MARGINAL NOTES[a]

INTRODUCTION

The Makokibatan Lake area is located in the eastern Uchi Subprovince within the Fort Hope–Miminiska greenstone belt in northwestern Ontario. The mapped area is portrayed on west (P.3843) and east (P.3844, Azar and Bellrose 2021) map sheets and covers roughly 3465 km², including a 500 m overlap with the Eabamet Lake—south sheet map (P.3825) of Azar and Rudolph (2018). Geochronology data from the Makokibatan Lake area, obtained as part of this mapping project, are summarized in Table 1 of each map sheet. The Makokibatan Lake area was originally mapped by V.K. Prest in 1940 and 1941 (Prest 1942) following reconnaissance mapping by E.M. Burwash in 1928 focussing along the Albany River system (Burwash 1929). Additional reconnaissance mapping was completed in 1969 by Thurston and Carter (1969) and Thurston, Carter and Riley (1969).

GEOPHYSICAL IMAGERY

The geophysical images shown in Figures 1 and 2 depict total residual magnetic field and the second vertical derivative of the total residual magnetic field (Ontario Geological Survey 2003a, 2003b) for the mapped areas and were used in the geophysical interpretation of many of the contacts, structures and magnetic bodies shown on the maps. The interpreted length, shape and continuity of iron formations (unit 5) and Proterozoic dikes (unit 12) were based primarily on linear features visible in the calculated second vertical derivative of the residual magnetic field (*see* Figure 2). These interpretations are supported locally by direct observations of these units and of similar units with the same characteristics in the field. The geophysical interpretations of the felsic intrusive rocks (units 8,10 and 11) are more tenuous and are based on broad changes in geophysical patterns with no or minimal direct field observation because of extensive surficial cover. Contacts within some of the felsic intrusive rocks can be recognized in the geophysical patterns, but do not always correspond with visible changes in rock types. Small round and oval magnetic bodies (units 7 and 9) are generally interpreted to be small mafic intrusions, whereas more sinuous and irregular magnetic bodies are interpreted to be rafts of metasedimentary material (units 5 and 6). Finally, magnetic lineaments in granitoid units (blue lines) are interpreted to be remnant stratigraphy, predominantly metasedimentary rocks such as iron formations after units 5 and 6 and more rarely mafic intrusive rocks (unit 7).

GEOLOGY, GEOCHEMISTRY AND GEOCHRONOLOGY

The supracrustal rocks in the Makokibatan Lake area are dominated by mafic to intermediate pillowed and massive flows which have been metamorphosed to greenschist or amphibolite facies. The mafic flows are dominantly tholeiitic and display either normal mid-ocean ridge or island arc tholeiite basalt geochemical affinities as revealed by their slightly depleted to slightly enriched rare earth element (REE) profiles relative to primitive mantle (McDonough and Sun 1989), low potassium values (<0.5 wt % K), where relatively unaltered, and moderate titanium values (0.5 to 1.7 wt % TiO_2) (*see* "Geochemistry" in Azar 2021; Hakimian 2017). Coarse- to medium-grained synvolcanic mafic sills and dikes, some of which are interpreted as feeders for pillow lavas, are common throughout the mafic metavolcanic package and display the same chemistry as the extrusive equivalents. The areas near Frenchman's Rapids (west map) and Kagiami Falls (east map) along the Albany River are dominated by felsic to intermediate volcaniclastic rocks that include tuff, crystal tuff and lapilli tuff. Lapilli are commonly the same composition or more felsic than the surrounding ash layers and are flattened parallel to foliation. These felsic to intermediate metavolcanic rocks are dominantly calc-alkalic with enriched REE profiles, in particular the light REE, relative to primitive mantle. The mafic and intermediate or felsic magmas follow distinct geochemical evolutionary trends on zirconium versus niobium plots, suggesting they represent distinct magma sources (Hakimian 2017).

An intermediate tuff in the Frenchman's Rapids area (west map) was erupted at 2733.3±1.0 Ma (Kamo and Hamilton 2017) and felsic volcaniclastic rocks in the Kagiami Falls (east map) area were deposited at 2738.3±0.8 Ma indicating that these 2 metavolcanic rock units are temporally distinct and represent different eruptive events in the region. The latter age corresponds to the eruptive age for the intermediate volcaniclastic rocks to the north in the Eabamet Lake area 2737.7±1.3 Ma (*see* P.3825, Azar and Rudolph 2018; Kamo 2016).

On the shoreline of Washi Lake, thick metavolcanic packages dominated by pillowed mafic flows, are crosscut by feldspar porphyry dikes (unit 8w). The porphyry dikes contained a heterogeneous population of zircons ranging in age from *circa* 2705 to *circa* 2740 Ma. The older component in the zircon population may represent xenocrystic zircons originating from the surrounding mafic metavolcanic rocks (Kamo and Hamilton 2017). The youngest zircon crystals may represent the age of emplacement of the dikes. These dikes are frequently the locus of shearing and commonly strongly sericite altered.

Clastic metasedimentary rocks in the mapped area consist of wacke and mudstone with dominantly felsic to intermediate provenance based on geochemistry (unit 6). The metasedimentary rocks show 2 different relative age relationships with respect to the metavolcanic rocks in the area. The maximum age of deposition of the metawacke along the shoreline of Makokibatan Lake is *circa* 2702.1 Ma (Davis, Ménard and Sutcliffe 2018), which is consistent with depositional age constraints for the English River sandstones (Corfu, Stott and Breaks 1995). A small subset of zircons (4 total) in this unit has ages of 2901±28 Ma whose provenance is unclear, but which is more commonly associated with older rocks from the North Caribou terrane to the north (Thurston, Osmani and Stone 1991). The maximum age constraint for the metawacke on Makokibatan Lake is similar to the maximum age of the Miminiska metasedimentary terrane, *circa* 2705 Ma, located on the south shoreline of Miminiska Lake northwest of the map area (Buse and Hamilton 2012). Chemical metasedimentary rocks (unit 5) in the map area consist of silicate- and oxide-facies iron formation, although sulphide-facies iron formation may have been recorded in the some of the drill holes in the region drilled by the Hoey Syndicate in 1965 (Kidd 1965). Rocks of unit 5 occur as thin, discontinuous lenses throughout the mafic volcanic pile and the metawacke-dominated sedimentary basins. For additional information and explanation of the supracrustal rocks see Azar (2016).

There are 2 sets of mafic intrusive rocks in the region. One set is considered synvolcanic and occurs as sills within the metavolcanic packages. These sills (unit 7) are metamorphosed to amphibolite facies and are geochemically equivalent to the mafic volcanic rocks. A second set of mafic intrusive rocks is syntectonic to posttectonic (unit 9), occurs throughout the map area and is less metamorphosed, as the rocks retain some primary mineralogy. Unit 7 and unit 9 mafic intrusive rocks have normal mid-ocean ridge basalt chemistry and a relatively flat chondrite normalized rare earth element (REE) pattern typical of mantle derived melts. The unit 9 mafic intrusions are dominantly mesocratic gabbro to norite, with more leucocratic and melanocratic enclaves. The best exposure of one of these layered mafic intrusions (unit 9) occurs on Abazotikichuan Lake (west map) and has an age of 2702.1±1.1 Ma (Kamo 2018), interpreted as the age of crystallization. A similar intrusion to the west of the west map on the shoreline of the Peninsular Lake yielded a similar age of 2702.1±0.7 Ma (Kamo 2018). Several geophysically interpreted smaller mafic to ultramafic intrusive bodies (unit 9) appear as oval to round-shaped bodies within the surrounding granitoids. In the east map, some of these units were drilled by Debut Diamonds in 2012, and were found to be primarily websterites, pyroxenites and hornblendites, although no mineralization was reported (Kleinboeck and Lavigne 2013).

Felsic to intermediate intrusions surround the greenstone belt and are subdivided into 3 map units (unit 8, unit 10 and unit 11). Synvolcanic to syntectonic intrusions (unit 8) are calc-alkalic and possess volcanic arc granite signatures (Pearce, Harris and Tindle 1984) and are mostly peraluminous (aluminous saturation index of 0.9 to 1.4, Shand 1943). At the northern end of the west map, a quartz monzodiorite to granodiorite that dominates the shoreline of the Albany River, has an age of 2740±4 Ma (Davis 2016, 2021; Azar and Rudolph 2018) indicating that it is synvolcanic. Multiple granitoid bodies (unit 10) are present in the western and southern parts of the map areas. These intrusions commonly contain relict greenstone belt stratigraphy as xenoliths and have intruded the more intensely deformed granitoids from unit 8. One unit 10 intrusion at Opichuan Lake has an age of 2706±3 Ma (Davis and Sutcliffe 2017). This age correlates to the Talbot Lake intrusion in the Keezhik Lake area (Buse and Hamilton 2012). The unnamed, oval-shaped, arc-derived, syntectonic to posttectonic granitic to granodioritic plutons of unit 10 occur along the north boundary of the map sheets. Lastly, a series of granitoid bodies (unit 11) occur along the southern part of the map area. Limited direct observations of these intrusions were made, but they are interpreted to be a part of the English River Subprovince and may represent stitching plutons along the boundary with the Uchi Suprovince. This boundary is not well defined or well studied in the area. No ages were obtained for these plutons. Late pegmatite dikes, considered part of unit 10, crosscut all map units, excluding units 11 and 12.

Three sets of Proterozoic mafic dikes are found in the map area (unit 12), but the 3 sets are not differentiated by unit code on the map. These dikes contain fresh clinopyroxene and are commonly magnetic. Buse and Hamilton (2012) determined the ages of 2 of the dike sets: *circa* 1883 Ma for the north-northwest-trending set, which is interpreted to be an extension of the Molson dike swarm; and *circa* 2102 Ma for the northeast-trending set, which is interpreted to part of the Marathon dike swarm. The northwest-trending dikes have been interpreted as part of the Paleoproterozoic Matachewan dike swarm. Local variations in the strike of mafic dikes occur where they intersect pre-existing faults.

STRUCTURAL GEOLOGY

Supracrustal rocks in the Makokibatan Lake area predominantly young toward the south. The supracrustal successions display a regional penetrative foliation trending parallel to the general stratigraphy striking east or west, steeply dipping to the north or south. Folding is characterized by regional, east-trending isoclinal folding expressed as isoclinal upright folds in outcrop. These dominant east-trending fold axes locally display other trajectories as a result of modifications brought about by later deformation events or pluton emplacement. Ductile shear zones are also present in the mapped area. These shear zones strike between 060° and 090°, parallel or subparallel to the regional foliation, are steeply dipping and up to 5 m wide. Shear sense indicators are rare; but, where identified, displayed both sinistral and dextral sense. Late faults are defined primarily by breaks in stratigraphy from geophysical imagery, and more rarely by direct observation. Where fault displacement is observable it is generally dextral.

LAKE SEDIMENT GEOCHEMISTRY

Sample locations from the Fort Hope lake sediment sampling program (Ontario Geological Survey 2001a, 2001b) are presented on the map face along with data values above the 90th percentile which highlight areas with anomalous chemical results. For brevity, only data for gold, copper, molybdenum, nickel and platinum (Au, Cu, Mo, Ni, and Pt, respectively) are shown on the map. All lake sediment sampling sites are shown on the map—even those sites with no anomalous results. Makokibatan Lake, Hebner Lake, Whitefish Lake and Harvey Lake all contain elevated copper (Cu) and/or nickel (Ni). Elevated copper and nickel were noted at many lakes south of Makokibatan Lake and in the western part of the west map area. More broadly, elevated zinc (Zn) is found predominantly in the northern extent of the map areas (west and east maps). Elevated gold (Au) was found locally within the metavolcanic rock or metasedimentary rock packages.

MINERAL POTENTIAL

Although exploration was conducted in the map areas between the 1930s and the 1980s, only a few mineralized occurrences have been identified. Assay samples, collected by Asarco Exploration in 1967, from a copper occurrence with greater than 5% observed chalcopyrite within a shear zone along Washi Lake, yielded 2.51% Cu (*see* occurrence 1 east map; Mason and White 1995). Within sheared mafic to intermediate metavolcanic rocks northwest of Washi Lake, core from a drill hole (W-69-2, drilled by Barringer Inc.) yielded elevated zinc (173 ppm and 157 ppm Zn) and copper (32 ppm and 94 ppm Cu) assays (*see* occurrence 2 east map). East-southeast of Frenchman's Rapids near Schist Lake (*see* occurrence 1 west map; Kidd 1965), core from a drill hole by F. Hoey in the 1960s contained a 60 cm intercept that recorded 0.51 ounces of gold per tonne within a zone of quartz stringers and veins with disseminated sulphides including pyrite, chalcopyrite and pyrrhotite. Subsequent re-assaying of the core in the 1980s yielded much lower values of 0.010 to 0.057 ounces of gold per tonne (Mason and White 1995). Other occurrences in the area that were documented in the Mineral Deposit Inventory (*see* "Occurrences", Ontario Geological Survey 2021) are discretionary occurrences; however, they could not be found by field party personnel.

During mapping, multiple samples were taken for assay. Assays of rock samples of mafic volcanic flows containing disseminated sulphides in the strongly folded rocks northwest of Makokibatan Lake yielded one sample with 1792 ppm Cu (west map). Sulphide-bearing quartz veins were noted in some metawacke on the north shoreline of Makokibatan Lake yielding 765 ppb Au and 2004 ppm Zn (east map). A sample retrieved within a strongly deformed mafic mesogabbro in granodiorite, along the northeast shoreline of Makokibatan Lake, contained 400 ppm Ni, which is highly anomalous for the region (east map). Molybdenite- and pyrite-bearing quartz veins were found north of Kagiami Falls following the west shoreline of the Albany River along the contact between some mafic metavolcanic rocks to the south and granodiorite to the north. One of these veins has molybdenum contents above 2000 ppm Mo (east map). Intensely pyrite-altered mafic pillowed flows on the eastern shoreline of Teabeau Lake have iron contents up to 21.5 wt % Fe (east map).

Based on anomalous gold values, the highest potential for mineralization within the Makokibatan Lake map area appears to be in shear zones with quartz–sulfide veining in supracrustal rocks. Furthermore, precious and base metals may be remobilized into map-scale fold hinges, such as those described in "Structural Geology". Mafic intrusions that were sampled did not show elevated nickel or copper but did contain pyrrhotite and minor pyrite. Because of limited outcrop exposure in the map area, geophysical methods, such as electromagnetic surveys, may be the only way to identify potential conductive base metal targets in the metavolcanic-dominated supracrustal packages.

Since much of the region is under thick overburden cover, it is also recommended that potential targets be identified using geophysical data, such as the Ontario Geological Survey's airborne geophysical (magnetic and electromagnetic) surveys (Ontario Geological Survey 2003a, 2003b).

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[a] *Marginal notes are shared between map sheets P.3843 and P.3844, Makokibatan Lake—West sheet and Makokibatan Lake—East sheet, respectively.*

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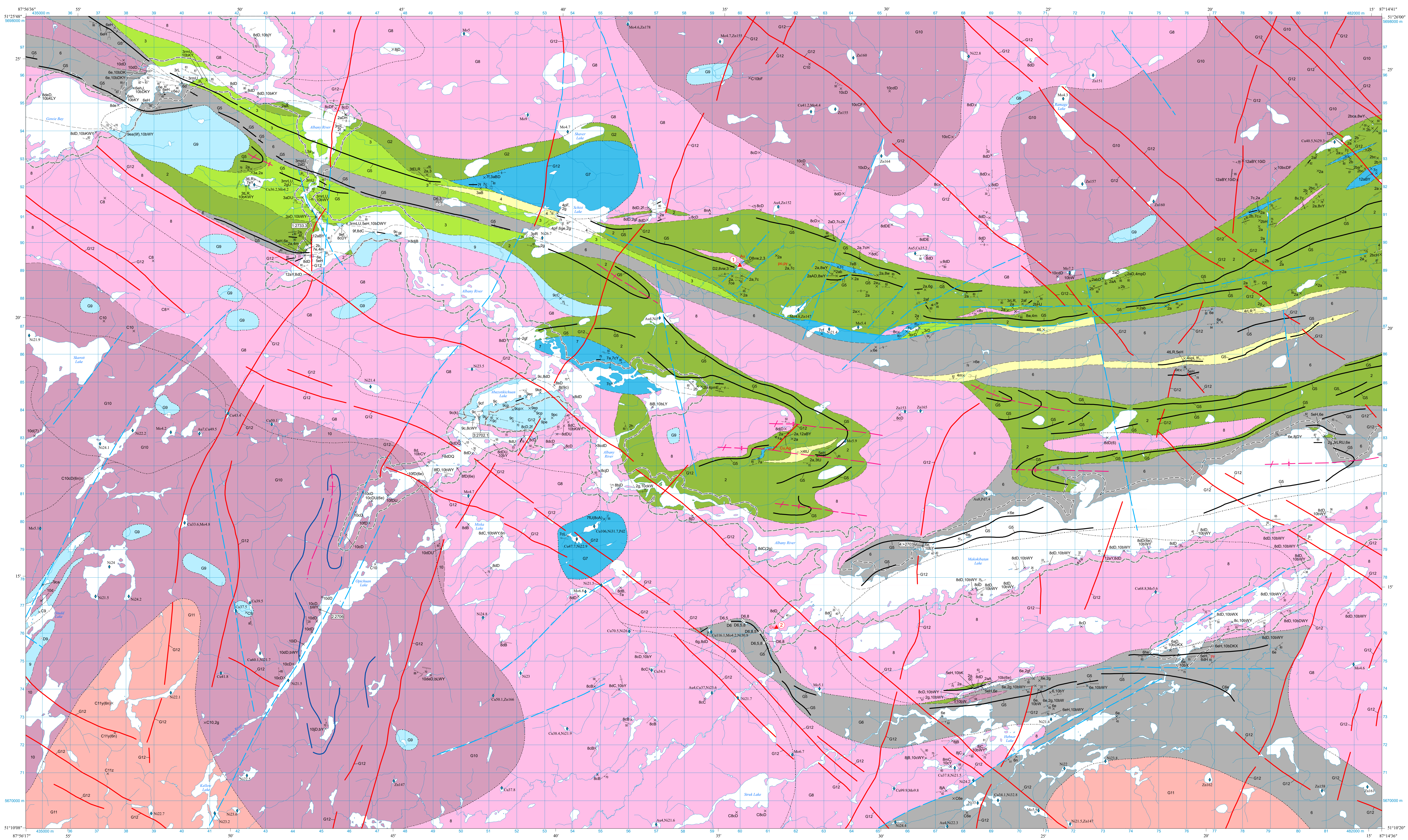

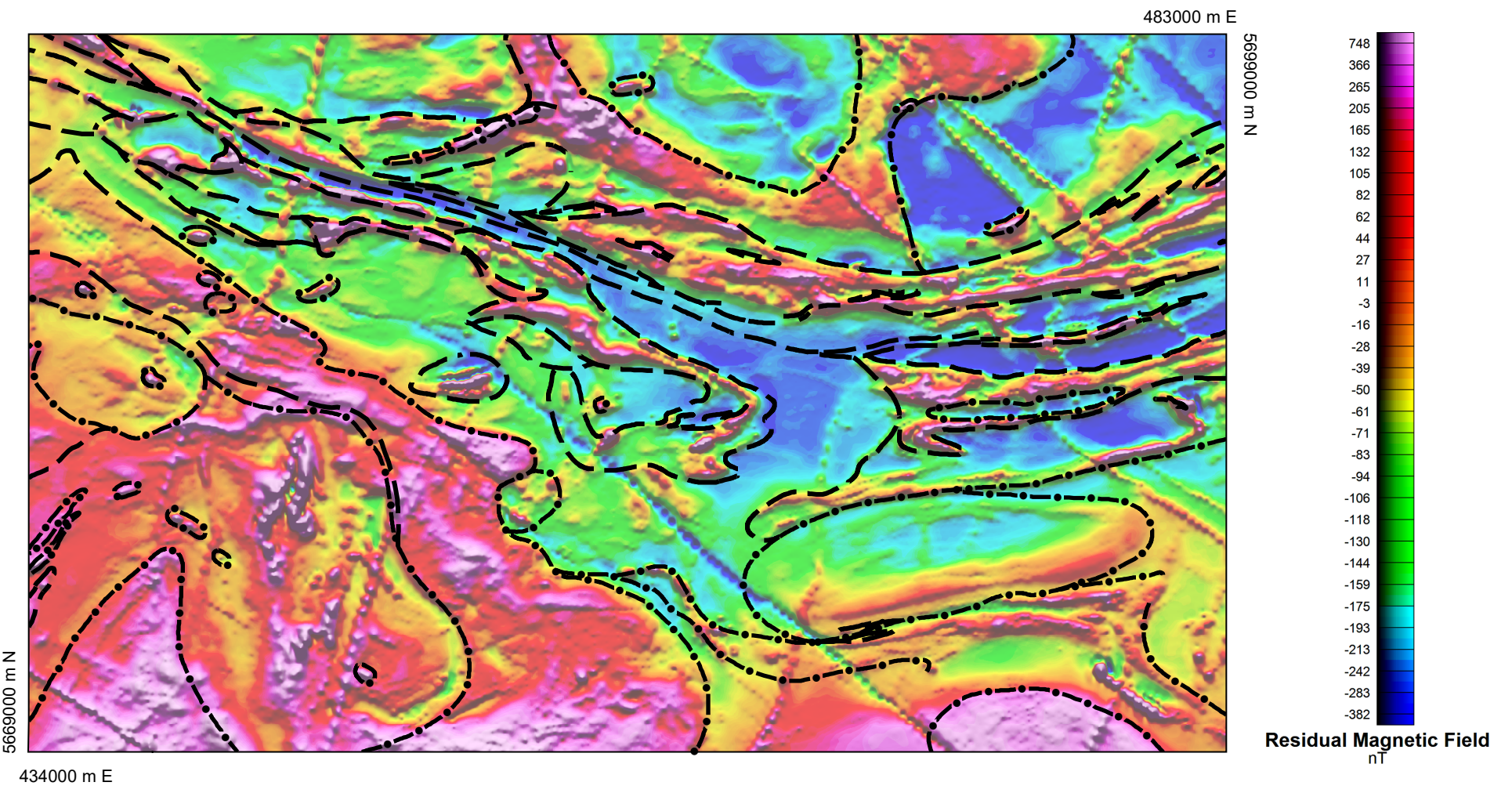

Figure 1. Map of the Makokibatan Lake area showing the total magnetic field with interpreted contacts as black lines, scale 1:250 000. Data *from* Ontario Geological Survey (2003a, 2003b).

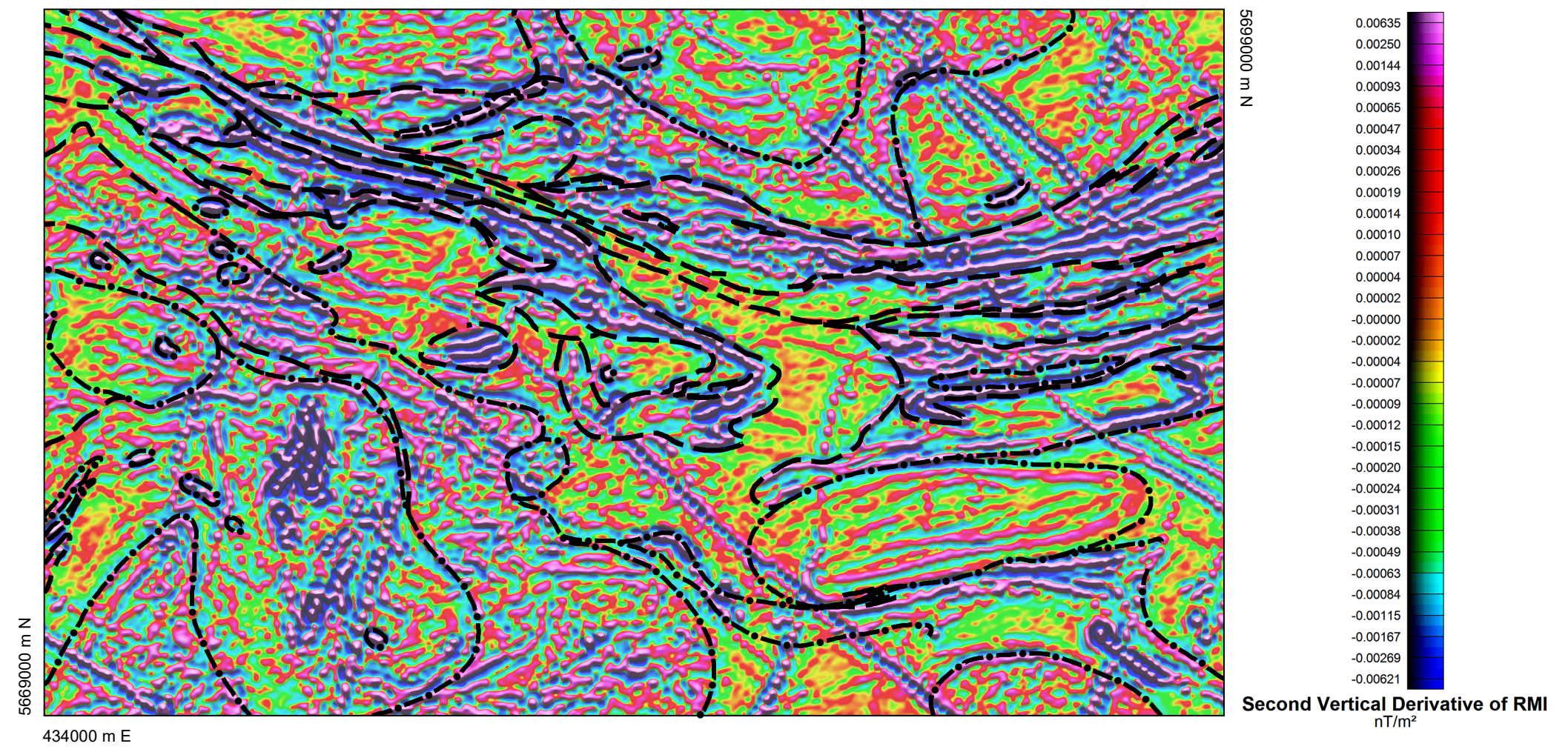

Figure 2. Map of the Makokibatan Lake area showing the calculated second vertical derivative of the residual magnetic field with interpreted contacts as black lines, scale 1:250 000. Data *from* Ontario Geological Survey (2003a, 2003b).

Table 1. Uranium–lead (U/Pb) geochronological data for samples collected in the Makokibatan Lake (west) area.

Number	Age (Ma)	Method[a]	Easting[b] (m)	Northing[b] (m)	Sample Number	Rock Type (map unit)	Interpretation	Source[c]
1	2733.3±1.0	ID-TIMS	444814	5690920	16OT011A	intermediate lava flow (3aD)	estimate of the age of eruption	1
2	2706±3	LA-ICP–MS	444947	5676858	16BA225	biotite monzogranite (10cD)	age of emplacement	2
3	2702.1±1.1	ID-TIMS	450649	5683746	16BA150	mesogabbro (9c)	age of emplacement	3
4	>2703±3	LA-ICP–MS	466563	5679126	16BA220	feldspathic wacke (6e)	maximum age of deposition	4

[a] *Abbreviations: ID-TIMS, isotopic dilution thermal ionization mass spectrometry; LA-ICP–MS, laser ablation inductively coupled plasma mass spectrometry.*

[b] *Location provided as UTM co-ordinates in North American Datum 1983 (NAD83), Zone 16N.*

[c] *Sources: 1 = this study: Kamo and Hamilton (2017); 2 = this study: Davis and Sutcliffe (2017); 3 = this study: Kamo (2018); 4 = Davis, Ménard and Sutcliffe (2018); all conducted at the Jack Satterly Geochronology Laboratory, University of Toronto.*

OCCURRENCES

Number on map face	MDI[a] Number	Name(s)	MDI Deposit Type	Primary Commodity	Easting (m)	Northing (m)
1	MDI42M05SE00002	Schist Lake Occurrence	Mineral Occurrence	Au	457158	5687585
2	MDI000000000111	GSC Map 56-1963 Copper Occurrence	Discretionary Mineral Occurrence	Cu	461299	5676238

[a] *Mineral occurrences in the study area, based on data from Ontario Geological Survey (2021), UTM co-ordinates are in NAD83, Zone 16N; however, discrepancies may occur in the location of these occurrences documented in the Mineral Deposit Inventory: users should verify location(s).*

Abbreviations: Ag, silver; Cu, copper MDI, Mineral Deposit Inventory.

LEGEND[abcdefg]

PHANEROZOIC

CENOZOIC

QUATERNARY

RECENT
Lake, stream and swamp deposits; areas of extensive drift through which geological contacts cannot be reliably extrapolated

PLEISTOCENE
Glacial, glaciofluvial and glaciolacustrine deposits; sand, gravel, clay, till

UNCONFORMITY

PRECAMBRIAN

PROTEROZOIC

12 **Proterozoic Mafic Intrusions**
12a Diabase

FEATURES
B Feldspar phenocrysts and/or megacrysts
Y Dike

INTRUSIVE CONTACT

ARCHEAN

NEOARCHEAN

11 **Late Tectonic Intermediate to Felsic Intrusive Rocks Associated with English River Subprovince: Peraluminous Intrusive Rocks**
11c Monzogranite
11y Inhomogenous metasedimentary diatexite (granite or pegmatite with 10 to 40% clastic inclusions)
11z Homogenous metasedimentary diatexite (massive, granite or pegmatite with <10% clastic inclusions)

FEATURES
C Biotite > amphibole
D Biotite only
E Magnetite bearing
Y Dike

INTRUSIVE CONTACT

10 **Syntectonic to Posttectonic Intermediate to Felsic Intrusive Rocks**
10a Alkali-feldspar granite
10b Syenogranite
10c Monzogranite
10d Granodiorite
10e Tonalite
10f Trondhjemite
10i Quartz monzonite
10j Trondhjemite
10k Quartz monzogabbro
10m Quartz diorite

FEATURES
B Amphibole > biotite
C Biotite > amphibole
D Biotite only
F Potassium feldspar porphyritic
K Muscovite bearing
L Garnet bearing
U Gneissic
W Pegmatitic
X Sill
Y Dike

INTRUSIVE CONTACT

9 **Synvolcanic to Syntectonic Mafic to Ultramafic Intrusive Rocks**

LITHOFACIES
9a Diorite
9c Gabbro
9e Leucogabbro (colour index <35%, light)
9f Melanogabbro (colour index >65%, dark)
9h Peridotite
9j Pyroxenite
9k Hornblendite
9p Gabbronorite (based on geochemistry)

TEXTURE, MINERALS
C Plagioclase porphyritic

INTRUSIVE CONTACT

8 **Synvolcanic to Syntectonic Intermediate to Felsic Intrusive**
8b Syenogranite
8c Monzogranite
8d Granodiorite
8e Tonalite
8f Trondhjemite
8i Quartz monzonite
8j Quartz monzodiorite
8m Quartz diorite
8n Quartz gabbro
8s Monzodiorite

PORPHYRY AND FELSITE INTRUSIONS
8v Quartz feldspar porphyry
8w Feldspar porphyry

TEXTURE, MINERALS
A Amphibole only
B Amphibole > biotite
C Biotite > amphibole
D Biotite only
F Potassium feldspar phenocrysts and/or megacrysts
G Plagioclase phenocrysts and/or megacrysts
Q Epidote alteration (>10% of rock)
U Gneissic
W Pegmatitic
Y Dike

INTRUSIVE CONTACT

7 **Synvolcanic to Syntectonic Mafic to Ultramafic Intrusive Rocks**

LITHOFACIES
7a Diorite
7b Quartz gabbro
7c Gabbro
7e Leucogabbro (colour index <35%, light)
7f Melanogabbro (colour index >65%, dark)
7p Gabbronorite (based on geochemistry)

TEXTURE, MINERALS
B Cumulate layering
E Glomeroporphyritic
H Actinolite
J Magnetite bearing
L Gneissic
U Garnet bearing
X Sill
Y Dike

INTRUSIVE CONTACT

6 **Clastic Metasedimentary Rocks**

LITHOFACIES
6a Quartz arenite
6c Lithic arenite
6d Quartz wacke
6e Feldspathic wacke
6g Siltstone
6h Mudstone
6n Metatexite (40 to 90% paleosome interlayered with granitic and pegmatitic leucosome)
6p Diatexite (10 to 40% paleosome interlayered with >60% granitic and pegmatitic leucosome)

FEATURES
D Subrounded to rounded clasts dominate
H Garnet bearing
J Staurolite bearing

UNCONFORMITY

5 **Chemical Metasedimentary Rocks**

LITHOFACIES
5d Sulphide ironstone
5e Silicate ironstone (amphibole bearing)

FEATURES
H Garnet bearing

4 **Felsic Metavolcanic Rocks**

LITHOFACIES
4a Massive flow
4f Dike

PYROCLASTIC DEPOSITS
4m Tuff (>80% fragments <2 mm)
4p Tuff-crystal
4r Lapilli-tuff (tuff and lapilli fragments)
4s Lapillistone (>80% fragments 2 to 64 mm)
4t Tuff-breccia (lapilli, blocks, tuff)

TEXTURE
D Feldspar phenocrysts and/or crystals
E Quartz phenocrysts and/or crystals
F Quartz and feldspar phenocrysts and/or crystals
L Monolithic
R Fragments more felsic than matrix
U Garnet bearing

3 **Intermediate Metavolcanic Rocks**

LITHOFACIES
3a Massive flow
3b Pillowed flow
3h Gneiss, derived from subunits 3a and 3b, medium to coarse grained

PYROCLASTIC DEPOSITS
3m Tuff (>80% fragments <2 mm)
3p Tuff-crystal
3r Lapilli-tuff (tuff and lapilli fragments)
3t Tuff-breccia (lapilli, blocks, tuff)

TEXTURE
B Amphibole phenocrysts and/or crystals
D Feldspar phenocrysts and/or crystals
E Quartz phenocrysts and/or crystals
H Quartz-filled amygdules
J Carbonate-filled amygdules
L Monolithic
R Fragments more felsic than matrix
U Garnet bearing

2 **Mafic Metavolcanic Rocks**

LITHOFACIES
2a Massive flow
2b Pillowed flow
2c Pillow fragment breccia
2f Dike
2g Amphibolite, derived from subunits 2a through 2f, medium to coarse grained, possibly after subvolcanic dikes in some areas
2h Gneiss, derived from subunits 2a through 2f, medium to coarse grained, possibly after subvolcanic dikes in some areas

FEATURES
A Gabbroic coarse flow or centre of flow
D Feldspar phenocrysts
G Amygdaloidal, vesicular
H Quartz-filled amygdules
J Carbonate-filled amygdules
U Garnet bearing

[a] *This legend is a field legend that incorporates the results of laboratory investigations, including petrography, geochronology and geochemistry. All Precambrian rocks have been subjected to regional metamorphism; many nonmetamorphic terms are used for the sake of brevity and where the protolith is established.*

[b] *The Precambrian legend is a lithotectonic one, and stratigraphic order is only in part implied by numerical order.*

[c] *The letter "C" preceding a code refers to data compiled from previous geological maps listed under "Sources of Information". Note that the location and shape of compiled outcrops may be less precise than those mapped by the authors.*

[d] *The letter "D" preceding a code refers to data compiled from drill hole databases listed under "Sources of Information". Note that the location may not be as precise for older drill holes; furthermore, drill hole logs were subject to interpretation by the authors.*

[e] *The letter "G" preceding a code refers to data interpreted from aeromagnetic geophysical surveys listed under "Sources of Information".*

[f] *Rock codes in parentheses "()" describe the xenoliths within the intrusive unit preceding the code.*

[g] *This legend is shared by Preliminary Maps P.3843 (Makokibatan Lake area—west sheet) and P.3844 (Makokibatan Lake area—east sheet), although not all rock types may be present on each map.*

SYMBOLS[a]

- Outcrop (observed)
- Geological contact (interpreted)
- Geological contact, based on interpretation of geophysical data
- Fault, unknown displacement, interpreted (trend only)
- Fault, dextral horizontal component, unknown generation, interpreted (trend only)
- Fault, sinistral horizonal component, unknown generation, interpreted (trend only)
- Antiform, unknown generation, interpreted (trend only)
- Synform, unknown generation, interpreted (trend only)
- Recumbent fold, unknown generation, interpreted (trend only)
- Magnetic lineament, interpreted as remnant stratigraphy after unit 6
- Bedding, unsubdivided, facing direction not known (inclined, vertical)
- Pillows with facing direction known (inclined, vertical, overturned)
- Bedding, flow top, facing direction known (overturned)
- Bedding, pyroclastic, facing direction known (overturned)
- Bedding, volcanic, facing direction not known (inclined)
- Foliation, unknown generation (trend only, magnitude of dip unknown, inclined, vertical)
- Gneissic banding, unknown generation (trend only, inclined)
- Fracture, unknown generation (inclined, vertical)
- Fracture, dextral displacement, unknown generation (inclined)
- Brittle fault, sinistral displacement, unknown generation (vertical)
- Ductile shear, unknown displacement (inclined, vertical)
- Ductile shear, dextral displacement (trend only, inclined, vertical)
- Ductile shear, sinistral displacement (inclined)
- Vein, unknown-type, unknown generation (inclined)
- Vein, shear-type, unknown generation (inclined, vertical)
- Vein, extension-type, unknown generation (trend only, inclined)
- Vein, foliation-type, unknown generation (inclined)
- Igneous contact, unsubdivided (trend only, inclined, vertical)
- Igneous contact, felsic dike (trend only, inclined, vertical)
- Igneous contact, mafic dike, corresponds to unit 2 (trend only, magnitude of dip unknown, inclined)
- Igneous contact, Proterozoic mafic dike, corresponds to unit 12 (trend only, inclined, vertical)
- Axial planes of fold, unknown asymmetry (inclined)
- Axial planes of fold, S-asymmetry (trend only, inclined, vertical)
- Axial planes of kink folds, S-asymmetry (trend only)
- Axial planes of kink folds, Z-asymmetry (trend only)
- Lineation, undefined, unknown generation
- Lineation, fold hinge, unknown asymmetry, unknown generation
- Lineation, fold hinge, S-asymmetry, unknown generation
- Lineation, fold hinge, Z-asymmetry, unknown generation
- Crenulation lineation, M-asymmetry, unknown generation
- Lineation, elongation, unknown generation
- Lineation, mineral, unknown generation
- Glacial striae (direction unknown, known)
- 2: 2706 Location of isotopic age determination in Ma (first number corresponds with Table 1)
- Ni21.4 Location of lake sediment sample with significant mineral content[b] (in ppm) (data from Ontario Geological Survey (2001a, 2001b).
- D6,8 Compiled drill hole data[c] *from* Ontario Geological Survey (2021b)
- 1 Au Mineral occurrence (number corresponds with "Occurrences" list)

[a] *This legend is shared by Preliminary Maps P.3843 (Makokibatan Lake area—west sheet) and P.3844 (Makokibatan Lake area—east sheet), although not all symbols may be present on each map.*

[b] *Only chemical data with anomalous values in the 90th percentile of results are presented and only for elements of economic interest, with the exception of palladium (Pd) which shows only anomalous values in 98th percentile of results.*

[c] *Only drill holes that intersected bedrock and provided bedrock descriptions have rock codes corresponding to the legend, some of the codes were based on interpretation of the drill hole logs by the authors.*

ABBREVIATIONS[ab]

Ag	silver
Au	gold
Cu	copper
Fe	iron
Mo	molybdenum
Ni	nickel
Pd	palladium
po	pyrrhotite
py	pyrite
Zn	zinc

[a] *This list of abbreviations is shared by all mapped areas and is common to both Preliminary Maps P.3843 and P.3844, although not all abbreviations may be present.*

[b] *Abbreviations in red indicate mineralization; abbreviations in black refer to elements reported for lake sediment analyses shown on the map face.*

Ontario

Ontario Geological Survey

MAP P.3843

PRECAMBRIAN GEOLOGY

MAKOKIBATAN LAKE AREA
FORT HOPE—MIMINISKA
GREENSTONE BELT
WEST SHEET

NORTHWESTERN ONTARIO

Scale 1:50 000
1000 m 0 1 2 km

NTS Reference: 42 M/3, 4, 5, 6

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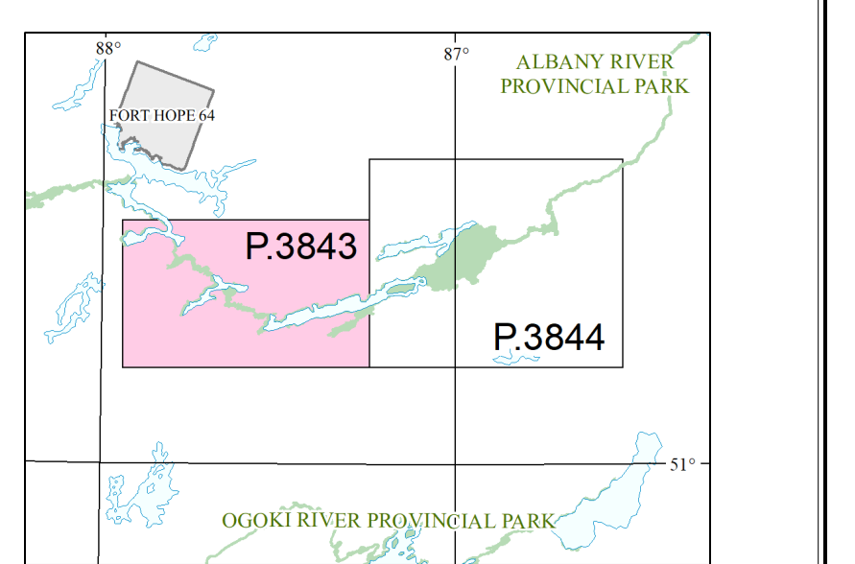

Location Map 1 cm equals 25 km

SOURCES OF INFORMATION

Digital base map information derived from the Land Information Ontario Data Warehouse, Land Information Ontario, Ministry of Natural Resources and Forestry, scale 1:50 000, with modifications by staff of the Ministry of Energy, Northern Development and Mines.

Mapping conducted using Universal Transverse Mercator (UTM) co-ordinates in North American Datum 1983 (NAD83), Zone 16.

Compiled geology, geochronology and geophysical interpretation derived from:

Azar, B. 2016. Preliminary results from geological mapping in the Makokibatan Lake area, Fort Hope–Miminiska greenstone belt, eastern Uchi Subprovince; *in* Summary of Field Work and Other Activities 2016, Ontario Geological Survey, Open File Report 6323, p.3-1 to 3-9.

Davis, D.W., Ménard, J. and Sutcliffe, C.N. 2018. U-Pb geochronology by LA-ICPMS in samples from northern Ontario; Part B - LA-ICP–MS Geochronology; internal report prepared for the Ontario Geological Survey, Jack Satterly Geochronology Laboratory, University of Toronto, Toronto, Ontario, 94p.

Davis, D.W. and Sutcliffe, C.N. 2017. U-Pb geochronology by LA-ICP–MS in samples from northern Ontario; internal report prepared for the Ontario Geological Survey, Jack Satterly Geochronology Laboratory, University of Toronto, Toronto, Ontario, 131p.

Hakimian, M. 2017. Geochemistry and petrogenesis of the Frenchman's Rapids and Kagiami Falls metavolcanic rocks in the Fort Hope greenstone belt, Uchi Subprovince; unpublished BSc thesis, University of Ottawa, Ottawa, Ontario 88p.

Kamo, S.L. 2018. Part A: Report on U-Pb ID-TIMS geochronology for the Ontario Geological Survey: Bedrock Mapping Projects, Ontario, Year 3: 2017–2018; internal report prepared for the Ontario Geological Survey, Jack Satterly Geochronology Laboratory, University of Toronto, Toronto, Ontario, 44p.

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——— 2001b. Lake sediment geochemical data (including Au, Pt and Pd) from the Fort Hope Area, Northern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 89.

——— 2003a. Ontario airborne geophysical surveys, magnetic and electromagnetic data, grid and vector data, Geosoft® format, Fort Hope area (Blocks 1, 2 and 3); Ontario Geological Survey, Geophysical Data Set 1109b.

——— 2003b. Ontario airborne geophysical surveys, magnetic and electromagnetic data, profile data, Geosoft® format, Fort Hope area (Blocks 1, 2 and 3); Ontario Geological Survey, Geophysical Data Set 1109d.

——— 2021. Mineral Deposit Inventory; Ontario Geological Survey, Mineral Deposit Inventory (February 2021 update), online database.

Prest, V.K. 1942. Eastern extension of the Fort Hope area, District of Kenora (Patricia Portion), Ontario; Ontario Department of Mines, Annual Report Map 51C, scale 1:253 440.

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Thurston, P.C. and Carter, M.W. 1969. Operation Fort Hope, Makokibatan–Melchett lakes sheet, districts of Kenora (Patricia Portion) and Thunder Bay; Ontario Department of Mines, Preliminary Map P.0565, scale 1:126 720.

Thurston, P.C. and Carter, M.W. 1970. Operation Fort Hope; Ontario Geological Survey, Miscellaneous Paper 42, 72p.

Thurston, P.C., Carter, M.W. and Riley, R.A. 1969. Operation Fort Hope, Attwood–Caribou lakes sheet, districts of Kenora (Patricia Portion) and Thunder Bay; Ontario Department of Mines, Preliminary Map P.0564, scale 1:126 720.

Geology is not tied to survey lines.

Magnetic declination for centre of map area, was approximately 5°51.6'W in 2021, and was calculated using the International Geomagnetic Reference Field (IGRF–13, version December 2019).

Metric conversion factor 1 foot = 0.3048 m.

CREDITS

Geological mapping by B. Azar and J. Bellrose with assistance from M. Hakimian and A. Brubacher in 2016. Geological mapping by B. Azar, K. Zammit and M. Hakimian with assistance from K. Ho and J. Redmond in 2017.

Preparation of geophysical imagery by D.R.B. Rainsford.

Digital drafting by B. Azar and J. Webb.

Cartographic production by J. Rose.

Corresponding digital data for this map area are available from the following Ontario Geological Survey publication:

Azar, B. 2021. Geological, geochemical and geophysical data related to the Makokibatan Lake area, Fort Hope–Miminiska greenstone belt, northwestern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 380.

Issued 2021.

Information from this publication may be quoted if credit is given. It is recommended that reference to this map be made in the following form.

Azar, B. and Bellrose, J.R. 2021. Precambrian geology of the Makokibatan Lake area, Fort Hope–Miminiska greenstone belt, northwestern Ontario—west sheet; Ontario Geological Survey, Preliminary Map P.3843, scale 1:50 000.

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