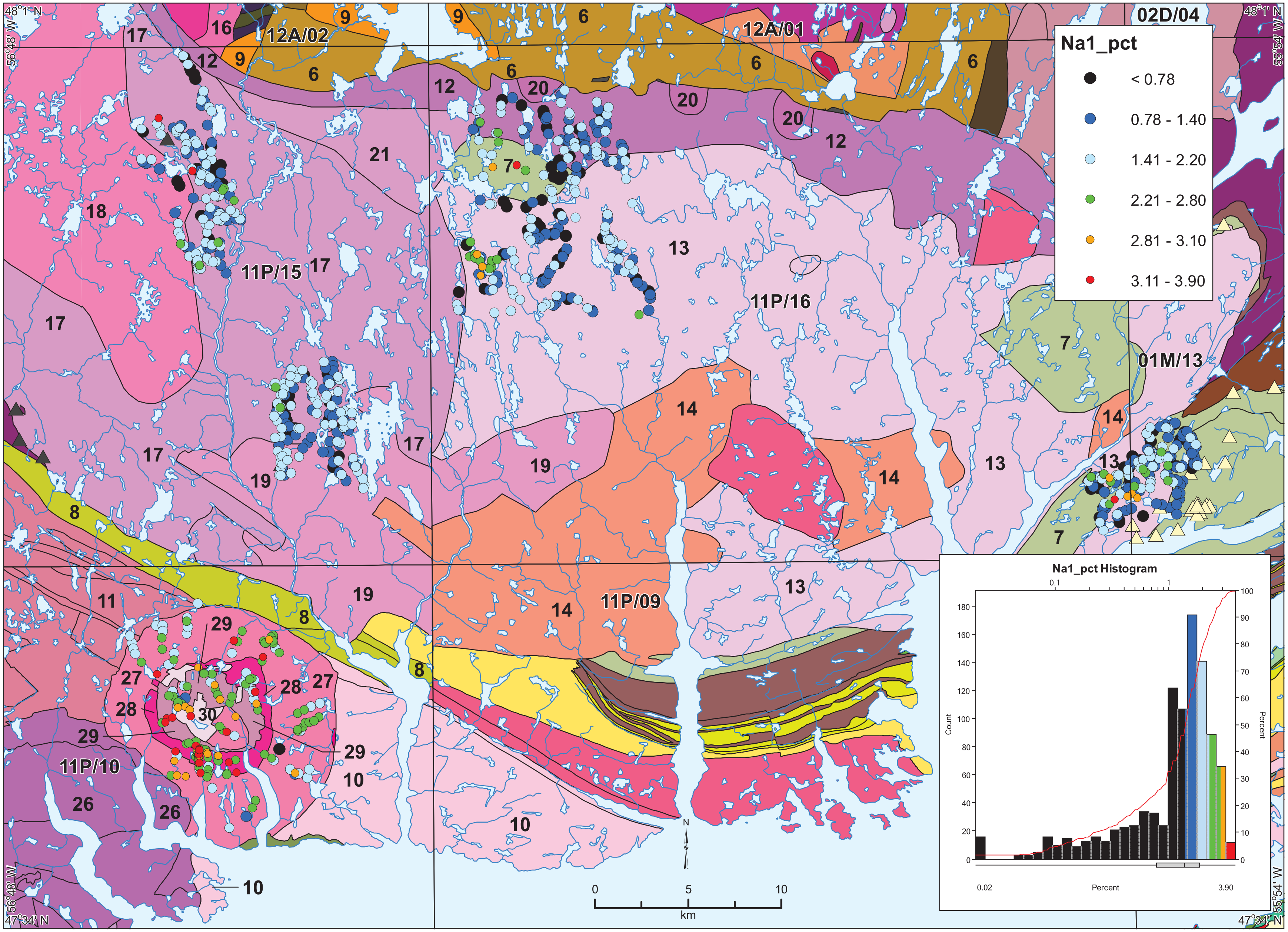

Figure 36. *Sodium (Na1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

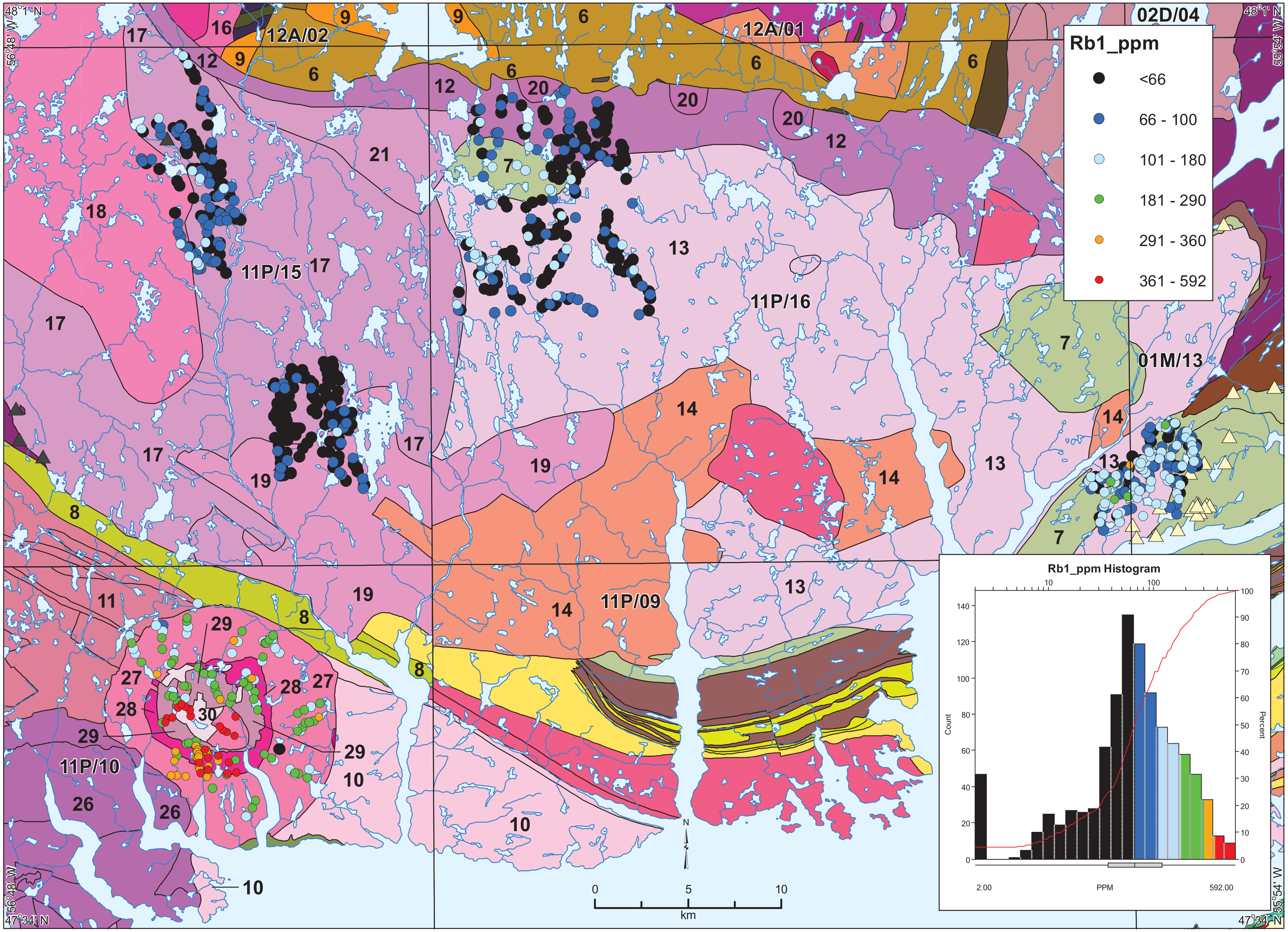

Figure 37. *Rubidium (Rb1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

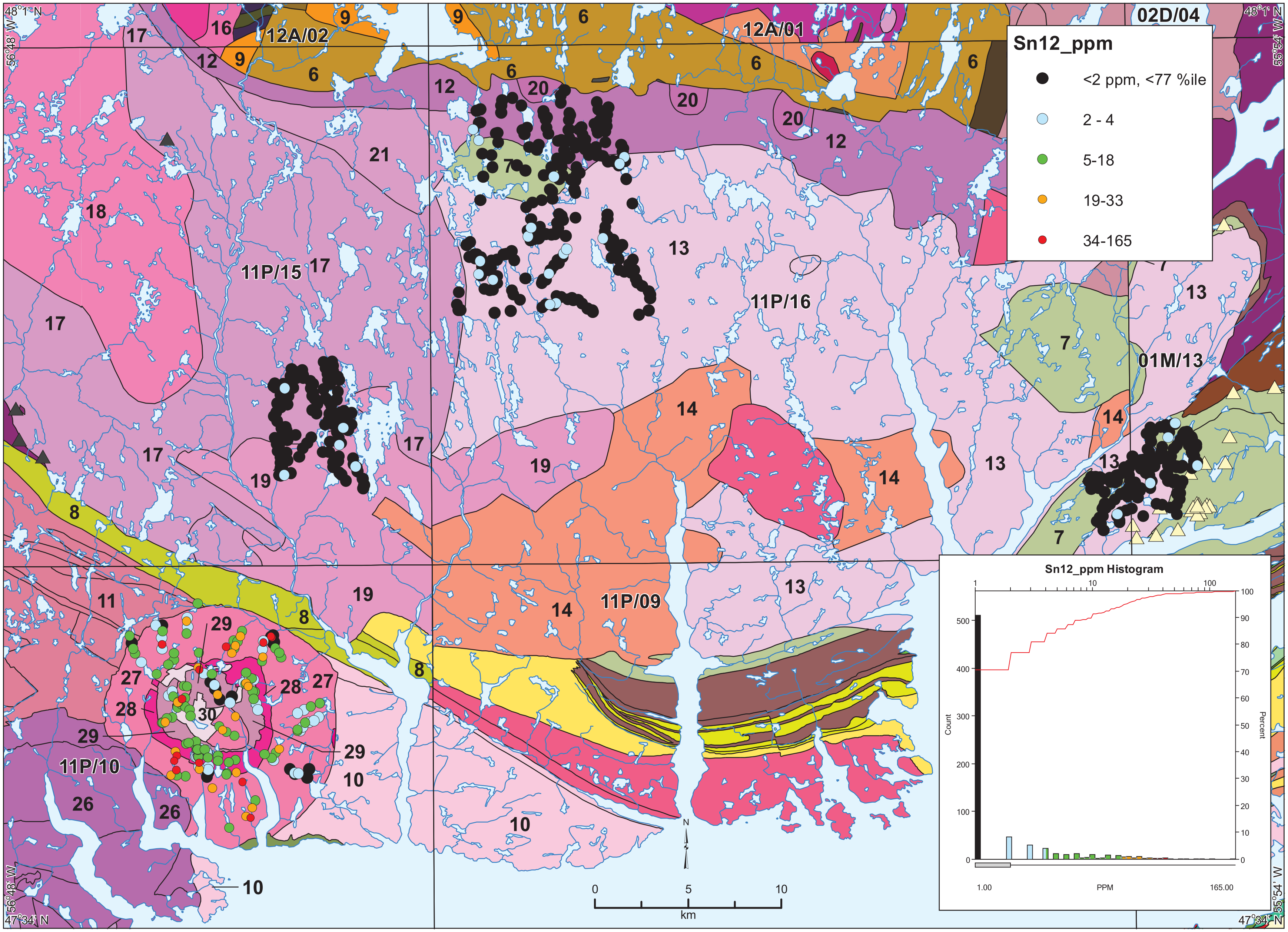

Figure 38. *Tin (Sn12) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

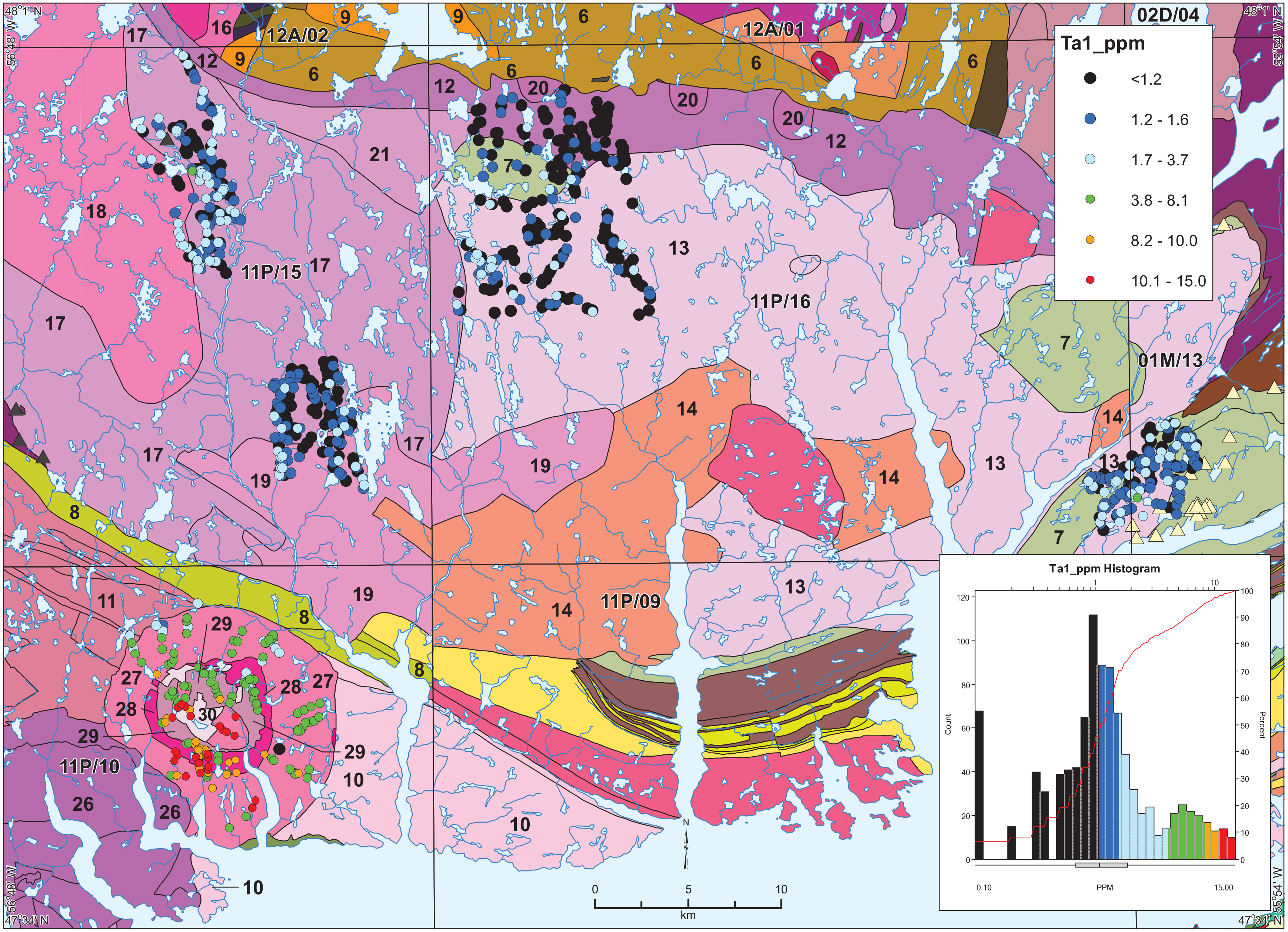

Figure 39. *Tantalum (Ta1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

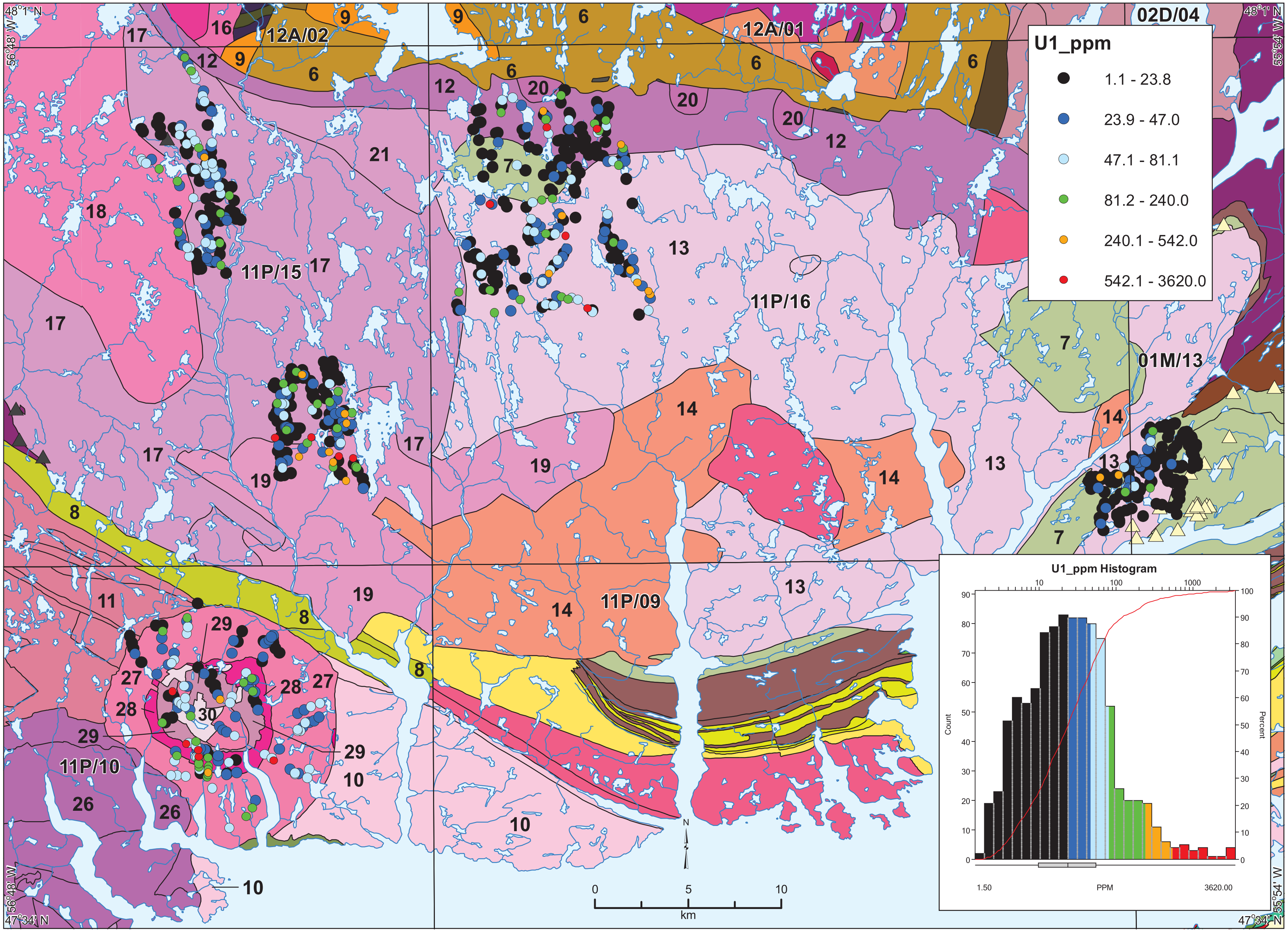

Figure 40. *Uranium (U1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

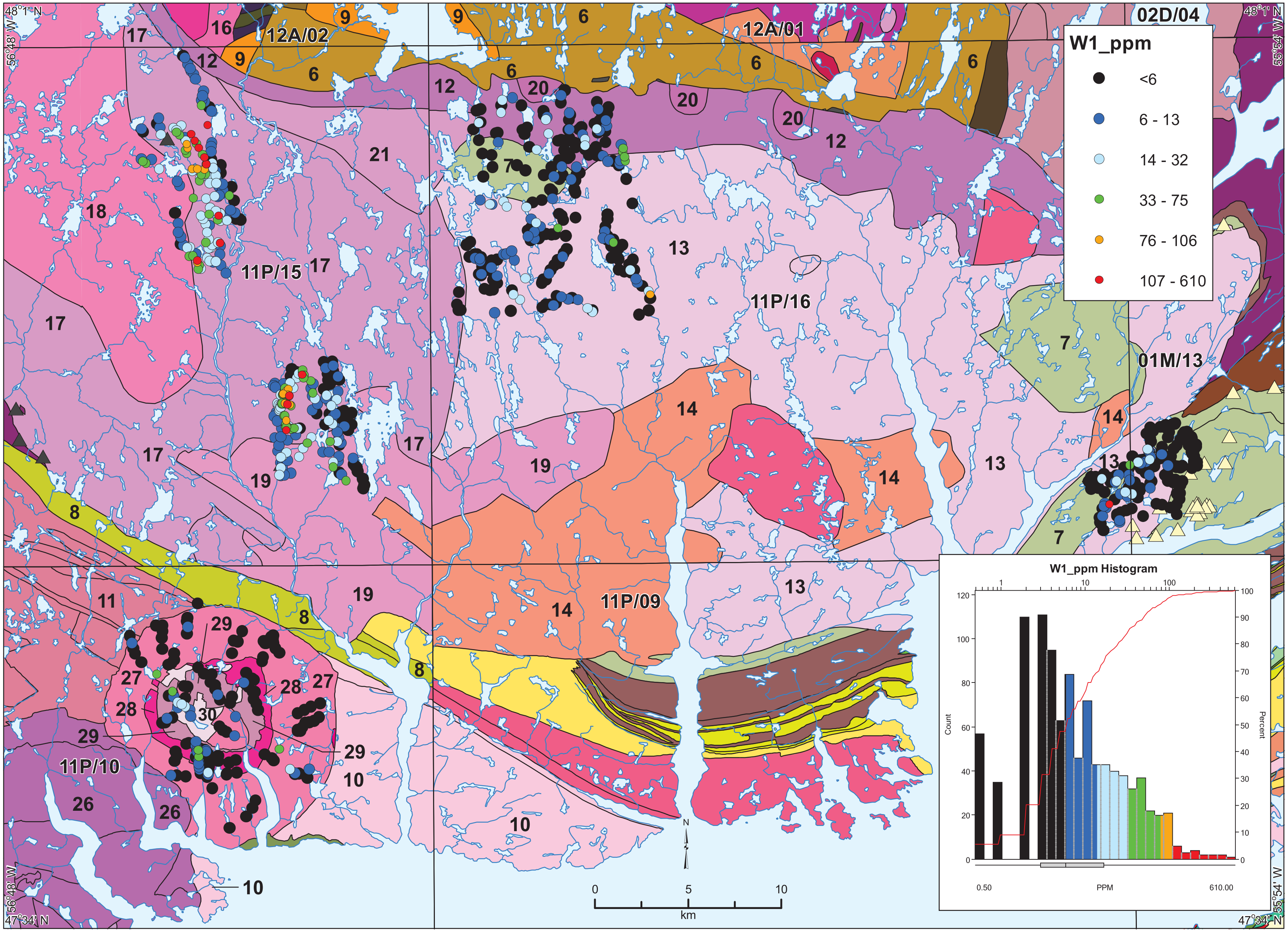

Figure 41. *Tungsten (W1) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

The highest tungsten content in the entire survey, at 610 ppm, is from sample 4010618, located in the Dolland Brook area. However, it also has high Fe4 and Mn4 contents at 20.11% and 15 010 ppm Mn4, respectively, which may somewhat diminish the significance of the high tungsten content. The sample is located about 1800 m north and up-ice of the only known tungsten occurrence in the Dolland Brook area.

The distribution of tungsten (W11) analyzed by inductively coupled plasma emission spectroscopy (ICP-ES) is shown in Figure 42. It is included principally because two samples in the Bottom Brook area have high tungsten contents and these samples were not analyzed by instrumental neutron activation analysis (INAA; W1).

Stream-sediment Data from the Ackley Granite Area

Many stream-sediment samples in the Ackley Granite area had insufficient fine material for analysis by the initial analytical methods (*see* Table 1). To compound the problem, many more had insufficient material remaining to prepare the required 5–10 gram aliquot when samples were sent for INAA in 2013 (Table 1). Only 17 samples were analyzed by INAA.

Fe

The distribution of iron (Fe4) is shown in Figure 43. It is included as a reference for checking other analyses for possible correlation with iron resulting from iron (hydr)oxide scavenging.

LOI

Because of the lack of sample material, loss-on-ignition (LOI) analyses were not performed on the collected samples.

Sn

The distribution of tin (Sn12) is shown in Figure 44. There are no stream samples that have high values present although there are three samples with elevated (orange symbols) contents and several with moderate values. The lack of high values likely reflects the fact that all known tin mineralization is found near the southeast contact of Unit 25 of the Ackley Granite with units of the Belle Bay Formation. The latter area has few streams, hence few samples.

F

The distribution of fluoride (F9) is shown in Figure 45. The samples are clearly enriched in fluoride relative to the other areas described in this report. Reference to the histogram shows that nearly all samples exceed the 85th percentile.

REE

Maps showing the distribution of most of the analyzed rare-earth elements (REE) are included to show the variation in relative concentrations of the different REE. The figures are present-

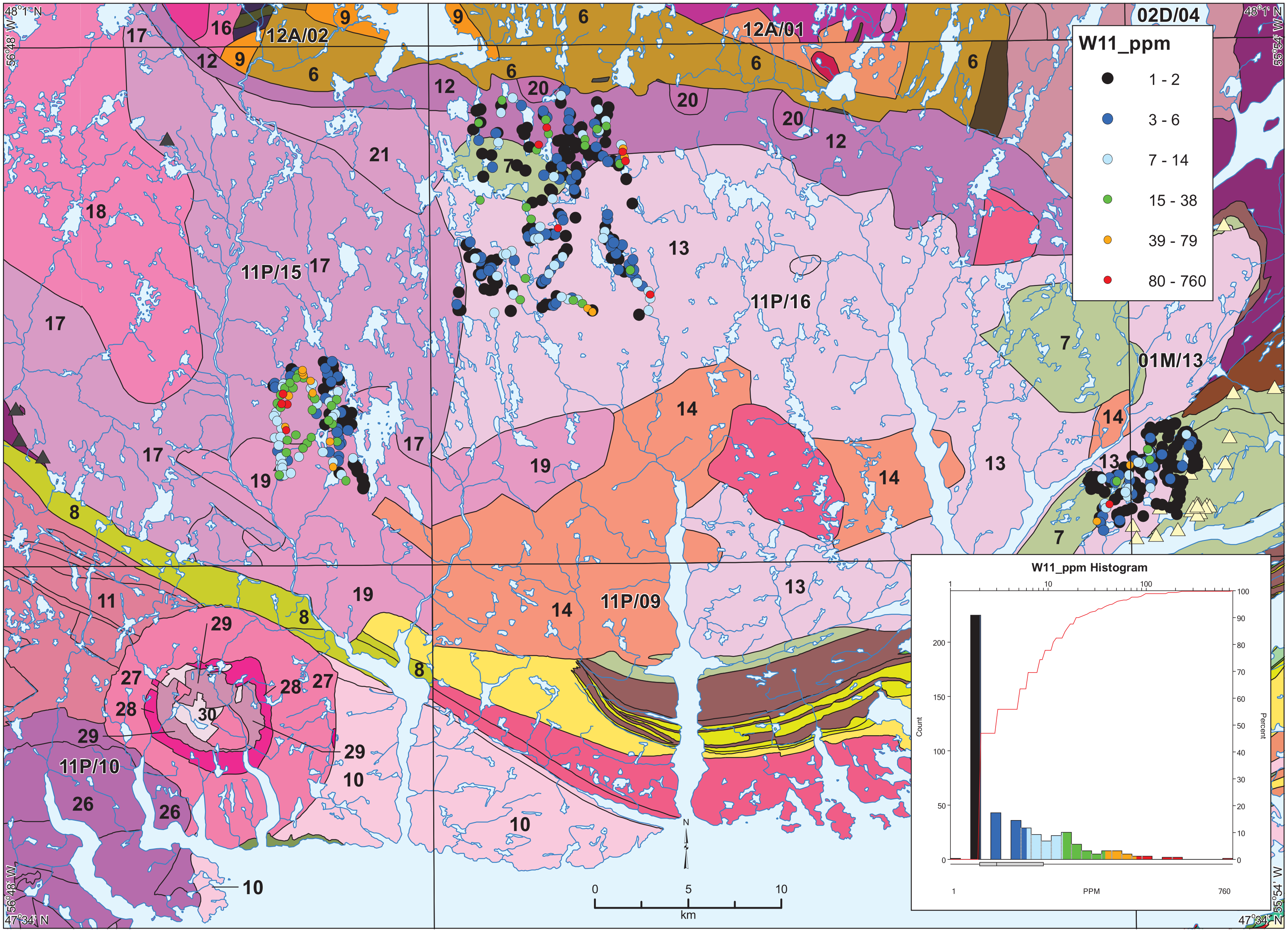

Figure 42. *Tungsten (W11) in stream sediments in the Dolland Brook, Dolland Brook North, Bottom Brook, East Bay and François Granite areas.*

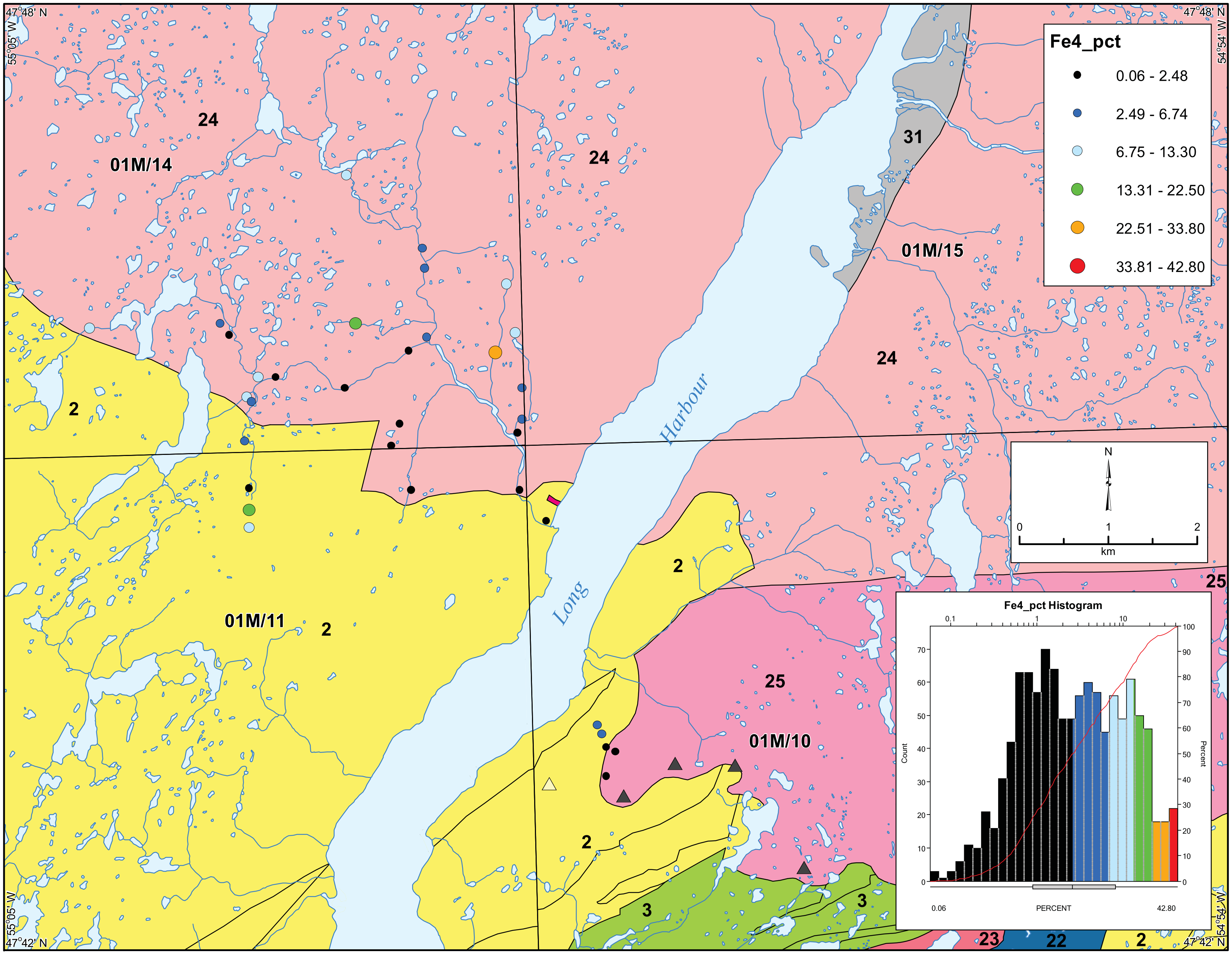

Figure 43. *Iron (Fe4) in stream sediments in the Ackley Granite area.*

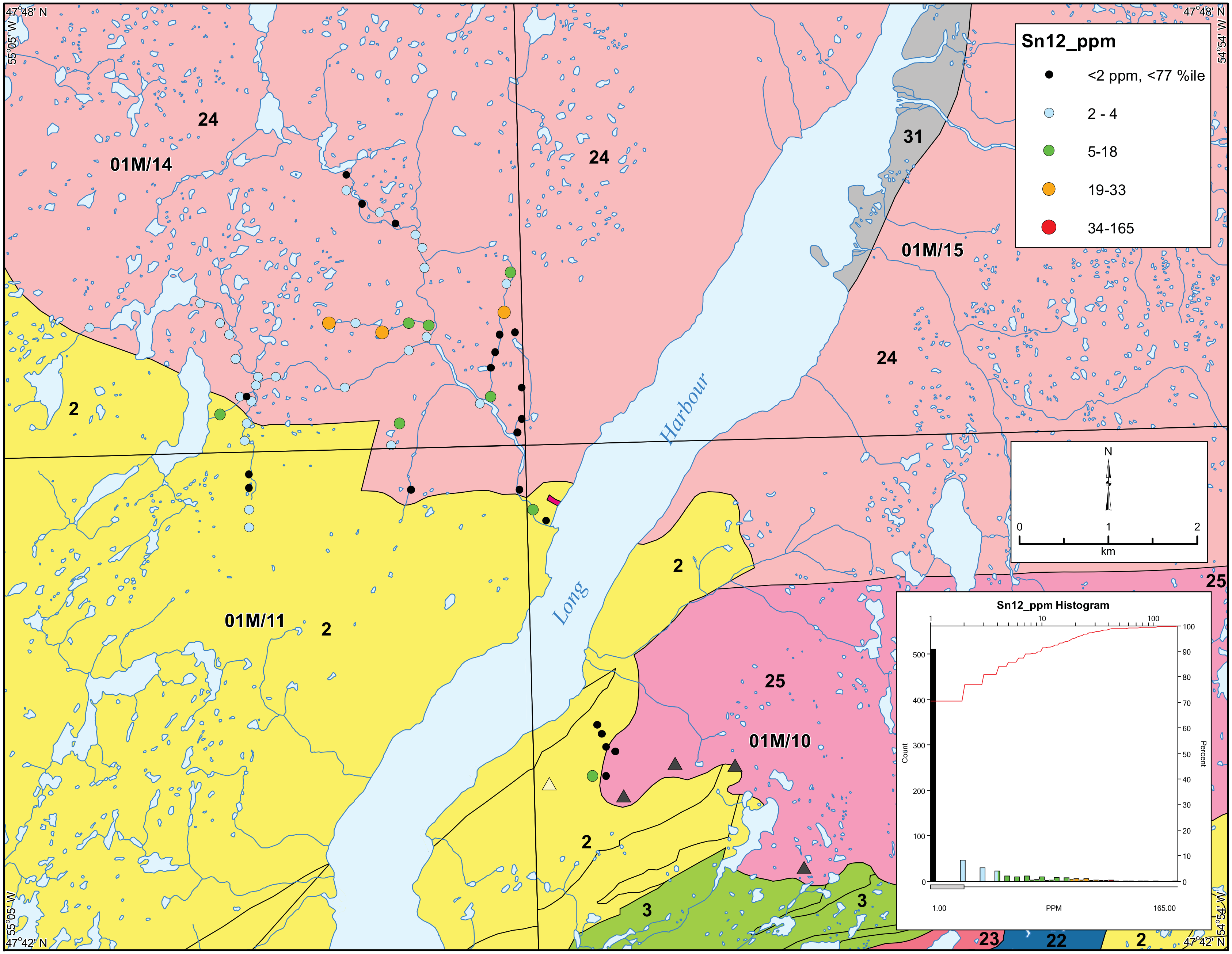

Figure 44. *Tin (Sn12) in stream sediments in the Ackley Granite area.*

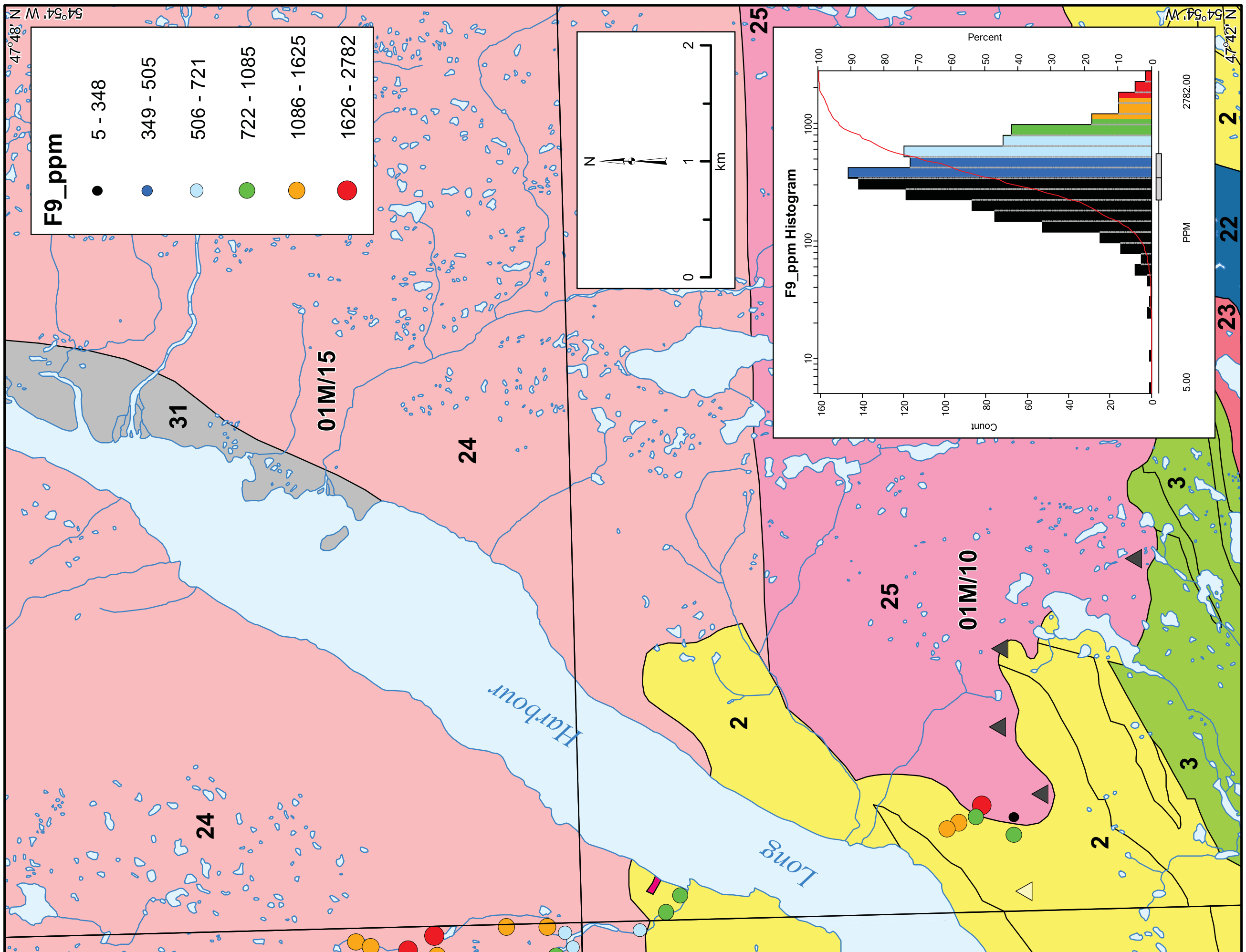

Figure 45. *Fluoride (F9) in stream sediments in the Ackley Granite area.*

ed in order of increasing atomic weight beginning with lanthanum (La1; Figure 46), and continuing with cerium (Ce1; Figure 47), samarium (Sm1; Figure 48), terbium (Tb1; Figure 49), ytterbium (Yb1) in Figure 50 and ending with lutetium (Lu1; Figure 51). Europium (Eu1) is not plotted because it has only seven analyses due to interference effects. Relative concentrations (as shown by symbol colours) of the light REE are generally lower than those of the heavier REE.

Pb

The distribution of lead (Pb4) is shown in Figure 52. It is included to show the high lead values in sediments in this area. Two samples with high lead values collected over the Belle Bay Formation west of Long Harbour are higher than found elsewhere over this formation and may reflect transport of till from the north with a provenance in the Ackley Granite. Their positions are downstream from Unit 25 of the Ackley Granite.

DISTRIBUTION IN SOILS

The locations of soil-sampling areas, with sites colour-coded by year of collection, are shown in Figure 53. Figures showing the locations of individual, numbered, reconnaissance sample-sites for the Granite Lake, Dolland Brook, Bottom Brook and Ackley Granite survey areas are shown in Figures 54 to 57, respectively. Each site is identified with the last 3 digits of a sample's field number. In addition, rock-sample locations within the soil-sampling areas are also shown. Similar figures giving the locations of numbered grid sample-sites for grids in the Granite Lake, Dolland Brook and Ackley Granite areas are shown in Figures 58 to 61.

Soil Data from the Granite Lake Area

Fe

The distribution of iron (Fe4) in reconnaissance soil samples is shown in Figure 62. Iron is included because, as with stream sediments, it may form (hydr)oxides with other elements resulting in abnormally high contents of those elements in soil. In the grid soils this effect is not pronounced (Table 11); however, silver (Ag4) and copper (Cu4) have the highest correlations at r=0.49 and r=0.41, respectively. The distribution of iron (Fe4) in grid soils is shown in Figure 63. Most samples in the western grid have high or elevated contents.

LOI

The distribution of loss-on-ignition (LOI) in reconnaissance soil samples is shown in Figure 64. It has high values in the central and eastern portions of the northern sampling line, high and elevated values in the central line, and across most of the southern line. It is also an environmental indicator and may be associated with enhanced or depressed contents of some elements. For example, silver has a correlation of r=0.66 with LOI in the Granite Lake area grid soils.

The distribution of loss-on-ignition (LOI) in grid soil samples in the Granite Lake area is shown in Figure 65. Most samples in both grids have high or elevated contents.

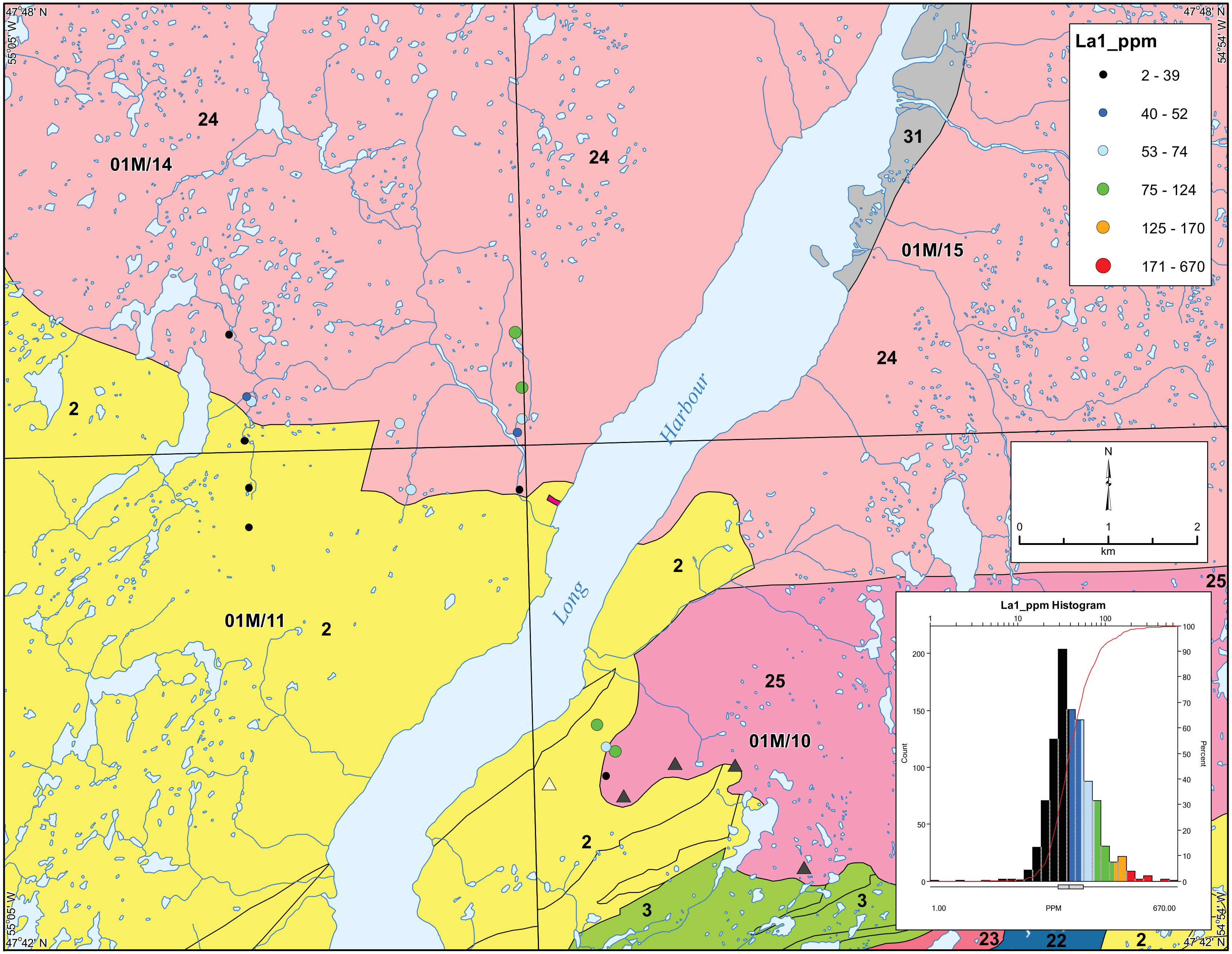

Figure 46. *Lanthanum (La1) in stream sediments in the Ackley Granite area.*

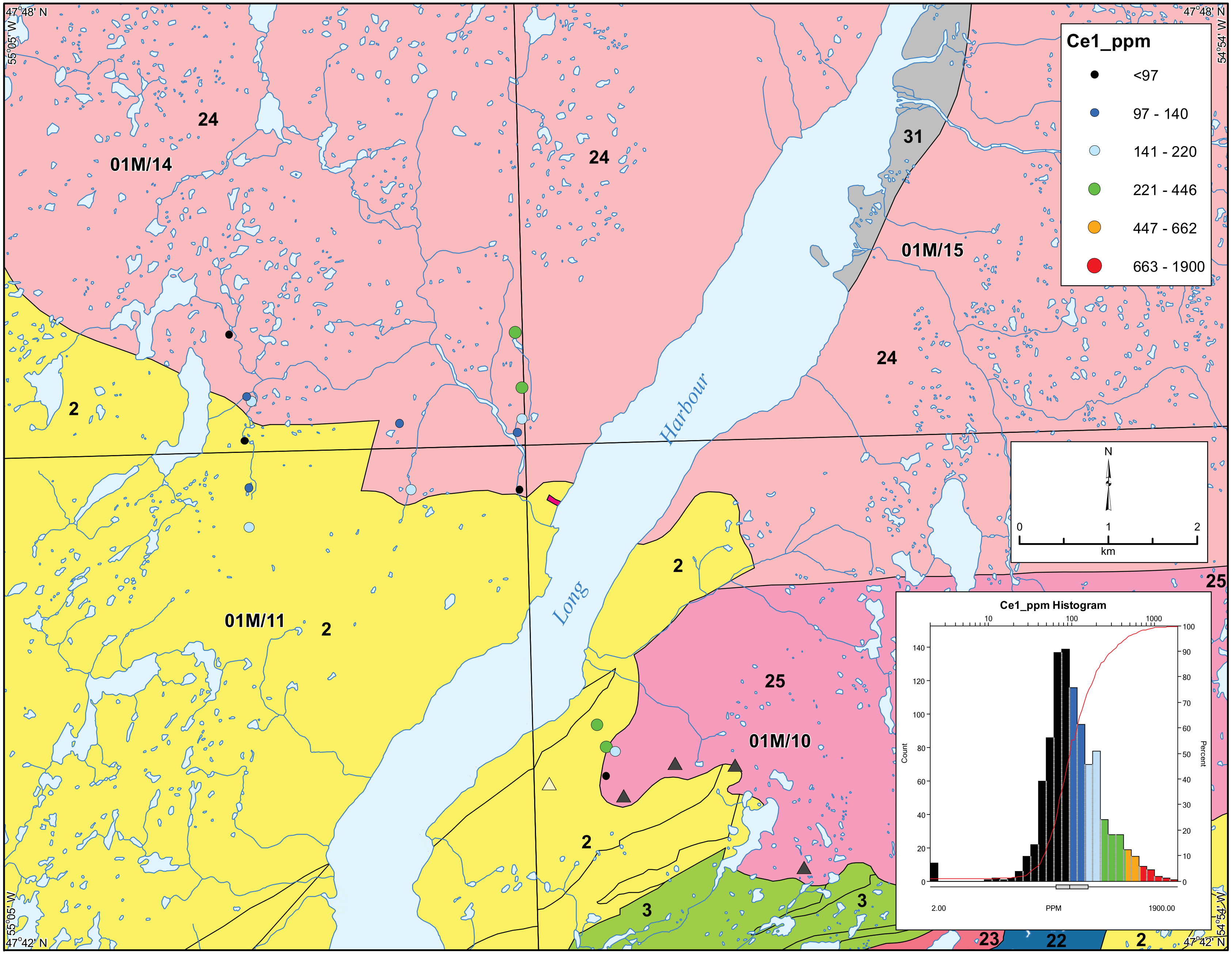

Figure 47. *Cerium (Ce1) in stream sediments in the Ackley Granite area.*

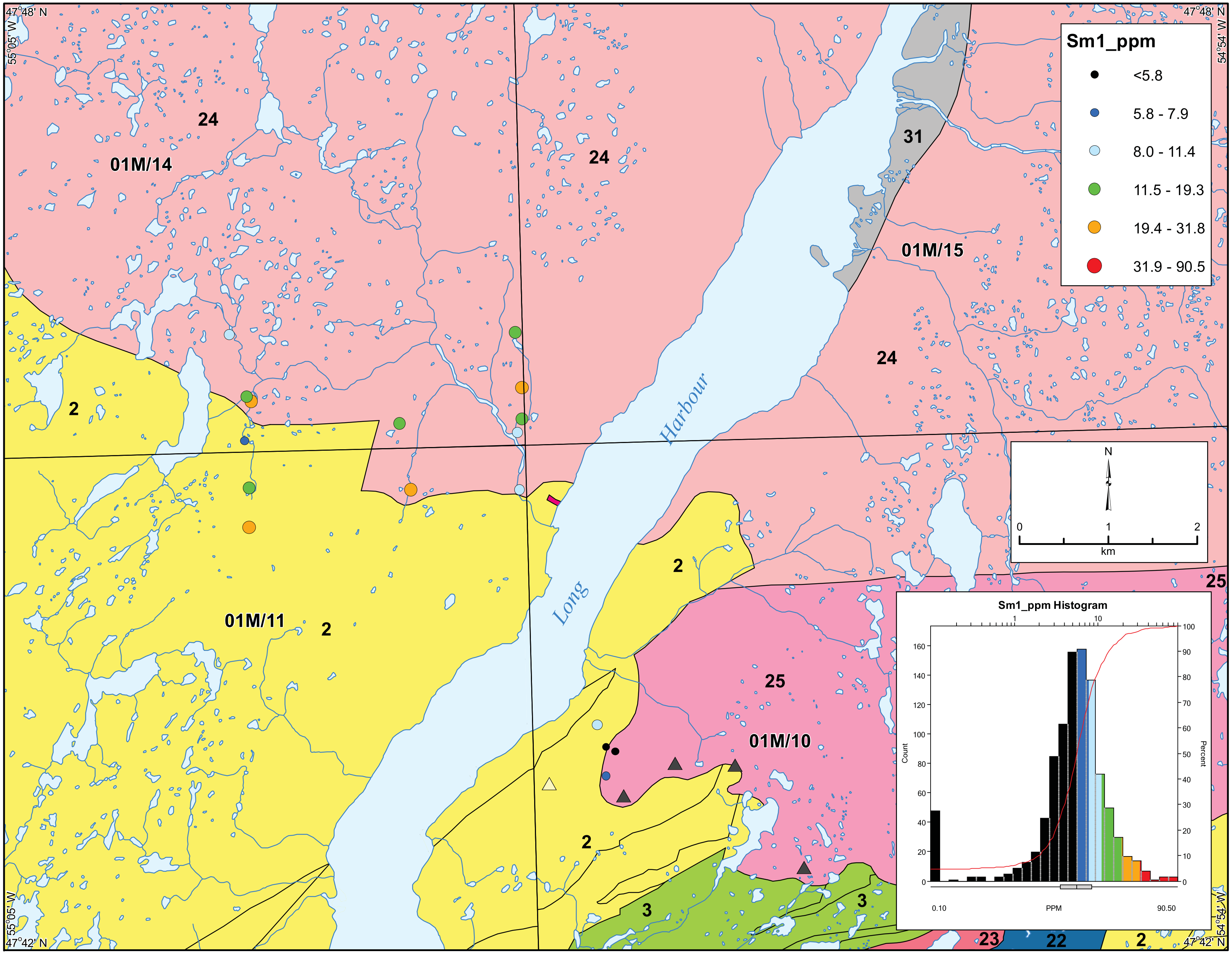

Figure 48. *Samarium (Sm1) in stream sediments in the Ackley Granite area.*

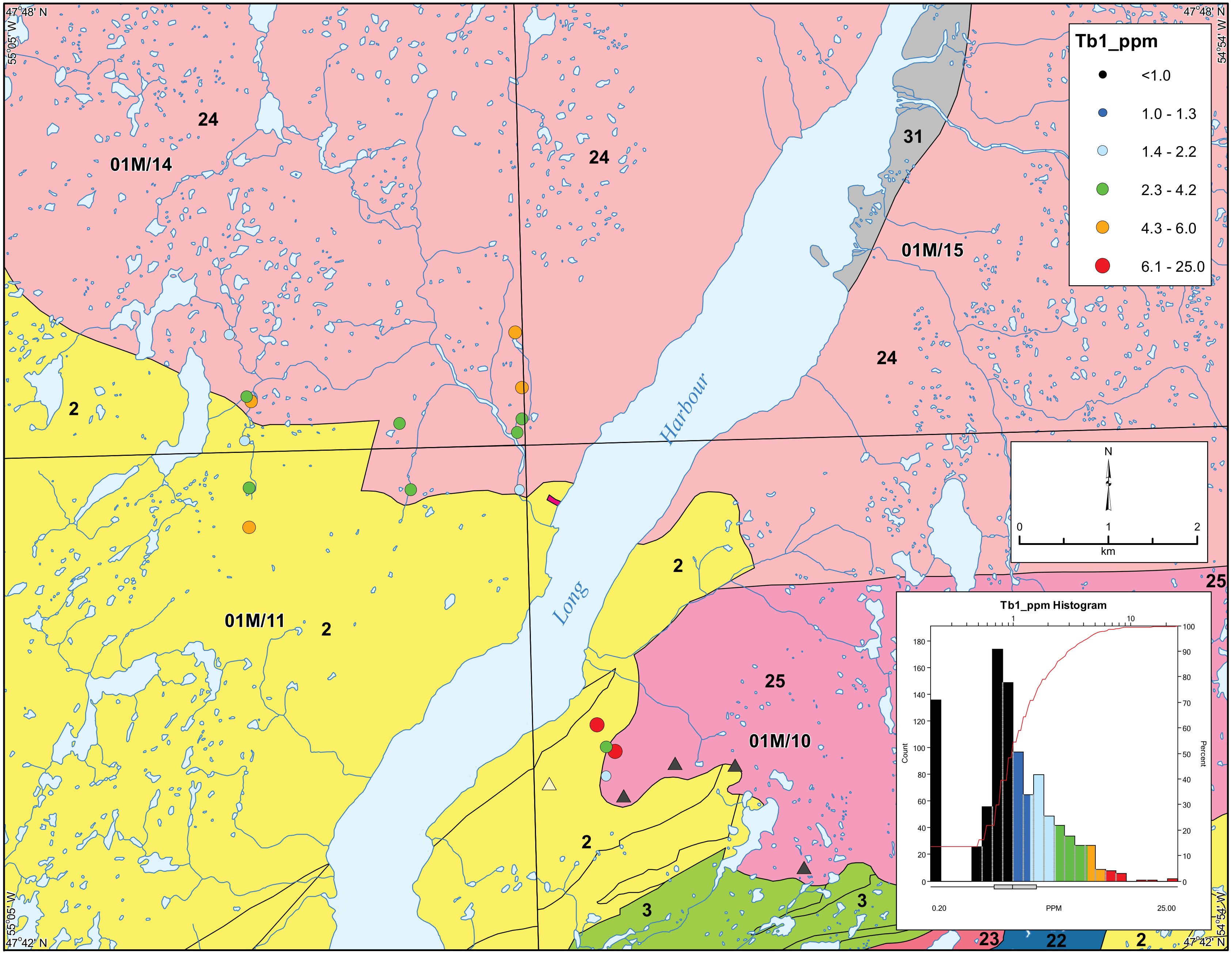

Figure 49. *Terbium (Tb1) in stream sediments in the Ackley Granite area.*

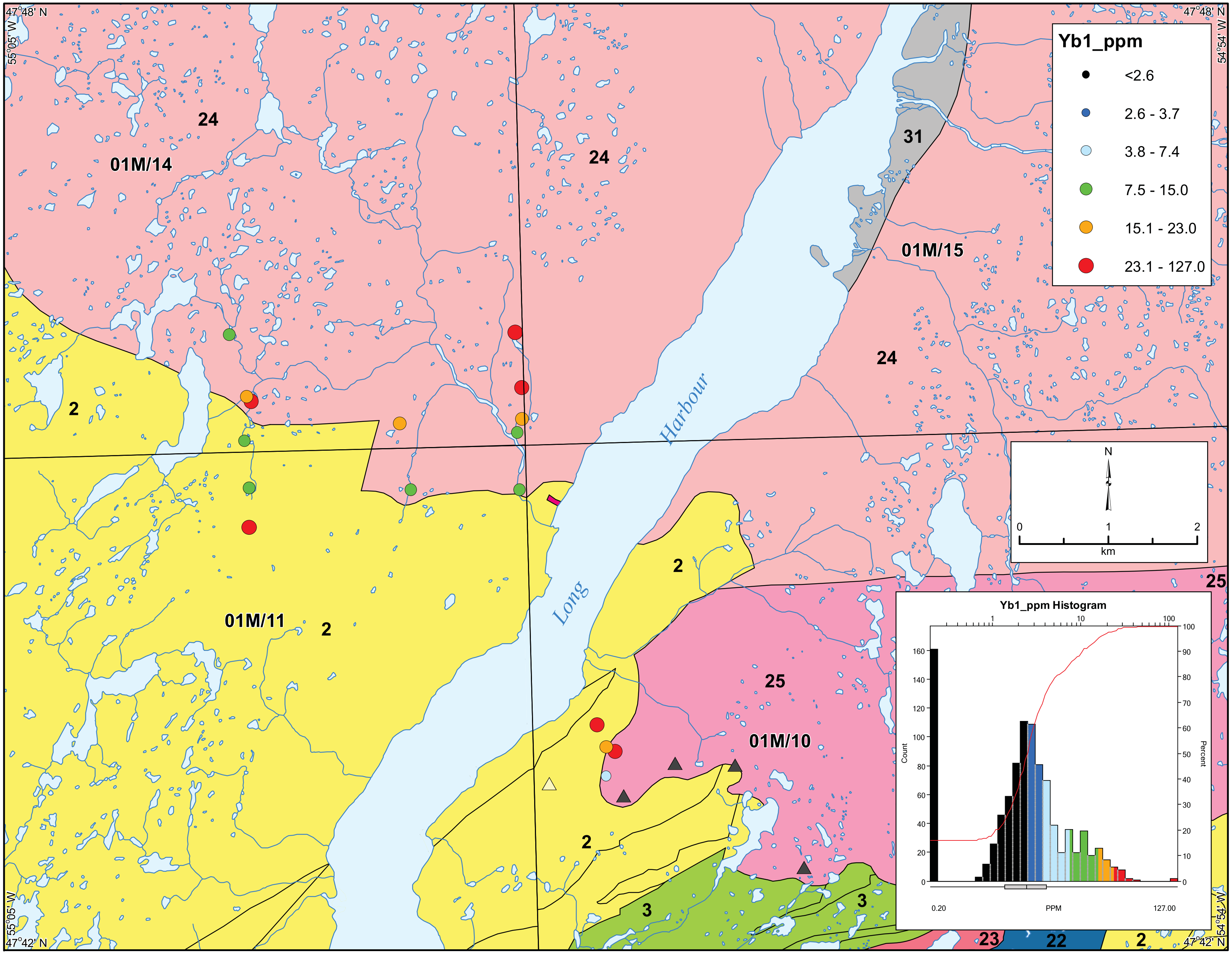

Figure 50. *Ytterbium (Yb1) in stream sediments in the Ackley Granite area.*

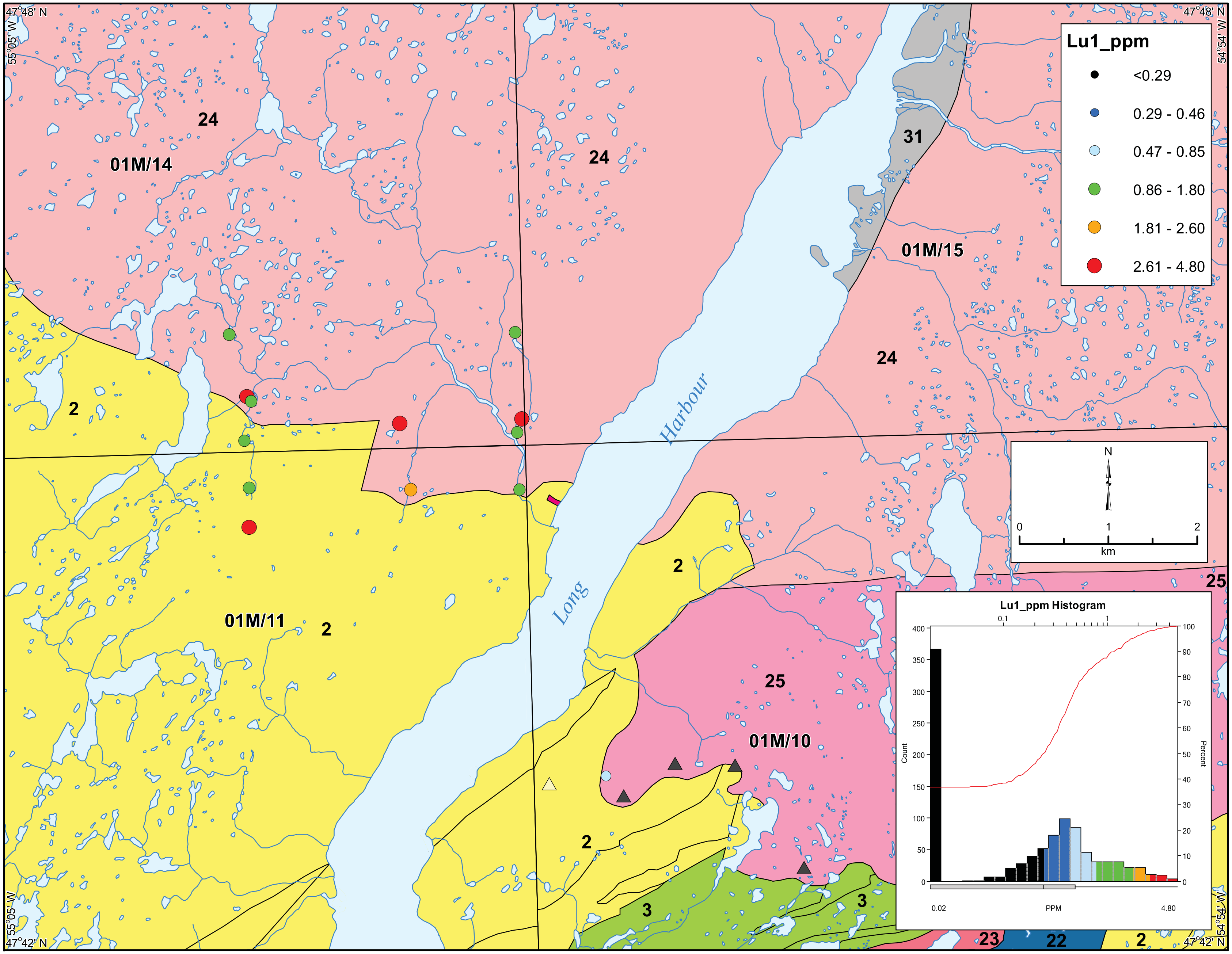

Figure 51. *Lutetium (Lu1) in stream sediments in the Ackley Granite area.*

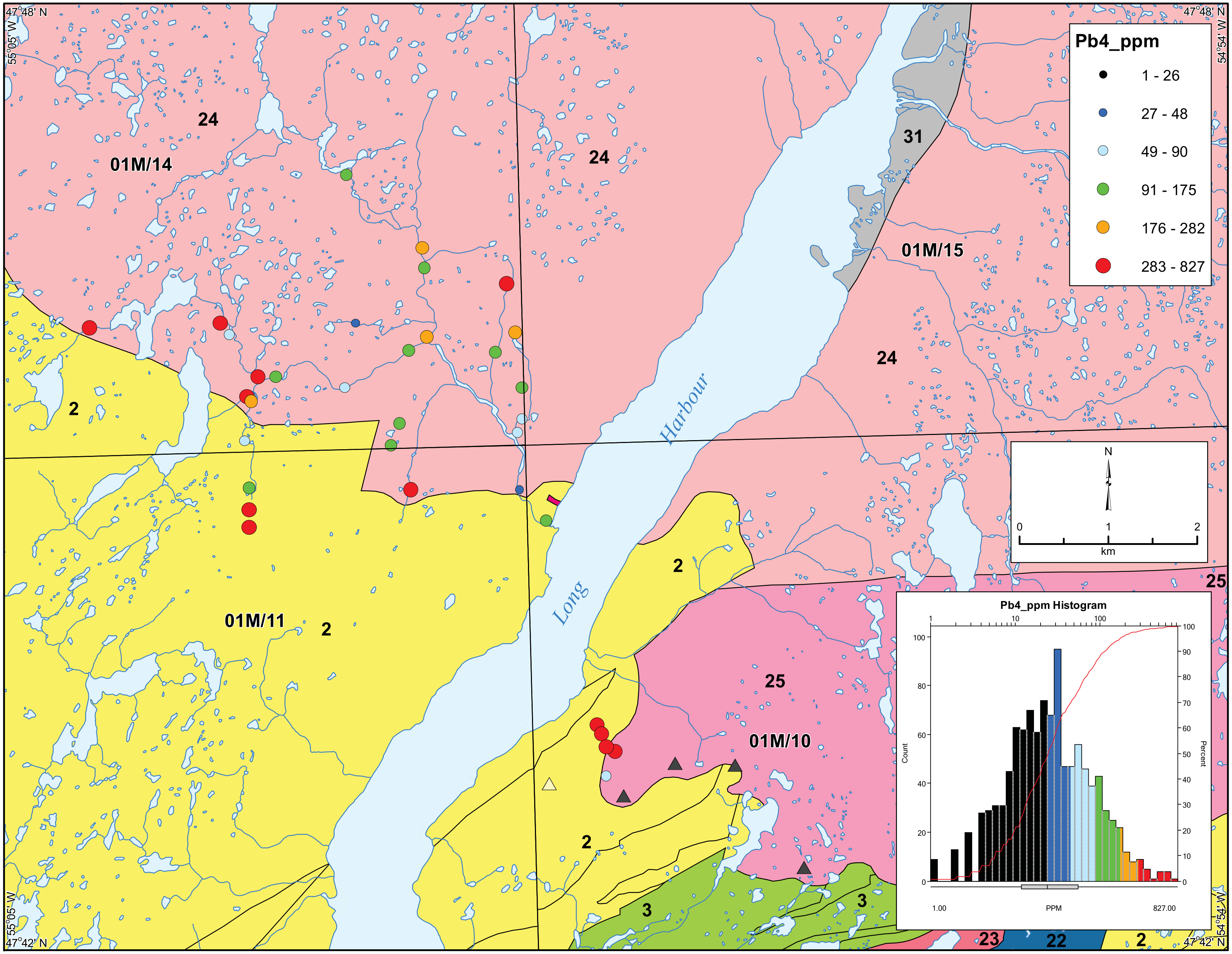

Figure 52. *Lead (Pb4) in stream sediments in the Ackley Granite area.*

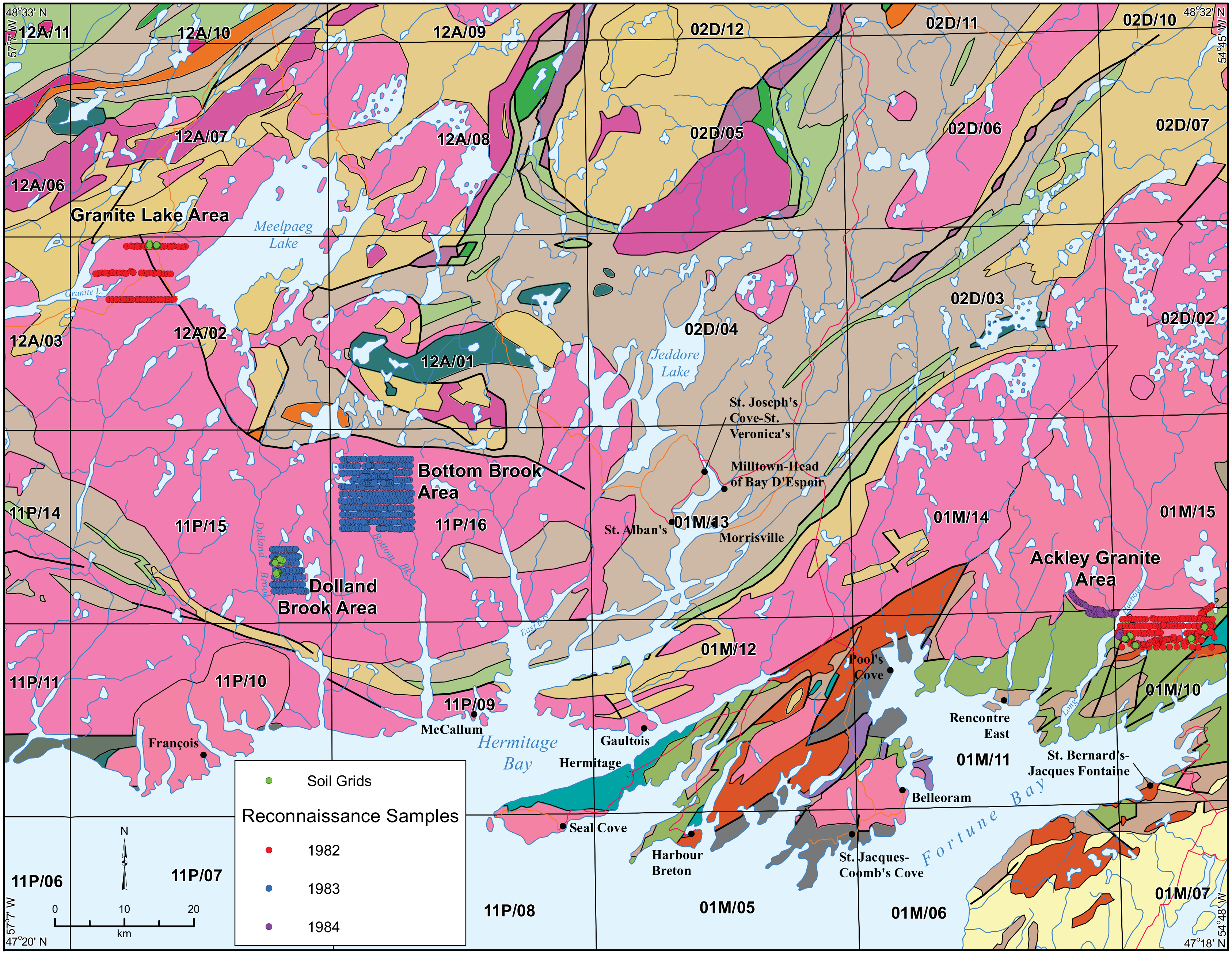

Figure 53. *Soil sampling areas.*

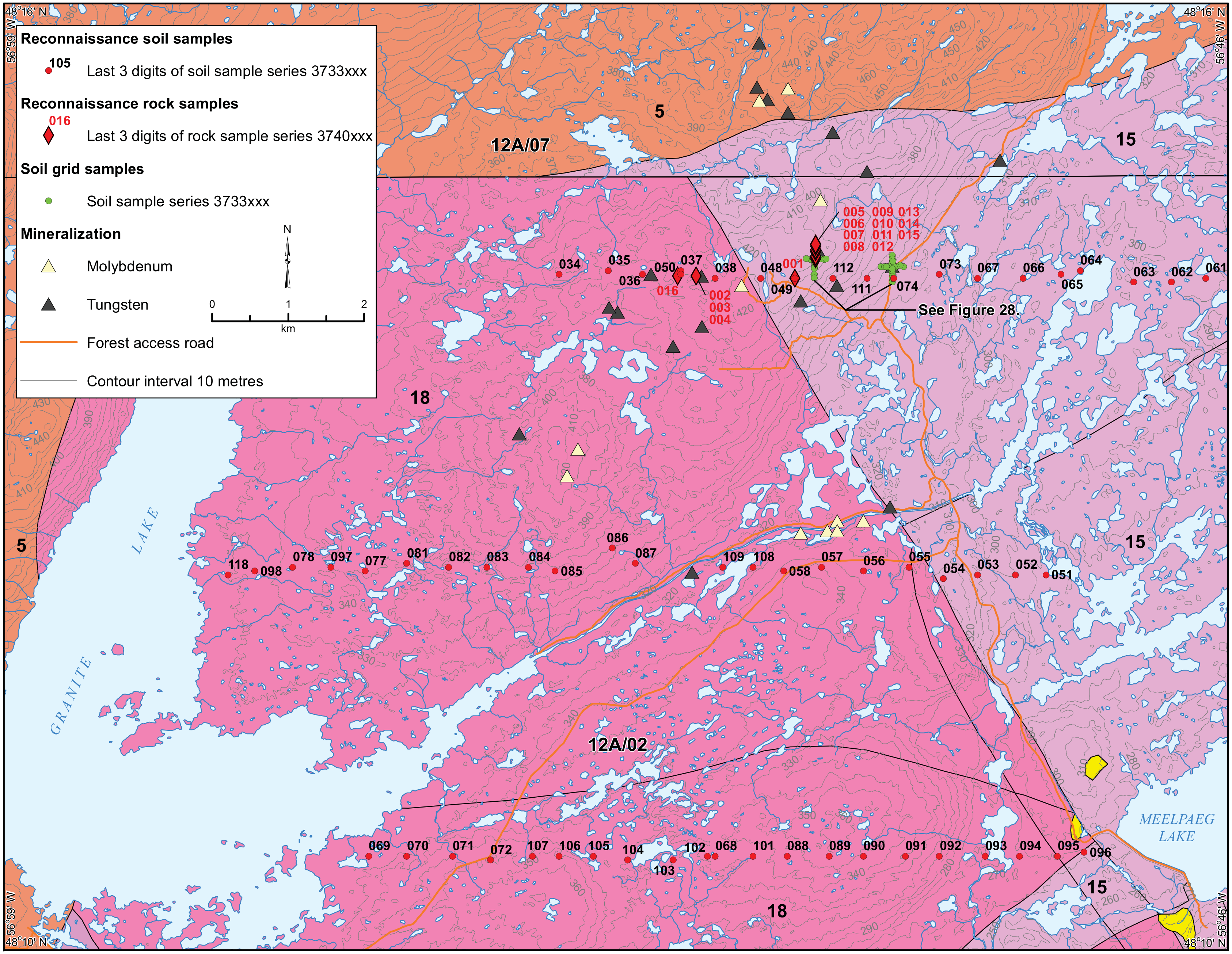

Figure 54. *Reconnaissance soil- and rock-sample locations with sample numbers in the Granite Lake area.*

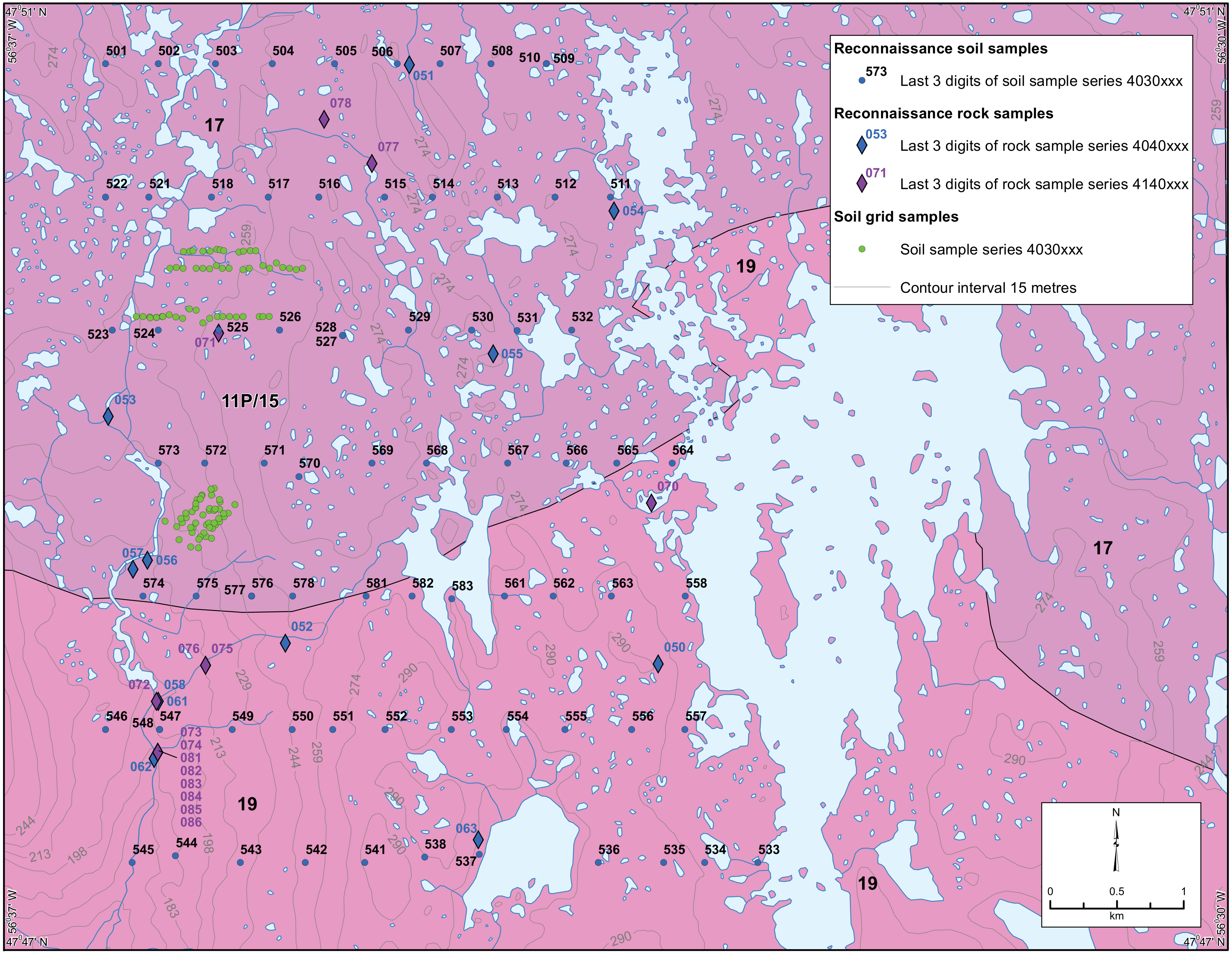

Figure 55. *Reconnaissance soil- and rock-sample locations with sample numbers in the Dolland Brook area.*

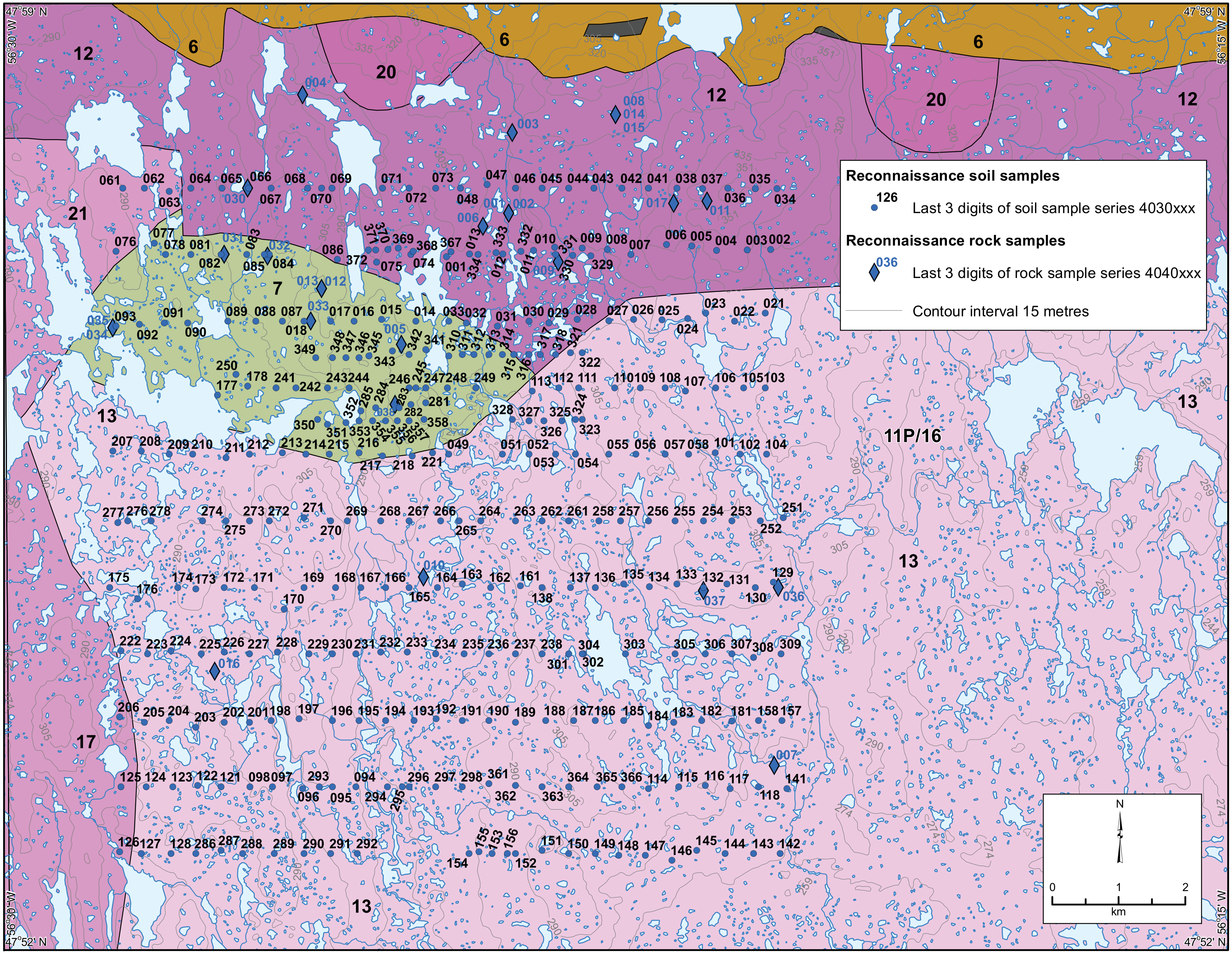

Figure 56. *Reconnaissance soil- and rock-sample locations with sample numbers in the Bottom Brook area.*

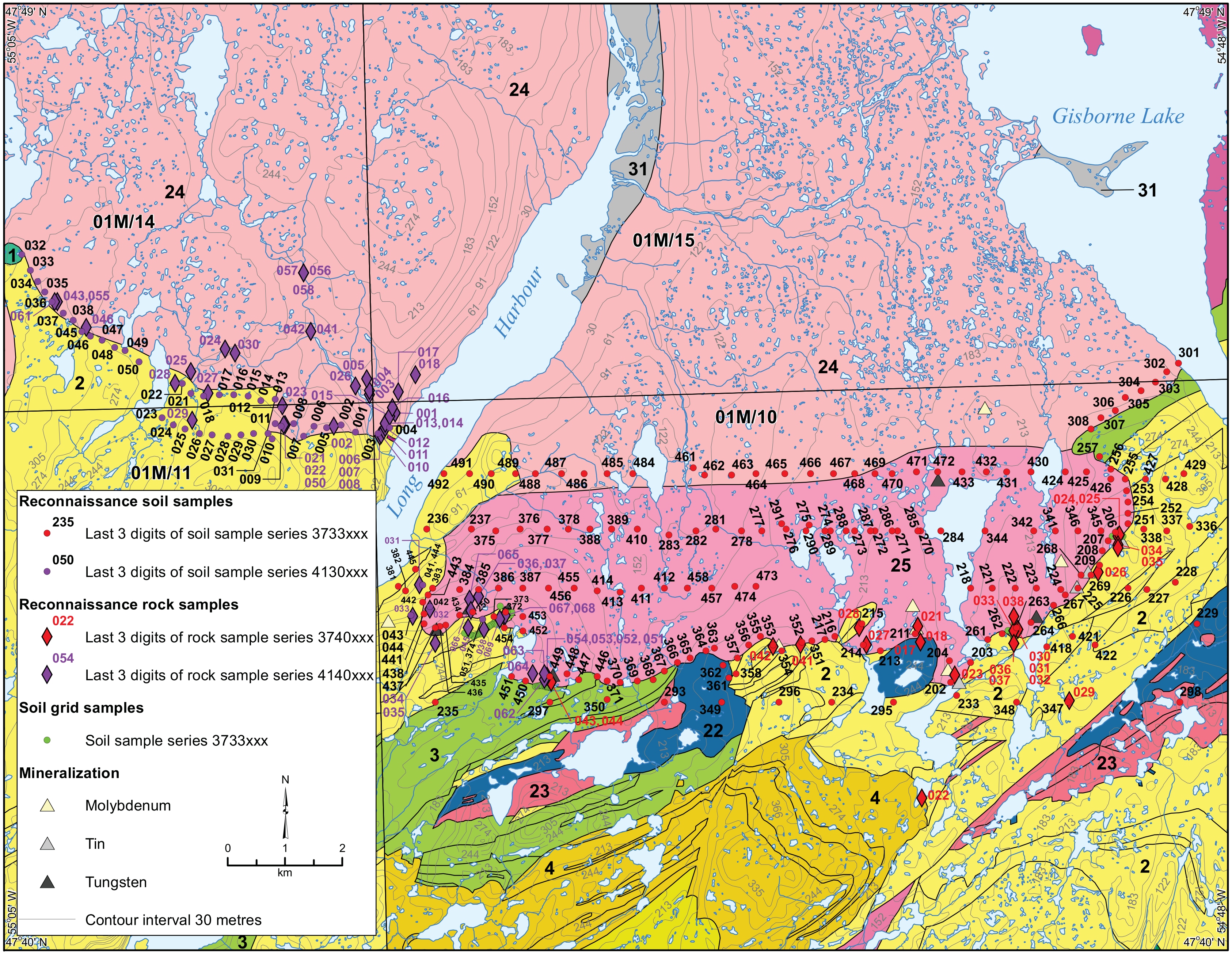

Figure 57. *Reconnaissance soil- and rock-sample locations with sample numbers in the Ackley Granite area.*

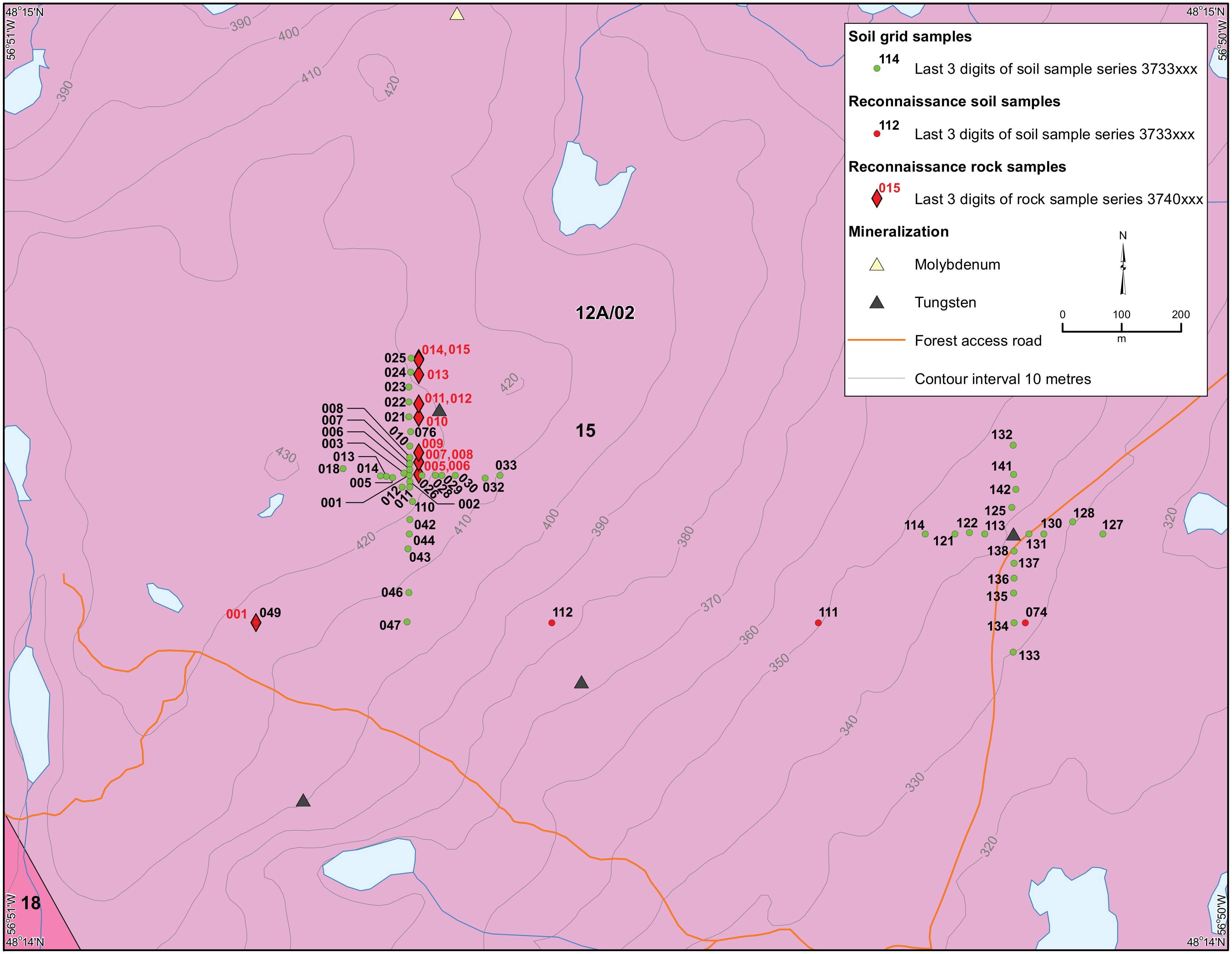

Figure 58. *Grid soil- and rock-sample locations with sample numbers in the Granite Lake area.*

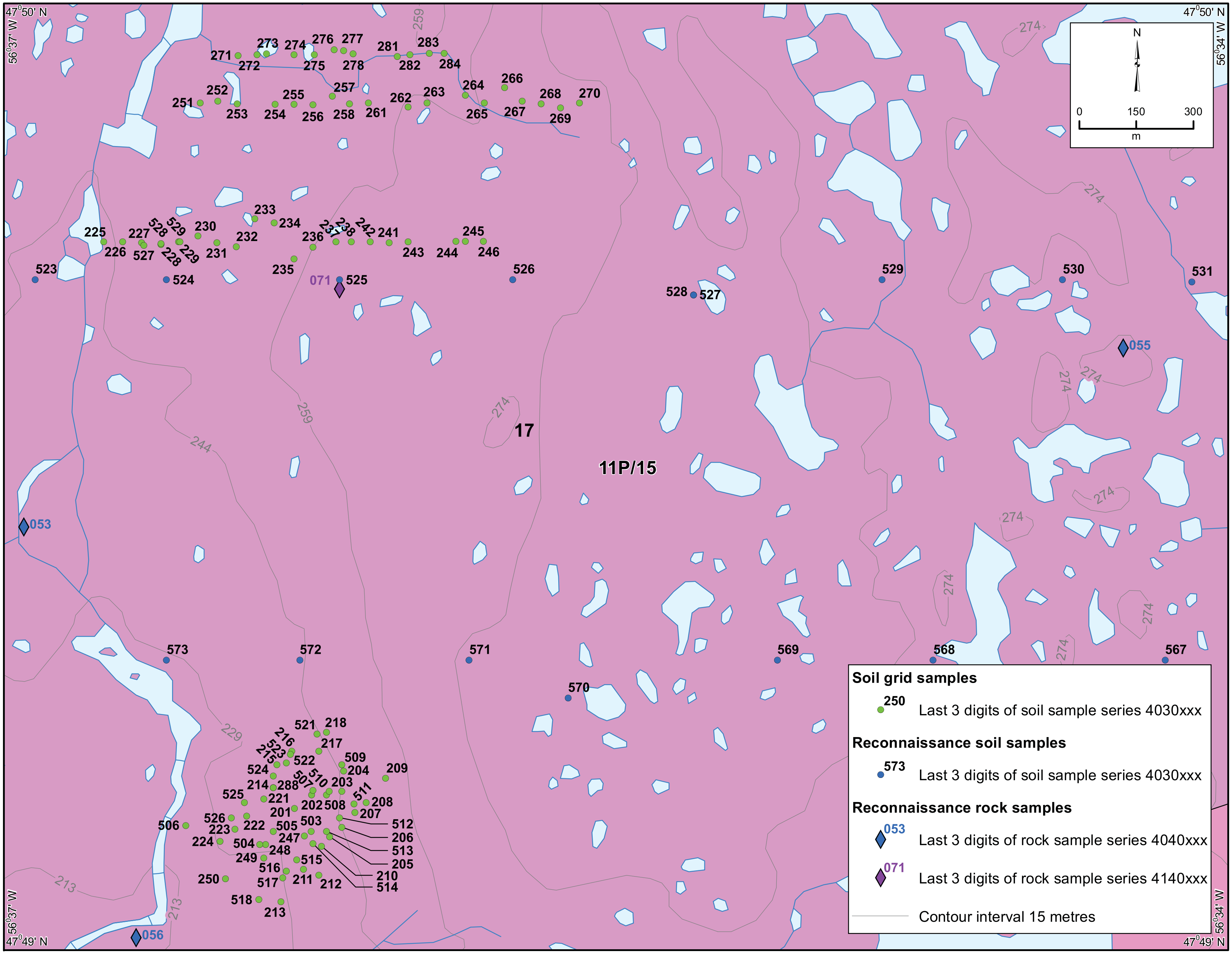

Figure 59. *Grid soil- and rock-sample locations with sample numbers in the Dolland Brook area.*

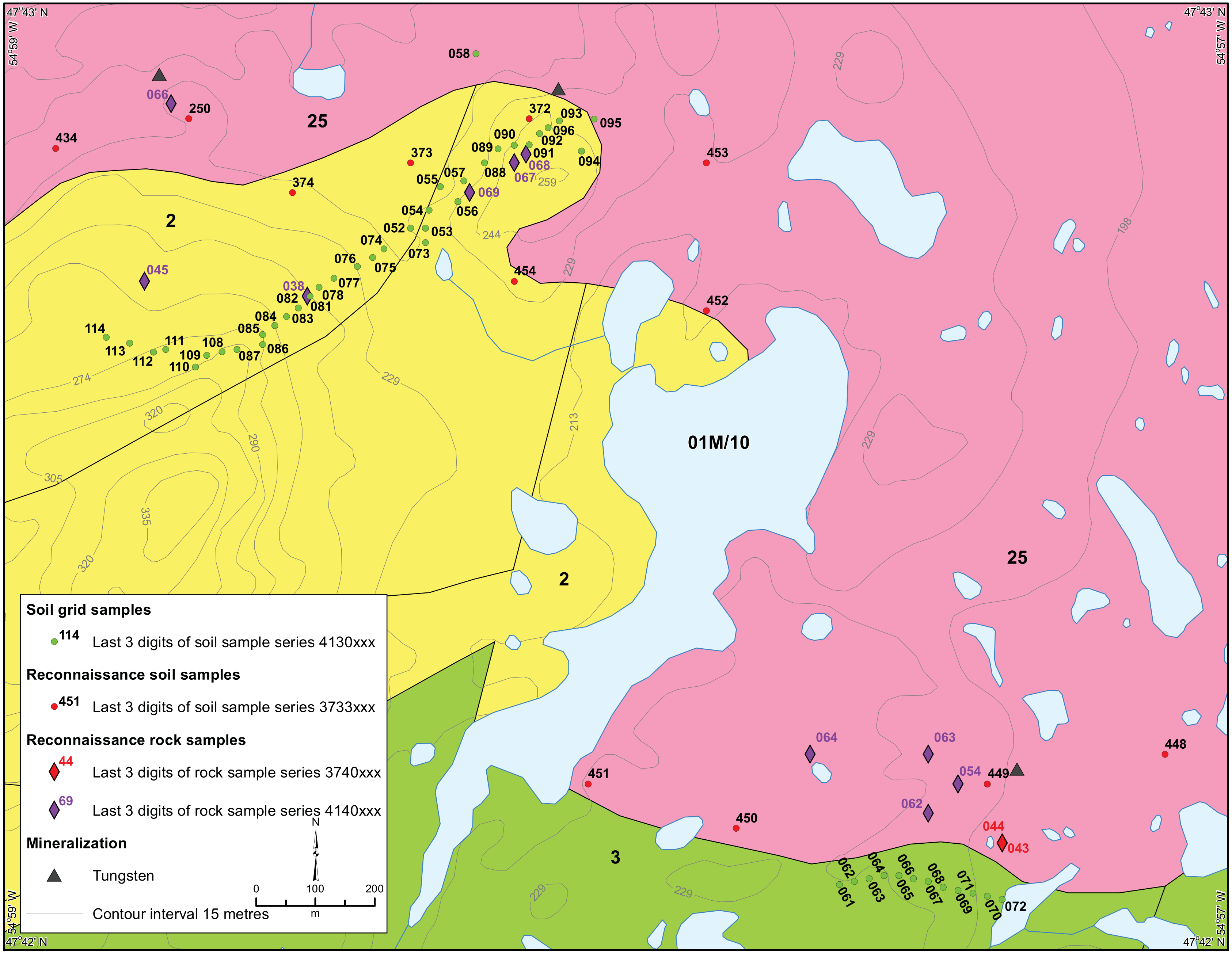

Figure 60. *Grid soil- and rock-sample locations with sample numbers for the western grids in the Ackley Granite area.*

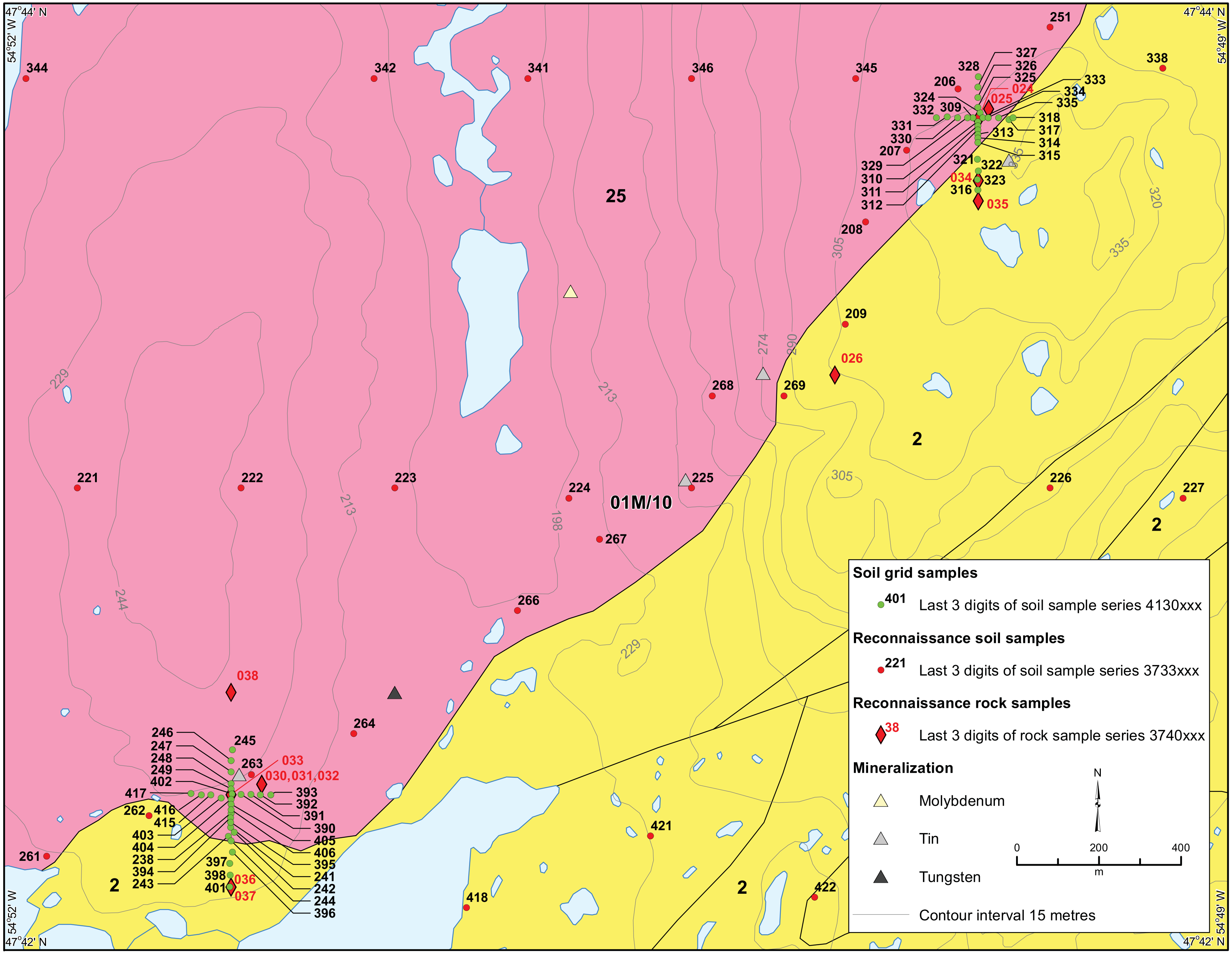

Figure 61. *Grid soil- and rock-sample locations with sample numbers for the eastern grids in the Ackley Granite area.*

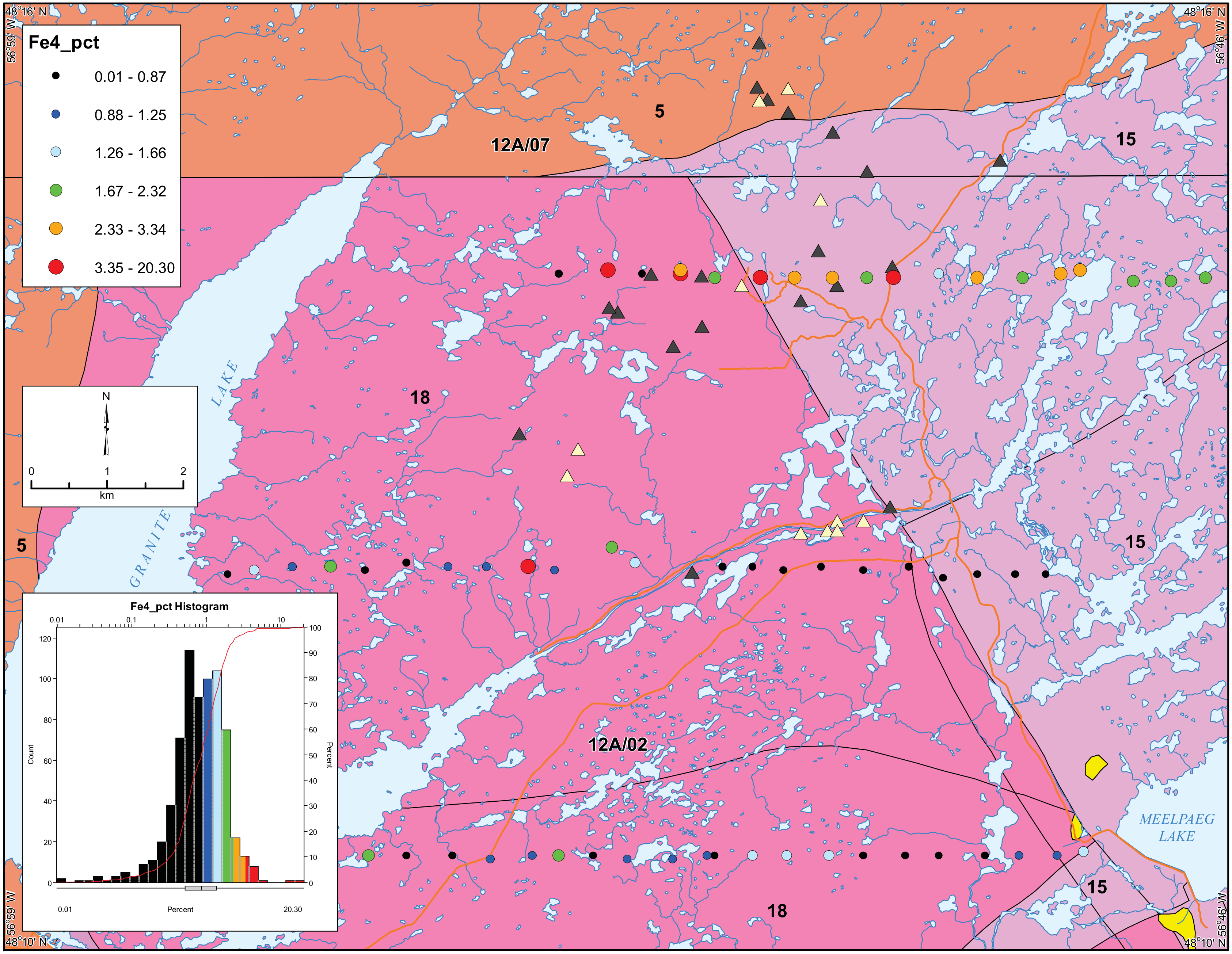

Figure 62. *Iron (Fe4) in reconnaissance soils in the Granite Lake area.*

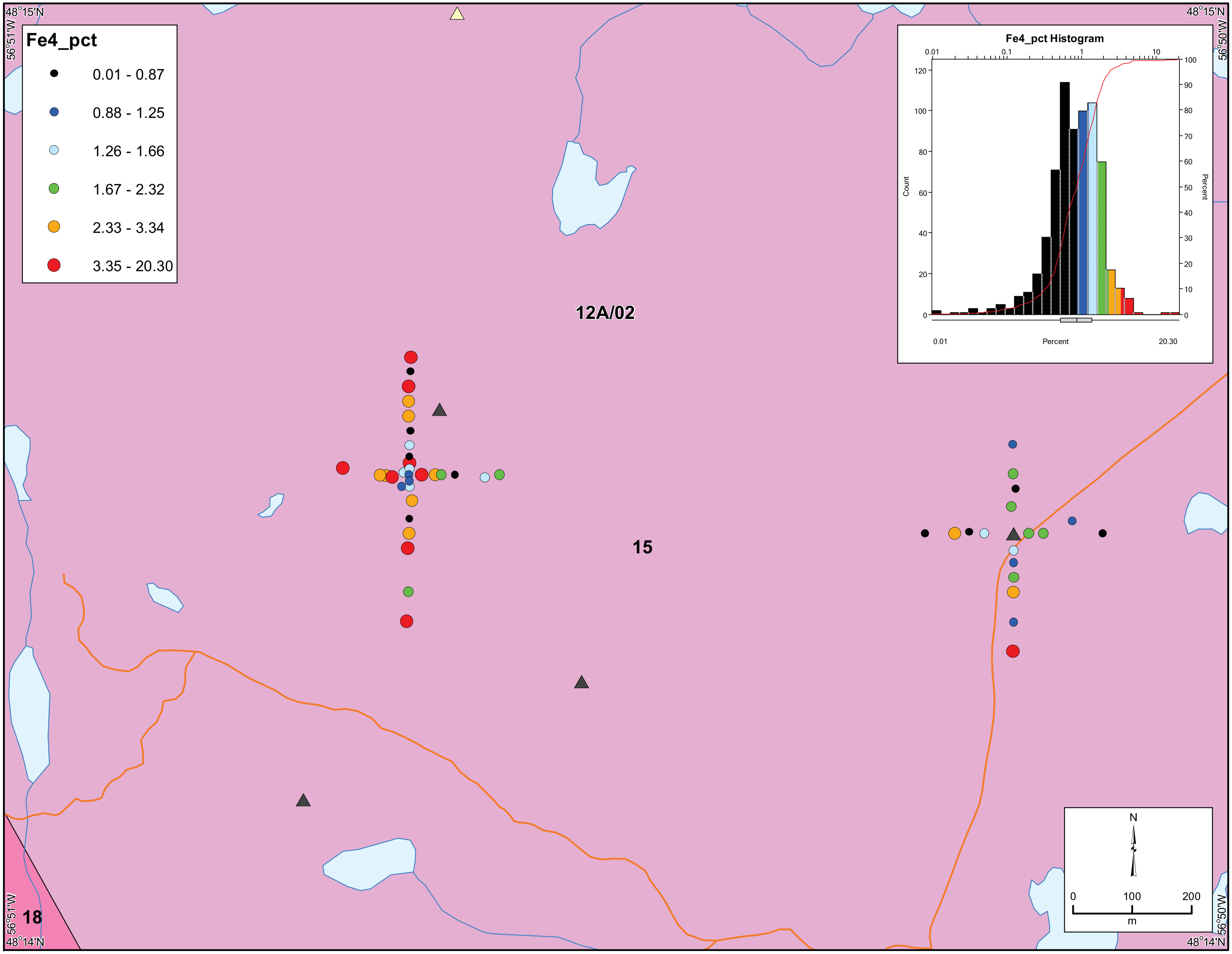

Figure 63. *Iron (Fe4) in grid soils in the Granite Lake area.*

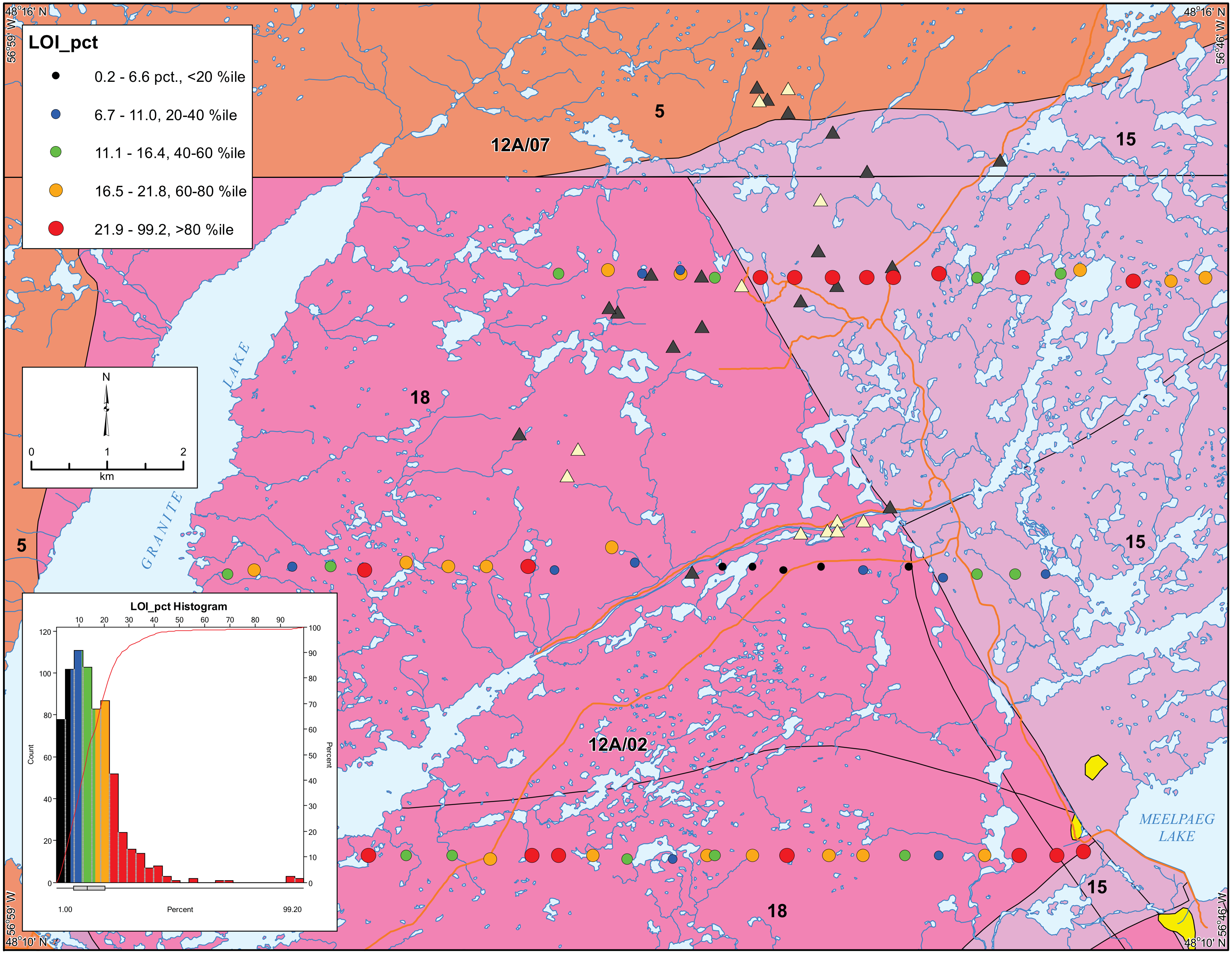

Figure 64. *Loss-on-ignition (LOI) in reconnaissance soils in the Granite Lake area.*

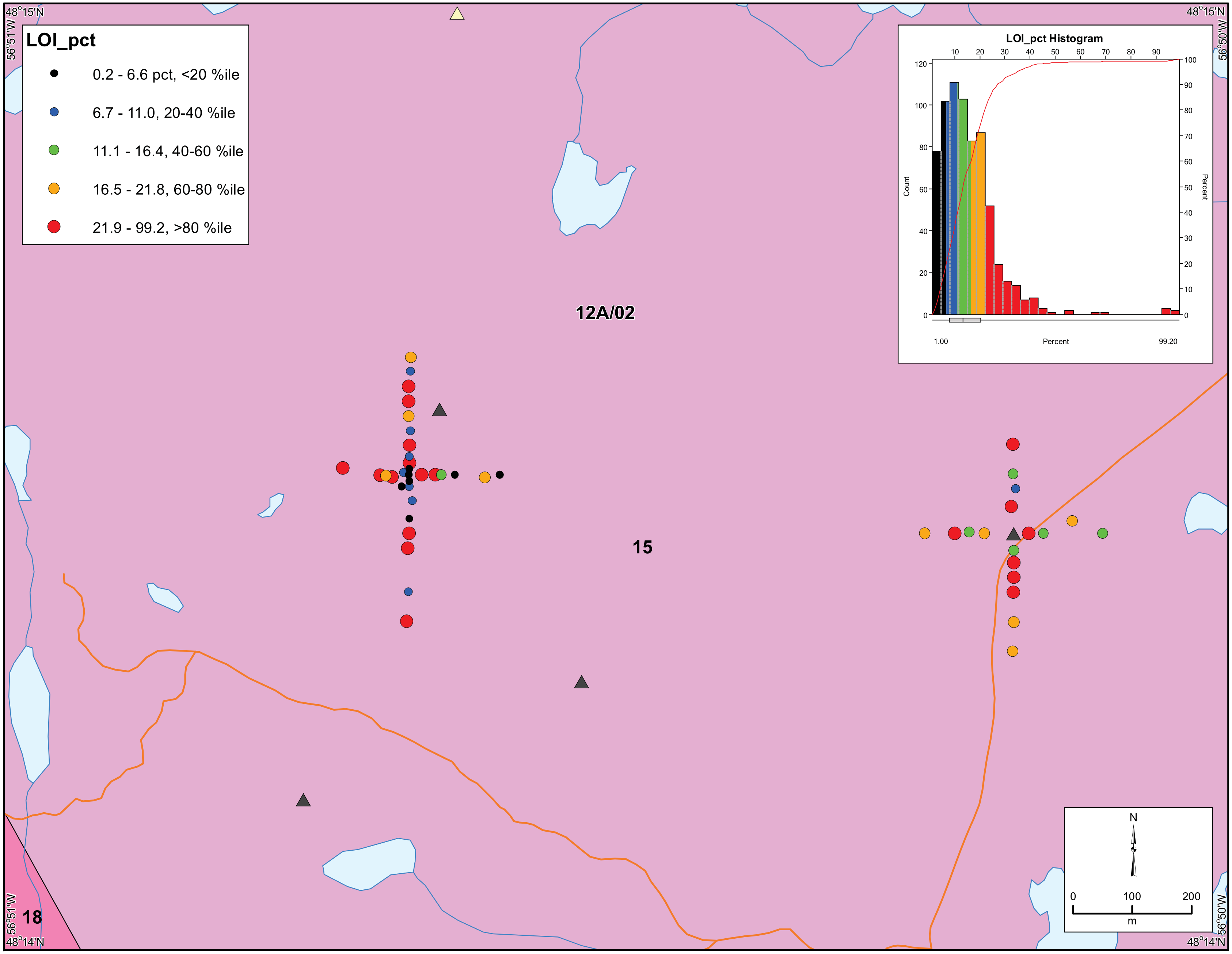

Figure 65. *Loss-on-ignition (LOI) in grid soils in the Granite Lake area.*

Ag

The distribution of silver (Ag6) in reconnaissance soil samples is shown in Figure 66. There is a continuous zone of high silver values in the centre of the northern sampling line. This is partially coincident in samples that have high levels of iron noted in Figure 63, and with LOI in Figure 65. The high silver values are also in proximity to several known tungsten occurrences.

The distribution of silver (Ag6) in grid soil samples is shown in Figure 67. Many samples in the western grid, and 3 samples in the eastern grid, have high or elevated levels of silver. The high-value samples in the western grid are partially coincident with samples with high iron values, less so with those in the eastern grid. The samples that have high values of silver in both grids are also mostly coincident with samples with high LOI values.

Cd

The distribution of cadmium (Cd4) in reconnaissance soil samples is shown in Figure 68. There are only a few samples above detection limit in the entire survey; two of which have high values and three with elevated values. Three of these high and elevated samples are near a cluster of tungsten occurrences on the northern sampling line, and near the grid soil samples, which themselves have several samples with high and elevated values of cadmium (Figure 69).

The distribution of cadmium (Cd4) in grid soil samples is shown in Figure 69. The two grids have 11 samples with high or elevated values of cadmium. Only seven of the 955 samples analyzed from all soil grids described in this report were classified as high. Five of these are in the two soil grids in the Granite Lake area. There is little correlation of these five cadmium values with iron or LOI content.

Cu

The distribution of copper (Cu4) in reconnaissance soil samples is shown in Figure 70. Although most samples have contents in the lowest classification interval there is continuous zone of eight samples that have high or elevated copper contents. These samples are coincident with an area of several tungsten occurrences and are also just south of the two soil grids.

The distribution of copper (Cu4) in grid soil samples is shown in Figure 71. Most of the samples in the west grid have high or elevated copper contents, and the samples in the eastern grid have elevated copper contents or contents that exceed the 85^{th} percentile (green symbols).

Mo

The distribution of molybdenum (Mo5) in reconnaissance soil samples is shown in Figure 72. Most samples have contents that exceed the 85^{th} percentile and there is a continuous zone of 6 samples with high or elevated molybdenum contents in the west half of the northern line of samples. There is one known molybdenite occurrence in this area and five tungsten occurrences. The

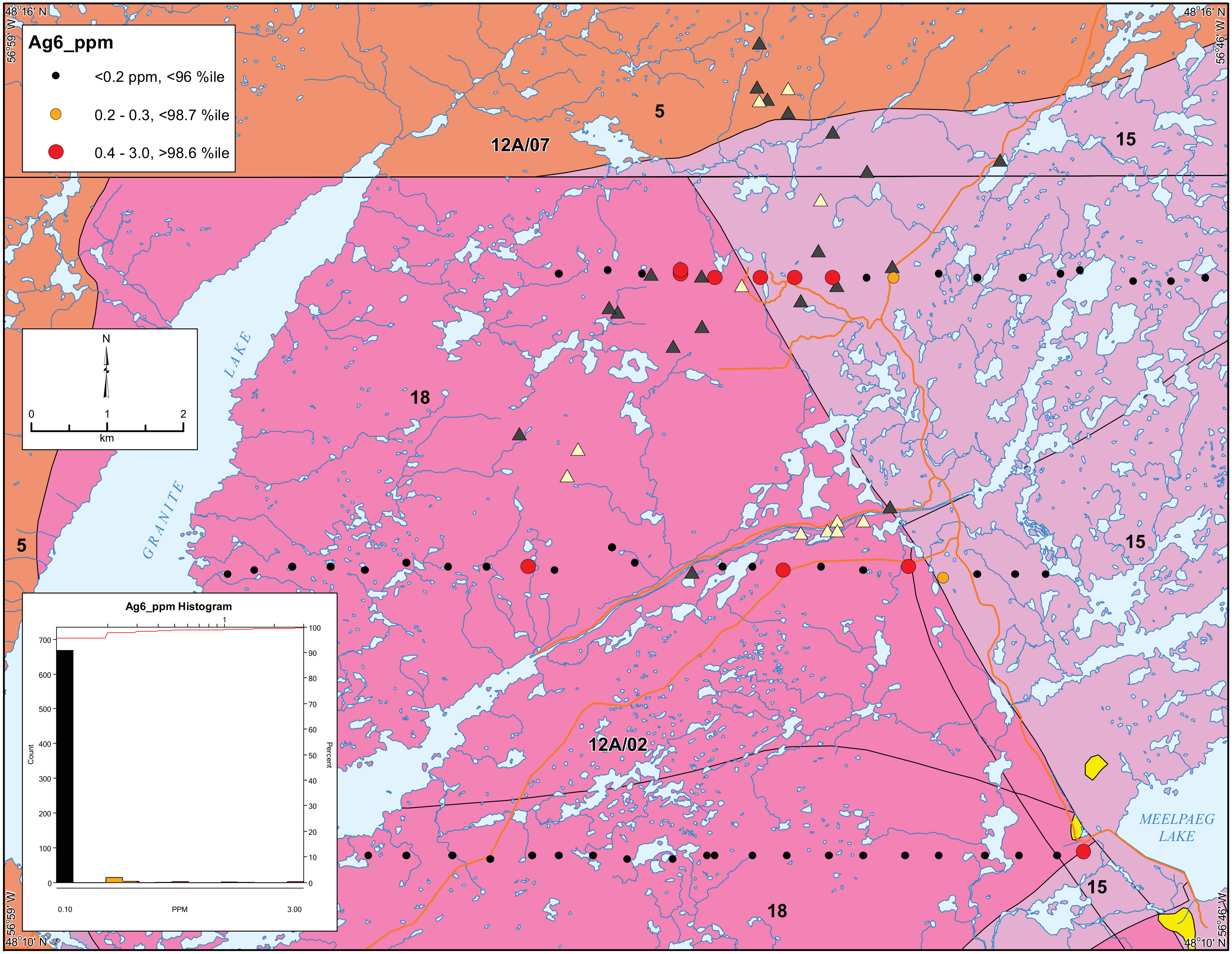

Figure 66. *Silver (Ag6) in reconnaissance soils in the Granite Lake area.*

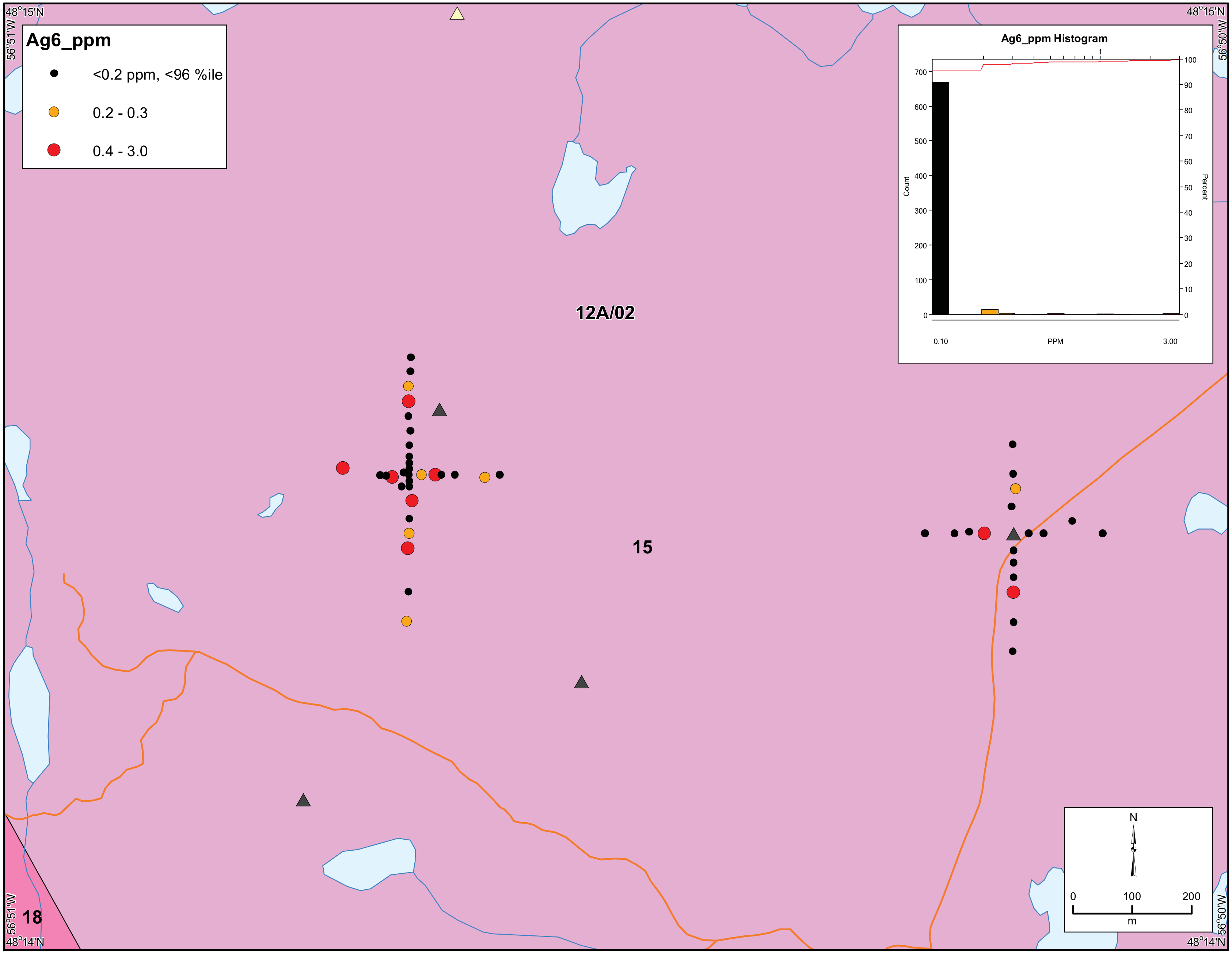

Figure 67. *Silver (Ag6) in grid soils in the Granite Lake area.*

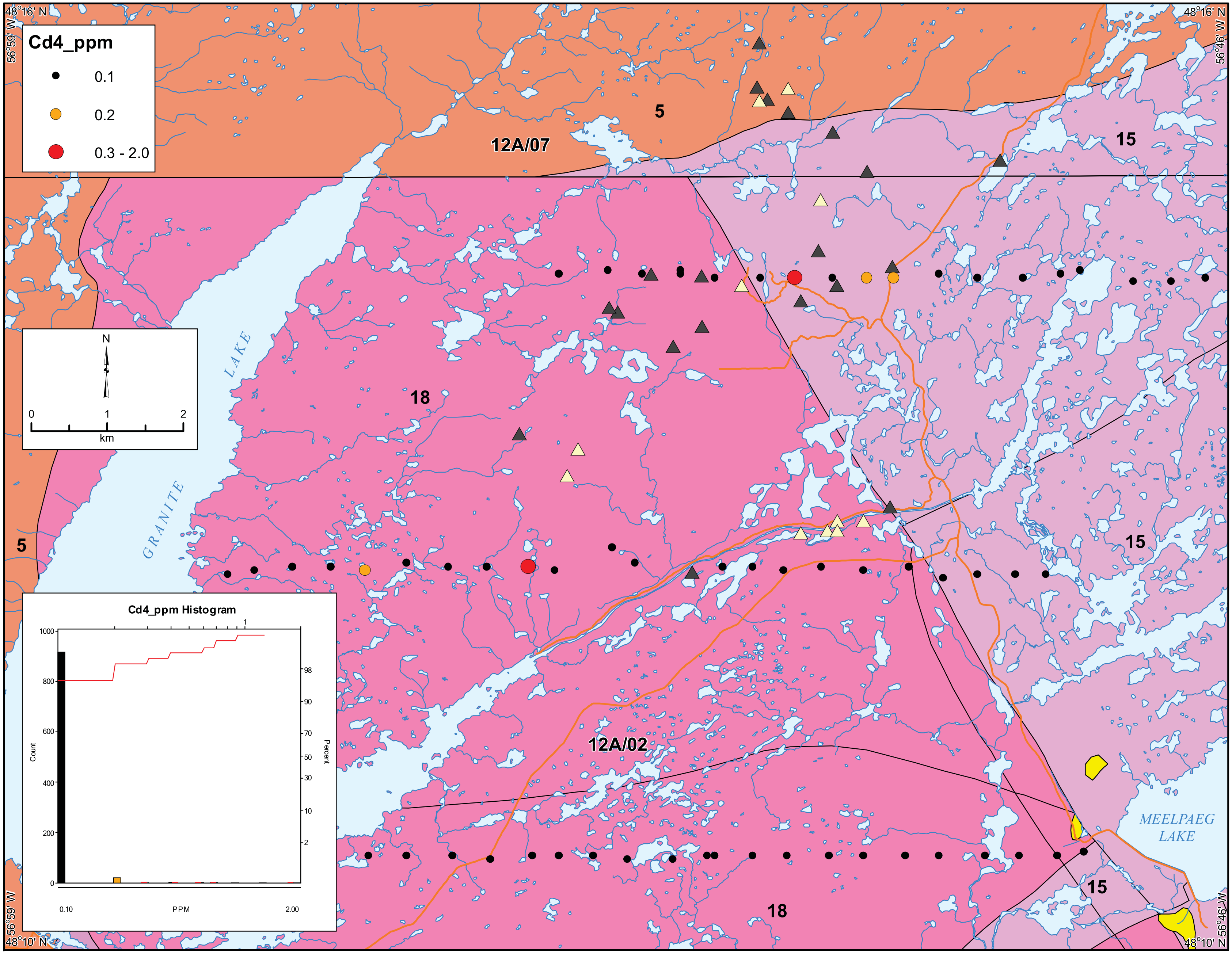

Figure 68. *Cadmium (Cd4) in reconnaissance soils in the Granite Lake area.*

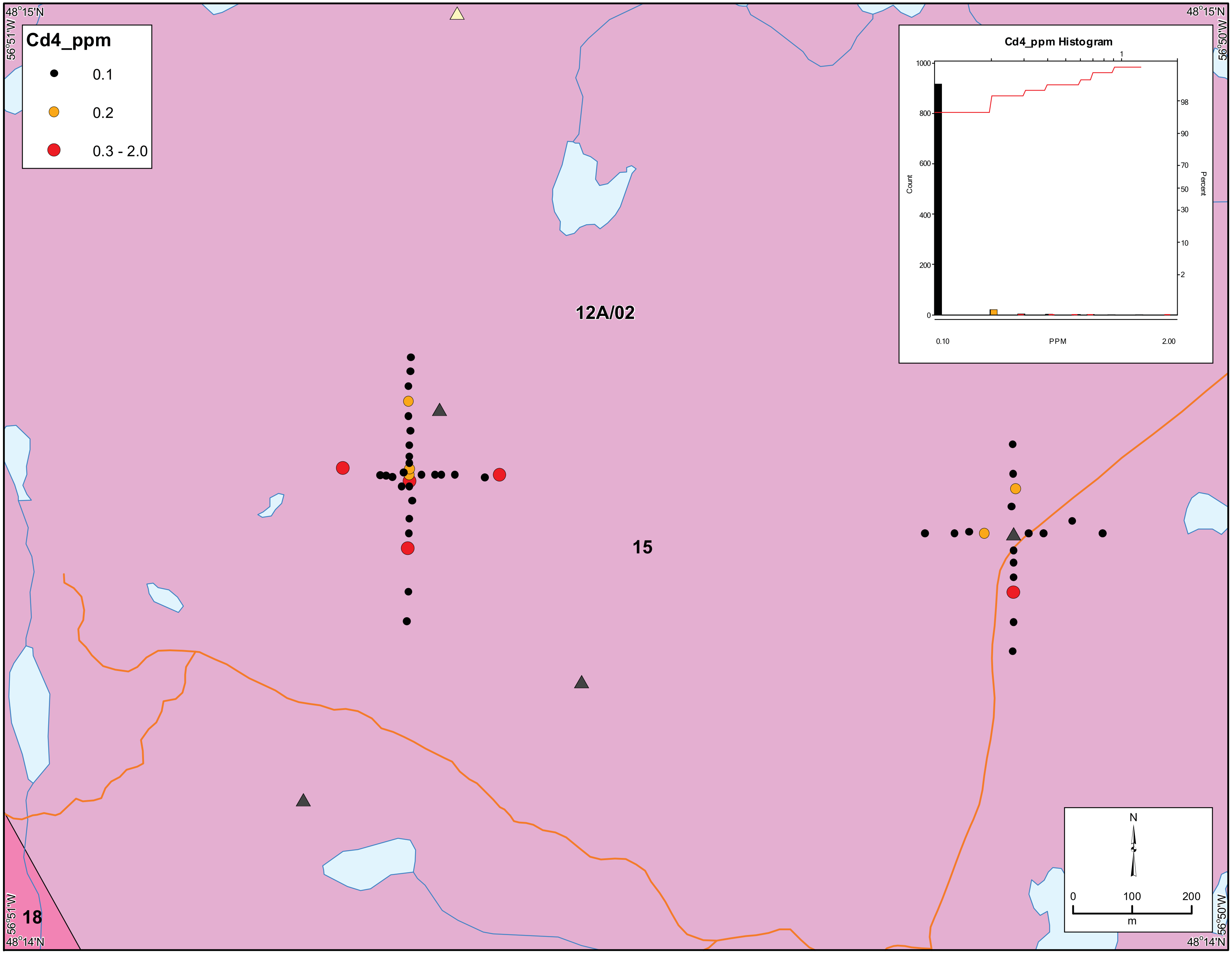

Figure 69. *Cadmium (Cd4) in grid soils in the Granite Lake area.*

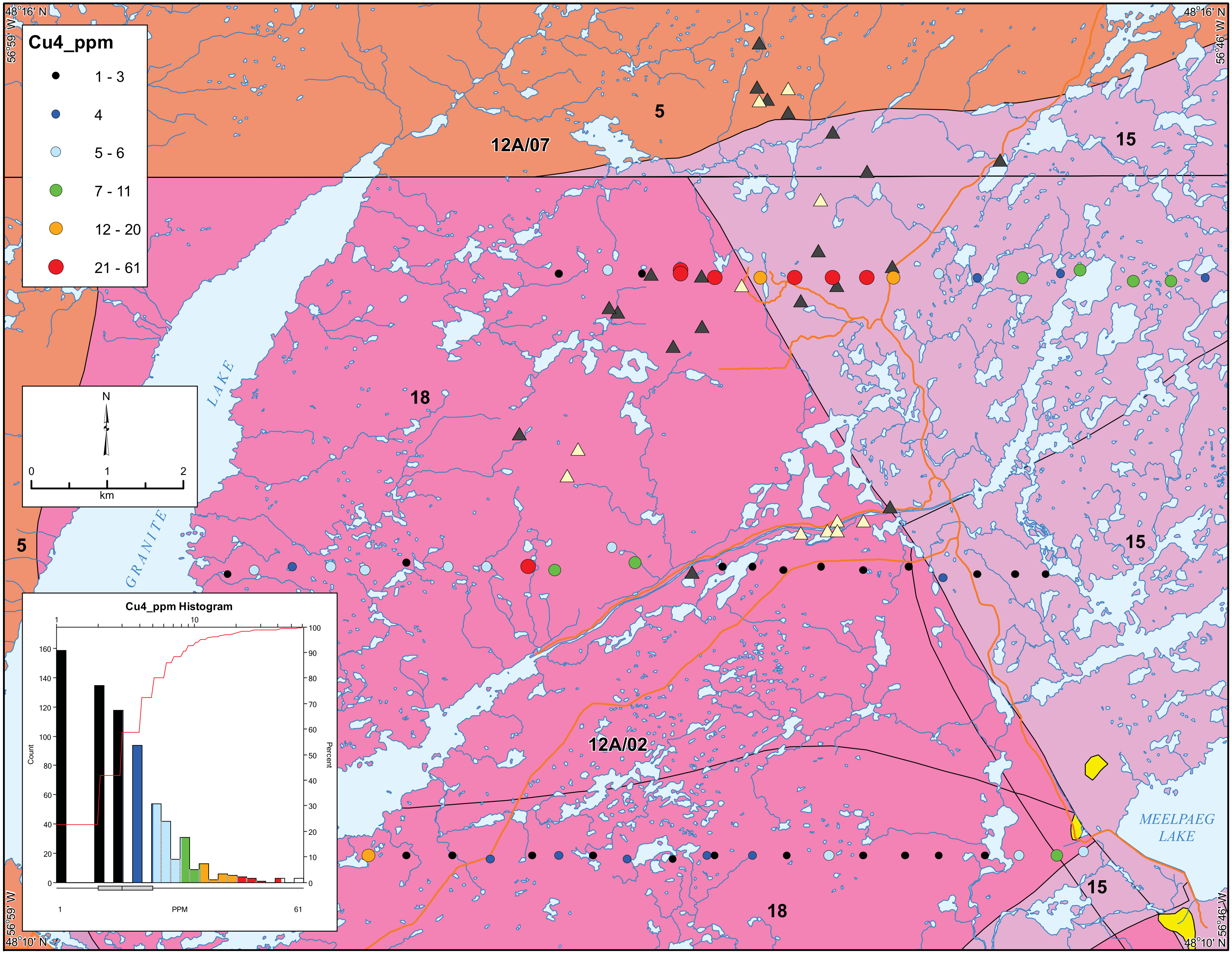

Figure 70. *Copper (Cu4) in reconnaissance soils in the Granite Lake area.*

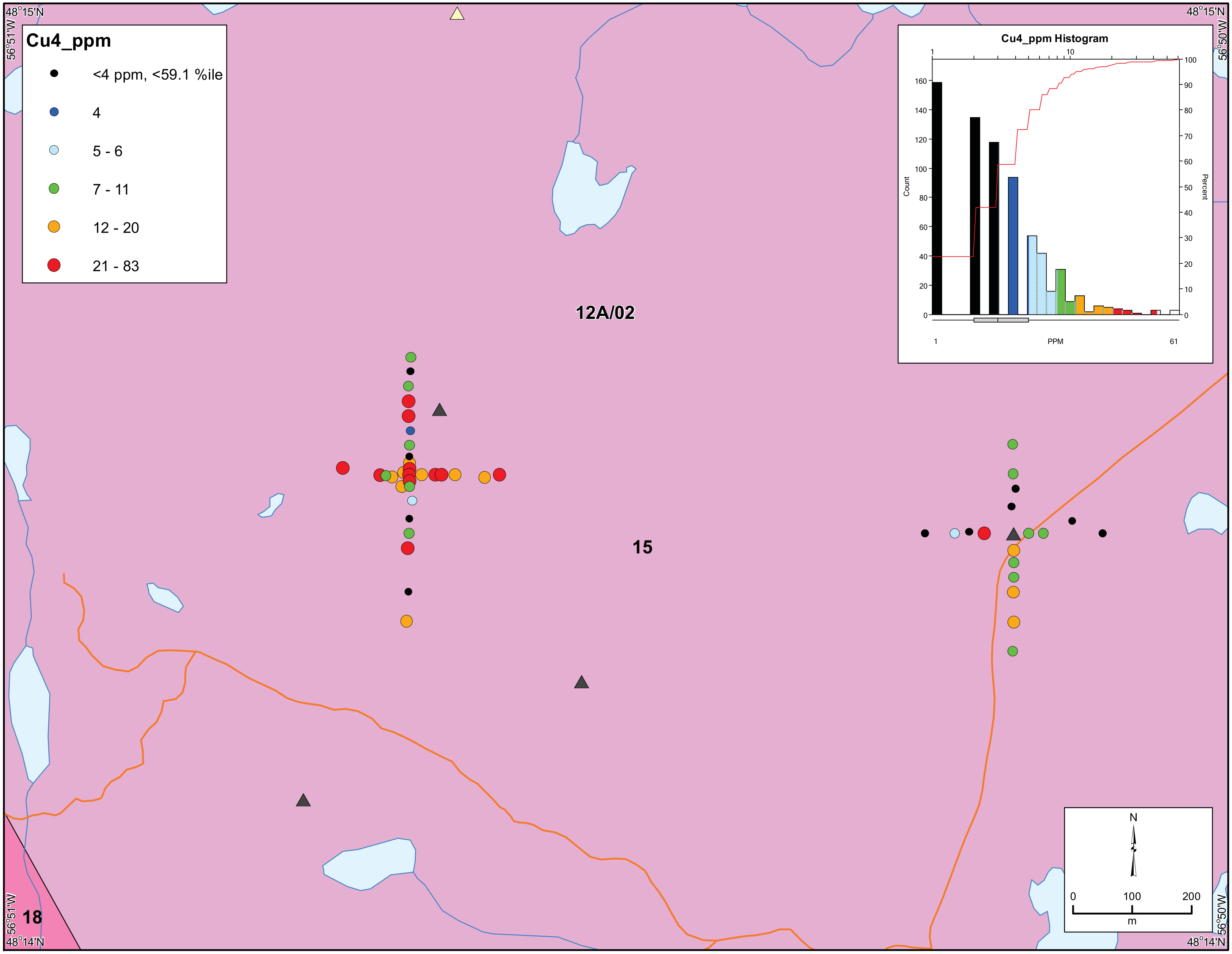

Figure 71. *Copper (Cu4) in grid soils in the Granite Lake area.*

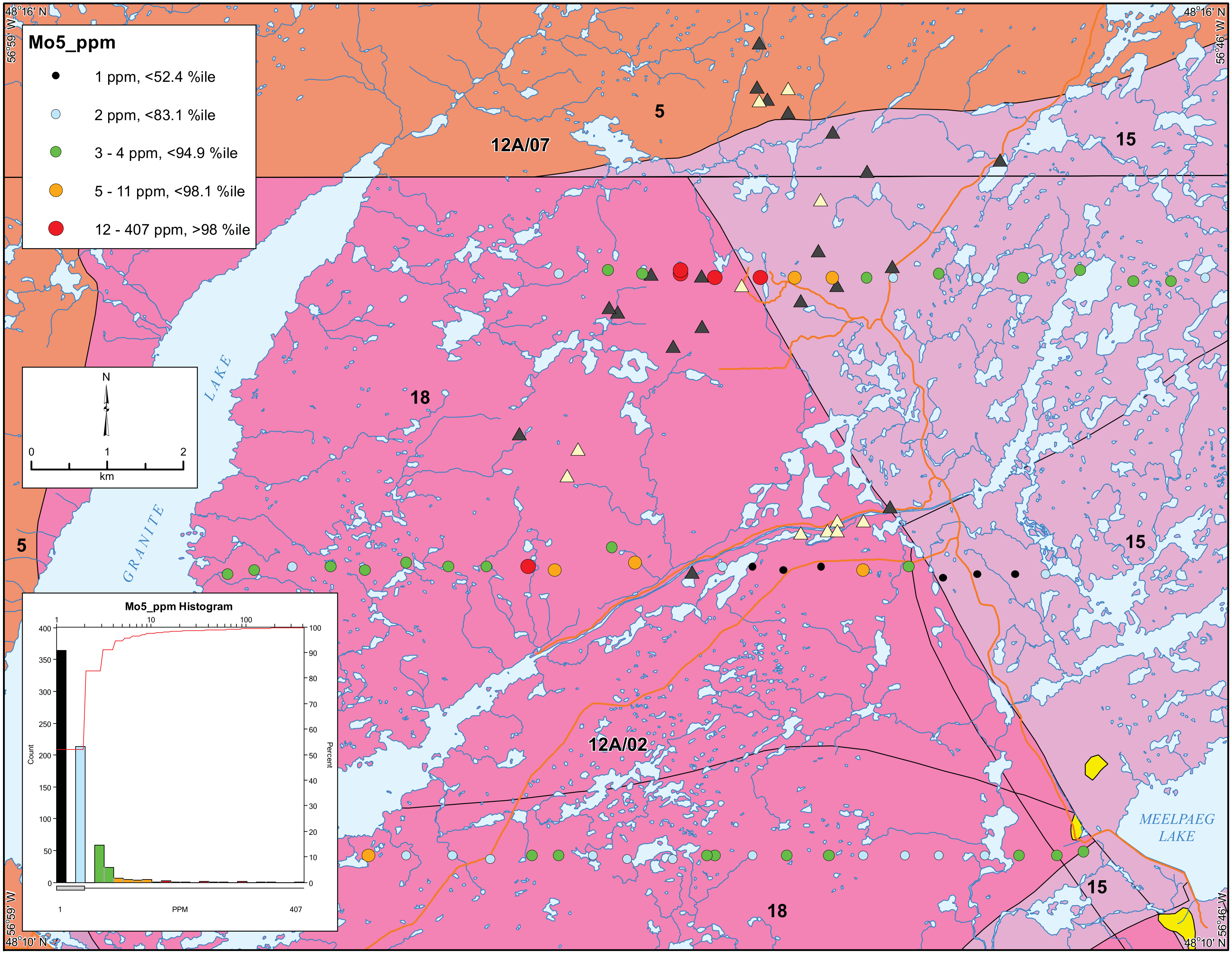

Figure 72. *Molybdenum (Mo5) in reconnaissance soils in the Granite Lake area.*

two samples that have high values at the west end of the zone include samples 3733350 and 3733037, which were taken from an earlier exploration trench. The first has the highest molybdenum content encountered in the entire survey (407 ppm) and the highest tungsten content (955 ppm). Sample 3733037 has the third highest molybdenum content (148 ppm) and the fourth highest tungsten content (560 ppm).

The distribution of molybdenum (Mo5) in grid soil samples is shown in Figure 73. All but one of the samples in the western grid have high or elevated contents of molybdenum. In the eastern grid, molybdenum contents are lower, but most samples have Mo5 contents exceeding the 85^{th} percentile.

Sn

The distribution of tin (Sn12) in reconnaissance soil samples is shown in Figure 74. The pattern of high tin values in soil is different from that of other elements. All the high values are found in samples located along the central sampling line in a region generally free of known mineral occurrences. There are no tin analyses for samples collected over the two grids.

U

The distribution of uranium (U8) in grid soil samples is shown in Figure 75. Samples generally have low contents of U8, with the exception of two elevated value samples, one in each grid. The reconnaissance samples in the Granite Lake area were not analyzed for uranium.

W

The distribution of colorimetric tungsten (W13) in reconnaissance soil samples is shown in Figure 76. Nearly all the samples have tungsten contents in excess of the 85^{th} percentile. However, there is a continuous zone of samples having high values in the north line of samples, that is coincident with the presence of several tungsten occurrences and is near the two soil grids. The westernmost sample with a high content of W13 (3733050) in this zone has the highest tungsten content of all samples collected in the survey, 955 ppm, and is located about 110 m west of a tungsten occurrence. The sample was taken next to a former exploration trench. Two other samples in the central line flank a known tungsten occurrence.

The distribution of tungsten (W13) in grid soil samples in the Granite Lake area is shown in Figure 77. Nearly all samples in both grids have high values of tungsten, including samples that lie to the north and up-ice of the known mineralization. For example, sample 3733024, which is located 80 m north-northwest of the tungsten mineralization in the western grid and is the second sample south from the north end of the grid, has the highest tungsten content of any sample collected from any grid in the survey. Generally, most of the samples with the highest tungsten contents (>100 ppm) are found in an arc extending to the southwest to southeast from the tungsten occurrences in both grids.

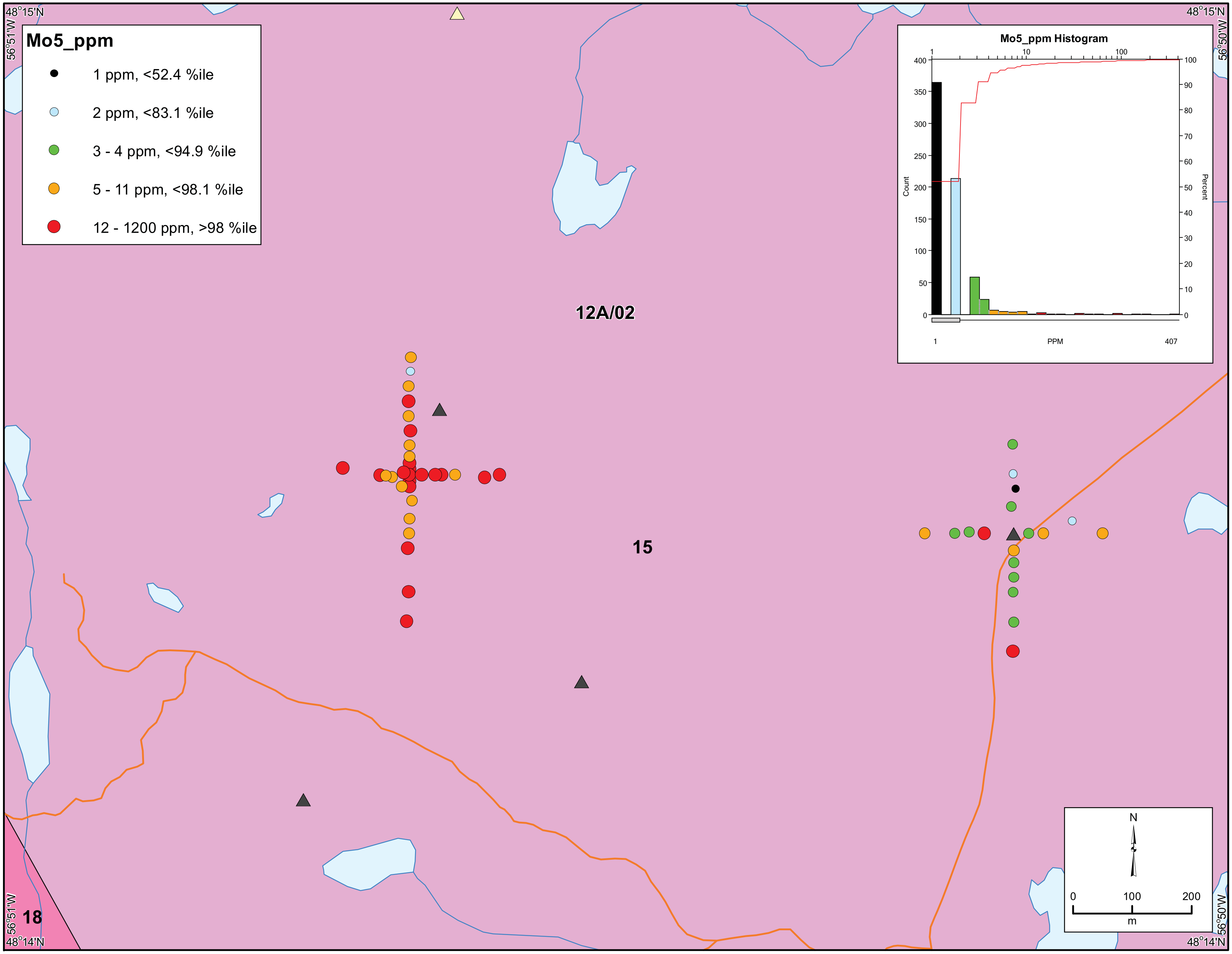

Figure 73. *Molybdenum (Mo5) in grid soils in the Granite Lake area.*

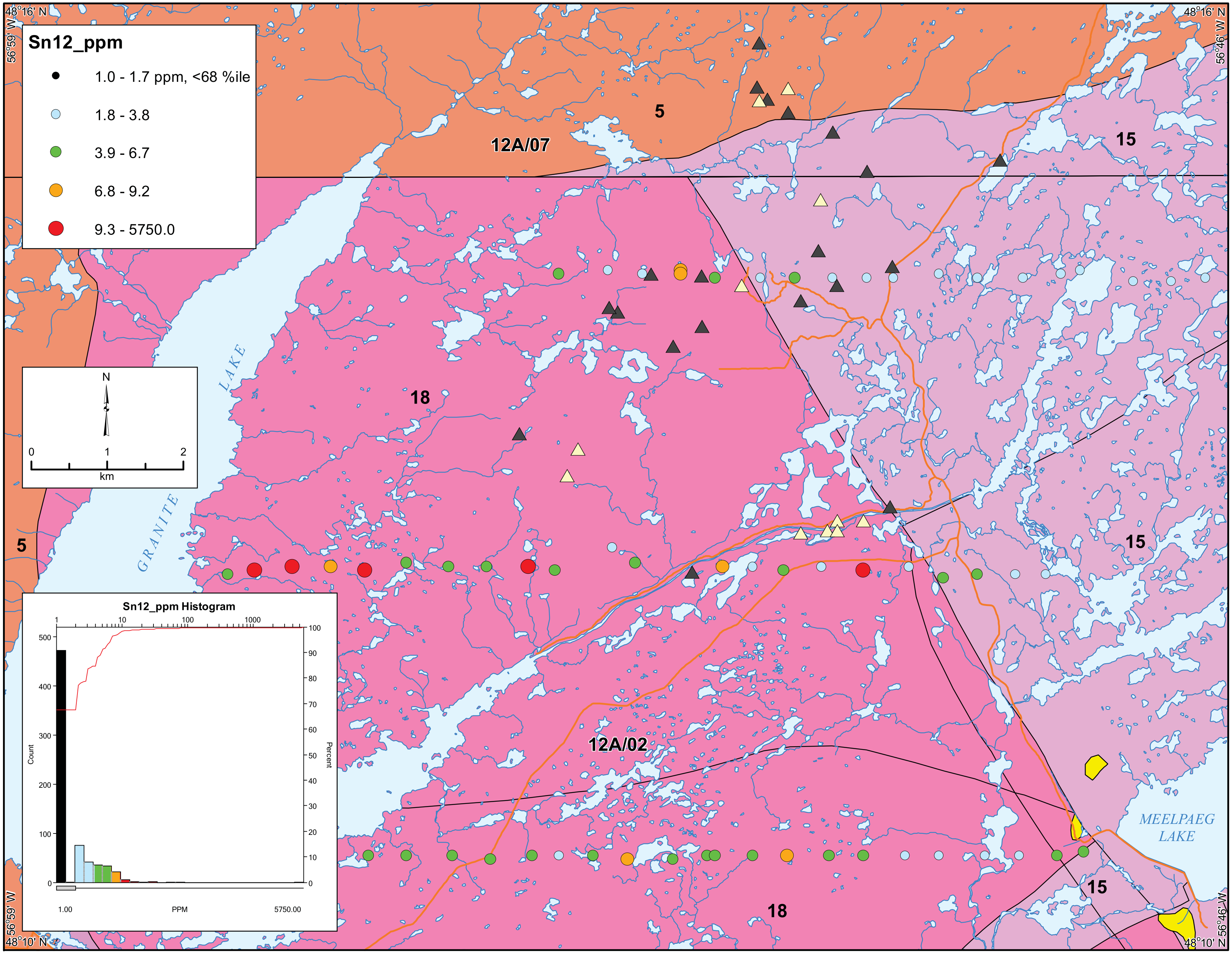

Figure 74. *Tin (Sn12) in reconnaissance soils in the Granite Lake area.*

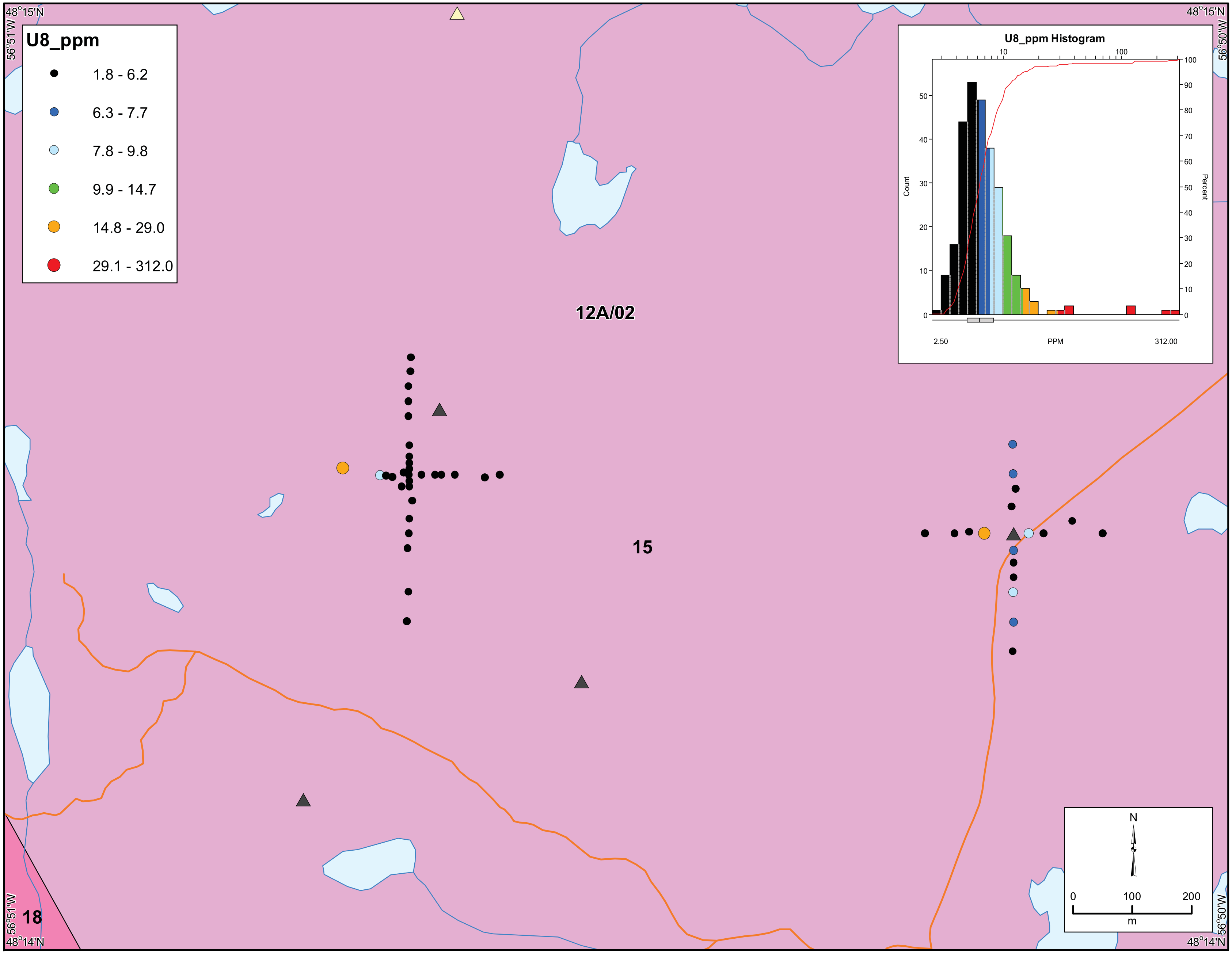

Figure 75. *Uranium (U8) in grid soils in the Granite Lake area.*

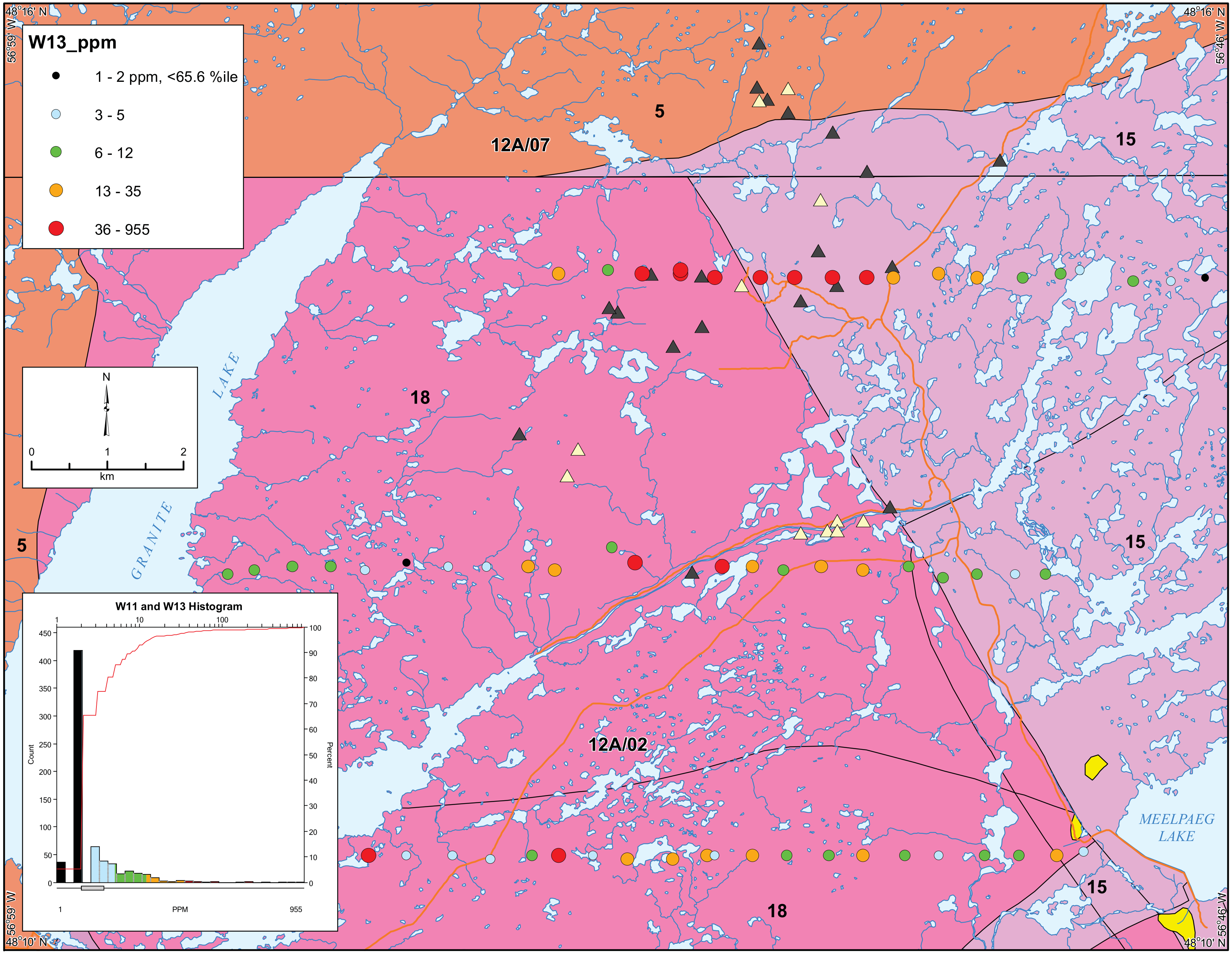

Figure 76. *Tungsten (W13) in reconnaissance soils in the Granite Lake area.*

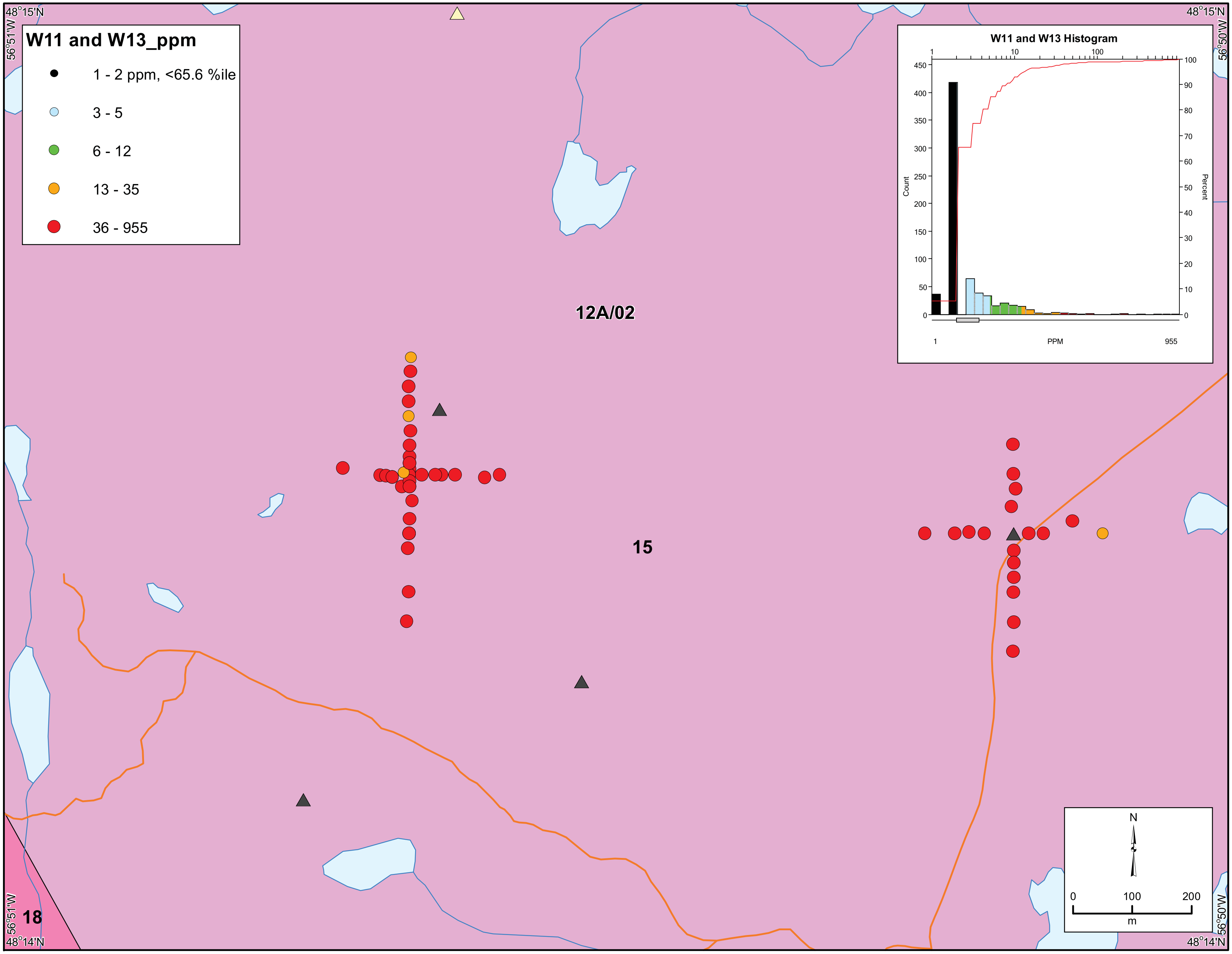

Figure 77. *Tungsten (W11 and W13) in grid soils in the Granite Lake area.*

Zn

The distribution of zinc (Zn4) in reconnaissance soil samples is shown in Figure 78. Generally, zinc contents in soils from the Granite Lake area are higher than in soils from the other three survey areas sampled. Most of the samples in the northern soil-sample line have contents in excess of the 85th percentile and three of these have high values.

The distribution of zinc (Zn4) in grid soils in the Granite Lake area is shown in Figure 79. Most of the samples in the western grid have high or elevated Zn4 contents. In the eastern grid, most of the samples have zinc contents in excess of the 85th percentile.

Soil Data from the Dolland Brook Area

Few values of economic interest are found in the samples from either the reconnaissance or grid samples in the Dolland Brook area. Therefore, no figures are included in the text, but all data are presented in figures in Appendix 2.

Soil Data from the Bottom Brook Area

There are no soil grids in the Bottom Brook area. The distribution of iron (Fe4) in reconnaissance soil samples is shown in Figure 80.

The distribution of loss-on-ignition (LOI) is shown in Figure 81. Contents in most samples are higher than the average value in the survey.

The distribution of cobalt (Co4) is shown in Figure 82. There are several samples that have high and elevated values, particularly over the Riches Island Formation, the Dolland Pond Granite and the D'Espoir Brook Granite. There is also a cluster of three, high-value samples at the east end of two lines collected over the East Bay Granite.

The distribution of copper (Cu4) is shown in Figure 83. There are several samples that have high and elevated copper contents collected over all units except the Dolland Brook Granite. The cluster of three samples with high and elevated contents at the east end of the two lines over the East Bay Granite is coincident with the cluster of three samples with high cobalt values.

The distribution of uranium (U8) is shown in Figure 84. Three samples with high uranium contents and one with elevated content form a continuous zone in the northern two lines over the D'Espoir Brook Granite extending for 1200 m. The sample at the east end of the zone has the second highest uranium content of the entire survey at 248 ppm, and the other two samples with high values have 38 and 35 ppm, and are the fifth and sixth highest contents. The anomaly also may be reflected 900 m to the south in two samples with contents in excess of the 85th percentile.

The distribution of tungsten (W11) is shown in Figure 85. Most samples have very low contents, but there is a cluster of three samples having elevated and high contents of tungsten taken over the Riches Island Formation. The sample with a high value has a tungsten content of 48 ppm.

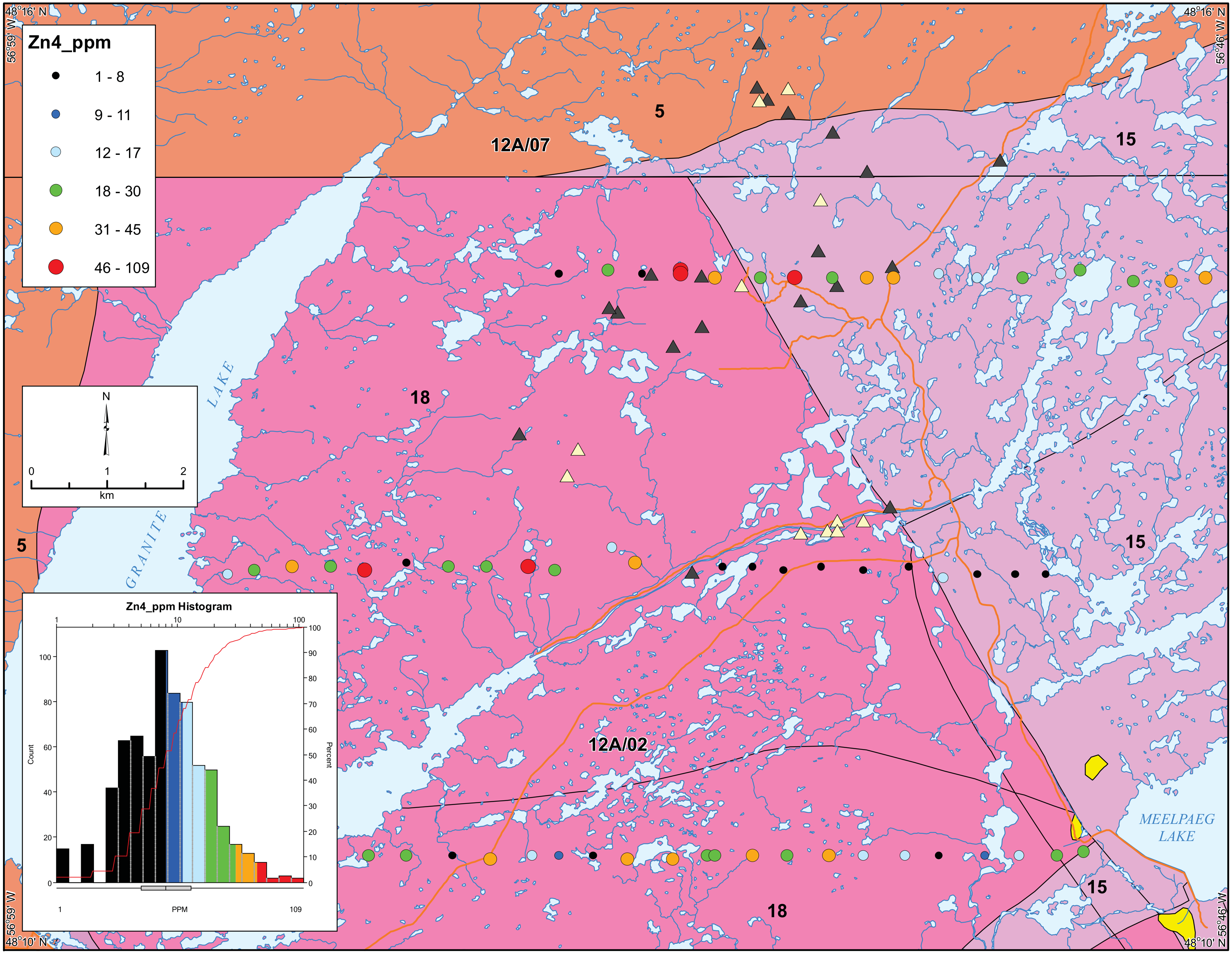

Figure 78. *Zinc (Zn4) in reconnaissance soils in the Granite Lake area.*

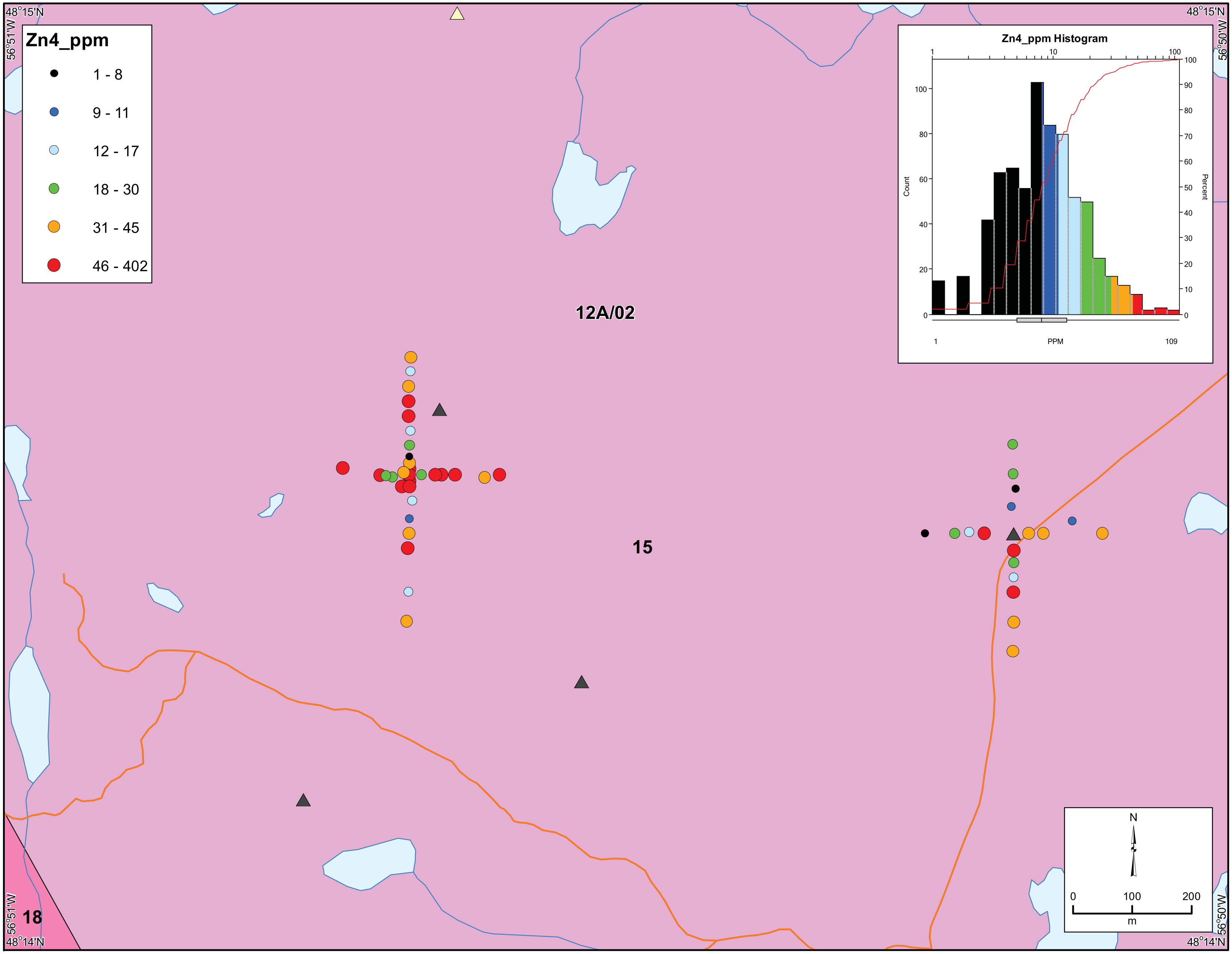

Figure 79. *Zinc (Zn4) in grid soils in the Granite Lake area.*

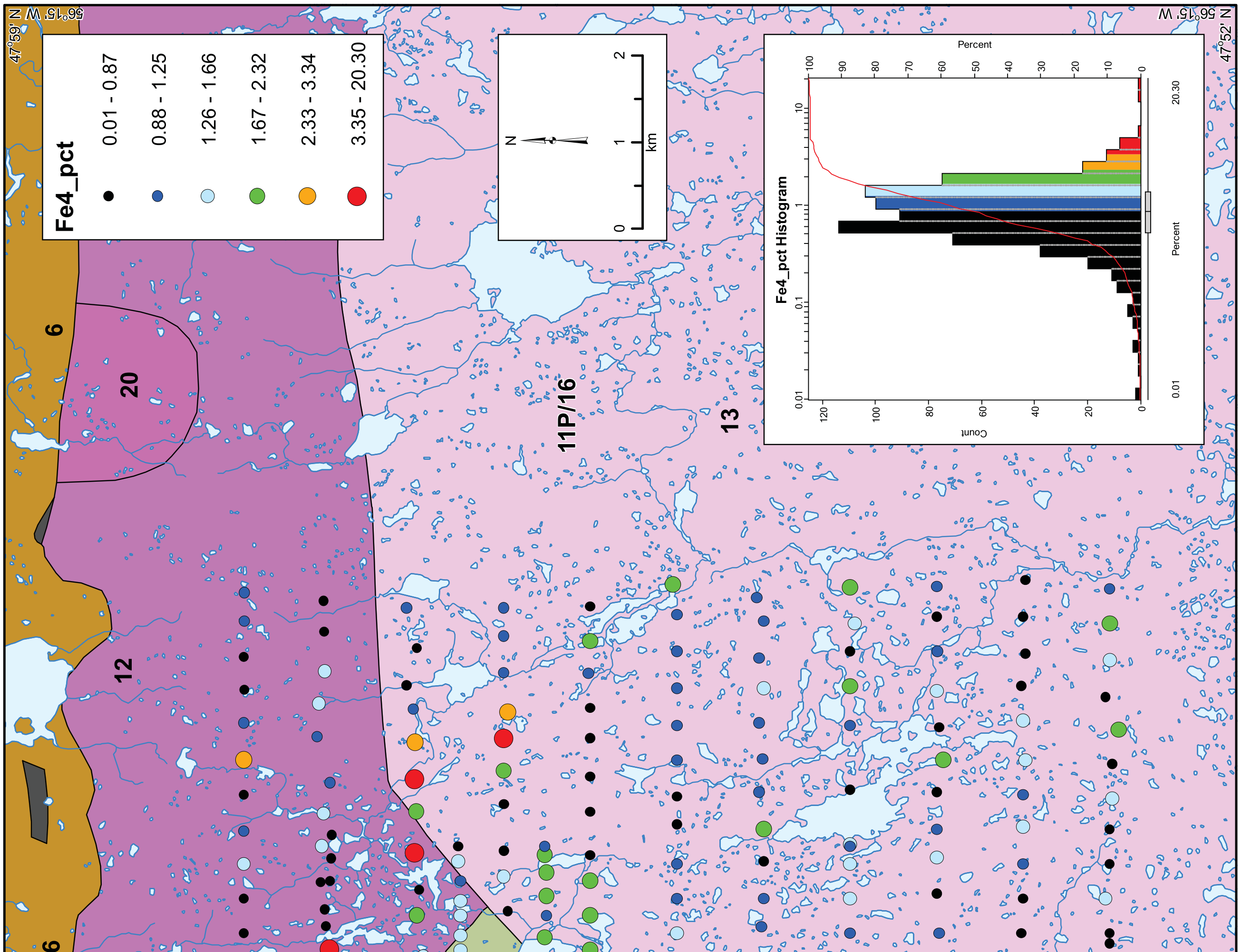

Figure 80. *Iron (Fe4) in reconnaissance soils in the Bottom Brook area.*

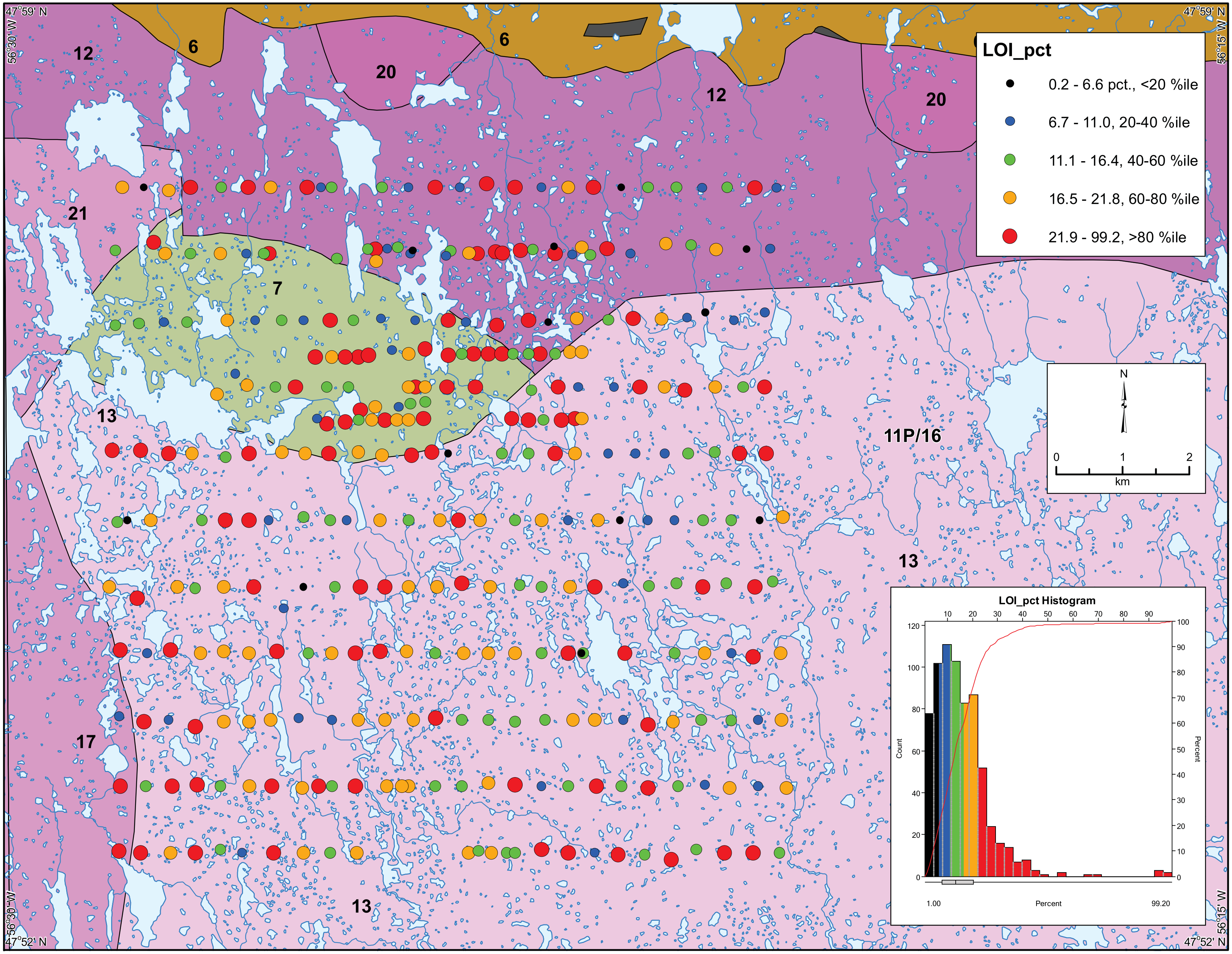

Figure 81. *Loss-on-ignition (LOI) in reconnaissance soils in the Bottom Brook area.*

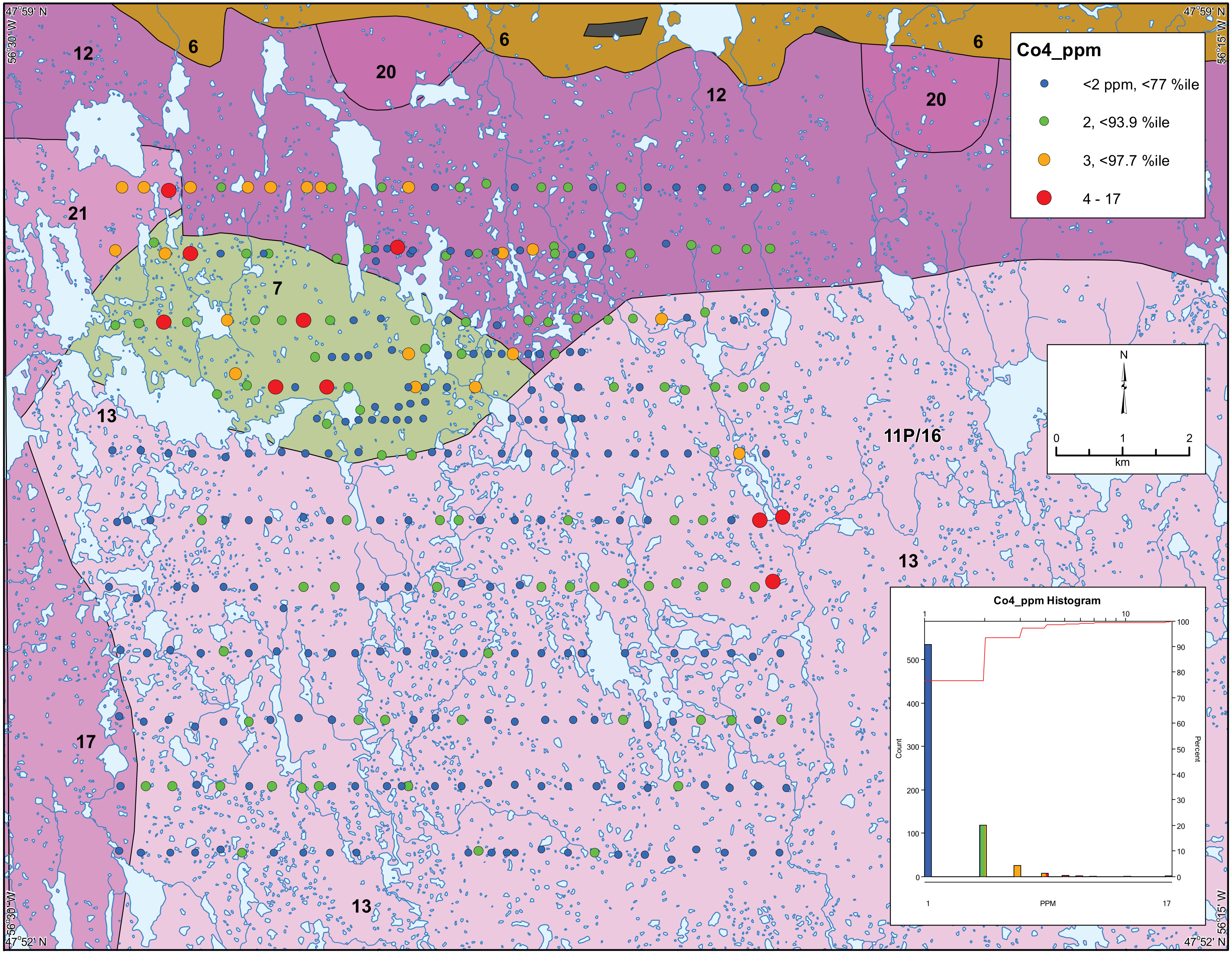

Figure 82. *Cobalt (Co4) in reconnaissance soils in the Bottom Brook area.*

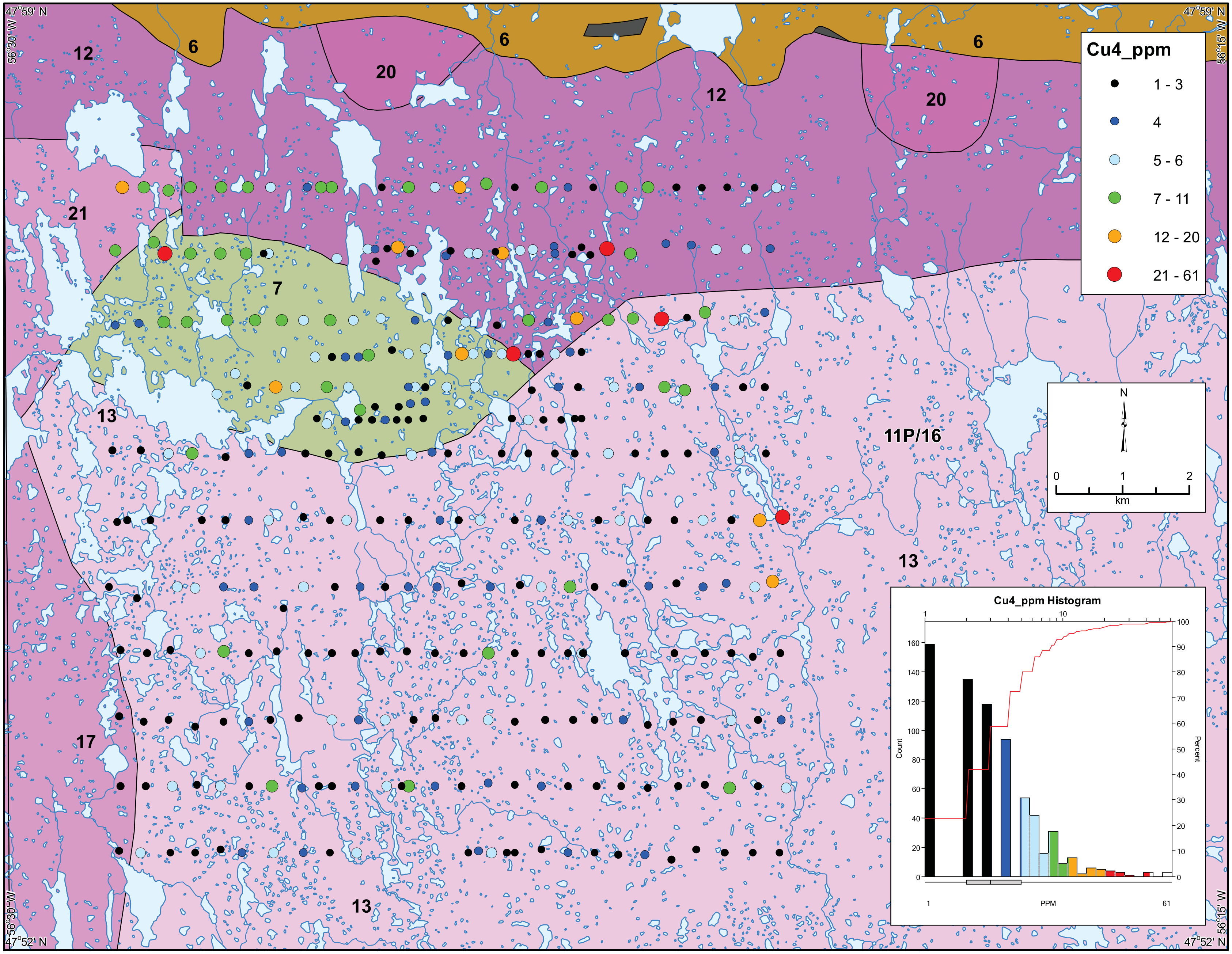

Figure 83. *Copper (Cu4) in reconnaissance soils in the Bottom Brook area.*

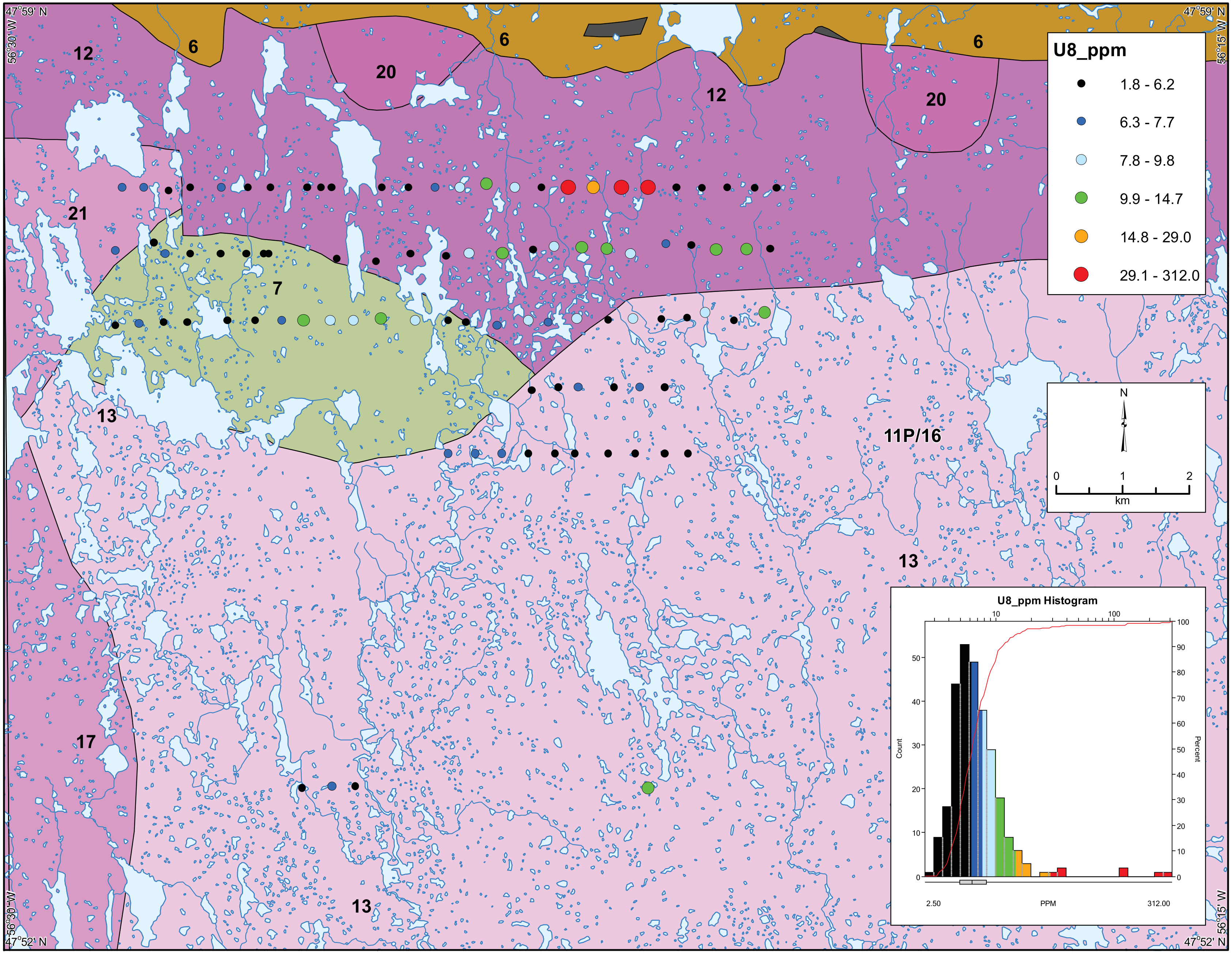

Figure 84. *Uranium (U8) in reconnaissance soils in the Bottom Brook area.*

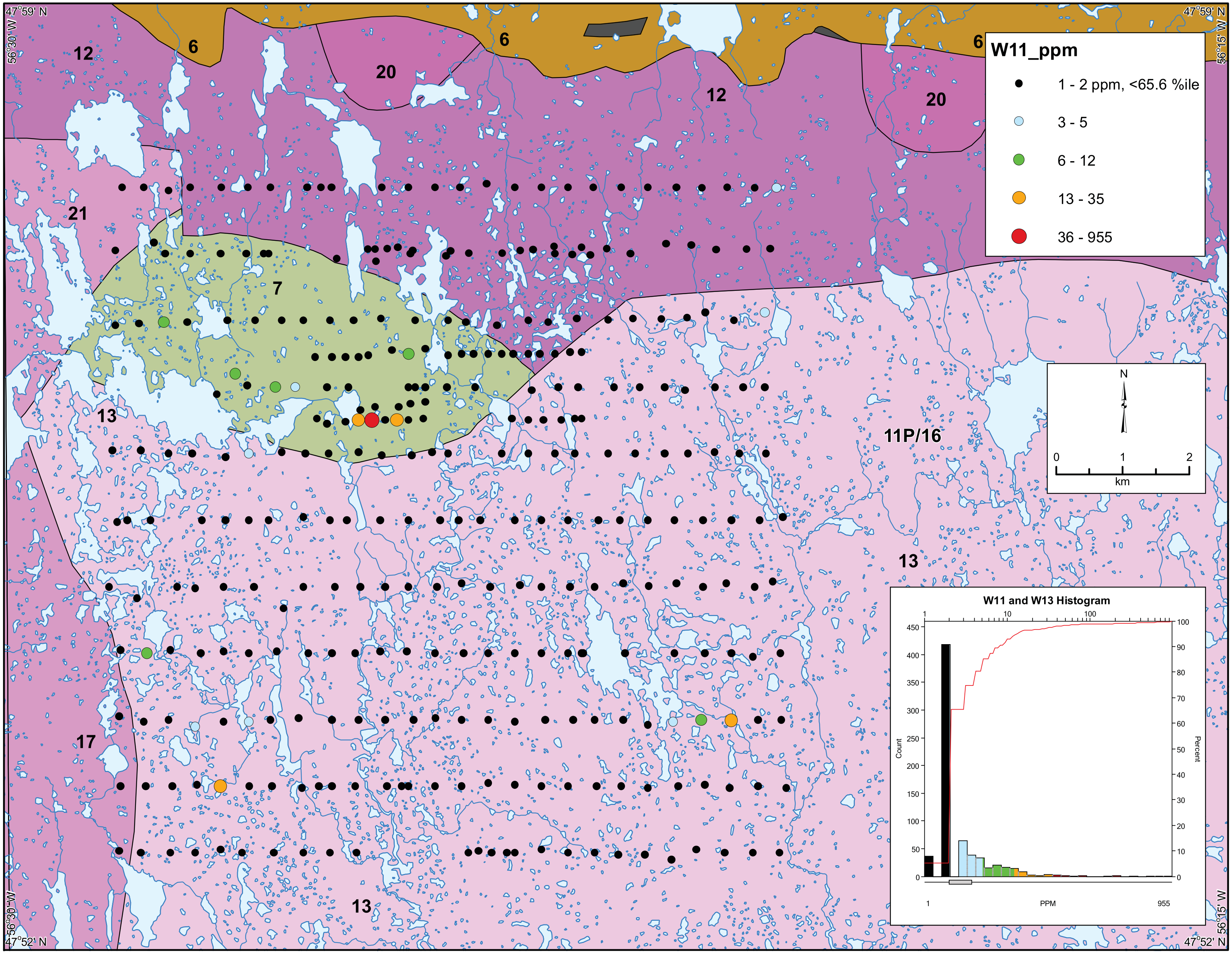

Figure 85. *Tungsten (W11) in reconnaissance soils in the Bottom Brook area.*

Soil Data from the Ackley Granite Area

In addition to reconnaissance soil samples, there are four grids over which soil samples were collected at a high density. Data for the four grids are displayed in two sets of figures, each of which contains two grids designated 'western grids' and 'eastern grids'.

Fe

The distribution of iron (Fe4) in reconnaissance soil samples is shown in Figure 86. The distribution of iron in grid soil samples is shown in Figures 87 and 88. Generally, iron contents are very low.

LOI

The distribution of loss-on-ignition (LOI) in reconnaissance soil samples is shown in Figure 89, and in grid soil samples is shown in Figures 90 and 91. As with iron, values of LOI are generally low.

Mo

The distribution of molybdenum (Mo5) in reconnaissance soil samples is shown in Figure 92. Most samples have contents that exceed the 70th percentile. There are several samples with high and elevated molybdenum contents located along the contact of the Snooks Tolt member of the Belle Bay Formation with Unit 25 of the Ackley Granite. Several molybdenum (and tungsten) occurrences are found adjacent to the contact. One of the most interesting clusters of samples with high molybdenum values is found near this contact, about 800 m east of Long Harbour. Here there are 6 samples that have high or elevated contents. The more southerly of the two samples with high contents (3733442) has the fourth highest molybdenum content found in the survey (90 ppm) and the highest uranium content (312 ppm) despite being located about 650 m away and up-ice from the molybdenum occurrence.

The distribution of molybdenum (Mo5) in grid soil samples is shown in Figures 93 and 94. There are three samples with elevated molybdenum contents in the western grids. In Figure 94 there are 17 samples with high and elevated contents in the more westerly of the two grids and only one sample with a high content in the more easterly grid.

Pb

The distribution of lead (Pb4) in reconnaissance soil samples is shown in Figure 95. The distribution of lead is shown, not because of any direct economic potential, but because it shows a pattern of high and elevated values in samples collected along the contact of the Snooks Tolt member of the Belle Bay Formation with Unit 25 of the Ackley Granite. Of particular note are the six samples with high lead contents that also have high and elevated molybdenum contents as described above.

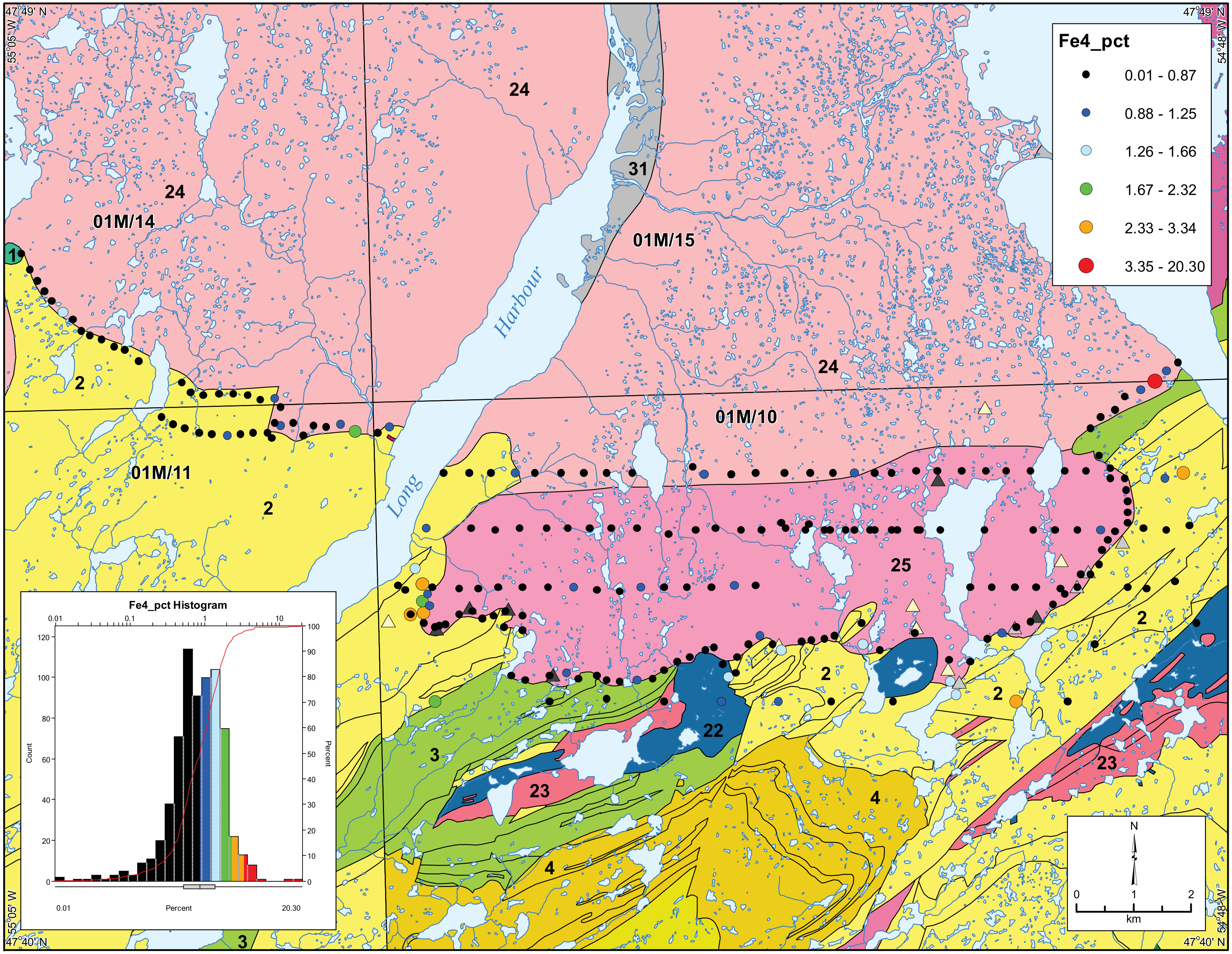

Figure 86. *Iron (Fe4) in reconnaissance soils in the Ackley Granite area.*

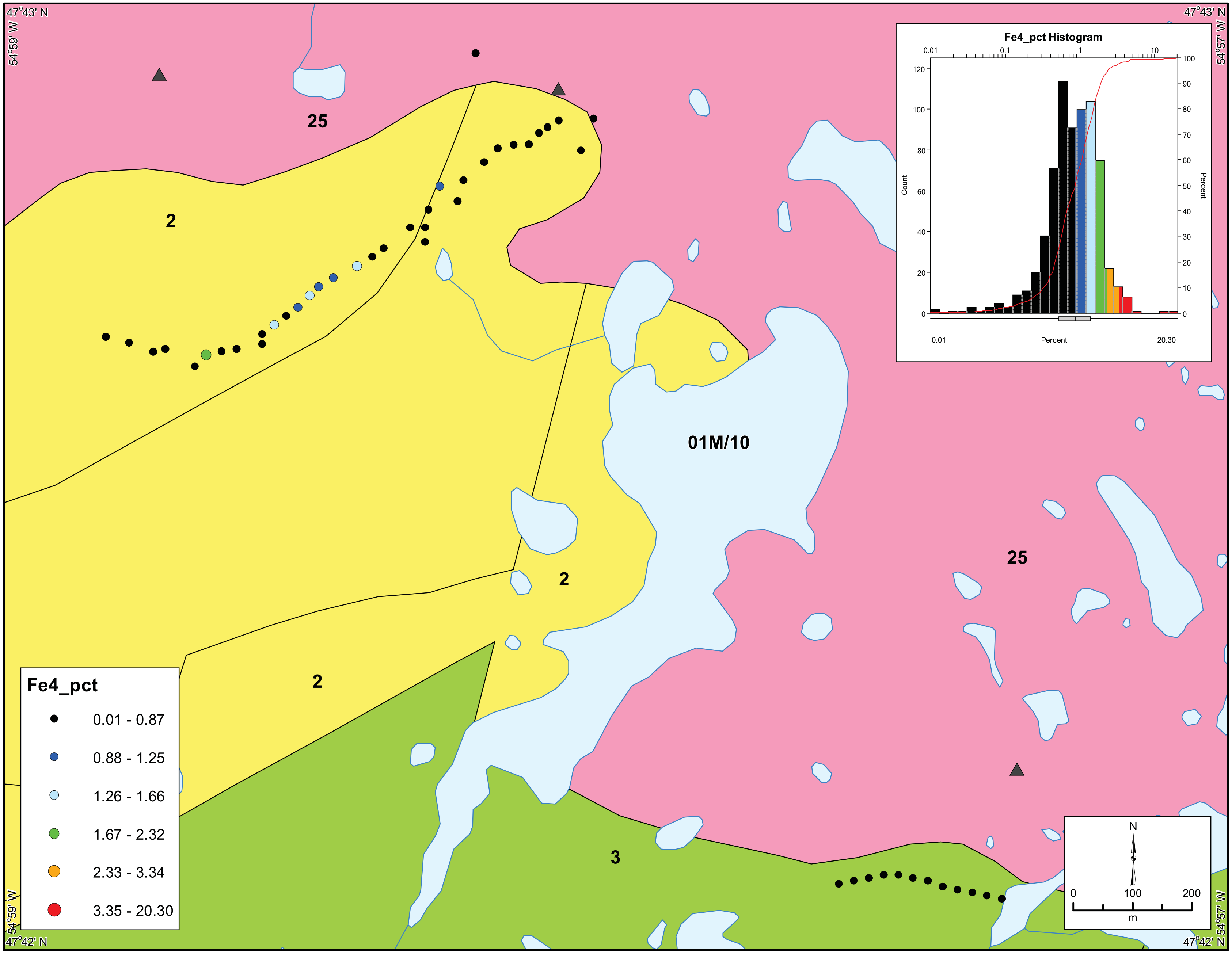

Figure 87. *Iron (Fe4) in soils of the western grids in the Ackley Granite area.*

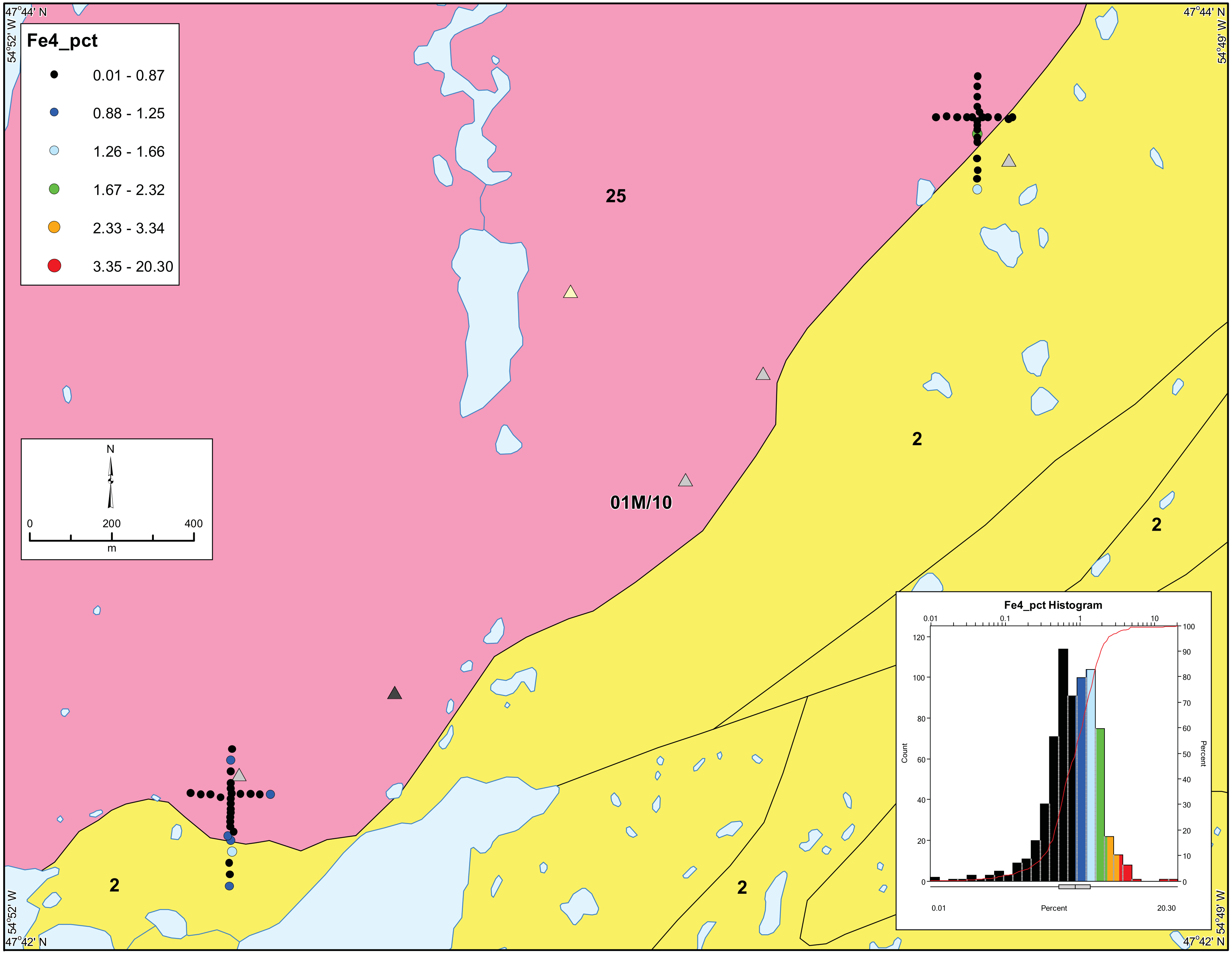

Figure 88. *Iron (Fe4) in soils of the eastern grids in the Ackley Granite area.*

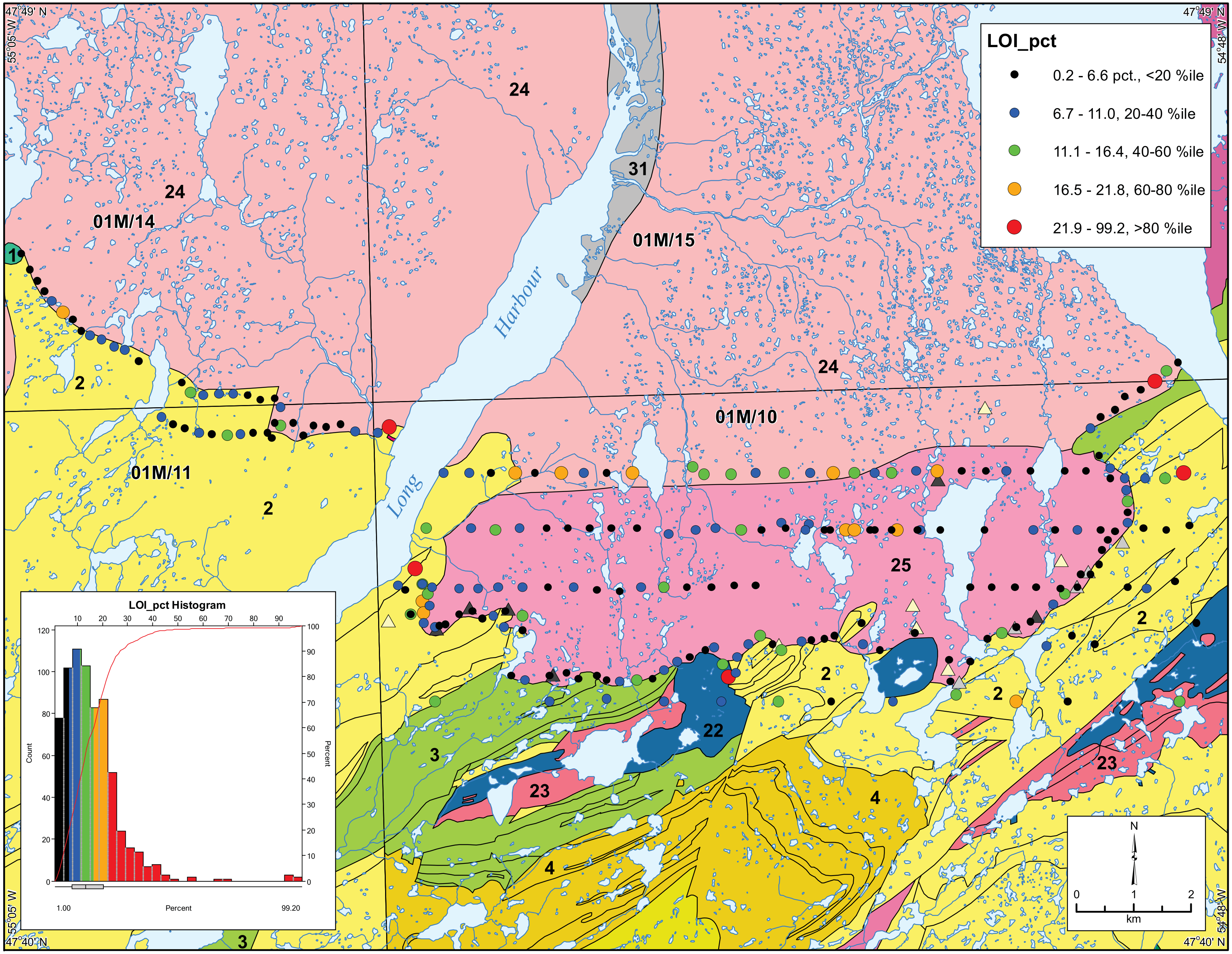

Figure 89. *Loss-on-ignition (LOI) in reconnaissance soils in the Ackley Granite area.*

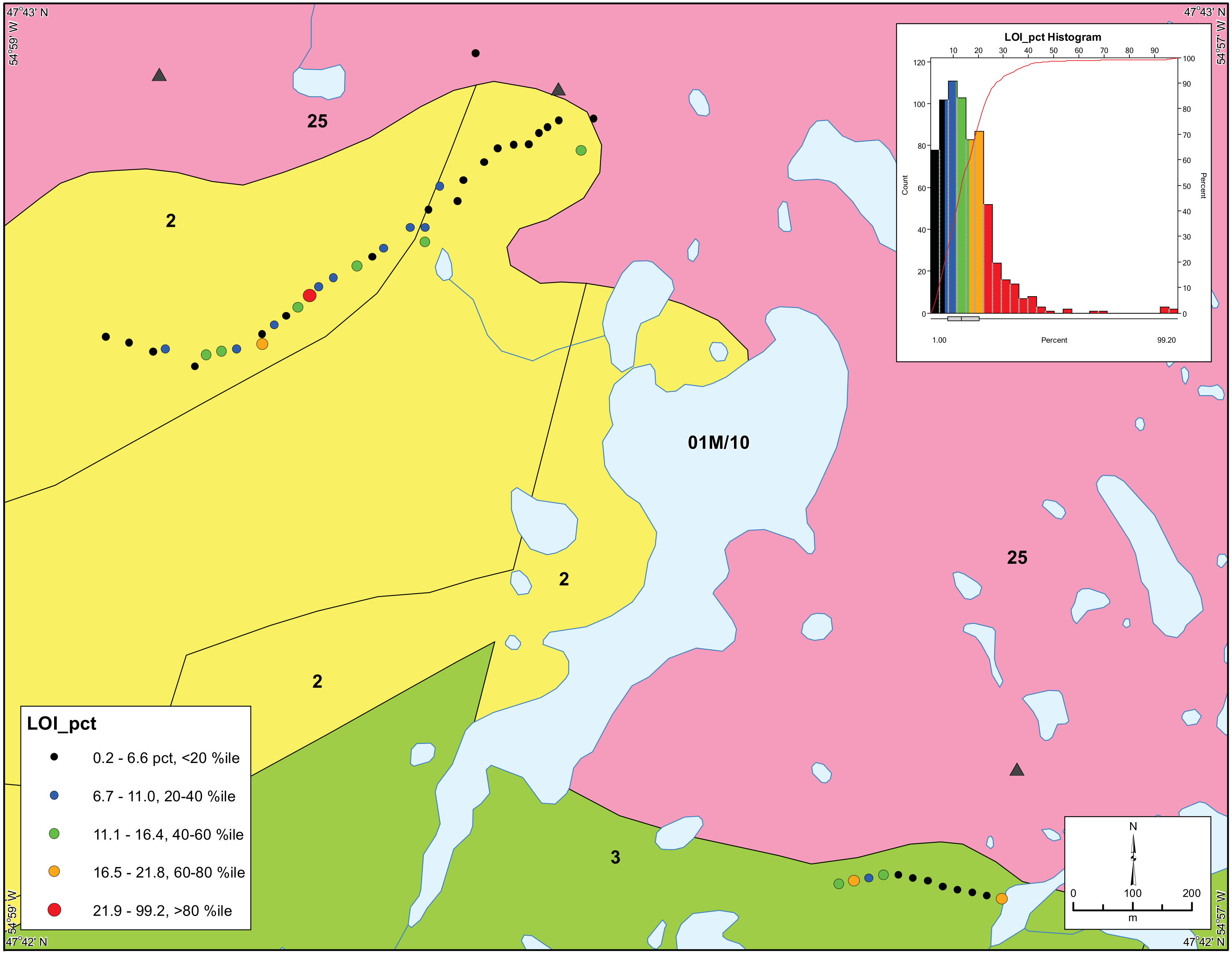

Figure 90. *Loss-on-ignition (LOI) in soils of the western grids in the Ackley Granite area.*

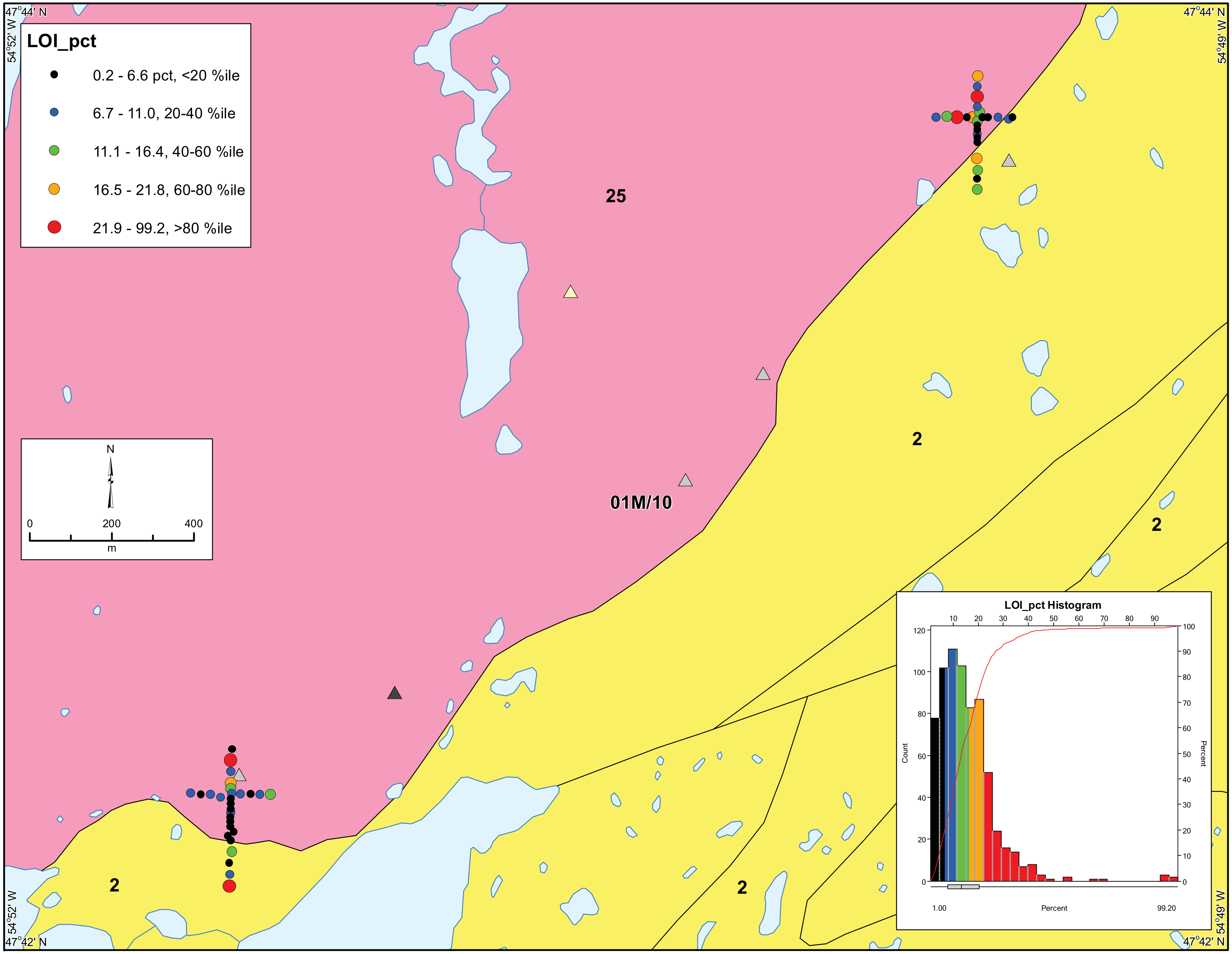

Figure 91. *Loss-on-ignition (LOI) in soils of the eastern grids in the Ackley Granite area.*

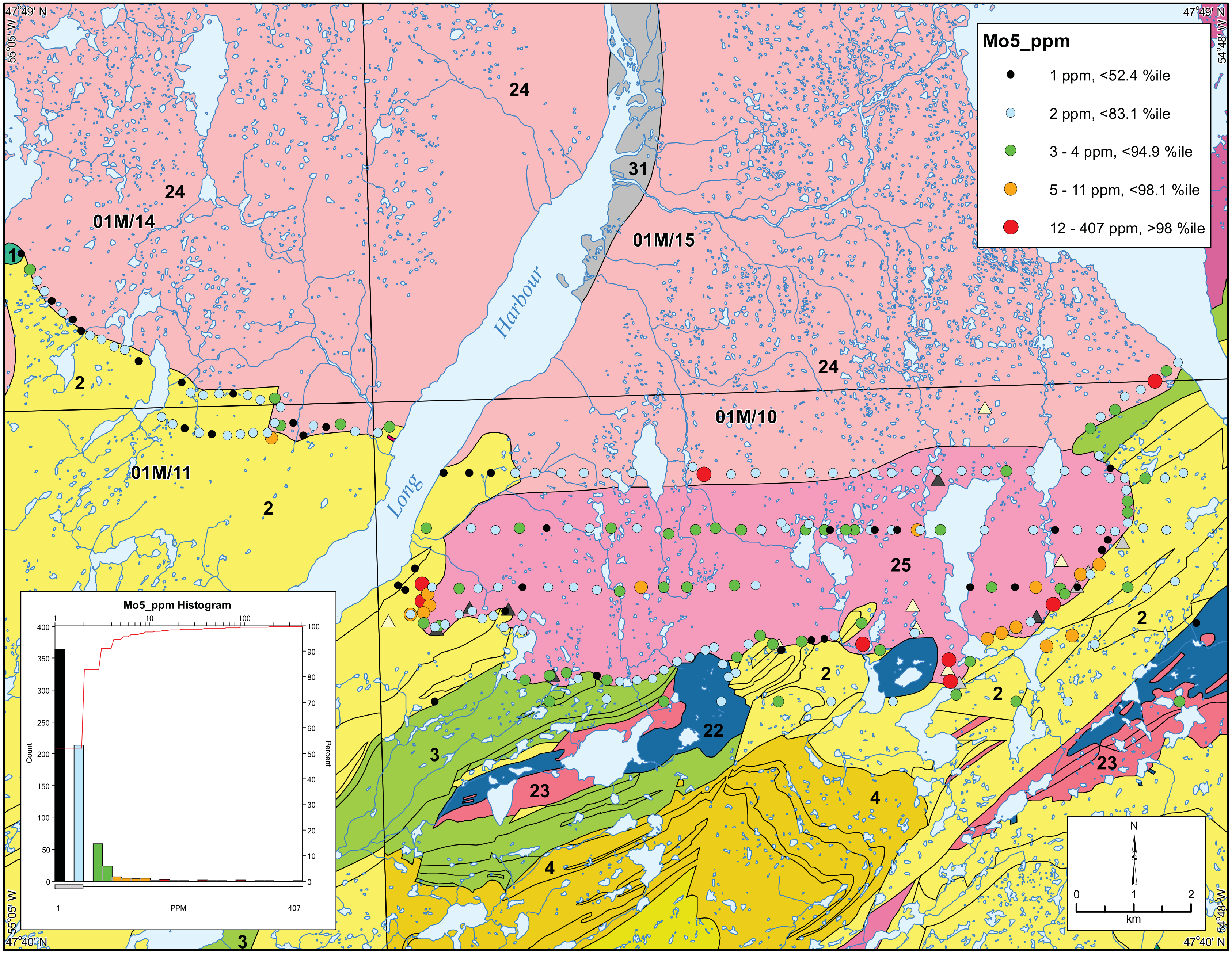

Figure 92. *Molybdenum (Mo5) in reconnaissance soils in the Ackley Granite area.*

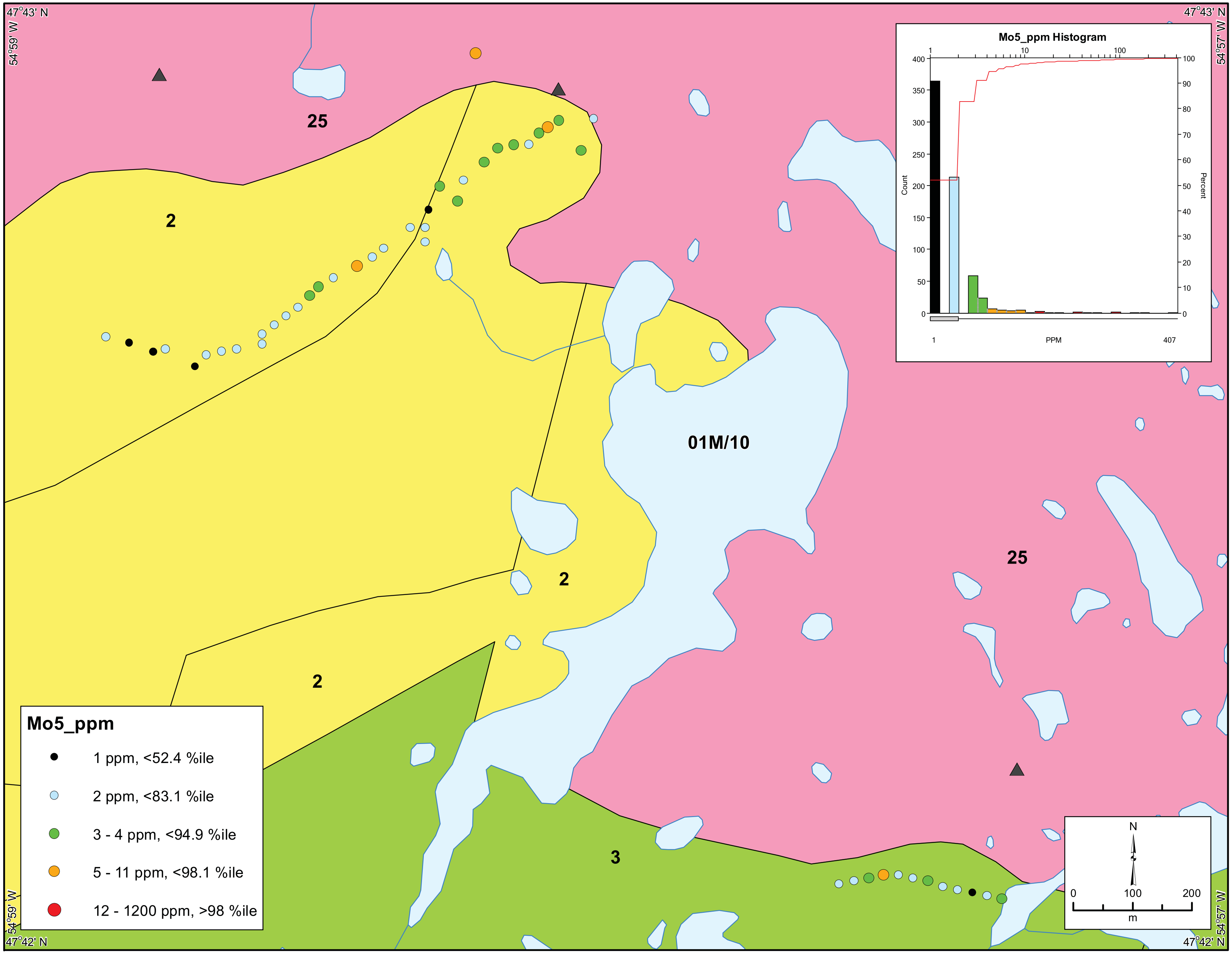

Figure 93. *Molybdenum (Mo5) in soils of the western grids in the Ackley Granite area.*

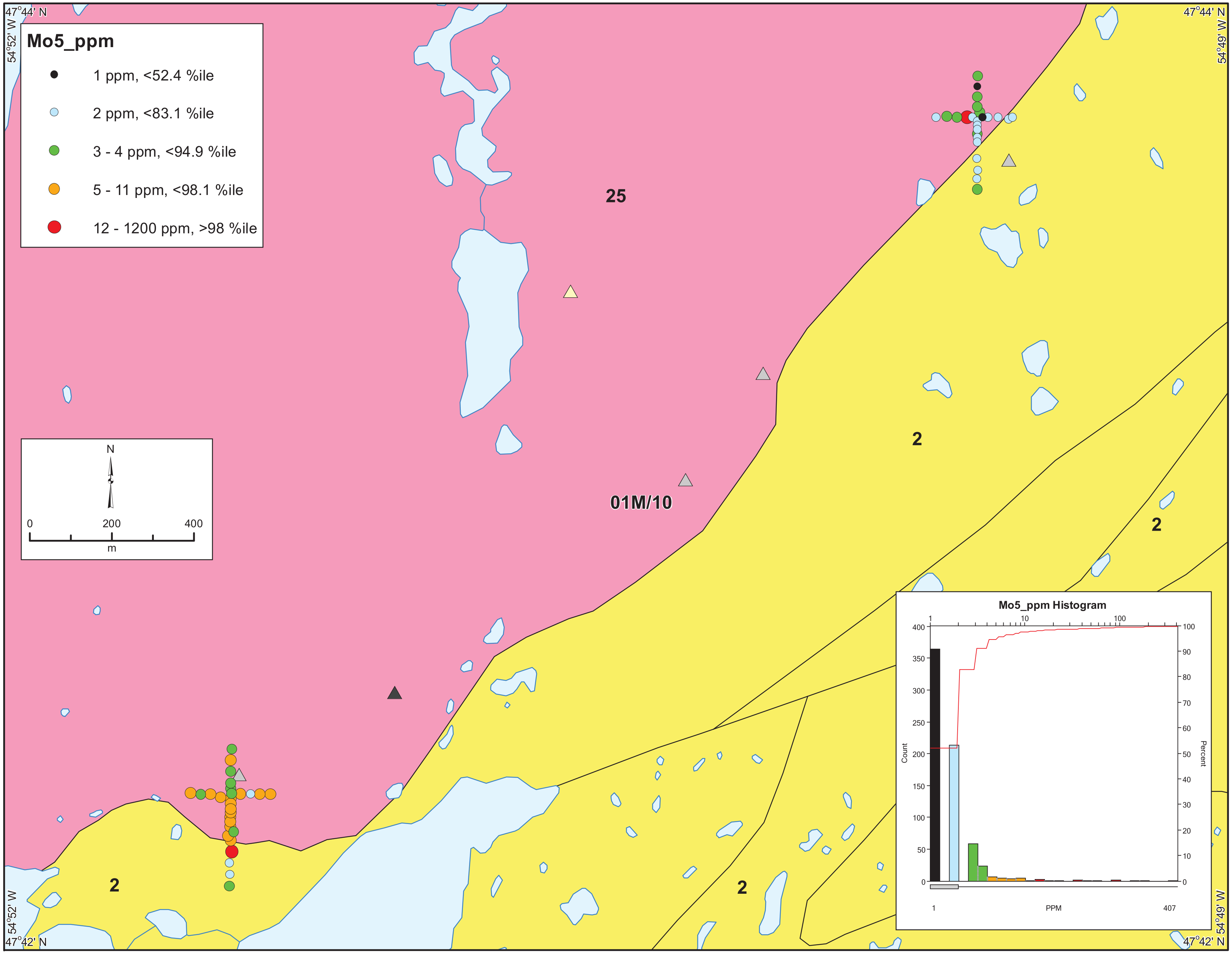

Figure 94. *Molybdenum (Mo5) in soils of the eastern grids in the Ackley Granite area.*

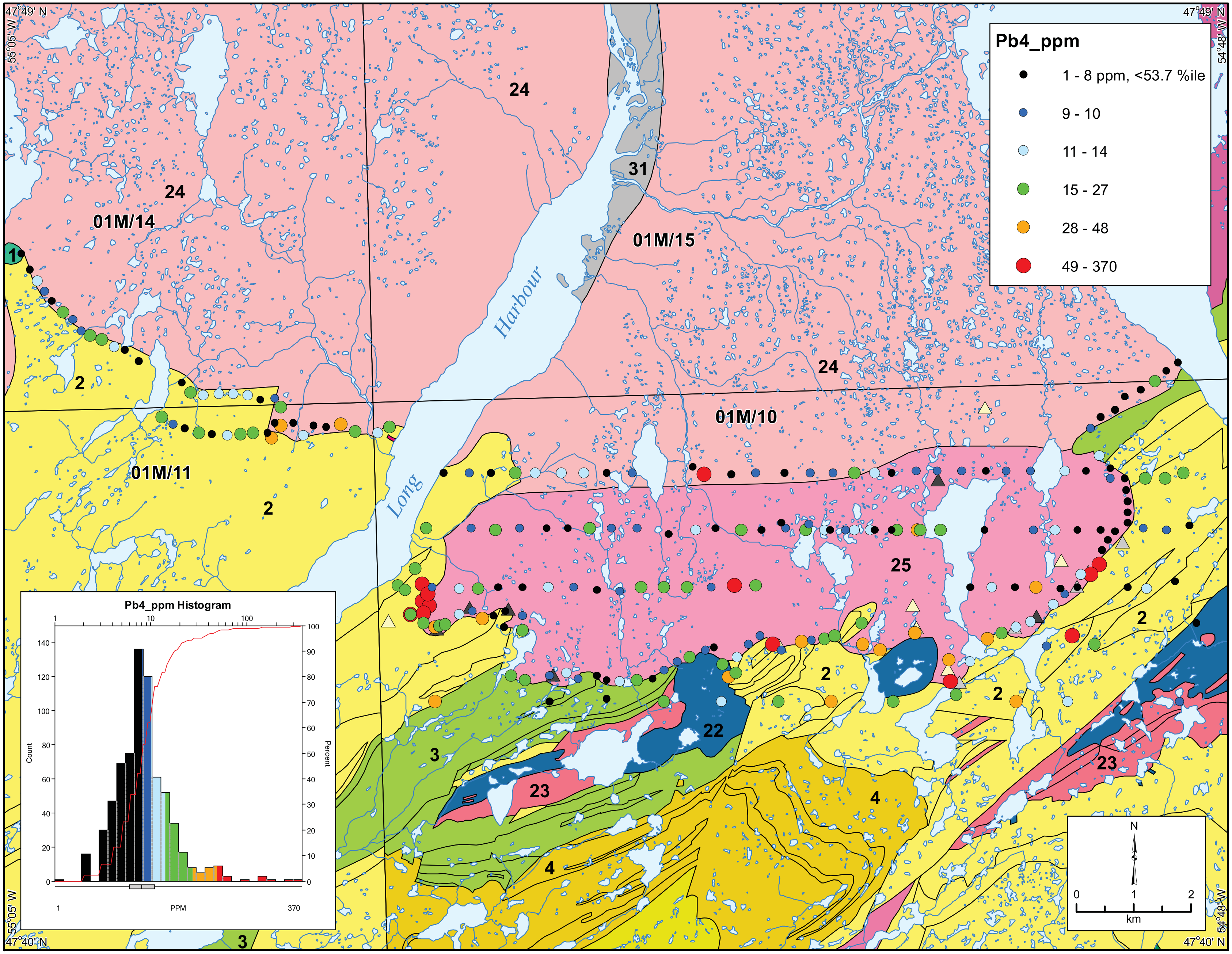

Figure 95. *Lead (Pb4) in reconnaissance soils in the Ackley Granite area.*

The distribution of lead (Pb4) in grid soil samples is shown in Figures 96 and 97. Samples in the southwest half of the northern grid in Figure 96 have many high and elevated contents. This portion of the grid also has relatively high tungsten and tin content. In Figure 97, over one third of the samples in the southwestern grid have lead contents that exceed the 85th percentile. Most samples in this grid also have high contents of tin. The samples with higher than normal lead values generally have higher uranium values as well (*see* discussions below).

Sn

The distribution of tin (Sn12) in reconnaissance soil samples is shown in Figure 98. With few exceptions, the samples with high and elevated tin contents are localized near the contact of units 2 (Belle Bay Formation) and 25 of the Ackley Granite Suite. A large cluster of 13 samples with high or elevated contents is located along the northeast-striking contact at the southeast side of Unit 25. This zone extends for 3 km and includes three of the four known occurrences of tin mineralization. Another four samples with high and elevated tin contents are found near the west end of the contact near some tungsten occurrences. Note that the western sample with the high tin content is nearly obscured by a sample with elevated tin. The tungsten occurrences may have associated tin values.

The distribution of tin (Sn12) in grid soils is shown in Figures 99 and 100. The grids in Figure 99 are located down-ice from tungsten occurrences. Nevertheless, there are two samples with high tin contents. The high-value sample in the northwest grid is also about 250 m down-ice of a reconnaissance sample that also has a high tin value. In Figure 100, most samples in the southwesterly grid have high values of tin. This grid is located over, and down-ice from, a known tin occurrence. In contrast, only one sample from the northeast grid has a high tin content, however this grid is located mostly up-ice of a tin occurrence.

U

The distribution of uranium (U8) in reconnaissance soil samples is shown in Figure 101. Uranium was only analyzed in samples collected in 1982. Most of the samples with high or elevated samples are located near the contact of the Snooks Tolt member with Unit 25 of the Ackley Granite. They also correspond approximately with the samples with higher lead contents discussed above.

The distribution of uranium (U8) in soils in the two eastern Ackley Granite grids is shown in Figure 102. Samples from the western grids were not analyzed. Most samples in the southwestern grid have contents in excess of the 85th percentile. Most samples in the northeastern grid have low uranium contents.

W

The distribution of tungsten (W11 and W13) in reconnaissance soils samples is shown in Figure 103. Generally most samples have relatively low contents with three samples having high or elevated contents. These are located along the contact of the Snooks Tolt member with Unit 25.

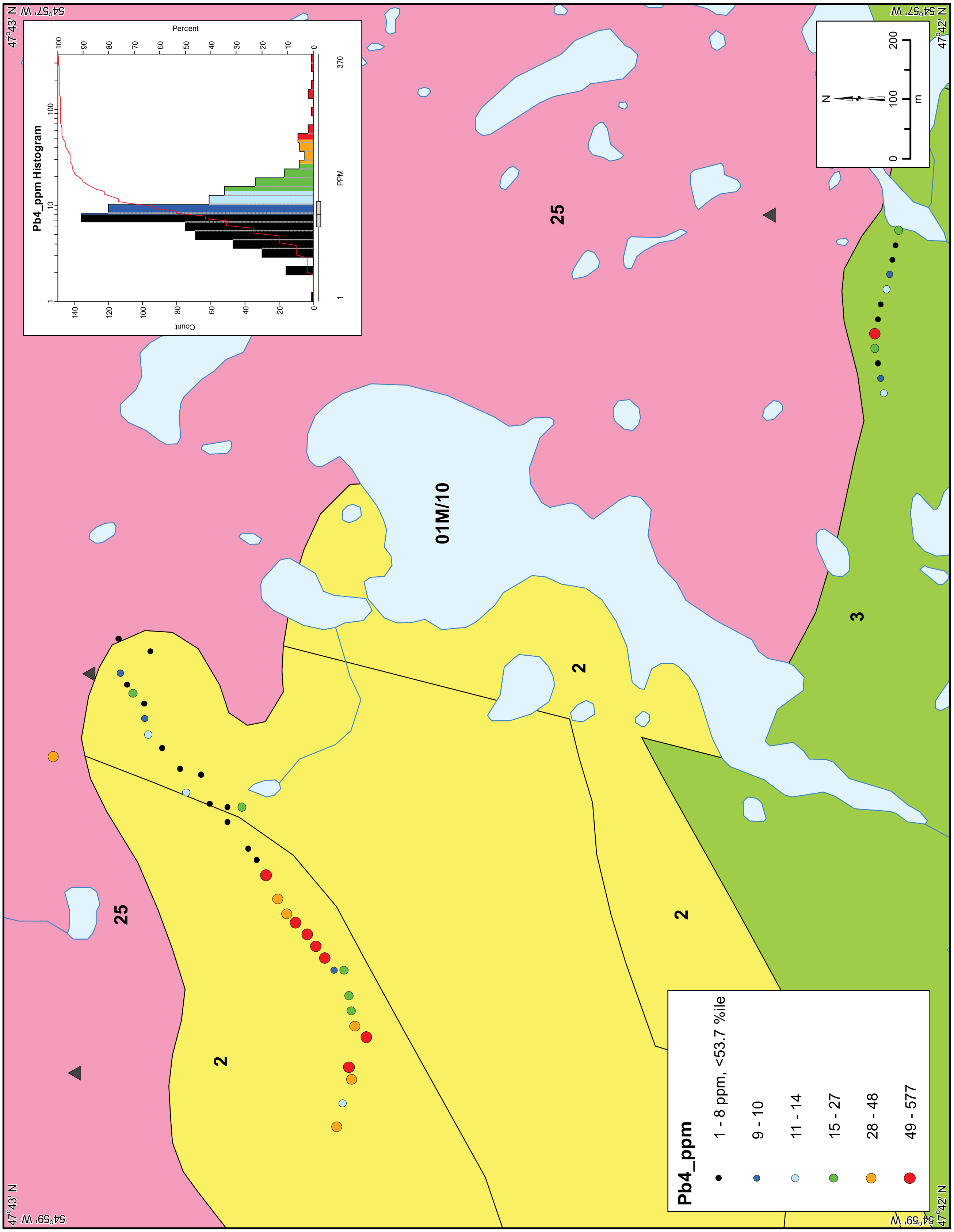

Figure 96. *Lead (Pb4) in soils of the western grids in the Ackley Granite area.*

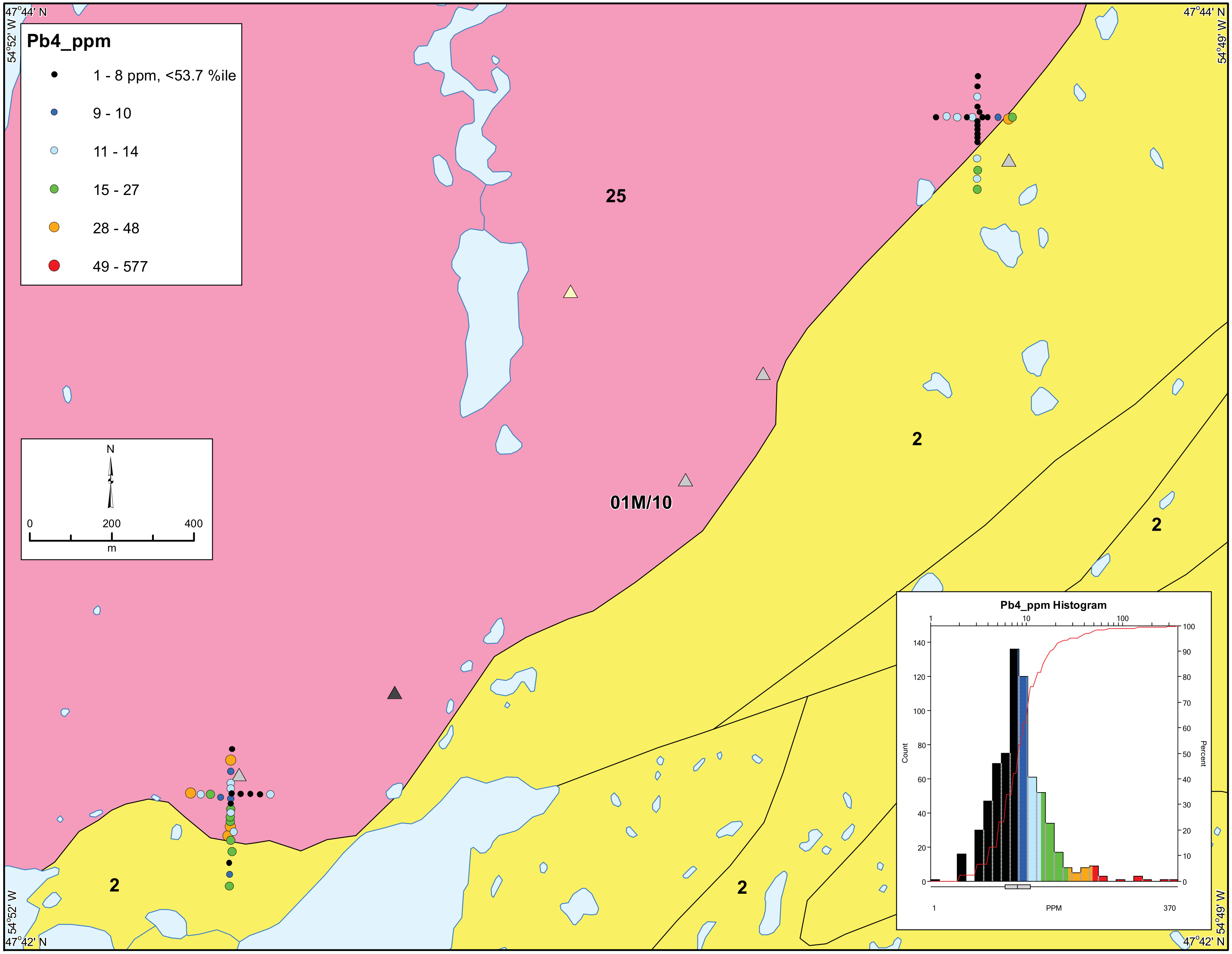

Figure 97. *Lead (Pb4) in soils of the eastern grids in the Ackley Granite area.*

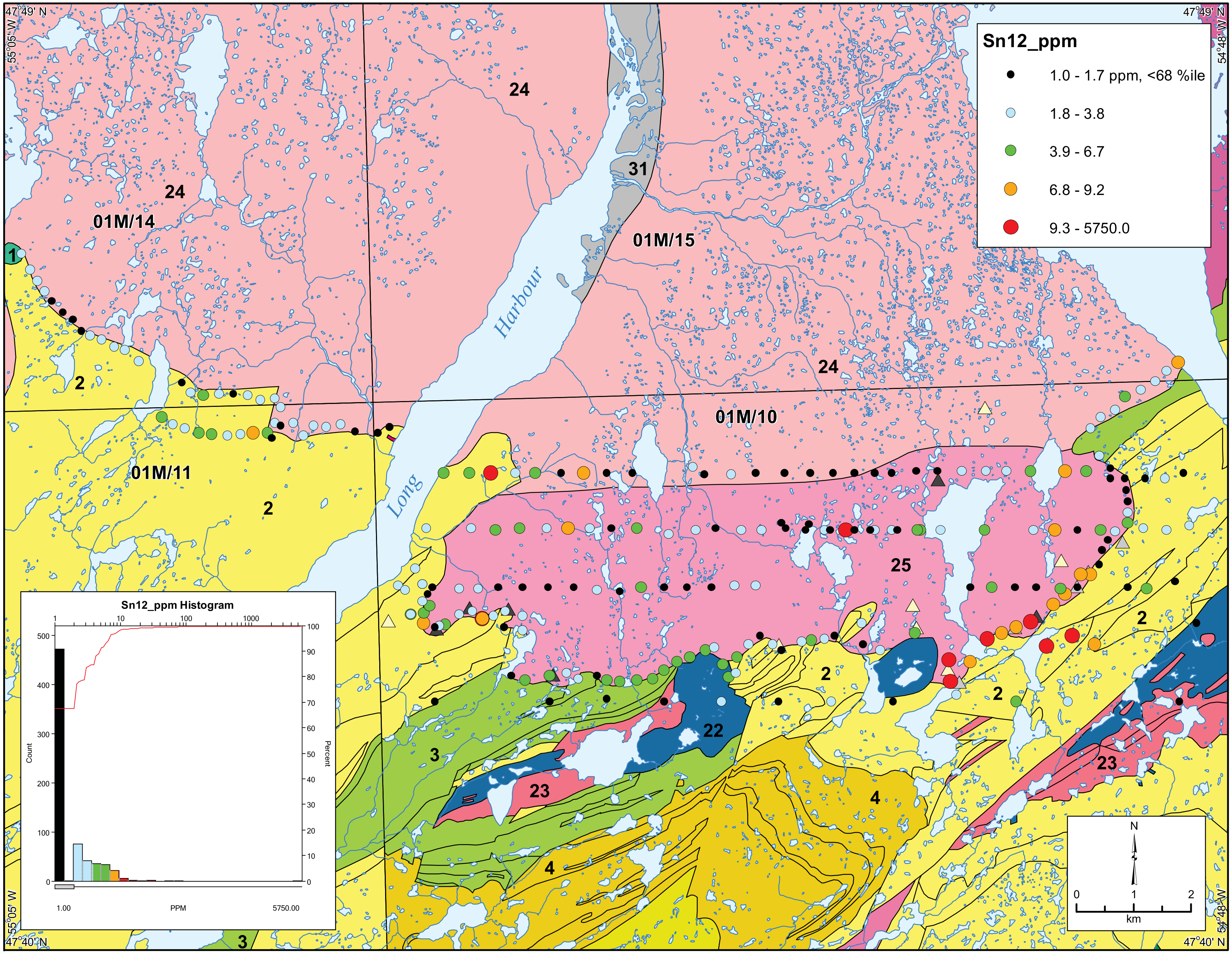

Figure 98. *Tin (Sn12) in reconnaissance soils in the Ackley Granite area.*

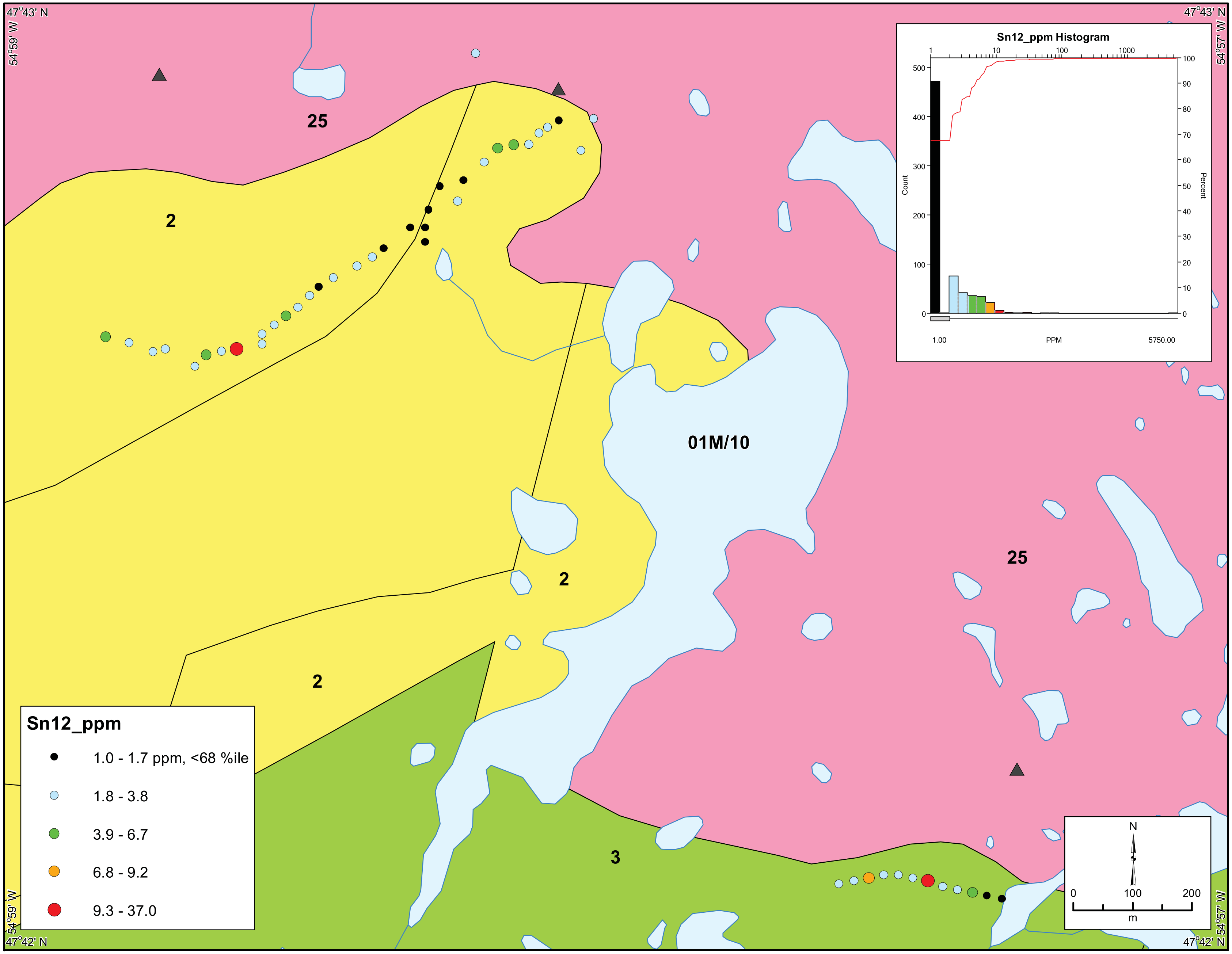

Figure 99. *Tin (Sn12) in soils of the western grids in the Ackley Granite area.*

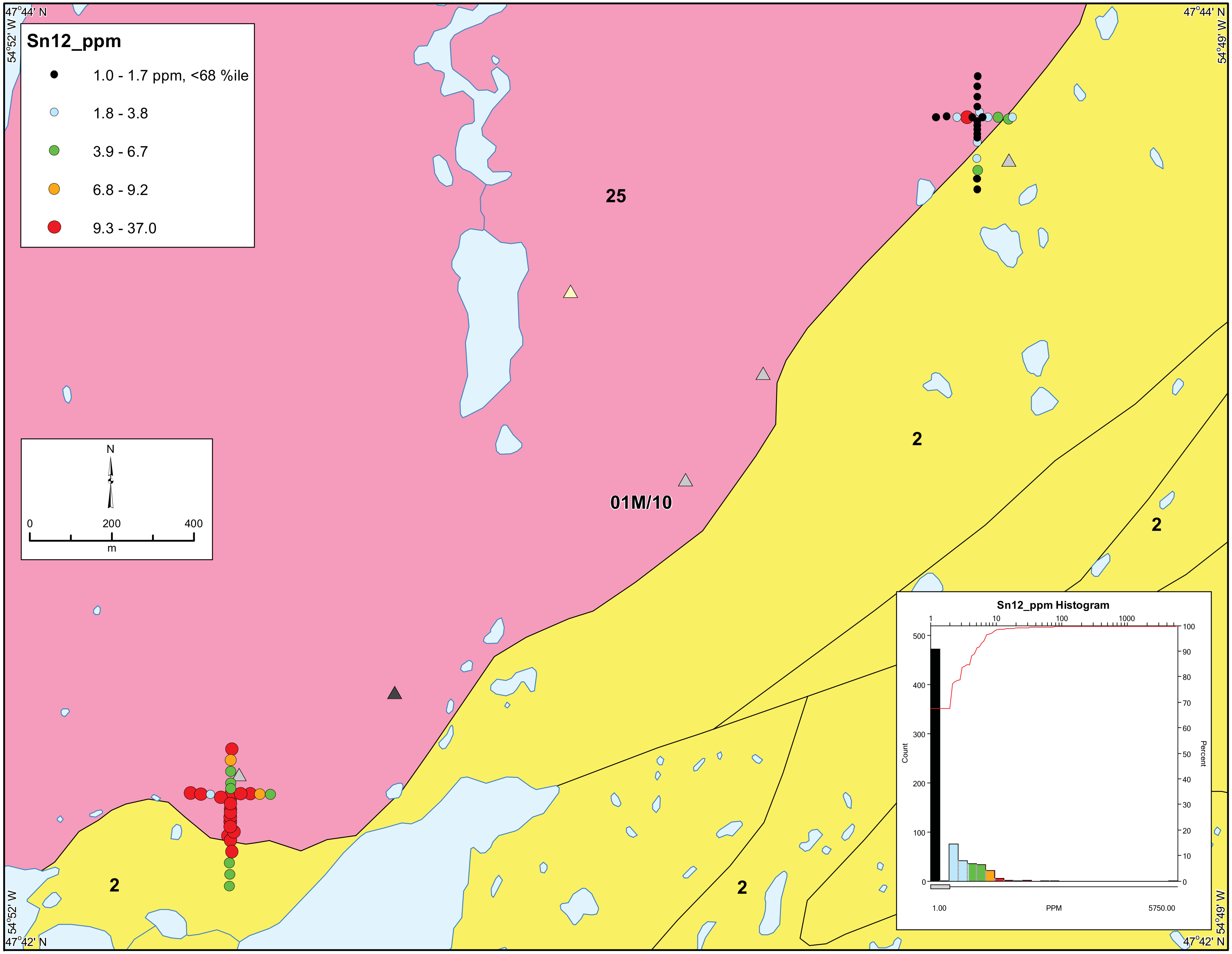

Figure 100. *Tin (Sn12) in soils of the eastern grids in the Ackley Granite area.*

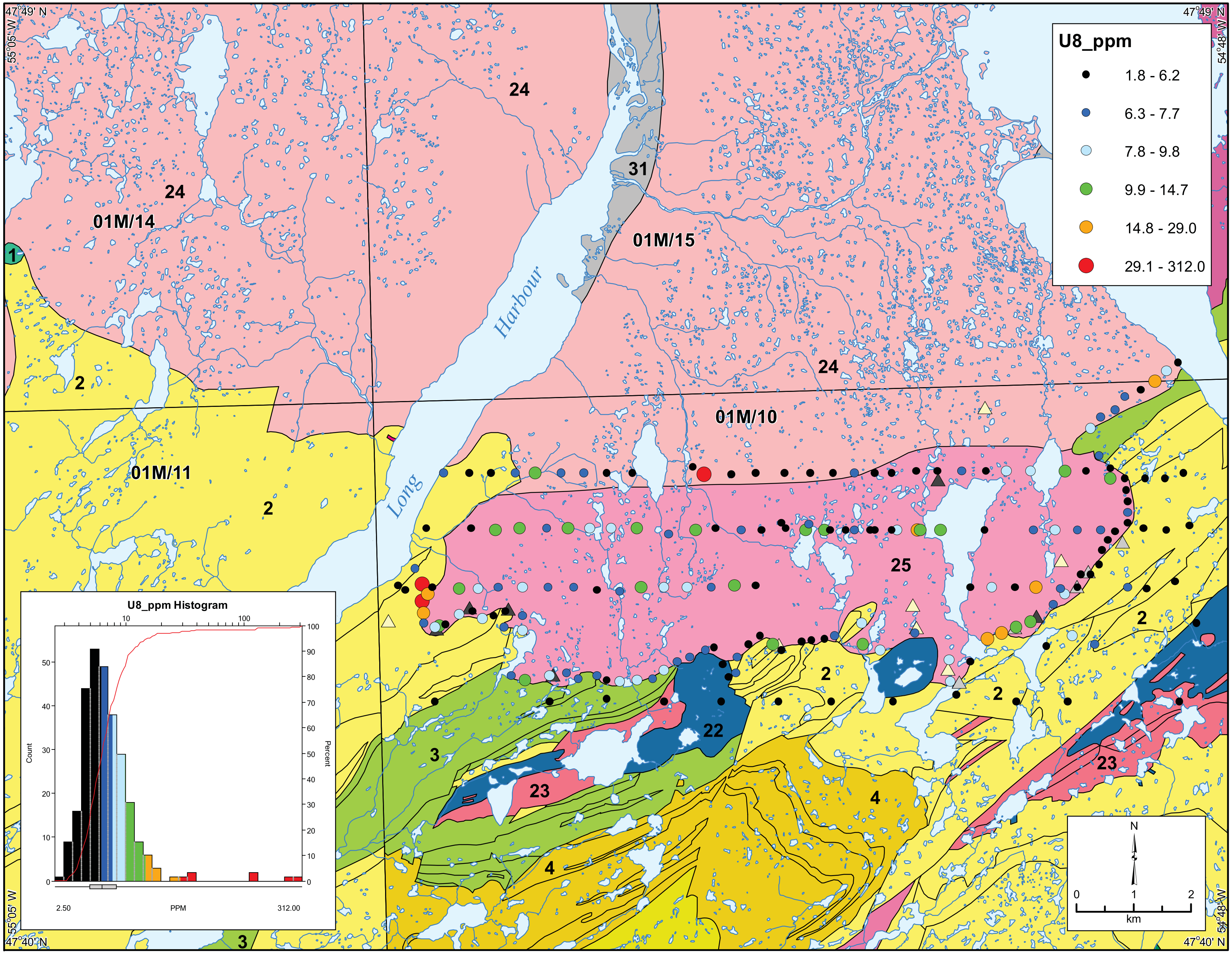

Figure 101. *Uranium (U8) in reconnaissance soils in the Ackley Granite area.*

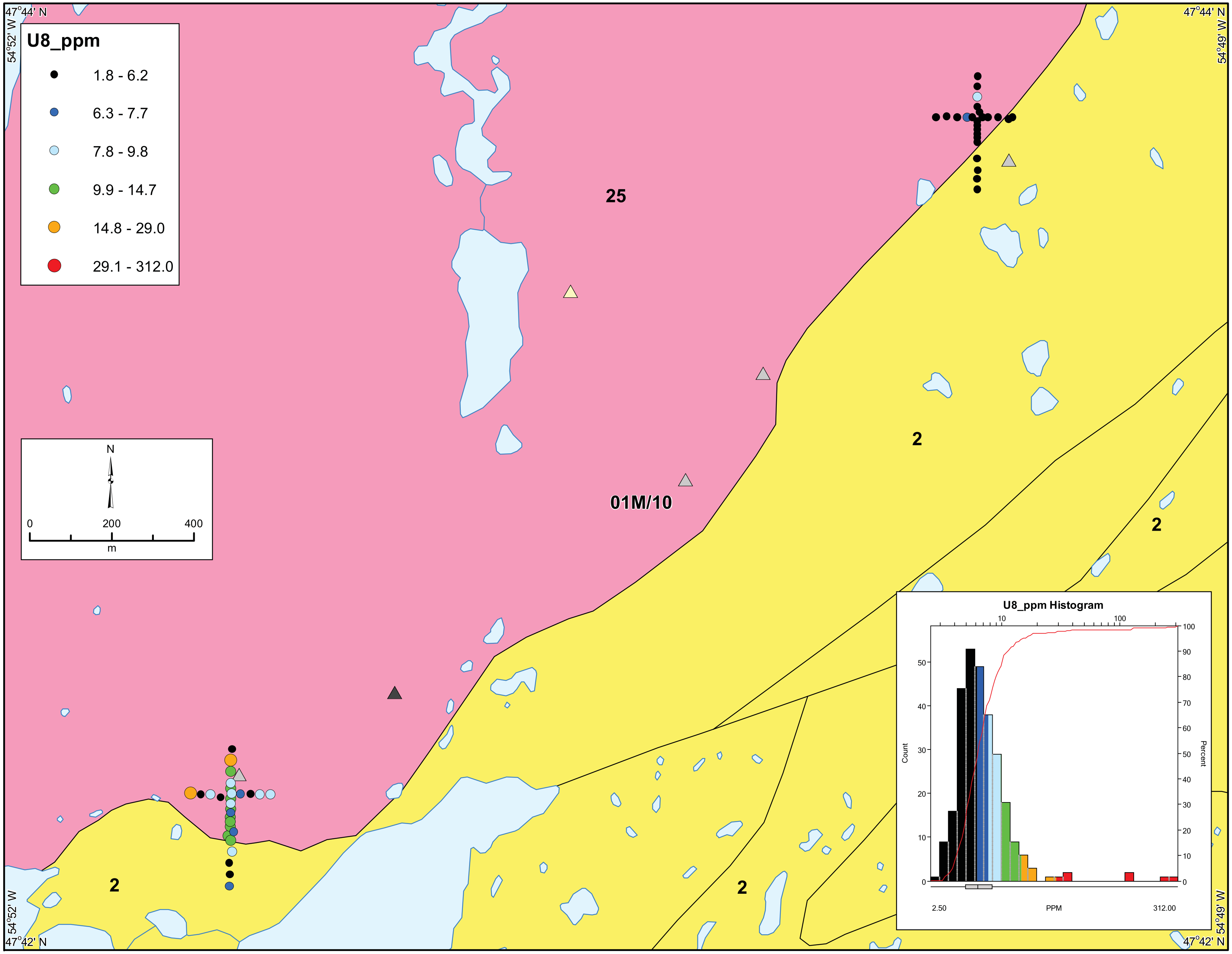

Figure 102. *Uranium (U8) in soils of the eastern grids in the Ackley Granite area.*

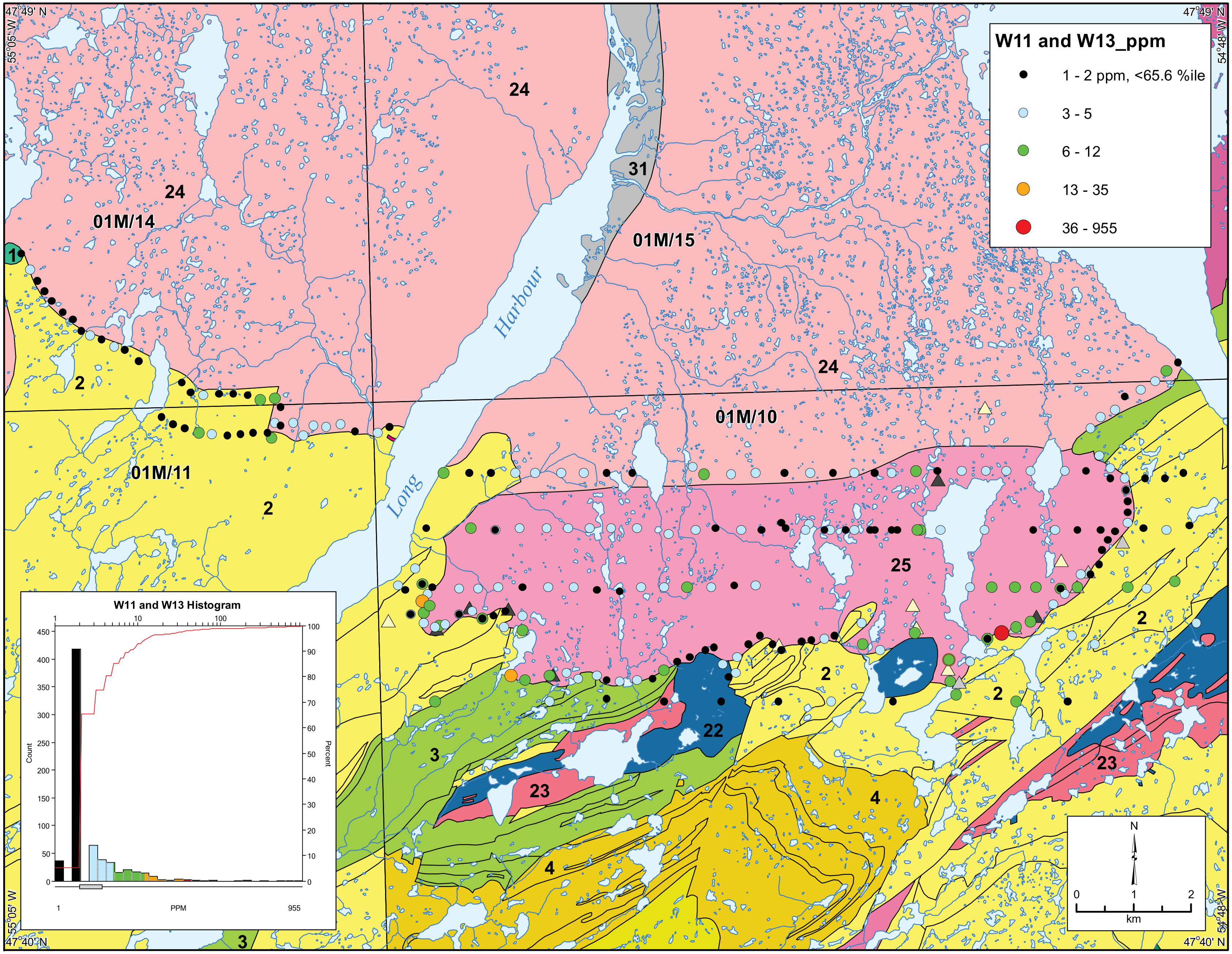

Figure 103. *Tungsten (W11 and W13) in reconnaissance soils in the Ackley Granite area.*

The distribution of tungsten (W11) in soil samples of the two western Ackley Granite grids is shown in Figure 104. Despite the northern grid being located down-ice from two tungsten occurrences, the tungsten expression is subdued with only one sample having an elevated content. Samples from the southern grid have even lower tungsten contents.

The distribution of tungsten (W13) in soil samples of the two eastern Ackley Granite grids is shown in Figure 105. The tungsten content of most soil samples in the southwestern grid are greater than the 70th percentile but no soil samples have high or elevated contents. Most soil samples in the northeastern grid have contents less than the 50th percentile.

CONCLUSIONS

1. Stream-sediment and soil geochemistry are effective in delineating most areas of known mineralization.

2. In the Granite Lake area, molybdenum data highlight most molybdenum occurrences and also suggest the presence of unrecognized mineralization.

3. Uranium data for streams in the Granite Lake area define three tight clusters of samples with high and elevated values of uranium (Figure 21). Another isolated sample has the highest uranium content found in the entire survey.

4. Tungsten contents in stream sediments in the Granite Lake area generally reflect known occurrences, but also suggest other prospective areas remote from mineralization including a group of two samples with the highest analyses of tungsten (W13) encountered in the survey.

5. Rare earth elements and alkali metals in stream sediments in the François Granite area display distribution patterns that do not coincide exactly with mapped lithologic units and which may be explained by the geochemistry of the different phases of the intrusion.

6. Tin contents in stream sediments over the François Granite are generally much higher than in streams elsewhere described in this report. Samples with high and elevated tin contents are found fairly evenly distributed. The two samples with the highest tin analyses found in the entire survey are from the northeast part of the François Granite.

7. Two stream-sediment samples in the Bottom Brook area have very high uranium contents. No uranium mineralization is presently known in the area.

8. Several strong tungsten anomalies are found in stream sediments in the Dolland Brook and Dolland Brook North areas. These are remote from known tungsten occurrences.

9. Tungsten anomalies in reconnaissance and grid soil samples in the Granite Lake area clearly reflect known tungsten mineralization. There are also anomalies in the reconnaissance data that are remote from known mineralization.

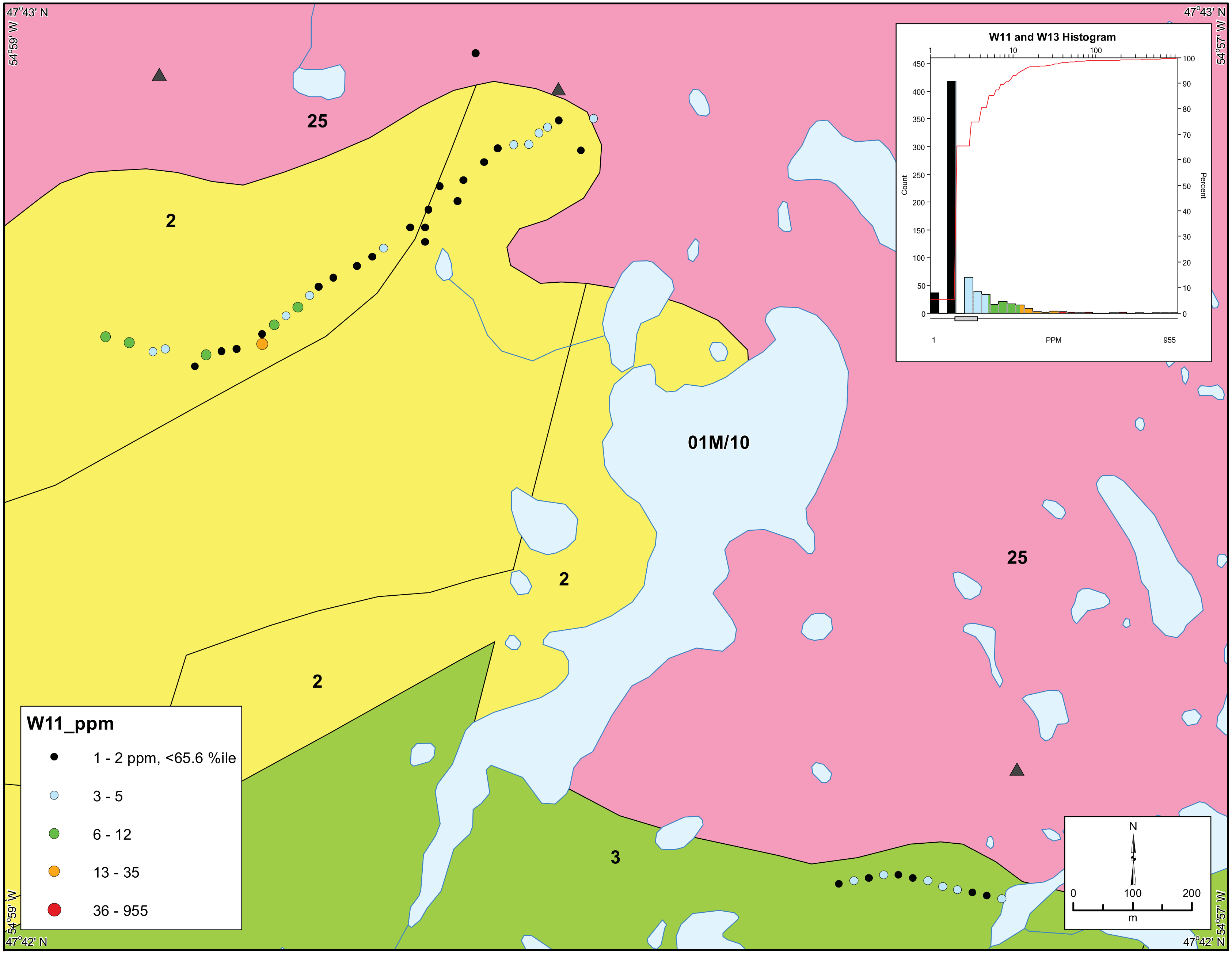

Figure 104. *Tungsten (W11) in soils of the western grids in the Ackley Granite area.*

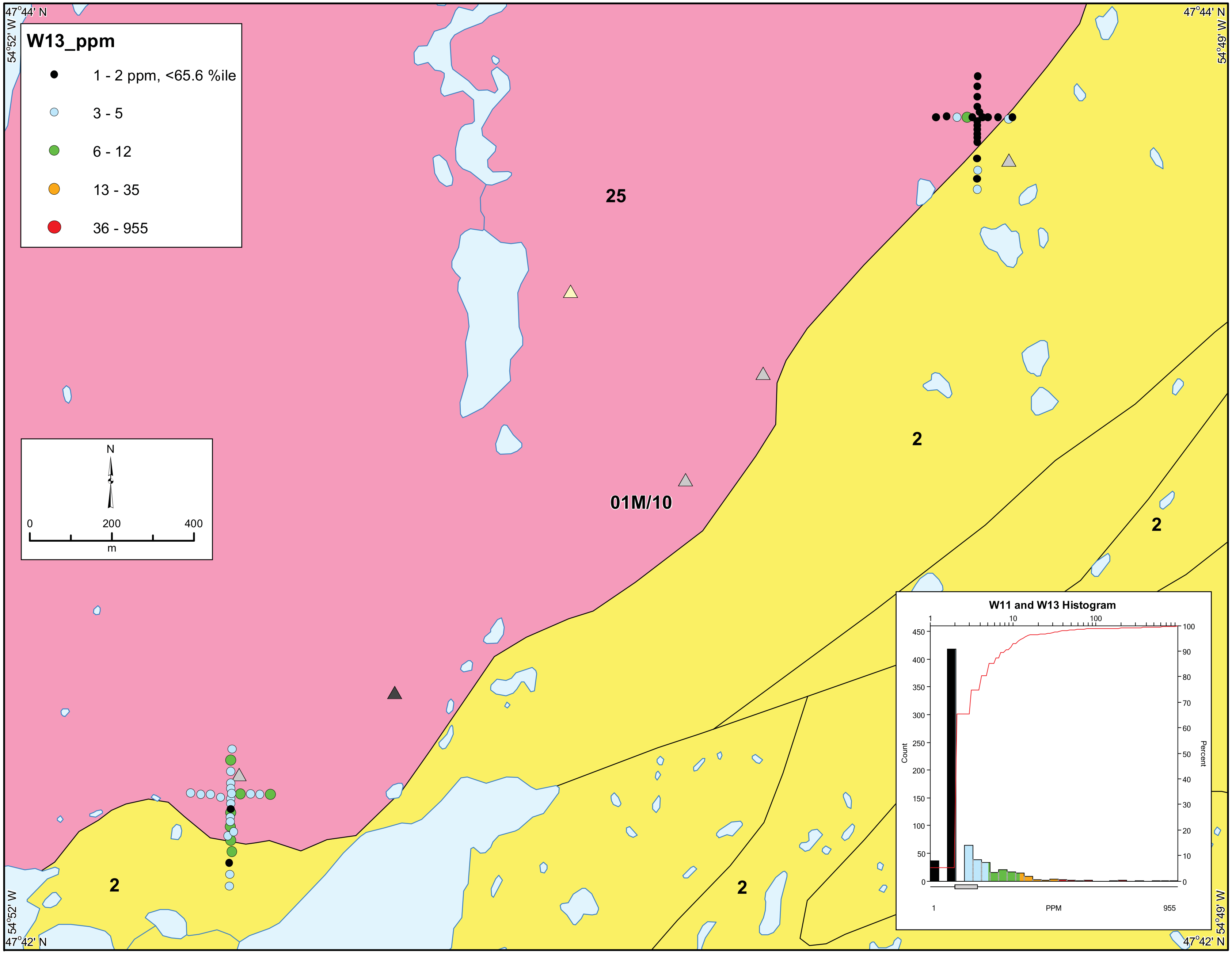

Figure 105. *Tungsten (W13) in soils of the eastern grids in the Ackley Granite area.*

10. There is a uranium anomaly in four adjacent reconnaissance soil samples extending for 1200 m in the Bottom Brook area.

11. There is a five-sample cluster of reconnaissance soil samples having high and elevated contents of molybdenum in the Ackley Granite area near the contact along which most mineralization is found. The closest known molybdenum mineralization is located about 650 m away and down-ice from the sample with the highest molybdenum content, and cannot therefore be explained by glacial dispersal.

12. Tin in both reconnaissance and grid soil samples reflect known mineralization in the Ackley Granite area.

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During the three summers of field work that these surveys were conducted, many students, primarily from Memorial University, provided the back power and brain power to see them done well. I thank them for their efforts and great companionship in the field. Many have gone on to have notable careers including some in geoscience. Neil Stapleton is thanked for producing the final figures. The report benefitted from the helpful suggestions of reviewers Martin Batterson, Pauline Honarvar and Steve Amor and the editing of Chris Pereira.

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