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Operation Superior: Multimedia Geochemical Survey Results from the Edmund Lake and Sharpe Lake Greenstone Belts, Northern Superior Province, Manitoba (NTS 53K)

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INTRODUCTION

In 1996 the Manitoba Geological Services Branch embarked upon a five year program of helicopter- and fixed wing-assisted multimedia geochemical sampling, designed to assist in the definition of exploration targets and the assessment of mineral resource potential in the northern Superior geological province. This initiative has been called Operation Superior and preliminary results for the area surveyed in 1996 were released in Fedikow *et al.* (1997a,b).

The application of belt-scale and regional geochemical surveys to relatively underexplored terrane has been extensively documented. Usually these surveys have utilized one or two sampling media, such as soil or rock, with generally positive results in reducing large tracts of ground to more localized areas of higher exploration prospectivity. Operation Superior belt-scale multimedia geochemical surveys specifically address the relatively underexplored Archean greenstone belts in the Superior province of northeastern Manitoba by systematically collecting rock, till, b-horizon soil, humus and vegetation samples from sample sites established at 1 km centers, within mapped boundaries of the greenstone belts. The results of surveys conducted in year two of this project are presented in this report, representing geochemical survey results for rock, till, b-horizon soil, humus, and vegetation and kimberlite indicator mineral survey results for diamonds, respectively.

One of the non-geochemical benefits of landing a helicopter every 1 km during sampling is the opportunity to make geological observations at outcrop sample sites and in areas of recent burn. Forest fires in 1988 and 1989 have exposed large areas of outcrop in the northern Superior Province that were covered with vegetation and/or soil. An excellent example of this benefit has been described in Fedikow *et al.,* (1997a, b) and Fedikow and Nielsen (1997), where an areally extensive, highly altered base and precious metal depositional environment was recognized.

A complimentary project was initiated by the Geological Survey of Canada, in 1996. In the federal government survey, which focussed on the predominantly intrusive geological terrane separating the greenstone belts, till samples were collected on a 40 km sample spacing to provide a regional framework for interpretation of the more detailed multimedia program. This survey was undertaken by Harvey Thorleifson of the Geological Survey of Canada and Gaywood Matile of the Manitoba Geological Services Branch and has been released as Open File Report OF97-3.

Historically, the commodity focus in Manitoba has focussed on base and precious metals with lesser interest in the pegmatite-hosted rare element deposits such as those at Bernic Lake. This multimedia geochemical survey is designed to address base and precious metals, pegmatite and carbonatite-hosted rare element deposits as well as diamonds. The approach is to collect a variety of sample media at each site and analyze these samples in a multi-element manner using the most advanced technological instrumentation and innovative digestion techniques available. Instrumental neutron activation, (INA) inductively coupled plasma-atomic emission spectrometry (ICP-AES) and inductively coupled plasma-mass spectrometry (ICP-MS) are the main analytical techniques chosen for this purpose. Additionally, pH and conductivity measurements, converted to H^+ and specific conductance respectively, represent water-extractable components in rock, b-horizon soil and humus samples and are also examined in this survey. The pH measurements were done using a VWR model 8000 pH meter with a Ross #8165 BN Combination pH electrode. Conductivity was measured with an Orion model 125 conductivity meter with an Orion #011020 glass conductivity cell.

The enzyme leach selective extraction has once again been applied to b-horizon soil samples in this survey. This approach utilizes a phase-specific dissolution that liberates metals adsorbed onto the amorphous Mn-oxide coatings of individual mineral grains in the b-horizon. The leachate is analyzed using ICP-MS, and element concentrations are reported at parts per billion concentration levels. Because of the relatively thick cover of surficial deposits in this year's study area and the successful application of this technique in year one of the project, this year b-horizon soils were only analysed using enzyme leach-ICP-MS technology.

An unique opportunity to assess the diamond potential for the Superior Province in Manitoba has been extended by cooperative efforts with MONOPROS Ltd. Eleven litre pails of till collected at each sampling site were concentrated, mineralogically picked and microprobed to provide mineral chemistry for classification purposes. Sample locations were withheld until release of the open file report to ensure equal opportunities for follow-up by all interested parties in the exploration community. This approach permitted diamond potential to be assessed in the 1997 survey area. Under normal circumstances the kimberlite indicator mineral survey would have been too costly for the Geological Services Branch to undertake.

In another beneficial cooperative arrangement with the Geological Survey of Canada, crown twig samples collected from black spruce trees were ashed in the GSC laboratories under the direct supervision of Dr. Colin Dunn. The opportunity to prepare vegetation geochemical samples with good control on ashing temperatures and contamination and to bracket analyses with vegetation geochemical standards prepared in these same laboratories, has resulted in the development of a well constrained vegetation geochemical database.

The element Hg was analysed in outcrop rock chip and humus samples as a specialty element. The analysis was undertaken at Activation Laboratories Ltd. (Ancaster, Ontario) using a flow injection mercury system designed by Perkin Elmer Ltd. Till was analyzed for Hg by cold vapour – atomic absorption spectrometry (AAS).

The interpretation of exploration geochemical data often relies upon the recognition of localized patterns of element variation. This approach to data interpretation is strongly recommended for the data presented from the 1997 Operation Superior multimedia geochemical survey.

The format of this years (1998) multimedia geochemical survey report has been significantly modified from that produced in 1997. Data and preliminary interpretations for results from each of the sampling media are included in one binder. This was achieved by producing element-and media-specific percentile bubble plots for both the Edmund Lake and Sharpe Lake belts (NTS 53K) on the same page. This significantly reduces hardcopy volume. Finally, all text and graphical data is presented on CD-ROM for ease of computer applications. The design and construction of the CD-ROM was undertaken by Paul Lenton of the Geological Services Branch.

METHODOLOGY

Multimedia geochemical samples were collected on approximately 1 km centres or as dictated by access to landing sites using a float equipped helicopter (Bell Jet Ranger 206B). The procedure at each site was to establish by way of hand augering, the location from which a till sample was to be collected. All other samples were collected in and around the immediate area of the till pit. Sample site locations were plotted on airphotos while viewing the sites from the helicopter subsequent to sample collection.

The specifics of sample collection, preparation and analyses, including data and derived products are described individually for each media type.

DATA DISPLAY

Geochemical data for all sample types are presented in table format with site identification and UTM coordinates. This same data is presented as delimited ASCII and EXCEL 4.0 files on CD-ROM in the back of this report. The variation in concentration of the various elements throughout the survey areas is presented as percentile intervals bubble plots produced using MAPINFO GIS software, digitized sample locations and analytical data. Percentile values represent the percentage of data points that fall below a certain analytical value; e.g. a 25^{th} percentile value of 30 ppm Cu indicates that 25% of the data points have values for Cu that are less than 30 ppm. Likewise, at a 95^{th} percentile value of 200 ppb Cu, only 5% of the data points would have values in excess of 200 ppm. Geochemical data from the Edmund Lake and Sharpe Lake greenstone belts is presented separately on the percentile bubble plots. This was done to preserve any geochemical characteristics in the datasets attributable to geological variations between the belts and variable metal assemblages in the mineralized zones.

This graphical display is a preliminary attempt to identify areas of high metal contents and thereby reduce the large areas surveyed to smaller areas for follow-up work. Although for any given area and sample media the number of samples may be low for the calculation of percentiles, the user can still quickly assess geochemical response by examining non-transformed geochemical data. Users can manipulate the geochemical data in the manner they feel appropriate to their needs by accessing the data on CD ROM. Elements consistently below the Lower Limit of Detection (LLD) have been excluded from the data tables and are not discussed further. Samples with concentrations below the LLD for any particular element are marked by a "<" symbol. For all plotting purposes a value of ½ of the LLD was substituted for a value below the LLD. For brevity and simplicity in the graphical display of geochemical data only total REE is plotted for rock, humus and vegetation data. Concentrations for individual REE are presented in the Appendices.

Users will note that the boundaries of the greenstone belts as well as simplified geology are presented on the percentile bubble plots. This was accomplished using a digital version of the 1:1 000 000 bedrock map of the province (Map 79-2) and the geological map of Corkery *et. al.,* (1997a), respectively. Field sampling targets were located using the 1:250 000 Bedrock Geology Compilation Map Series maps for NTS 53K. UTM coordinates for sample sites are accurately derived from 1:50 000 topographic maps.

Mylar sample site location map overlays are provided to enable sample numbers to be derived by overlaying on the bubble plots.

BEDROCK GEOLOGY AND MINERAL DEPOSITS OF THE 1997 SURVEY AREAS

Multimedia geochemical and mineralogical surveys were conducted in the Edmund Lake and Sharpe Lake greenstone belts in 1997 (Figure 1). Simplified regional geology and mineral deposits in the survey area are presented in Figure 2. A sample site location map for these two belts is presented in Figure 3a and a mylar overlay in Figure 3b. The Edmund Lake belt in Manitoba extends from the Manitoba-Ontario border northwest to Edmund Lake for approximately 60 km. The Sharpe Lake belt trends east-west from the provincial boundary and was sampled as far west as the south shore of Webber Lake, a distance of approximately 90 km.

Edmund Lake Belt

Previous geological mapping in the Edmund Lake belt was undertaken by Downie (1937) at a scale of 1:250 000 and a reconnaissance map of the Little Stull Lake area was produced by Corkery (1989). Corkery (1981) provided preliminary geological characteristics in the Little Stull Lake area. Most recently, geological mapping in the belt has been undertaken by Corkery (1996a, b) and Corkery *et al.,* (1997a, b), as part of a larger geological initiative designed to critically assess mineral potential in Superior Province greenstone belts in Manitoba through lithologic, geochemical, structural and geochronological studies.

In the Edmund Lake – Margaret Lake area, the supracrustal belt forms a west-thinning, east-plunging homocline flanked by tonalite and granite terranes to the north and south. Lithologically, this portion of the belt is characterized by pillowed and massive basalt flows of the Hayes River Group (Downie, 1938). Gabbro and felsic dykes intrude the basalts. A 310^{o} trending shear zone ("Wolf Bay Shear Zone" or WBSZ) transects the greenstone belt from the Manitoba-Ontario border. This deformation zone divides the belt into a northern and southern series of basalts. The northern edge of the Shear zone is marked by felsic and mafic volcaniclastic rocks, iron formation and sedimentary rocks (Corkery, 1996a) that were assigned to the Oxford Group by Downie (1938). Corkery (1996a) notes the presence of numerous rusty weathered zones in these units as well as within the Wolf Bay Shear Zone. A sample of silicified mafic tectonite from the north shore of Edmund Lake assayed 50 ppb Au (Corkery, 1996a). Preliminary map 1996S-1 (Corkery, 1996b) at a scale of 1:20 000 presents the geological characteristics of this portion of the Edmund Lake belt and geological descriptions of individual lithologies are presented in Corkery (1996a).

A slight to moderate deflection of the WBSZ occurs approximately midway between the west end of Little Stull Lake and the east end of Margaret Lake. This deflection is characterized by a slight bend to a more westerly trend from its overall northwest-southeast attitude. This area is marked by a number of small lakes possibly occupying topographic depressions formed by the development of a dilational zone subsequent to right lateral movement along the WBSZ (Tim Corkery, pers. comm.).

Southeast of Edmund and Margaret Lakes, in the Little Stull Lake area, detailed mapping by Corkery *et al.,* (1997a, b) has delineated 4 lithologically discrete structural panels. Each panel is characterized by a distinctive supracrustal assemblage and is in fault contact with adjacent panels. These panels, from south to north, comprise the following assemblages: 1) basalt and associated gabbro intrusions; 2) subaerial sandstone and conglomerate; 3) intermediate to felsic tuff, breccias, associated volcaniclastic and epiclastic rocks; and 4) basalt. Some panels can be traced northwestwards to the Edmund Lake area. Panels 1 and 4 are interpreted to represent Hayes River Group, Panel 2 is assigned to the sedimentary subgroup of the Oxford Lake Group and Panel 3 represents the volcanic subgroup of the Oxford Lake Group. A 77 m.y. time span between the deposition of the volcanic and sedimentary subgroups of the Oxford Lake Group is inferred on the basis of geochronological studies by Davis and Moore (1991) and Heaman (pers. comm., 1997 in Corkery *et al.,* 1997a). The Little Stull Lake gold deposits that occur in this portion of the belt are associated with the Wolf Bay Shear Zone (WBSZ). This zone is developed within mafic volcanic flows and gabbroic synvolcanic intrusions of Panel 1. Details of these gold deposits are presented in a subsequent section. Recent geological mapping in the Little Stull Lake area has identified a quartz-feldspar porphyritic felsic intrusion at the northwest end of the lake. The western portion of this intrusion is altered to a sericite-pyrite assemblage. The metallogenetic significance of this late stage felsic intrusion as a heat engine and/or a metal source for the Little Stull Lake gold deposits is uncertain. Cutforth and Petak (1977) describe occurrences of barren sulphide mineralization in exposed areas of the belt.

Details of the individual lithologies and structures within the 4 lithostructural panels are available in Corkery *et al.,* (1997a). These observations are depicted by Corkery *et al.,* (1997b) in a 1:20 000 preliminary map of the area.

Sharpe Lake Belt

The geological database for this greenstone belt is sparce. Downie (1936) mapped the Stull Lake area, including the Sharpe Lake belt, at a scale of 1 inch to 4 miles and the marginal notes that accompany these maps represent the bulk of the descriptive geological information presented here. Some details of the western portion of the belt from Webber Lake to Sharpe Lake were acquired from Marten (1973).

At the eastern most end of this belt in Manitoba, Downie (1936) mapped Hayes River Group felsic to mafic volcanic rocks with interbedded slate, quartzite and iron formation. Oxford Group sedimentary rocks, however, predominate over Hayes River Group volcanic rocks in this area. These sedimentary rocks include conglomerate, arkose, greywacke, slate, quartzite, chert and garnetiferous schist. Corkery *et al.,* (1997) modified map 451A (Downie, 1936) by subdividing the Oxford Lake Group into a more northerly Volcanic Subgroup, represented by a west-thinning wedge of volcanic rocks that terminates just west of the Twin Lakes area, and a Sedimentary Subgroup.

The remainder of the belt, sampled in 1997, is described by Downie (1936) on Map 452A as predominantly Hayes River Group volcanic rocks. At Webber Lake, porphyritic rhyolite is described as the characteristic rock type. Locally the flows have been sheared to form “talcose sericite schists, well mineralized with pyrite”.

Marten (1973b) reported highly deformed supracrustal rocks in the Webber Lake area as consisting predominantly of fine grained schistose amphibolite and flattened pillow basalt. Strongly cleaved quartz porphyry and felsite units up to 15m thick are interpreted as intrusions. Marten (1973) also notes ultramafic intrusions and four gabbroic dykes, up to 80m thick, in the Webber Lake – Sharpe Lake portion of the belt.

Cutforth and Petak (1977) briefly describe the geology of this belt and note the presence of several small gossans in the nose of a fold developed in greywacke in the Sharpe Lake area. Graphitic and sulphidic iron formations, sparsely mineralized with chalcopyrite and sphalerite, are also mentioned from the Webber Lake area.

Mineral Deposits

Significant mineralized zones in the 1997 survey area are represented by the Twin Lakes and Seeber River gold deposits in the Sharpe Lake belt and the Little Stull Lake gold deposits in the Edmund Lake belt (Fig. 3a). The following descriptions of these deposits are taken from Richardson and Ostry (1996), the most current literature available.

Sharpe Lake Belt

Twin Lakes Au Deposits

This gold deposit contains estimated preliminary reserves ("geological" reserves) of 2.45 million tonnes grading 2.5 g/tonne in the "A" Zone and 472 000 tonnes grading 14.3 g/tonne in the "B" Zone.

Mineralization consists of sericitized and silicified felsic to intermediate, massive and fragmental volcanic rocks with pyrite and arsenopyrite. The gold zones are discontinuous high grade auriferous shoots encompassed by a large tonnage, low grade mineralized envelope. High grade intersections occur within massive, blue-grey quartz veins. B Zone high grade mineralization ranges from 6.73 to 24.16 g/tonne over 1.4 to 3.4 m. Low grade intersections range from 0.48 to 3.06 g/tonne over true widths of 2.0 to 34.0 m.

Seeber River Au Deposit (C Zone)

This deposit is hosted by silicified and sericitized felsic volcanic rocks with arsenopyrite and pyrite and consists of a large, low grade mineralized zone (0.46 to 2.24 g/tonne over true widths of 4.0 to 52.0 m) with higher grade (5.9 to 16.4 g/tonne over 3.0 to 6.7 m) intersections contained within it. The Seeber River C Zone contains 590 000 tonnes grading 9 g/tonne.

The Twin Lakes and Seeber River Au deposits occur within the east-west trending Twin Lakes-Monument Bay deformation zone that has been traced for 30 km. The known deposits have been delineated over a 3.5 km portion of this deformation zone at depths ranging from 20 to 460 m. Recent diamond drilling along the deformation zone approximately 1100 m west of the Seeber River deposit intersected 96 g/tonne Au over 2.9 m. This intersection strongly suggests that highly prospective nature of this deformation zone and its excellent residual exploration potential.

Edmund Lake Belt

Little Stull Lake Au Deposits

The Little Stull Lake gold deposits comprise 5 mineralized zones developed within an 8 km long structure that has been named the “Little Stull Break”. From southeast to northwest these are the Beaver Lodge, Rocky, Central, West and Otter Zones, (Fig. 4). Collectively, these zones comprise 750 000 tonnes grading 9.3 g/tonne.

The Little Stull Break forms part of the much larger Wolf Bay shear zone identified by Corkery (1996b). This shear zone is traced from Edmund Lake in the west, through Margaret Lake along the south shore of Little Stull Lake and on to the east end of Rapson Bay on Stull Lake (Figure 2). Mylonites and phylonites are developed within the zone as well as the interleaving of numerous rock types. Corkery (1996b) documents dextral kinematic indicators with strike slip movement and south side up based on shallow southeast to horizontal lineations. The structure appears to be developed at or near the contact between Hayes River Group mafic volcanic rocks and Oxford Lake Group sedimentary rocks.

Corkery (1997a) delineates the structural and alteration characteristics that are apparent in the area of the Little Stull Lake gold deposits. These include: 1) the deformation of mesogabbro by 310º trending mylonite; 2) significant albitization and silification of the sheared gabbro; 3) the filling of a closely spaced 340º-350º trending dilatational fracture cleavage, that is associated with the 310º shearing, by quartz and carbonate; and 4) sulphidization of the phylonites to produce variable amounts of pyrite.

These events are indicative of a protracted structural and alteration history responsible for suitable ground preparation for the formation of these deposits.

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QUATERNARY GEOLOGY OF THE 1997 SURVEY AREAS

Stratigraphy

Large parts of the Edmund Lake-Sharpe Lake greenstone terrane is flat and monotonous with extensive wetlands and relatively few rock outcrops; exceptions being near the western ends of the belts around Edmund Lake and Sharpe Lake where rock outcrops are common. The sparse distribution of till samples (see till geochemistry maps) gives some appreciation of the wide distribution of fen and bog, which hindered sampling in the area. Wetland areas are particularly extensive in the areas east of Margaret Lake, west of Kistigan and Little Stull lakes and between Monument Bay and Twin Lakes where few till samples were collected. As a consequence of the flat terrane, observations on the Quaternary stratigraphy were limited to hand-dug pits.

The Quaternary stratigraphy as revealed from hand-dug pits consists of a single till sheet and an extensive blanket of fine grained glaciolacustrine silt and clay. Extensive wetlands, which are wide spread throughout the area, are underlain by fine textured glaciolacustrine sediments that also drape most of the surrounding hills, in places forming an impenetrable obstacle to sampling the underlying till from hand-dug pits. The extensive wetlands and the widespread glaciolacustrine sediments are the greatest impediments to till sampling from hand-dug pits in the area.

The landscape of the area is dominated by the Sachigo Interlobate Moraine, which forms a large and very prominent south trending ridge along the east side of Little Stull Lake and Kistigan Lake. The 150 km long moraine formed between the eastern margin of the large ice lobe that occupied northeastern Manitoba and an equally large ice lobe situated in northwestern Ontario, during the latter part of the Wisconsinan. In the Kistigan-Little Stull Lakes area, the moraine appears to be composed of silt and fine sand giving rise to the sandy beaches and arcuate shorelines on the east side of those lakes. Further south in Ontario, the moraine is composed of sand and coarse gravel. The four eskers crossing the area are relatively narrow and are generally not an impediment to regional till sampling other than perhaps at the east end of Little Stull Lake, where a southeast trending esker crosses the greenstone belt before joining the Sachigo Moraine in Ontario. A southerly trending esker occurs at the east end of Edmund Lake and two south southwesterly trending eskers are found where the Red Sucker River enters Sharpe Lake and at Webber Lake.

The till is gray to beige, massive and sandy to silty similar to the till previously described in other parts of the northern Superior Province (Fedikow *et al.,* 1997, Matile and Thorleifson 1997). In bedrock-dominated terrain the till forms thick accumulations of lee-side till, down ice from bedrock obstructions, but also commonly occurs as drumlins or drumlinoid ridges tens of metres high and several kilometres long. A large proportion of the till is allochthonous having been derived from the Paleozoic carbonate terrain of the Hudson Bay Lowland. Paleozoic carbonate, Proterozoic Omarolluk greywacke and iron formation erratics derived from the Hudson Bay Lowland are common constituents of the till throughout the area. Matile and Thorleifson (1997) indicate the till matrix (<63 micron) in this area is composed of approximately 20% calcite and 20 % dolomite whereas the pebble fraction (8-16 mm) is about 45-69 % distantly traveled carbonate. Other erratics including distinctive granites, rhyolites, dacites, a variety of arkoses and conglomerates and quartzite's from various sources in northern Manitoba, Keewatin and eastern Hudson Bay further testify to the allochthonous character of the till.

Ice Flow Direction

Glacial striae recorded at twelve sites in the Edmund Lake belt ranged between 176° and 198° whereas striae at fourteen sites in the Sharpe Lake belt ranged between 179° and 227°. The more southerly and south southeasterly striae were found at the eastern end of both belts. Towards the west the orientation gradually changes to become more southwesterly. Older striae towards 250° and 280° were recorded at two sites and T. Corkery (pers. comm. 1997) observed older striae trending 225° cut by younger striae at 176° in Little Stull Lake. The older striae testify to an earlier westerly ice flow, which is believed to have had little impact on the observed glacial dispersal pattern recorded by the dominant striae direction and till composition.

The orientation of drumlins and drumlinoid ridges is similar to the orientations recorded by the glacial striae. Drumlins in the Margaret Lake-Little Stull Lake-Monument Bay area trend towards 175°. At the west end of the belts, in the Barclay Lake-Webber Lake area, drumlins are orientated towards 200° and south of the west end of Edmund Lake towards 195°. In the area near the center of the belts, such as immediately west of Makataysip Lake, drumlins are orientated towards 185°.

TARGET AREAS FOR MULTI-MEDIA GEOCHEMICAL SAMPLING

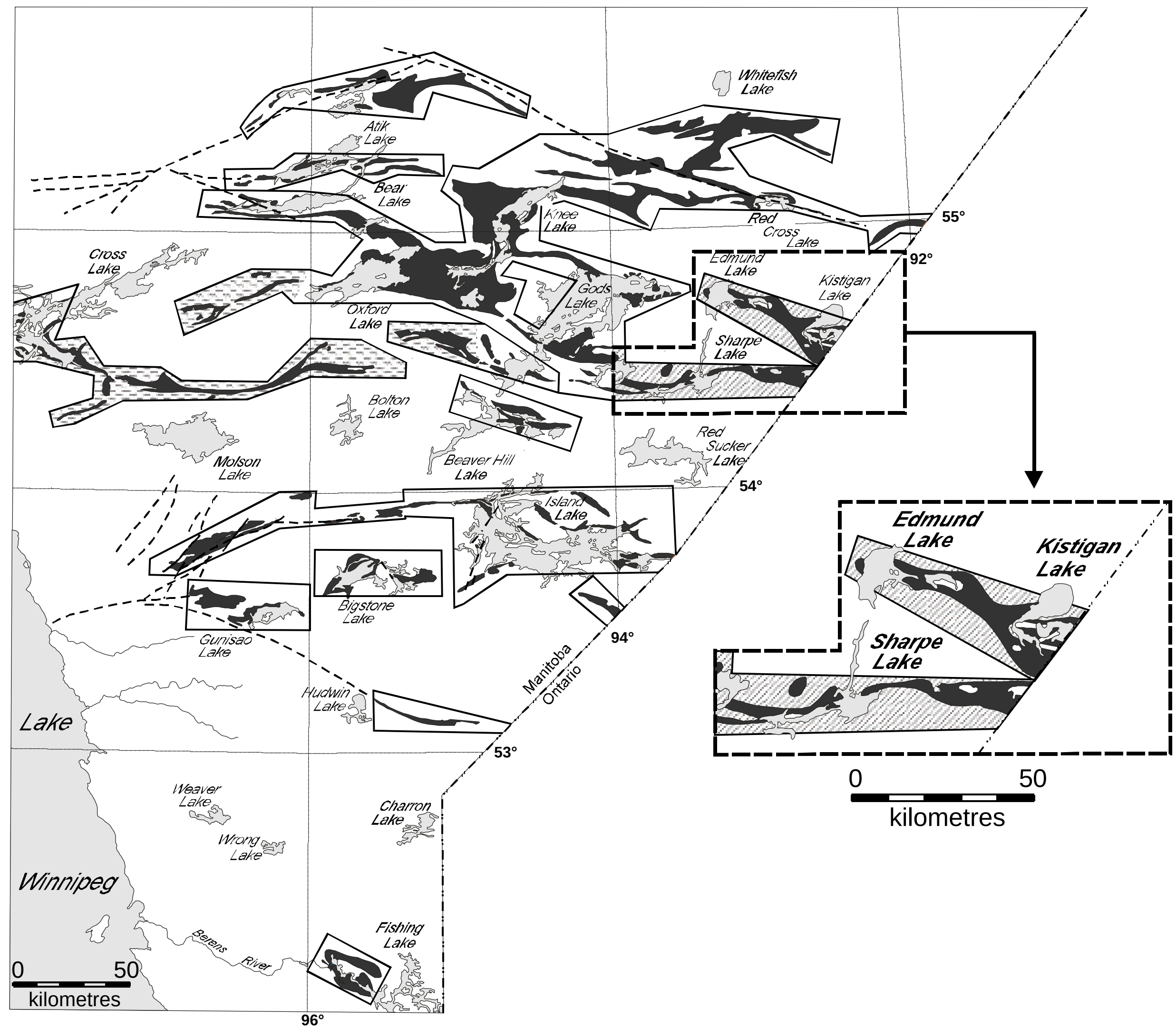
1997 Multi-media geochemical surveys

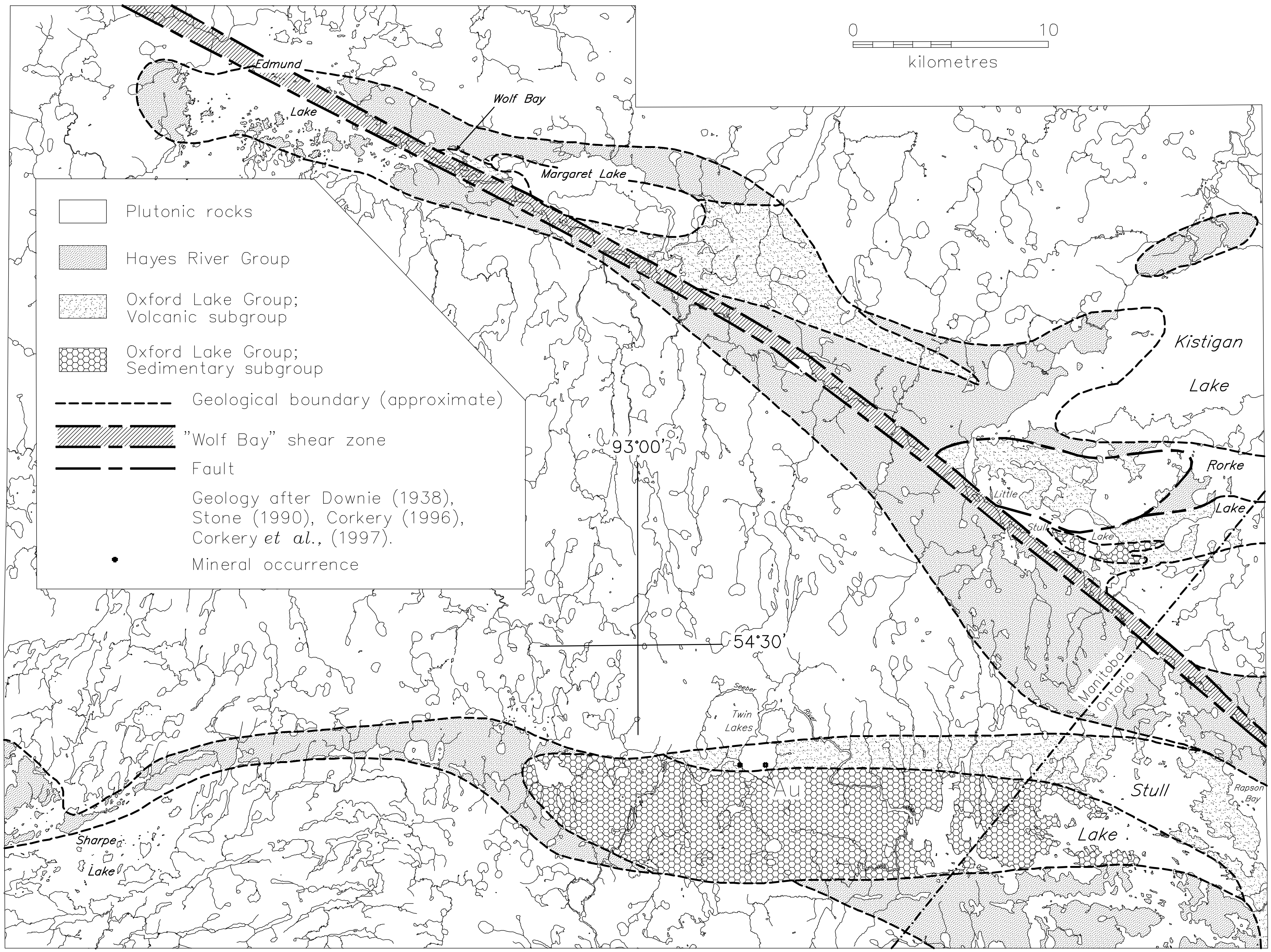
1996 Multi-media geochemical surveys

Limits of greenstone, gabbro/sediment belts

Proposed survey boundary

Faults

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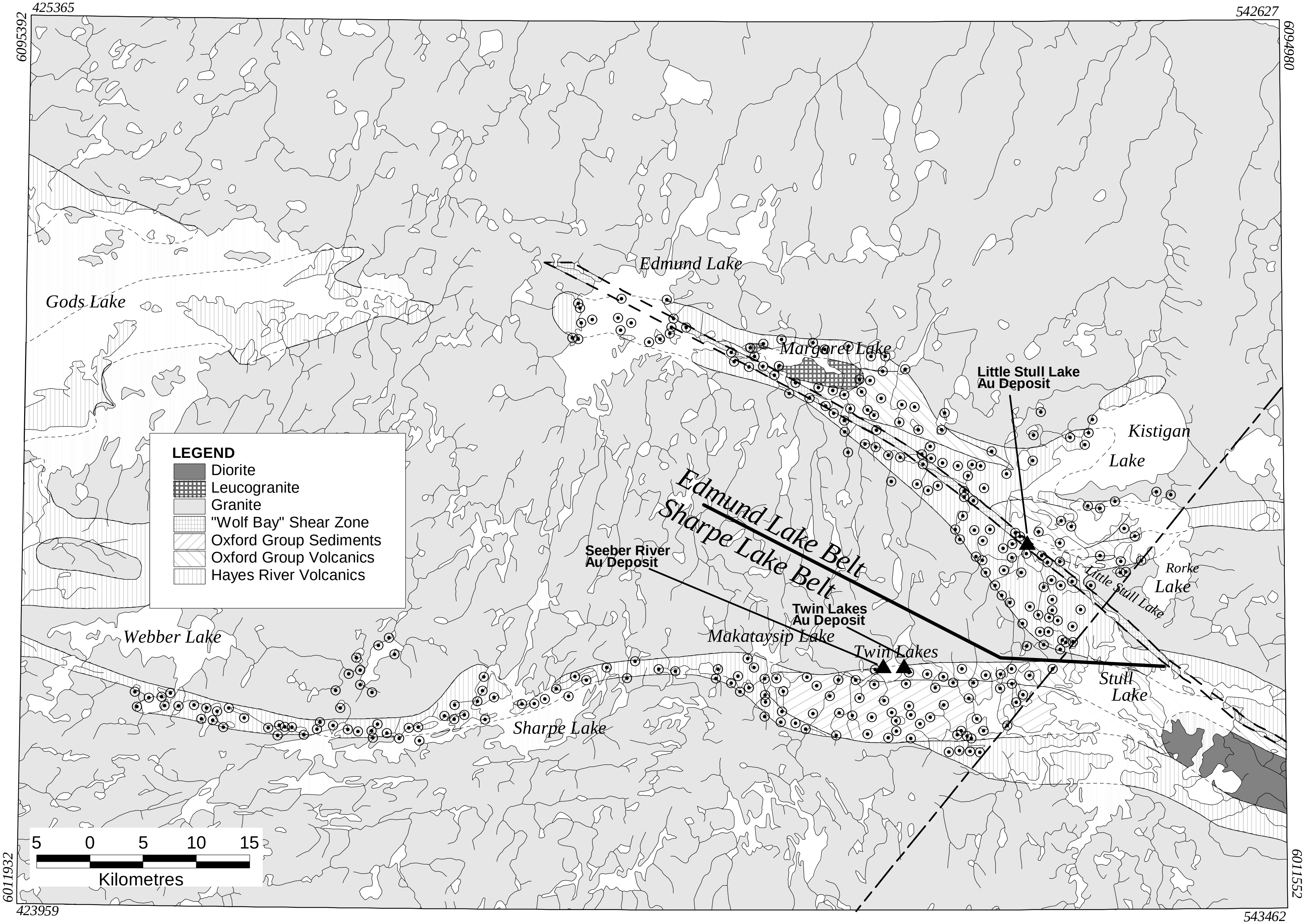
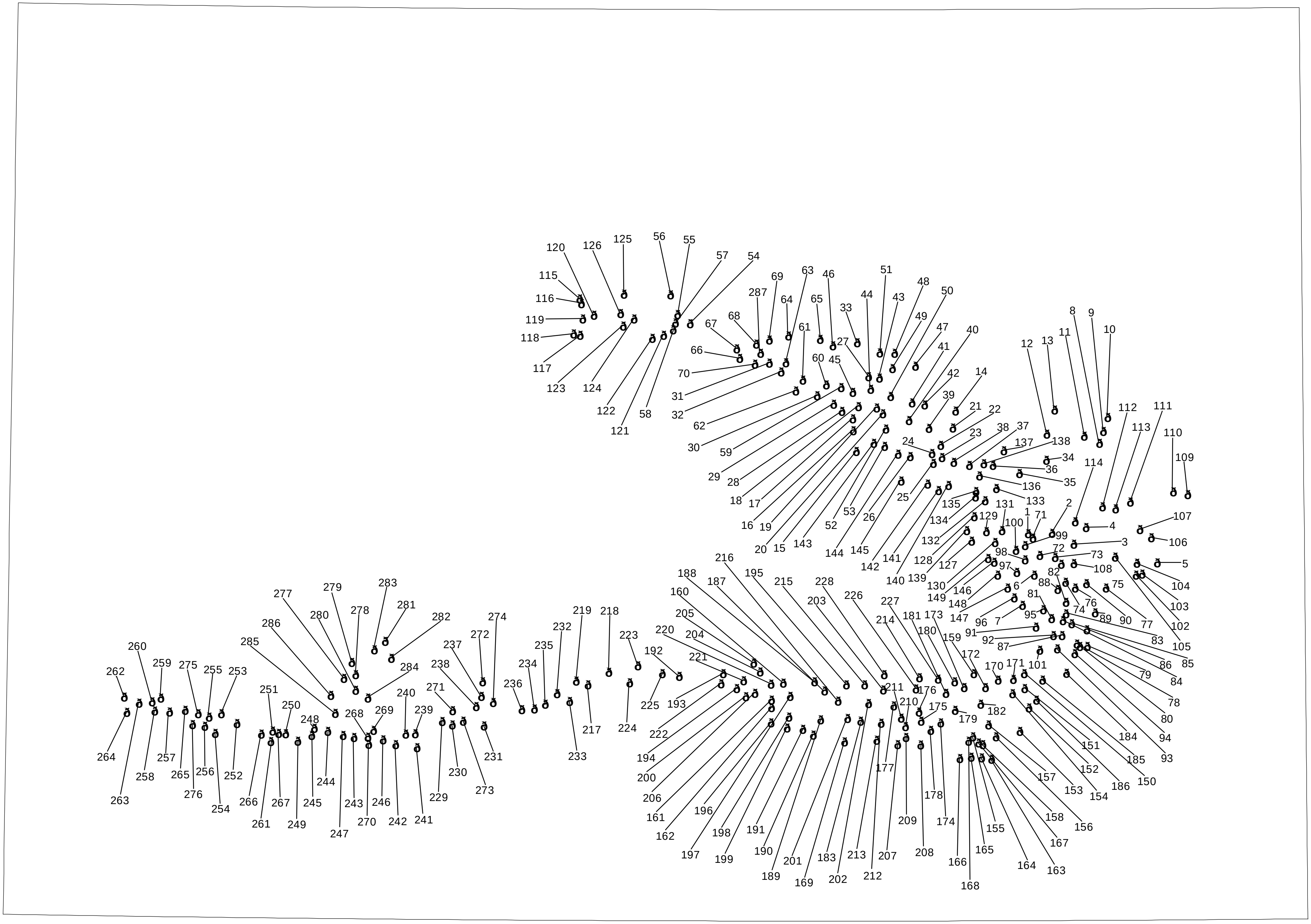
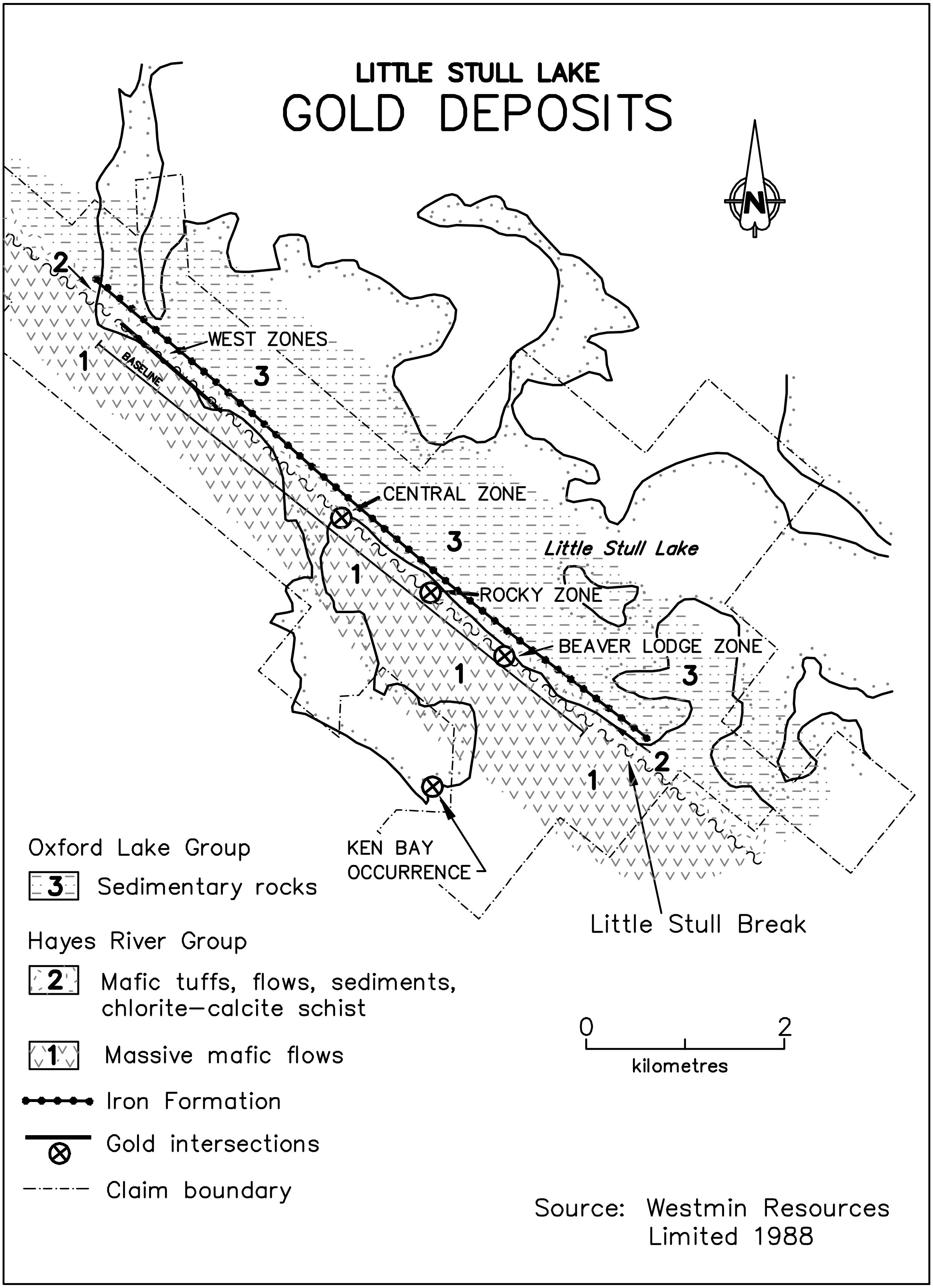
kilometres
Plutonic rocks
Hayes River Group
Oxford Lake Group;
Volcanic subgroup
Oxford Lake Group;
Sedimentary subgroup
Geological boundary (approximate)
"Wolf Bay" shear zone
Fault
Geology after Downie (1938),
Stone (1990), Corkery (1996),
Corkery et al., (1997).
Mineral occurrence
Edmund
Lake
Wolf Bay
Margaret Lake
Kistigan
Lake
Rorke
Lake
Little
Stull
Lake
93°00'
54°30'
Manitoba
Ontario
Twin
Lakes
Au
Stull
Lake
Rapson
Bay
Sharpe
Lake



425365
542627
6095392
6094980
6011932
6011552
423959
543462
Edmund Lake
Gods Lake
Margaret Lake
Little Stull Lake
Au Deposit
Kistigan
Lake
Edmund Lake Belt
Sharpe Lake Belt
Seeber River
Au Deposit
Twin Lakes
Au Deposit
Rorke
Lake
Little Stull Lake
Makataysip Lake
Twin Lakes
Webber Lake
Sharpe Lake
Stull
Lake
LEGEND
Diorite
Leucogranite
Granite
"Wolf Bay" Shear Zone
Oxford Group Sediments
Oxford Group Volcanics
Hayes River Volcanics
5 0 5 10 15
Kilometres




LITTLE STULL LAKE
GOLD DEPOSITS
N
WEST ZONES
BASELINE
CENTRAL ZONE
Little Stull Lake
ROCKY ZONE
BEAVER LODGE ZONE
KEN BAY
OCCURRENCE
Little Stull Break
Oxford Lake Group
3 Sedimentary rocks
Hayes River Group
2 Mafic tuffs, flows, sediments, chlorite–calcite schist
1 Massive mafic flows
Iron Formation
Gold intersections
Claim boundary
0
2
kilometres
Source: Westmin Resources Limited 1988