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Geology of Blackwell and Laurie Townships

by

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Ontario Geological Survey

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FOREWORD

Prior to 1986 the geological data base available for Blackwell and Laurie Townships was at a reconnaissance level. The detailed investigations described in this report were designed to encourage mineral exploration interest and to provide a proper basis for land use planning.

Most rocks of the area are Archean in age and can be subdivided into "Quetico-type" metasediments, "Keewatin-type" supracrustal rocks, "Timiskaming type" rocks, and several intrusive lithologies. Mineral deposits known in the area comprise gold and ironstone occurrences. Several lithologies and geological features make this an attractive region to conduct mineral exploration

V.G. Milne

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Contents

List of Figures

List of Photographs

List of Tables

Figure 1: Key map showing the location of the map area.

Abstract

The map area covers an area of about 178 km^2 and is centred about 60 km northwest of Thunder Bay. It straddles the boundary between the Quetico and Abitibi Subprovinces, the Quetico Subprovince lying to the north and the Abitibi Subprovince to the south. The rocks are Archean to Proterozoic and Pleistocene to Recent in age.

Most rocks of the area are Archean in age. The supracrustal rocks comprise a Keewatin-type sequence of a subaqueous to possibly subaerial subalkalic and alkalic (shoshonitic) sequence of metavolcanic rocks with minor interlayered metasediments; a Quetico-type sequence of metasediments and minor interlayered metavolcanic rocks; intrusive ultramafic to mafic and felsic rocks; a Timiskaming-type alluvial-fluvial metasedimentary sequence; and diabase and lamprophyre dikes. The Keewatin-type and Quetico-type rocks have been intruded by the metamorphosed ultramafic to mafic rocks and the felsic intrusives. All the rocks have been cut by later diabase and lamprophyre dikes. The Keewatin-type rocks comprise komatiitic, tholeiitic, calc-alkalic and alkalic flows and pyroclastic rocks and interlayered ironstone and clastic sedimentary units; the Quetico-type sequence comprises graded wackes with less abundant siltstone, mudstone, and chert and minor tholeiitic mafic rocks. The metamorphosed ultramafic to mafic intrusives comprise gabbroic rocks. The felsic intrusive rocks occur as batholiths and

stocks: the batholiths comprise pink phases ranging from quartz monzonite to granite, and grey phases comprising quartz monzodiorite and quartz diorite; the stocks comprising hornblende feldspar porphyries, feldspar porphyries and granophyre. The Timiskaming-type rocks, which comprise polymictic conglomerates, wackes, siltstones and mudstones and shoshonitic metavolcanic rocks unconformably overlie the Keewatin-type rocks.

Late Archean to Proterozoic rocks comprise biotite and hornblende lamprophyres and diabase dikes. The biotite lamprophyres resemble some of the Timiskaming-type metavolcanic rocks.

Pleistocene deposits comprise a red glaciolacustrine clay, which occurs in both Blackwell and Laurie Townships; ground moraine till, comprising sand and gravel, developed in Blackwell Township; and glaciofluvial sand and gravel forming an esker ridge in the southeastern part of the map area. Recent deposits comprise peat and muck in large swampy areas occurring principally in the central part of Laurie Township.

The supracrustal rocks have been folded about southeasterly axes into tight isoclinal folds. Foliation is subparallel to the bedding and dips steeply.

Faulting is of minor significance in the map area. However, an important fault, the Postans Fault, extends east-south easterly for 10 km across the map area separating the Timiskaming-type and Metamorphosed Mafic Intrusive rocks from the Quetico-type rocks. The other faults range from about 0.5-2 km in length, and trend northeasterly and northwesterly. The most

notable of these faults occur along the Matawin River at Middle Falls and about 2.5 km south of this. These faults trend northeasterly.

Mineral deposits comprise gold and ironstone. Gold deposits occur in shear zones in Keewatin-type metavolcanic rocks and in Timiskaming-type metasediments associated with shear zones and ironstone units. Early exploration activity was carried out mainly for iron ore deposits in the 1890s and 1900s as the southern part of the map area lies astride the Matawin Iron Range. Exploration for gold, base-metal sulphide mineralization, and nickel became important in the second quarter of the present century. Recently, with favourable gold prices, considerable gold exploration has occurred in the south-central part of Laurie Township. Overall, most of the exploration activity has taken place in southern Blackwell Township and in Laurie Township, areas underlain by Keewatin-type metavolcanics.

GEOLOGY OF BLACKWELL AND LAURIE TOWNSHIPS DISTRICT OF THUNDER BAY

by
M.W. CARTER[1]

INTRODUCTION

Location and Access

The map area comprises the townships of Blackwell and Laurie, and the extreme western end of the Dawson Road Lots. It is bounded by Latitudes 48°30'00"N, and 48°40'15"N and is centred about 60 km northwest of Thunder Bay. The location of the map area is shown in Figure 1. The region was mapped by the author and assistants during the field season of 1986.

Land access to the area is provided by Highway 17 immediately east of Blackwell Township; Highway 11, which passes through the townships in an east-west direction; and a forest access road which leads southward from Shabaqua Corners (immediately east of the map area) on Highway 11-17, and traverses the southeastern part of the map area. Lumber roads of the Great Lakes Paper Company Limited, which begin at Highway 590 southeast of the map area, provide access to the area east of Gold Creek in southwestern Laurie Township. The Matawin River provides

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access to the south-central part of the map area. The northwestern part of Laurie Township, and the southwestern and north-central parts of Blackwell Township are best reached by helicopter.

Physiography and Drainage

The map area lies within the Severn Upland physiographic region of the Precambrian Shield (Bostock 1967), and has moderate relief of 122 m, the maximum local relief being 91 m in the southeastern part of the area in an area 1.5 km southeast of Middle Falls in Laurie Township. This part of the area is underlain by Pleistocene eskers, and an east-west ridge underlain by mafic metavolcanics in southern Laurie Township. In general the areas underlain by the Keewatin-type metavolcanic rocks and the southern belt of the Timiskaming-type sediments form the most rugged terrain. Five major landform types occur: a bedrock knob type; a ground moraine type; a glaciolacustrine plain type; a glaciofluvial type; and an organic terrain type (Mollard 1979a, b; 1980a, b).

The bedrock knob type is the most extensive unit and covers the northern and southern parts of Blackwell Township, and occurs throughout Laurie Township. In northern Blackwell Township it is characterized by rather flat areas of low general relief and occurs in areas underlain by the northern batholithic granitic rocks. The very low knolls in this area do not possess any regional trends, and outcrops are sparse. In the southern part of Blackwell Township and in Laurie Township, however, this terrain type is characterized by irregular topography with steeper ridges in which the relief becomes progressively greater towards the south. The physiography is also characterized by east-southeasterly trending ridges which reflect the dominant east-southeasterly regional grain of the rocks in response to the east-southeasterly fold axes of the underlying Keewatin-type and Timiskaming-type metavolcanic-metasedimentary rocks. This physiographic unit is covered by only a thin veneer of till or organic deposits. Most of the rock outcrops of the map area occur in this central and southern part of the unit.

The ground moraine unit occurs only in the northwestern and northeastern corners of Blackwell Township and in its central part. These areas are characterized by more subdued relief than that seen in the southern part of the bedrock knob unit described above and forms undulating terrain. Glacial till covers most of the terrain and outcrops are sparse.

The glaciolacustrine-plain physiographic unit occurs in northeast-central and southeastern Blackwell Township and in southeastern and northwestern Laurie Township. It is characterized by flat areas of subdued relief, is commonly followed by the secondary river courses and is underlain by red clay. Outcrop in these areas is also spare to absent.

The glaciofluvial physiographic terrain type is restricted to the extreme southeastern edge of Blackwell

Township and to southeastern Laurie Township. This landform type is characterized by long, narrow, steep-sided, sinuous or straight ridges which trend south-southwesterly in southeastern Laurie Township where they are best developed. Relief is strong in the neighborhood of these ridges but these areas are marked by an absence of outcrops.

The organic terrain landform occurs along the secondary east-west river system south of the Shebandowan River in southern Blackwell Township; in the low-lying areas between bedrock knobs throughout Laurie Township; along the low area west of the Matawin River at the southern boundary of Laurie Township; and along its western tributaries. Outcrop is absent in these areas and the terrain is flat and swampy.

Drainage in the map area is dominantly to the east and is carried mainly by the Shebandowan River which drains easterly and then southerly; and the Matawin River which drains northeastwards into the Shebandowan River. The Shebandowan River ultimately drains easterly, east of the map area, to Lake Superior via the Kaministiquia River.

Previous Geological Work

The earliest geological work carried out in the map area was done in 1895 by A.P. Coleman (1895, p.82-84) when the Matawin Iron Range was being examined for its iron potential. This was followed by a geological survey in 1897 which included the area of the two townships by

W. McInnes (1899) as part of the mapping of the Shebandowan map area. Later, in 1924, T.L. Tanton (1926) carried out a geological survey of the southern half of Blackwell Township and most of Laurie Township as part of the Eastern Part of Matawin Iron Range map area. Following this, in the years 1928, 1929, and 1931, T.L. Tanton (Geological Survey of Canada 1930a, b; 1931; Tanton 1938) carried out geological mapping in the contiguous Shebandowan map area immediately to the west of the Eastern Part of Matawin Iron Range map area, which included the extreme western parts of Blackwell and Laurie Townships. In 1973 K.G. Fenwick and F.D. Weinstock (1973) mapped Blackwell and Laurie Townships. In the year 1984 L. Chorlton and G.H. Brown (1984), L. Chorlton (1987) mapped part of the southwestern corner of Laurie Township during a detailed study of gold mineralization in the Shebandowan area. In 1984 G.H. Brown (1985) carried out a detailed study of the structure and stratigraphy of the Keewatin-type and Timiskaming-type rocks along Highway 11.

Present Geological Work

Field work for this project was carried out during the summer of 1986 using vertical aerial photographs at a scale of 1 inch to 1/4 mile supplied by the Ontario Division of Forests. Pace-and-compass traverses were run at intervals of about 1/4 mile to investigate outcrop areas observed on the photographs, or areas of potential rock exposure. The traverses were run at right angles to the strike, where convenient, and river exposures were examined by canoe.

Geological data were recorded directly onto acetate sheets attached to the aerial photographs carried on traverse, or onto field-notebook sheets. The data were then transferred to 1 inch to 1/4 mile cronaflex base maps provided by the Surveys, Mapping and Remote Sensing Branch, Ministry of Natural Resources. The cronaflex base maps were derived from the Forest Resources Inventory maps.

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GENERAL GEOLOGY

The map area straddles the Abitibi (Shebandowan Belt section) - Quetico Subprovince boundary and is underlain by Precambrian rocks mantled by Pleistocene and Recent deposits. The lithologic units shown on the map face are listed in Table 1 in order of decreasing age. They belong to the Archean, Late Archean to Proterozoic and the Cenozoic.

The Archean rocks comprise: Keewatin-type metavolcanics consisting of komatiitic, tholeiitic, calc-alkalic and high-K calc-alkalic and shoshonitic rocks, and interlayered metasediments; mafic and felsic intrusive rocks; Timiskaming-type metasediments with interlayered high-K calc-alkalic and shoshonitic rocks; and late diabase and lamprophyre dikes.

The Keewatin-type rocks underlie Laurie Township and the southern part of Blackwell Township, south of Highway 11. These rocks consist of an older, tightly folded, steeply dipping sequence of subaqueous ultramafic to intermediate metavolcanics and metasediments which flank, on the north and south, a younger Keewatin-type intermediate to felsic metavolcanic and metasedimentary sequence which forms a linear, east-trending belt across south-central Laurie Township. This Keewatin-type sequence, because it consists of a sequence of interlayered flows and pyroclastic rocks is interpreted by the writer as a stratavolcanic sequence.

The older Keewatin metavolcanic sequence consists of interlayered units of komatiitic, tholeiitic, and calc-alkalic affinity. Ultramafic to mafic komatiites occur only on the northern flank of the younger Keewatin central volcanic edifice. These komatiitic rocks are characterized by spinifex textures, polygonal jointing, pillows and varioles, and form sequences up to 170 m thick. Tholeiitic mafic to intermediate units with massive, pillowed and amygdaloidal varieties occur on both the northern and southern flanks of the edifice in southern Blackwell and northern and southern Laurie Townships. On the northern flank, calc-alkalic rocks comprise feldspar-phyric basalts and aphyric andesitic and dacitic flows and tuffs, but these are absent on the southern side of the edifice.

The central part of the volcanic edifice, located in the south-central part of Laurie Township, consists of a younger Keewatin sequence of cream, grey, light grey and grey-green calc-alkalic rocks interlayered with less voluminous pink and red, hornblende-rich, high-potassium shoshonitic intermediate and felsic rocks. This area is dominated by coarse pyroclastics consisting of tuffs, lapilli-tuffs, and tuff-breccias, and is interpreted by the author as a central-facies volcanic unit (Williams and McBirney 1979, p.312-313; Easton and Johns 1986). These rocks have been the subject of a detailed study by L. Chorlton (1987) in the western part of the belt.

The Keewatin-type metasediments, which are interlayered with the older and younger Keewatin-type metavolcanic rocks, consist of clastic and chemical units. The clastic metasediments comprise wackes, argillites, and graphitic siltstones and mudstones which form sequences up to 100 m thick. On the southern flank of the volcanic edifice, in southern Laurie Township, a highly pyritic mudstone unit occurs which contains fine-grained disseminated pyrite forming up to 15 percent of the rock. This unit constitutes a marker horizon overlying the lower tholeiitic metavolcanics in this area. The chemical metasediments comprise grey and black chert, silicified graphitic units, and banded magnetic-jasper ironstone. These chemical metasediments form units up to 30 m in thickness.

The Quetico-type metasediments occur in northern Blackwell Township and appear to be penecontemporaneous with the older Keewatin-type rocks as the two are interlayered at their mutual contact zone. These metasediments consist predominantly of wackes which are locally biotite-rich, siltstones, mudstones, siltstone-mudstone couplets showing grading bedding, and garnetiferous wackes. When traced northwards into northern Blackwell Township, these rocks become more highly metamorphosed, lose their primary characteristics, and are converted into paragneisses and migmatites. Locally, the rocks become coarser grained and form grey, biotite-rich, granoblastic tonalitic masses.

Early mafic intrusions cut the Keewatin-type and Quetico-type rocks. These are lenses of dark-green, coarse-grained gabbro. The gabbroic rocks in the northern part of the map area occur at the contact of the Keewatin-type and Quetico-type sequences.

Felsic intrusive rocks occur in the northern and southern extremities of the map area. These rocks are massive, biotite and hornblende-biotite granite, granodiorite, and tonalite with colour indices ranging from 7 to 2. They intrude the Quetico-type sedimentary rocks in the north, and the tholeiitic Keewatin-type sedimentary rocks in the south. Their relationship to the mafic intrusive gabbroic rocks is not directly observable.

Timiskaming-type metasediments occur in the southern part of Blackwell Township, straddling Highway 11, and in the north-central part of Laurie Township, forming an east-trending belt. These metasediments consist of polymictic conglomerates and paraconglomerates containing clasts of predominantly intermediate, hornblende-bearing, calc-alkalic, and shoshonitic rocks, less common granitoid rocks, black chert, and jasper in an arkosic or chloritic matrix. Siltstones, mudstones, and arkoses also occur. Chemical metasediments comprise banded magnetite-jasper, magnetite-arkose and magnetite-mudstone units best exposed in the central part of Laurie Township where the unit is about 150 m thick. Timiskaming-type metavolcanics occur associated with the metasediments in the southern part of Blackwell Township north and south of Highway 11. The rocks are characteristically grey and dark grey calc-alkalic rocks, and red, and pink, hornblende-bearing shoshonitic rocks, and are interlayered with the sedimentary rocks. They are similar to the rocks occurring in the central volcanic facies in south-central Laurie Township which suggests that late Keewatin-type volcanism continued into the period of Timiskaming-type deposition.

Late Archean to Proterozoic mafic intrusive rocks comprise fresh aphyric and feldspar-phyric northeasterly and easterly trending diabase dikes, and biotite and hornblende lamprophyres. Intrusive relationships with the Timiskaming-type rocks show that some of these lamprophyres represent the latest igneous activity in the map area. The diabase and lamprophyre dikes form bodies varying from 3 to 30 m in width.

Pleistocene deposits comprise glaciolacustrine clays which are developed in northeastern and southeastern Blackwell Township and southeastern Laurie Township; ground moraine till that consists of sand and gravel exposed in the central part and the northeastern corner of Blackwell Township; and glaciofluvial deposits comprising cobbles and coarse sand, forming a steep esker ridge which trends northeastward in southeastern Laurie Township.

Recent deposits comprise organic material and alluvium consisting of peat and muck along the upper reaches of the Matawin River in southern Laurie Township, along stream courses throughout Laurie Township, and in southern Blackwell Township.

PRECAMBRIAN

ARCHEAN

METAVOLCANICS AND METASEDIMENTS (KEEWATIN-TYPE)

METAVOLCANICS

SUBALKALIC METAVOLCANICS

Komatiitic Metavolcanics

These rocks are exposed in the southern part of Blackwell Township and in the northern part of Laurie Township, and occur as units ranging from about 40 m to about 200 m thick. They vary in colour from grey to dark greenish-black on the fresh surfaces, but are reddish brown or dun coloured on the weathered surface. The occurrence of pillowed, polyhedrally-jointed and brecciated, variolitic, and spinifex-textured structures show that the rocks are extrusives.

Ultramafic Flows

Pillowed Flows

Pillowed flows were observed in two areas: at an outcrop located 2.7 km southwest of Shabaqua, in northeastern Laurie Township, and on the west shore of the Shebandowan River at the rapids at Mabella in southwestern Blackwell Township. The pillows (Photo 1) are best developed in the former area and are only poorly to vaguely developed in the latter. In the former area the pillows measure 0.6 x 0.3 m and have a chilled rim 2.5 cm thick. On the west shore of the Shebandowan River at Mabella the outlines of the pillows could only be vaguely seen.

Polysutured Flows (flow-top breccia)

Well developed polysuturing was observed in the flow at Mabella and at a flow located in northeastern Laurie Township at an outcrop occurring 2.2 km southeast of the southeastern end of Sand Lake (local name). In this flow the lengths of the sides of the polyhedra ranges from about 5 cm to about 11 cm and the material between the fragments is finer grained. Similar breccia showing well developed polygonal jointing was observed in komatiite in outcrops in the komatiite unit 2 km south-southeast of Shabaqua. Here the fragments were up to 20 x 10 cm. Ultramafic hyaloclastite was observed between the fragments. These polysutured brecciated subunits are interpreted as autoclastic flow-top breccias representing the chilled and fractured tops of komatiitic flows.

A thin section of the rock from the second outcrop described (Photo 2) shows it to be completely serpentinized and carbonatized with subhedral to euhedral pseudomorphs of chrysotile and carbonate after olivine, with interstitial chrysotile, and pale green chlorite. Many of the chrysotile-carbonate pseudomorphs are crossed by fractures formed of chrysotile and lined with granules and stringers of magnetite. In some grains the magnetite forms concentric rings parallel to the outlines of the pseudomorphs.

The chemical analyses of the rock from Mabella and the one from 2.2 km southeast of Sand Lake are listed in columns 1 and 2 of Table 2. In the chemical classification of Jensen (1976), Figure 2, the rocks are classed as ultramafic komatiites. A photomicrograph of the rock from Mabella is shown in Photo 3.

Spinifex-textured Flows

Spinifex-textured komatiite shows either bladed criss-cross mafic minerals up to 30 x 0.5 mm on the rusty-coloured weathered surfaces or short radially disposed olivine and pyroxene occurring in polyhedral or subrounded areas which commonly weathers into a knobby surface. In this type of spinifex - textured flow the blades range from about 0.5 to 15 mm long by 0.1 mm wide; the length of the blades depending on the radius of the polygonal or subrounded areas. The weathered surface of these rocks is russet brown.

Variolitic Komatiite

Variolitic komatiite shows varioles ranging in diameter from 5 to 7 mm where occurring as isolated and round bodies to 8 x 11 mm where ellipsoidal. Where the varioles coalesce they form aggregates of varioles measuring 25 x 20 mm. The varioles show positive weathering and stand out as lighter-coloured orange structures 0.5 to 1 mm above the general surface of the rock.

Mafic Flows

Associated with the komatiitic rocks are grey fine-grained to aphanitic rocks which are believed by the author to be komatiitic basalts. These rocks are grey to dark grey on the fresh surface and greenish grey to pale orange on the weathered surface. They have not been chemically analyzed and no thin sections have been made, but one rock resembling these and interlayered with the tholeiitic rocks was sectioned and analyzed. This rock is located on the eastern shore of the Matawin River about 1.2 km northwards along the river from the southern boundary of Laurie Township. The rock consists of pale green slightly pleochroic tremolite-actinolite with ragged terminations and saussuritized plagioclase. The chemical analysis of the rock is listed in column 3 of Table 2. In the chemical classification of Jensen (1976) the rock is classed as a komatiitic basalt (Figure 2).

Tholeiitic Metavolcanics

Tholeiitic metavolcanic rocks occur in the southern part of Blackwell Township and in the northern and southern parts of Laurie Township. In the first two areas mentioned the rocks are interlayered with calc-alkalic metavolcanic rocks. The tholeiitic rocks are dark green to very dark green on the fresh surface and greenish-grey or pale brown on the weathered surface. Individual flows were not mapped during the survey but where these rocks were interlayered with calc-alkalic rocks the thickness of individual units range from 40 m to 100 m. Apart from these, the tholeiitic rocks occur in composite units up to 1 km thick. Massive, amygdaloidal, foliated, pillowed and blastoporphyritic flows were observed. The colour index of the freshest rocks is greater than about 40 and the density of the rocks ranges from 2.80 to 3.07. Eight thin sections of the tholeiitic rocks were studied and thirteen chemical analyses were made. The chemical analyses are listed in columns 1 to 13 in Table 4, and their molecular norms in columns 1 to 13 in Table 5. They are plotted on Figures 3 and 4.

Mafic Tholeiites

Flows

Massive Flows

This is the most common type of flow in the map area and varies from coarse grained to aphanitic, the commonest grain size being the fine-grained type.

Two thin sections of these massive rocks were studied and intergranular and rapidly-cooled textures were observed. In these rocks the plagioclase occurs as disoriented acicular euhedral and subhedral grains which are brownish and sericitized. Ferromagnesian minerals comprise clinopyroxene, chlorite and epidote. The clinopyroxene occurs as lath-like grains, or as subhedral, colourless, fresh equant grains, and in one of the rocks, as sheaf-like radiating grains. The rock containing such sheaf-like clinopyroxene is interpreted to be a rapidly cooled rock. The chlorite occurs as pale green or olive green laths in places forming the cores of clinopyroxene, in places in sheaf-like form and polarizing in anomalous Berlin blue colours. The epidote occurs as irregular and acicular aggregates of pale yellow pleochroic pistacite. Opaque minerals comprise ilmenite as equant and irregular grains altered to leucoxene. Accessory subhedral and irregular grains of carbonate occur in the intergranular areas.

The chemical analyses of these rocks studied are listed in columns 1 and 2 of Table 4 and their molecular norms in columns 1 and 2 of Table 5. In the chemical classification of Irvine and Baragar (1971) they are classed as tholeiitic basalts.

Amygdaloidal Flows

One of these rocks showing quartz amygdules up to 3 mm in longest dimension in hand specimen was studied in thin section. It shows tabular subhedral phenocrysts of dusty, brownish, sericitized and carbonatized plagioclase and irregular areas of pale green chlorite in a fine-grained, granoblastic matrix of albite, chlorite, carbonate, olivine-green biotite and scattered square and rectangular grains of pyrite. No amygdules were observed in the thin section. The chemical analysis of this rock is listed in column 3 of Table 4 and its molecular norm in column 3 of Table 5. In the chemical classification of Irvine and Baragar (1971) the rock is classed as a tholeiitic basalt.

Foliated Flows

These rocks (Photo 4) are best developed in the southern part of the map area. Two specimens were studied in thin section. In one, the plagioclase occurs as clear, mostly untwinned grains of albite. Where twinned the plagioclase shows lamellar or simple albite twins. The ferromagnesian minerals comprise abundant acicular, irregularly terminated actinolite, pleochroic from yellow to blue-green, and less abundant flakes of biotite associated with the actinolite and pleochroic from colourless to brown. Opaque grains comprise irregular crystals of pyrite. In the other specimen, the foliation is marked by elongated, lensoid and lozenge-shaped carbonate grains and parallel streaks of pale green pleochroic chlorite showing pleochroism from pale green to pale purple, in a fine-grained, dark grey, chloritized and carbonatized feldspathic matrix. The chemical analyses of these two rocks are listed in columns 4 and 5 of Table 4 and their molecular norms in columns 4 and 5 of Table 5. In the classification of Irvine and Baragar (1971) they are classed as tholeiitic basalts.

Pillowed Flows

Pillowed flows are not common in the map area but were observed along the Canadian National Railway track in the southeastern corner of Blackwell Township; near the central part of the northern margin of Laurie Township; and near the central part of the eastern margin of Laurie Township. At the first-mentioned locality the pillows measure on average 1 by 0.5 m with a chilled fine-grained rim 2.5 cm thick and containing vesicles in both the rim and central areas. The vesicles measure 8 x 10 mm. At the second-mentioned locality the pillows were smaller measuring 25 x 15 cm with a narrower chilled rim 1 cm thick. In this area the pillows are also entirely vesicular. In the last area mentioned above the pillows range from 20 to 35 cm in longest dimension.

Blastoporphyritic Flows

These rocks are not abundant, but are exposed in southern Laurie Township. They are dark green on the fresh surface, massive or foliated, and consist of very dark green rectangular amphibole grains, some of which show six-sided cross sections, forming 10-15% of the rock and measuring 1.5 x 2 mm. Where feldspar is present it is similar in size to the amphiboles, but forms up to 20% of the rock. The amphibole and feldspar are set in a dark green matrix.

Autoclastic Breccia

Breccia, interpreted by the writer as flow-top breccia as it is monomictic and is associated with pillowed flows and tuffs, was observed in the area near the central part of the eastern margin of Laurie Township. The unit consists of sharply angular clasts of mafic rock varying from 0.5 to 5 cm. The unit is 20 cm thick.

Pyroclastic Rocks

Tuff

Tholeiitic tuff is uncommon in the map area but was observed near the Canadian National Railway track in the northeastern corner of Laurie Township; in central Laurie Township; and near the south-central part of the western boundary of Laurie Township. The rocks are fine-grained, medium green and dark green crystal tuffs. On the weathered surface, broken crystals of what were euhedral grains of dominantly dark green ferromagnesian crystals, feldspar and quartz measuring 1.5 - 2.00 x 2 mm in size, are set in a dark green to medium green, fine-grained matrix.

Three samples of these rocks were studied in thin section, two of which prove on chemical analysis to be tholeiitic basalt tuffs. They consist dominantly of broken subhedral and formerly euhedral grains of fresh clinopyroxene which show zoning, simple and lamellar twinning on the orthopinacoid, some of which show adhering devitrified brown glass (Photo 5), minor subhedral hornblende crystals, slightly altered subhedral laths of plagioclase, minor subhedral quartz, pale yellow anhedral epidote and irregular areas of ragged green chlorite. Lithic fragments comprise subrounded grains of hornblende porphyry and pyroxene basalt. The matrix consists of dark, brownish, fine-grained devitrified glass and ash.

The chemical analyses of these two rocks are listed in columns 6 and 7 of Table 4 and their molecular norms in columns 6 and 7 of Table 5. They are both tholeiitic basalts in the chemical classification of Irvine and Barragar (1971).

The third specimen studied in thin section shows vague grains of sericitized albitic feldspar and irregular areas of microgranular feldspar, irregular areas of pale green chlorite showing mauve interference colours, grains of colourless sericite and brownish hematized feldspathic areas, in a fine-grained, chloritized, devitrified matrix containing carbonate, opaque grains of leucoxene, and square and rectangular grains of pyrite. The rock has been cataclastically deformed and fractures in it have been hematized.

The chemical analysis of this rock is listed in column 8 of Table 4 and its molecular norm in column 8 of Table 5. In the chemical classification of Irvine and Baragar (1971) the rock is classed as a tholeiitic basalt, but the high silica content of 60.33% (anhydrous weight) would indicate an andesite, if the silica content is primary.

Calc-alkalic and High-K Calc-alkalic Metavolcanics

Average and high-K calc-alkalic metavolcanic rocks occur in the southern quarter of Blackwell Township and the northern and central parts of Laurie Township, and comprise basalts, andesites dacites and rhyolites occurring as flows and pyroclastic rocks.

The average-K calc-alkalic rocks are green and grey-green in colour and the high-K calc-alkalic rocks may be green or may have a mottled pink and green colour in the intermediate and felsic compositional range. Because the high-K rocks can have the same rock colour as the average-K rocks, the two groups have not been separated on the map (Map ...., back pocket).

Mafic Metavolcanics

Flows

Aphanitic Flows

The aphanitic flows show a pale brown weathered surface and a medium grey fresh surface. The colour index of these rocks ranges from about 20-40, and their specific gravity ranges from 2.87-2.91.

In thin section the rocks consist of disoriented microlites of plagioclase, too altered for optical determination of composition. Some plagioclase laths show swallow-tail terminations suggesting rapid cooling of the rock, lying in a dark brownish devitrified matrix. The rock is crossed by veinlets and irregular areas of quartz and carbonate. The density of the one specimen microscopically studied is 2.91.

The chemical analysis of this rock is listed in column 1 of Table 6 and its molecular norm is column 1 of Table 7. It is classed as a tholeiitic basalt in the classification of Irvine and Baragar (1971) but the high

Al_2O_3 content of 15.55% (anhydrous basis) at 52.31% SiO_2 (anhydrous basis) suggests that the rock is a calc-alkalic high-alumina basalt. In the Jensen classification (Jensen 1976) the rock is classed as a calc-alkalic basalt.

Porphyritic Flows

These contain prominent phenocrysts of greyish-white feldspar or dark, blackish green amphibole.

Feldspar-phyric rocks show euhedral and subhedral feldspar ranging from 2x2 mm to 7x8 mm forming about 7% of the rock, set in a grey, fine-grained matrix. These are highly distinctive rocks and can serve as marker units in field mapping. One thin section of this rock type was studied and it showed completely kaolinized and epidotized dark brownish phenocrysts of altered plagioclase in a matrix of disoriented but locally weakly flow-oriented microlites of plagioclase (An_{56}, labradorite) some of which show swallow-tail terminations, some of which are hollow, set in brown devitrified glass. Veinlets of quartz-clinozoisite, quartz-carbonate, and quartz-pistacite traverse the rock. The chemical analysis of this rock is listed in column 2 of Table 6, its molecular norm in column 2 of Table 7. The rock is classed as a tholeiitic basalt in the classification of Irvine and Baragar (1971) but the combination of anhydrous silica content of 53.99% and alumina content of 18.28% indicate a high-alumina calc-alkalic basalt on the Al_2O_3/plagioclase plot of Irvine and Baragar (1971). It is classed as a high-alumina basalt in this report.

An example of the amphibole-phyric rocks is pale brownish on the weathered surface and medium-grey green on the fresh surface. It shows dark, blackish green, lath-shaped and equant grains of ferromagnesian minerals measuring 0.5 x 3 mm and 2x2 mm to 3x3 mm, respectively. In thin section the rock is fresh and undeformed and shows porphyritic texture. Euhedral and subhedral, twinned, moderately fresh plagioclase feldspar and subhedral laths and cross-sections of hornblende with irregular terminations are set in a microporphyritic matrix of microphenocrysts of the same minerals and pistacite surrounded by dark, fine-grained feldspathic material suffused with equant grains and stringers of leucoxene after ilmenite, carbonate and minor opaque grains of pyrite. The phenocrystic feldspar is dusty, partly sericitized, subhedral to euhedral, and only simply twinned. The phenocrystic hornblende appears to be primary and the texture of the rock is shown in Photo 6. The chemical analysis of the rock is listed in column 3 of Table 6 and its molecular norm in column 3 of Table 7. In the classification of Irvine and Baragar (1971) the rock is a calc-alkalic basalt using the Al_2O_3/plagioclase diagram. The density of the rock is 2.87.

No high-K calc-alkalic basalts were located.

Intermediate Metavolcanics

Flows

Andesitic and dacitic flows occur in the southern part of Blackwell Township and the central part of Laurie Township interlayered with the tholeiitic rocks. On the weathered surface the rocks range in colour from buff to grey-green, and on the fresh surface from medium to dark grey-green in colour. Where foliated some of the rocks occurring in south-central Laurie Township, show pink laminae and streaks about 1-2 mm thick, and these are seen under the microscope to represent bands of sericite. Five samples of these rocks were examined in thin section and their chemical analyses are listed in columns 4 to 8 of Table 6 and their molecular norms in column 4 to 8 of Table 7.

Andesite

The andesitic rocks occur both undeformed and deformed.

A thin section of the undeformed andesite shows porphyritic texture with phenocrysts of chlorite occurring as irregular and lath-like green pleochroic grains, some of which are subhedral and appear to be pseudomorphs after hornblende. It also shows altered subhedral feldspar, and recrystallized subhedral quartz grains in a carbonatized and sericitized feldspathic matrix. The chemical analysis of the rock is listed in column 4 of Table 6 and is classed as a calc-alkalic andesite in the classification of Irvine and Baragar (1971).

A thin section of a deformed andesite shows foliated and cataclastic-microgranular texture displaying microlithons of microgranular quartzo-feldspathic material containing sericite, bordered by aligned sericite, chlorite, hematite stained material and opaque grains of ilmenite altered to leucoxene. The chemical analysis of this rock is listed in column 5 of Table 6 and its molecular norm in column 5 of Table 7. In the chemical classification of Irvine and Baragar (1971) the rock is classed as a tholeiitic basalt but the petrographic characteristics of the rock suggests that this is in error. In the classifications of Miyashiro (1974) and Jensen (1976) the rock is classed as a calc-alkalic andesitic which is consistent with its petrographic characteristics. It is classed as such by the author in this report.

Dacites

Three samples of rocks which are classed as dacites by the writer were examined in thin section. These rocks are grey-green on the weathered surface and green and grey-green on the fresh surface. All are microporphyritic - microgranular in texture. The phenocrysts comprise euhedral and subhedral altered plagioclase which are untwinned, show patchy interference colours and contain alteration products of sericite, chlorite, carbonate, and pistacite in an albitic background. The matrix of the rock is microgranular, quartzo-feldspathic, brownish in varying shades and contains patches of sericite, carbonate and grains of chlorite, pistacite, biotite, apatite, and opaque grains of pyrite and ilmenite altered to leucoxene.

The chemical analyses of these rocks are listed in columns 6, 7, and 8 of Table 6 and their molecular norms in columns 6, 7, and 8 of Table 7. The rock listed in column 6 is classed as a calc-alkalic dacite in the chemical classification of Irvine and Baragar (1971). That listed in column 7 of Table 6 is classed as a calc-alkalic andesite by Irvine and Baragar (1971), but the anhydrous silica content of 64.54 suggests dacite. The rock listed in column 8 of Table 6 is classed as a tholeiitic basalt in the classification of Irvine and Baragar (1971) but this rock is similar to the others, contains 65.68% silica and 14.97% alumina on an anhydrous basis. This analysis is not consistent with such a classification if it is compared with analyses for tholeiitic rocks given in Appendix II (Irvine and Baragar 1971). In the classification of Miyashiro (1974) it is classed as a calc-alkalic dacite, and in that of Jensen (1976) as a calc-alkalic andesite.

An example of a high-K dacite flow is pale grey-green on the fresh and weathered surfaces. In thin section the rock shows porphyritic-cryptogranular texture with sparse euhedral and subhedral sericitized and carbonatized grains of feldspar and a few equant lath-shaped and irregular grains of green chlorite in a sericitized and carbonatized fine-grained matrix containing flecks of chlorite. The chemical analysis of this rock is listed in column 9 of Table 6 and its molecular norm is column 9 of Table 7. On the K_2O/SiO_2 weight percent plot of Mackenzie and Chappell (1972, Figure 3), Figure 5 shows the rock to be a high-K calc-alkalic dacite.

Pyroclastics

Tuff

This is the most widespread unit of the pyroclastic rocks and underlies the southern part of Blackwell Township and the central part of Laurie Township. The rocks are greenish grey and pale greyish-buff on the weathered surface, and medium grey on the fresh surface. They are aphanitic to fine-grained rocks and consist mostly of broken, greyish-white feldspar grains averaging 1.5 x 2 mm. Quartz grains are present in some rocks forming up to 10% and can be up to 2x2 mm in size. Acicular grains of hornblende occur in some of these rocks forming 5% of the rocks. In a few cases lithic, aphanitic, volcanic fragments and black chert up to 3x5 mm were observed. These are sharply angular and are triangular or rectangular in shape. They do not form more than about 3% of the rocks. Stretched fragments of pumice were also observed. Flat bedding and lamination occurs in some exposures, the beds ranging from 10-15 cm and the laminae, which are also of much finer material, range from 0.5-2 cm. Cross-bedding was observed at one outcrop marked by dark- and light-coloured laminae. The dark laminae are 2 mm thick, the light laminae 10 mm thick.

Andesites Tuff

Two examples of high-K tuffs were studied in thin section and chemically analyzed. In thin section one of the rocks shows clastic texture (Photo 7), showing crystals of subangular and subrounded subhedral and euhedral sericitized and kaolinized cloudy feldspar comprising most of the rock, with less abundant brownish, pleochroic hornblende set in a grey, feldspathic matrix, containing grains of leucoxene after ilmenite and chlorite. A few lithic fragments showing disoriented microlithic feldspar in a devitrified glass matrix occur.

The chemical analysis of the rock is listed in column 10 of Table 6 and its molecular norm in column 10 of Table 7. In the chemical classification of Irvine and Baragar the rock is a calc-alkalic andesite, and in the chemical classification of Mackenzie and Chappell (1972) it is a high-K andesite, (Figure 5). The strontium content of the rock is 1262 ppm.

Another example of a high-K crystal tuff from an outcrop along the Shabaqua Road immediately west of Middle Falls, Matawin River in east-central Laurie Township was examined in thin section and chemically analyzed. The rock is bedded, and graded bedding can be observed on the outcrop. The weathered surface of the rock is green, and shows pink feldspar grains 1 x 1.5 mm to 8 x 3 mm. The fresh surface of the rock is dark grey-green.

In thin section this rock shows clastic texture comprising grains of abundant feldspar and minor quartz in a dark brownish matrix. The feldspars are euhedral and subhedral, equant and lath-shaped, some broken, others of irregular and triangular shapes, with one euhedral grain showing devitrified, adhering glass (Photo 8). These feldspar grains are sericitized. The quartz occurs as rectangular grains. The matrix is fine grained, dark brownish and chloritized, and contains chlorite as irregular areas, strips and threads, some forming veins of chlorite pleochroic from brown to purple. Carbonate occurs as irregular grains. One lithic fragment of an altered, intermediate, metavolcanic rock showing microlitic texture was observed. Opaque grains comprise pyrite and leucoxene after ilmenite.

The chemical analysis of the rock is listed in column 11 of Table 6 and its molecular norm in column 11 of Table 7. When plotted on the K_2O versus SiO_2 plot of Mackenzie and Chappell (1972, Figure 3), the rock is classed as a high-K andesite as shown in Figure 5.

Dacite Tuff

The chemical analyses of two high-K dacitic crystal tuffs of similar aspect to that just described, but grey rather than dark green are listed in columns 12 and 13 of Table 6 and their molecular norms in columns 12 and 13 of Table 7. On the K_2O/SiO_2 weight plot of Mackenzie and

Chappell (1972, Figure 3), Figure 5 shows the rocks to be high-K dacites.

A thin section from one of these rocks shows fragmental texture. The rock comprises angular, subangular and subrounded grains of partly sericitized clear and brownish crystals of plagioclase, and one lithic fragment of feldspar porphyry set in a fine, microgranular, brownish, carbonatized feldspathic matrix threaded by irregularly shaped stringers of chlorite. Accessory minerals are opaque grains of leucoxene after ilmenite, hematite and pyrite.

Debris Flows (fine-grained)

These rocks (Photo 9) are greyish-white on the weathered surface and medium grey and grey-green on the fresh surface, but have a mottled appearance where black chert and occasional mafic fragments are present. Clasts are subangular and subrounded, are predominantly rectangular in shape and comprise mainly grey aphanitic and fine-grained intermediate volcanic rocks forming about 20%, with less abundant black chert, felsic volcanic rocks, mafic volcanic rocks, and quartz-feldspar porphyry. In the unit located along the Shebandowan River south of Mabella, pyrrhotite nodules ranging from 0.4 x 0.5 cm to 3 x 3 cm occur forming about 3% of the rock. Where these nodules are weathered they form pitted outcrop surfaces with brown ovoid stains and render the unit easy to observe and map. This unit has been traced along strike for approximately 6 km and is about 100 m thick. It has been drilled at two places along strike by Three Brothers Mining Exploration Limited in 1956 (property, No. 15) and by Falconbridge Nickel Mines Limited (property No. 6) in 1962. No assay results from the drilling were given. The matrix of the lapilli tuff consists of grey crystal tuff similar to that described under tuff. The lapilli-tuff is matrix supported. No bedding was observed in the rocks.

Debris Flow (coarse-grained)

A coarse-grained debris flow (Photo 10) was observed in only one locality: along the Shebandowan River south of Mabella as part of the same lapilli-tuff unit containing pyrrhotite and pyrite described above. The weathered surface of the rock is grey, the fresh surface medium-grey. Clasts range in size from 0.5 cm to 30 cm are angular to subround and consist of chert, mudstone, dacite porphyry, felsic volcanics and spinifex-textured komatiite. The rock type is very poorly sorted and is clast supported. The matrix consists of crystal tuff containing about 5% mafic volcanic rocks.

Felsic Metavolcanics

These rocks comprise flows and tuffs and are exposed mainly in the south-central part of Laurie Township interlayered with the andesitic and dacitic rocks. However, one example of these rocks was also found interlayered with the Quetico metasediments in the south-central part of Blackwell Township.

Flows

Flows are aphanitic and porphyritic. These form units ranging from about 40 m to 700 m thick, but the average thickness is about 100 m.

Aphyric Flows

The megascopic aphanitic flows are light grey or light cream on the fresh surface and greyish-white on the weathered surface. A thin section of the cream-coloured rock shows porphyritic-microgranular-microlitic texture with euhedral, equant and rectangular, relatively fresh, complexly twinned and slightly sericitized plagioclase in a microlitic-microgranular matrix. The phenocrystic feldspar is also carbonatized, with discrete crystals of carbonate traversing the grains. It also occurs as lath-shaped microphenocrysts showing flow arrangement. Both the phenocrysts and microphenocrysts lie in a matrix of microgranular feldspar flecked with pale brownish euhedral carbonate, probably siderite, and opaque grains of pyrite and leucoxene. A chemical analysis of this rock is listed in column 1 of Table 8 and its molecular norm in column 1 of Table 9. The rock is classed as a calc-alkalic rhyolite in the chemical classification of Irvine and Baragar (1971).

Porphyritic Flows

Porphyritic flows are grey on the fresh surface and pale brownish on the weathered surface and contain quartz and/or feldspar phenocrysts. The feldspar phenocrysts average about 3-5 mm, are rectangular and are greyish-white in colour. The quartz phenocrysts are 0.3-0.4 mm in size and are set in a light to medium-grey matrix. They are best exposed in the southwestern part of Laurie Township where the rocks are foliated and the feldspars become aggregated to produce a faint banded texture.

A thin section cut from one of these rocks shows porphyritic-cryptogranular texture with euhedral and subhedral lath-shaped and equant grains of carbonatized plagioclase set in a cryptogranular, carbonatized quartzofeldspathic matrix with disoriented microphenocrysts of altered plagioclase with irregular and subangular grains of ilmenite altered to leucoxene.

A chemical analysis of this rock is listed in column 2 of Table 8 and its molecular norm in column 2 of Table 9. The rock is classed as a calc-alkalic dacite in the chemical classification of Irvine and Baragar (1971) but with a silica content of 70% the rock is here classed as a rhyolite.

Pyroclastic Rocks

Debris Flows (fine-grained)

These rocks are medium grey on the fresh surface and greyish-green on the weathered surface. Where the rocks are mineralized with fine disseminated pyrite, the weathered surface is brownish. The lapilli fragments are lithic and pumiceous. The lithic fragments are angular, grey-green, mainly felsic in composition, and range from 2-5 cm in size. Minor, less than 1 per cent, fragments of mafic metavolcanics are also present. The pumiceous fragments are smaller and occur as darker streaks measuring 0.6 x 3.2 cm. Accidental lithic fragments comprise ovoid clasts of grey and black chert ranging from 3 x 5 mm to 15 x 30 mm. The grey chert in these lithic fragments is commonly mineralized with fine-grained disseminated pyrite.

ALKALIC METAVOLCANICS

SHOSHONITIC METAVOLCANICS

These rocks occur interlayered with the calc-alkalic and high-K calc-alkalic rocks occurring in south-central Laurie Township. They are not very voluminous and comprise flows and pyroclastic rocks. They differ from the high-K calc-alkalic rocks in that they are red, dark red or brownish in the case of flows, and in the case of clastic rocks, the red or brown clasts lie in a dark red or dark reddish brown matrix rather than in a green matrix, as is the case with the high-K calc-alkalic rocks.

Flows

Felsic Rocks

A red quartz-phyric toscanite comprising vitreous phenocrysts of quartz about 1.5 x 1 mm and forming about 1% of the rock lie in a brown aphanitic matrix. The weathered surface of the rock is pale brown, and the fresh surface is light reddish brown. The colour index of the rock is <1, and its density is 2.71.

In thin section the quartz grains are euhedral and subhedral, show rounded and angular outlines, bipyramidal cross-sections and magmatic corrosion and embayment. The grains show wavy extinction due to strain. Feldspar phenocrysts are present, are completely altered by sericitization causing them to appear brown and turbid. They are hematized, contain irregular grains of pale green pleochroic chlorite, and are set in a hematized and sericitized quartzo-feldspathic matrix containing scattered grains of pale green pleochroic chlorite, and triangular, rectangular and irregularly-shaped opaque grains of leucoxene after ilmenite, and hematite.

A chemical analysis of this rock is listed in column 1 of Table 8 and its molecular norm in column 1 of Table 9. In the classification of Mackenzie and Chappell (1972, Figure 3), Figure 6 shows the rock to be a toscanite.

Intermediate Metavolcanics

These rocks are the most abundant of the shoshonitic rocks and in the map area occur mainly in southwestern Laurie Township. The rocks are reddish-brown on the weathered surface, and brown or dark brown on the fresh surface. Commonly the fresh surface is mottled with dark green ferromagnesian minerals. Quartz is usually absent. The colour index of the rocks is about 5. One of these rocks was examined in thin section and chemically analyzed.

In thin section it shows porphyritic-microgranular texture with euhedral and anhedral grains of sericitized feldspar, some of which show albite twinning, and aggregate polarization; and ovoid, rectangular and irregular areas of composite carbonate grains, in a highly carbonatized microgranular, sericitized quartzo-feldspathic matrix containing pale green pleochroic grains of chlorite. Accessory minerals comprise opaque grains of pyrite, hematite, and leucoxene after ilmenite. The sericite of the matrix is hematized.

In the classification of Mackenzie and Chappell (1972, Figure 3), Figure 6 shows the rock to be a high-K dacite, but as this rocks is altered and resembles the shoshonitic rocks of the map area in lithological characteristics, it is classed by the author as a member of the shoshonite association, probably a latite. Its normative colour index is 13 and its density is 2.74.

Pyroclastic Rocks

These rocks comprise tuffs, lapilli-tuffs and debris flows. Like the flows, the rocks are characteristically reddish or reddish brown on the weathered surface, and red to brown on the fresh surface. They occur in the south-central part of Laurie Township.

Tuffs

These are exposed in the central and west-central parts of Laurie Township, where they are interlayered with shoshonitic debris flows and calc-alkalic rocks. These tuffs are massive or foliated, fine grained, and are pink to greenish pink on the fresh surface and pinkish on the weathered surface. They are unbedded and form units 30-40 m thick. They consist predominantly of pink angular crystals of pink feldspar, angular to subangular rectangular grains of hornblende and chloritized hornblende measuring on average 1-1.5 mm in longest dimension, and sparse pink lithic clasts of feldspar porphyry about 2.5 mm, set in a finer-grained, pink and pinkish green matrix.

Lapilli-Tuffs

Lapilli-tuffs are similar in appearance to the tuffs but are coarser. They occur in the southwestern part of Laurie Township. They are unsorted, and consist of pink and peach-coloured angular and subrounded fragments of hornblende porphyry, hornblende-feldspar porphyry, and quartz-feldspar porphyry in a fine grained tuff matrix. This matrix is commonly a dark brown to greenish brown, darker in colour than the clasts, which range in size from 0.5 cm to 3 cm but with a few clasts as large as 12 cm.

Debris Flows

These rocks occur in southwestern Laurie Township. Like the lapilli-tuffs they consist of clasts of hornblende porphyry, feldspar porphyry, hornblende-feldspar porphyry and quartz or quartz-feldspar porphyry and occasionally chert, pumice, dark purplish hornblende porphyry and dark green mafic metavolcanics. These rocks are clast supported and are completely unsorted, with clasts ranging from 3X5 mm to 5X20 cm. The clasts are angular to subrounded. In most cases they are set in a matrix which consists of smaller pink clasts 3X5 mm in size which themselves are set in a dark green chloritic matrix. No bedding has been observed in these rocks.

METASEDIMENTS

These rocks comprise both clastic and chemical metasediments and occur interlayered with the metavolcanic rocks, principally the subalkalic rocks of the Keewatin-type sequence.

Clastic Metasediments

The clastic metasediments are more abundant than the chemical metasediments and the thickest unit of these rocks occurs in southern Laurie Township where a lens-shaped unit outcrops which, at its thickest, is about 1.2 km thick. The average thickness of the clastic units, however, is about 40 m. The rocks comprise wacke, siltstone, mudstone and a muddy laharic breccia.

Wackes are not very abundant in the map area but occur in southern and southwestern Laurie Township. They are light brown on the weathered surface and medium grey to black on the fresh surface. Bedding was observed in one outcrop only, located in the southwestern corner of Laurie Township, and here the beds are 25 cm thick and show graded bedding. The lithology ranges from a fine-grained sandstone at the base to mudstone at the top of the beds. A thin section of a wacke was examined and showed a micro-breccia texture comprising angular, subangular and less commonly subrounded grains of feldspar showing lamellar twinning and compositional zoning as the dominant detrital mineral, with minor angular and subangular quartz. Lithic fragments comprise ovoid-shaped clasts of microlitic volcanic rocks, microgranular felsitic rocks and quartz-feldspar porphyries. The crystals and lithic clasts are set in a grey, fine-grained matrix containing biotite pleochroic from brown to colourless, ovoid grains of carbonate and opaque grains of pyrite and possibly graphite as stringers and ovoid grains.

Siltstones occur in the southern part of Blackwell Township and in the northern half of Laurie Township. They weather to a grey colour on the weathered surface, and are dark grey on the fresh surface. These rocks are commonly interbedded with mudstones where the siltstone units form thin laminae 1-4 mm or beds 3-12 cm thick, but the average thickness of the beds is 3-5 cm. In the central part of the major siltstone-mudstone unit in southern Laurie Township a heavily pyritized facies of the siltstone was observed in two outcrops. The siltstone is black, and one of the outcrops contains ovoid pyrite nodules 1 x 2 cm in dimensions, and the more southerly outcrop contains finely disseminated pyrite forming 30% of the rock. It is believed by the author that this is the southerly of the two sulphidic conductive belts referred to by Jalna Resources Limited (Property No. 22) and shown on their accompanying geologic map (Assessment Files, AFRO, Toronto). Drilling had been carried out in the neighborhood of these outcrops by Caltor Syndicate in the period 1972-1973 and mineralization consisting of silver-lead-zinc-copper along with pyrite and pyrrhotite was encountered (see Property No. 22).

Mudstones occur associated with the siltstones in both the southern part of Blackwell Township and northern Laurie Township, but are most common in southern Laurie Township. The rocks are greyish to greyish-brown on the weathered surface and black on the fresh surface. They are massive to well foliated, and are very thinly laminated with laminae ranging from 1-3 mm. Where interlayered with siltstones the mudstone forms flame structures which serve to show the direction of local younging in the sediments.

Laharic breccia containing pyrite nodules forms a distinctive unit about 200 m thick and trending approximately east-west in south-central Laurie Township. This unit overlies the major sedimentary unit in the southern part of the Township. It is completely unsorted and is a polymictic, matrix-supported rock comprising rounded and angular fragments of graphitic shale, mud chips, chert, mafic and felsic volcanic rocks, and feldspar porphyry ranging from 3 mm to 30 cm in size and pyrite nodules averaging 3 cm across, in a black mudstone matrix. In addition to the pyrite nodules, pyrite grains measuring 1-2 mm are disseminated throughout the matrix and form about 2% of the rock. The finer-grained portion of the rock was assayed by the Geoscience Laboratories, Ontario Geological Survey, Toronto and it contained <0.01 ounce gold per ton, but 0.25 ounce silver per ton. This laharic unit is believed by the author to be the northern of the two subparallel sulphidic units forming the conductive sulphidic belt of Jalna Resources Limited (see Property No. 22).

Chemical Metasediments

Magnetite-jasper ironstone occurs interlayered with metavolcanic rocks in southwestern Blackwell Township and northeastern Laurie Township forming units up to about 4 m thick. It consists of parallel laminae of magnetite ranging from 0.5 to 2 cm alternating with bright red jasper bands ranging from 3-20 mm.

Jasper and chert unaccompanied by magnetite laminae were found in one area located about 1.3 km south-southwest of Mabella. Here the rocks occur as beds 2 cm thick interlayered with Keewatin-type intermediate to mafic tholeiitic metavolcanics forming a unit about 10 m thick.

METASEDIMENTS (QUETICO-TYPE)

Quetico-type rocks underlie the northern third of the map area in the northern half of Blackwell Township, and comprise wacke, siltstone, mudstone, gneiss and migmatite, of which wacke is the most abundant rock type. The rocks are intruded by the southern edge of a granitic batholith which extends northwards beyond the map area.

Wacke

These rocks are orange brown to greyish on the weathered surface and grey to dark grey on the fresh surface and are exposed throughout the area underlain by the Quetico-type metasediments. Bedding can commonly be observed in the rocks and the beds range in thickness from 0.2-15 cm but average 1-5 cm. Graded bedding has been observed and in these cases the rocks grade from a medium-to coarse-grained sandstone at the base to a mudstone in the upper part of the bed. The bedform is planar and planar cross-bedding was observed in one area only, namely near the eastern boundary of Blackwell Township in the east-central part of the township.

Garnetiferous wackes are dark grey rocks on the fresh surface and contain pink garnets which form 2-3% of the rocks and consist of equant grains of garnet ranging from 0.5 x 1.5 mm to 2 x 2 mm in dimensions. On the weathered surface these garnets are more resistant to weathering than the rest of the rock and this circumstance imparts a rough surface to the rocks. The rocks are restricted to the area to the south of the granitic batholith. The Quetico-type metasedimentary rocks in this region are therefore in the garnet grade of regional metamorphism.

Siltstone and Mudstone

Siltstone and mudstone were not encountered as independent units but as interlayered components within the wackes. They form laminae and thin beds ranging from 0.2-2 cm.

Gneiss

Paragneisses are exposed in the northeastern corner of Blackwell Township. These rocks are coarser in grain size than the wackes, the average grain size as shown by the feldspar grains is 1.5 x 2 mm; and by biotite is 1 x 1 mm. The rocks show vague to moderately well-developed alternating bands of biotite-rich and feldspar-rich laminae ranging from 3 mm to 5 mm. On some of the gneisses a dark, thin, biotite-rich laminae occurs and in these cases the gneisses grade into migmatites. Small pockets and clots of biotite-rich material are in some cases found in the gneisses. These pockets and clots range in dimensions from 4 x 2 cm to 5 x 3 cm.

Migmatite

Wacke-pegmatite migmatite was observed in one outcrop near the east-central part of the eastern boundary of Blackwell Township. The rock consists of veins of granitic pegmatite 4 cm thick bordered with a 2 mm biotite-rich melanosome with pinch-and-swell structures in the pegmatitic leucosome.

Wacke-tonalite migmatite was restricted in its occurrence to enclaves within the granitic batholith along the northern boundary of the map area. The migmatite consists of biotite-rich, dark grey medium-grained wacke interlayered with 20-25 cm parallel veins of grey tonalite with 2-3 mm biotite-rich melanosome selvedges. The occurrence of these dark biotite-rich selvedges suggest that the tonalite is a leucosome. The migmatite is a stromatic migmatite in the classification of Mehnert (1968, p. 10, Figure 1a, 5).

METAMORPHOSED MAFIC INTRUSIVE ROCKS

These rocks occur as elongate bodies intrusive into the Keewatin-type and Quetico-type rocks throughout the map area. They are all small and measure 60 x 100 m to 300 x 600 m, except for one body occurring along the Timiskaming-Quetico boundary in south-central Blackwell Township, which is a linear mass, in excess of 6 km x 200 m and which extends eastwards into Goldie Township (Carter 1985, in preparation a). In some areas the contact regions of these bodies were exposed and these show that the rocks are intrusive into the Keewatin-type and Quetico-type rocks. The bodies become fine-grained in their contact areas and may be sheared. In some cases they show complex, interlayered relationships with the enclosing rocks. Contact relations were not observed with the Timiskaming-type rocks and their relationship with these rocks have not been definitely established. Gabbroic bodies were not found interlayered with the Timiskaming-type rocks, however, and are therefore interpreted by the author to be older than the Timiskaming-type rocks.

Gabbro

These are medium- to coarse-grained, massive rocks grey to grey-green or pale brown on the weathered surface and grey-green, mottled medium grey, green and dark green on the fresh surface. The coarser-grained rocks show a stellate, radial arrangement of short, bladed ferromagnesian minerals alternating with grey, lath-shaped feldspar. Radial, stellate, lath-shaped ferromagnesian minerals are dark green, and measure 9 x 1.5 mm to 10 x 2 mm in dimensions. The radial feldspar measures about 6 x 3 mm. The medium-grained rocks are equigranular in texture and do not show the radial arrangement of feldspar and/or ferromagnesian minerals. The grains in the medium-grained rocks average about 3 mm across.

Three specimens of the coarse-grained rocks were examined in thin section. Their texture is coarse radial-intergranular. The clear parts of partially altered plagioclase is albite (An_8), otherwise the feldspar is completely or almost completely altered to a brownish mineral which is white by reflected light. The grains occur as subhedral and euhedral laths, generally subangular and are simply twinned or show lamellar twinning. Where altered this twinning can still be seen and the altered feldspar in these cases is interpreted to be plagioclase. The ferromagnesian primary mineral, where seen to be relict, is clinopyroxene showing twinning on (100) and this, in some grains together with salite parting on (001) gives rise to herringbone structure. In most cases however, the grains are altered to actinolite, massive or fibrous, and this in turn is altered to chlorite. The ferromagnesian clinopyroxene or actinolite is lath-shaped, euhedral, and in some cases is curved. The chlorite is pale green, shows anomalous Berlin blue and purple interference, occurs replacing actinolite or occurs as interstitial grains. Epidote occurs as irregularly-shaped, composite aggregates of smaller grains of pistacite and is derived from the clinopyroxene. Quartz occurs both in anhedral separate grains or combined with feldspar as micropegmatite, which, in some of the rocks, occurs as irregularly-shaped interstitial grains. Opaque grains comprise ilmenite, leucoxene after ilmenite, pyrite and magnetite.

One thin section of the non-radial-textured gabbros was examined. This rock is medium grained and massive, grey-green on the weathered surface and dark green on the fresh surface. It shows equigranular texture on the weathered surface and also in thin section where the feldspar, however, is surrounded by the ferromagnesian minerals. The thin section shows quartz occurring as anhedral grains showing slightly wavy extinction. The feldspar, which is too altered to be determined optically, occurs as euhedral and subhedral laths brown through alteration and white by reflected light. It shows simple and lamellar twinning and is interpreted to be plagioclase. Micropegmatite occurs as irregular areas. Clinopyroxene occurs as laths altered to actinolite and pale green chlorite locally, is twinned on (100) and gives rise to herringbone texture when the salite parting parallel to (001) is developed. Epidote comprises pistacite derived from actinolite and feldspar. The chlorite shows blue-grey interference colours. Opaque grains comprise ilmenite, leucoxene after ilmenite and pyrite.

FELSIC INTRUSIVE ROCKS

Granitic rocks forming parts of extensive complex batholiths outcrop at the northern and southern boundaries of the map area. Those at the northern boundary, in northern Blackwell Township, comprise the southern border zone of a unnamed batholith extending northward beyond the map area. Granitic rocks at the southwestern boundary of the map area, in southwestern Laurie Township comprise part of the northeastern border zone of the Sundbar-Batwing Batholith.

Brown hornblende-feldspar porphyry comprises the eastern part of a stock located at the middle part of the western boundary of Blackwell Township.

Small bodies of grey feldspar porphyry and grey granophyre interpreted to intrude the Keewatin-type and Timiskaming-type rocks respectively, occur in central

Laurie Township. Contacts with their enclosing rocks were not observed but thin-section study of these rocks suggest, from the coarseness of the matrix, the occurrence of granophyric texture and B-quartz paramorphs, that they are high level intrusives. The absence of vesicular and flow texture supports the interpretation that these rocks are not flows.

Batholiths

Northern Batholith

This batholith is intrusive into the Quetico-type metasedimentary rocks and contains xenoliths of wackes of the Quetico-type rocks. The rocks are predominantly massive and of medium to coarse grain, but are locally gneissic, the gneissosity being shown by the preferred orientation of biotite flakes. This gneissosity trends on average east-west and dips steeply north or south, or is vertical. The major unit is a leucocratic, pink, pink-weathering, massive, megascopically quartz-bearing phase which comprises biotite-muscovite granite, biotite granodiorite and biotite quartz monzonite and occurs in the northwestern and northeastern corners of Blackwell Township. A grey phase is of restricted distribution and occurs as two isolated masses approximately 200 x 300 m. One of these bodies located in northwestern Blackwell Township is a melanocratic, dark grey, massive, biotite-rich quartz monzodiorite and intrusive contacts show that it is older than the pink phase. It contains pink and grey feldspars. The other grey phase is located in the northeastern part of the township and is a biotite-rich quartz diorite. Contact relationships between this mass and the pink phase were not exposed, but the similarity of the two phases suggests that this grey phase is also older that the pink phase. The paucity of outcrop prevents obtaining a more reliable estimate of the sizes of the melanocratic phases.

Granite, Granodiorite and Quartz Monzonite - Pink

This phase underlies most of the area occupied by the batholith. It is massive and pink to pinkish grey on the fresh surface and pink on the weathered surface. The ferromagnesian mineral is biotite. Modal analyses show that this phase comprises granite, granodiorite and quartz monzonite in the classification of Streckeisen (1976). The modal analyses are listed in Table 13 and plotted on Figure 7.

Granite

This rock type is pink and in hand specimen has an estimated average grain size of 2 mm and colour index of 3.

One sample of these rocks was studied in thin section. It shows allotriomorphic-granular texture. Felsic minerals comprise: quartz, amounting to 29%, and occurring as anhedral grains with sinuous and interlocking boundaries; microcline (32%) and microcline-perthite (patch perthite) (1%) which occurs as anhedral grains with irregular boundaries, shows grid-iron twinning generally but locally is untwinned, and shows wavy extinction; and plagioclase (31%), which, where freshest is oligoclase (An21) but where sericitized shows secondary albite (An 9), occurs as anhedral grains variably-sericitized in the cores and rims, and shows narrow albite twinning. The ferromagnesian minerals comprise biotite (5%) occurring as laths and flakes pleochroic from brown to yellow; chlorite (1%) also occurring as flakes and pleochroic from green to pale yellow; and muscovite (10%) occurring as radiating colourless flakes. Accessory minerals comprise myrmekite lobed into the microcline where in contact with plagioclase; euhedral apatite; brown subhedral titanite, and square and rectangular pyrite. A modal analysis of the rock is listed in column 1 of Table 13 and is classed as a biotite-muscovite granite in the classification of Streckeisen (1976).

Granodiorite

These pink rocks have an estimated average grain size of 3 x 4 mm in hand specimen and a colour index of 3.

Two specimens were studied in thin section both of which show hypidiomorphic-granular texture formed by tabular subhedral plagioclase and anhedral quartz and microcline. The felsic minerals comprise: quartz (22%) which occurs as anhedral grains showing wavy extinction, has irregular, sinuous and straight boundaries and is interstitial; microcline and microcline perthite (21%)

which occurs as anhedral, equant grains, showing well-developed but patchy grid iron structure and has irregular boundaries; plagioclase (An 21) amounting to 47% which forms subhedral tabular grains that are variably sericitized (in the cores and rims) and show narrow albite twins and wavy extinction; and myrmekite (1%) occurring as bulbous masses attached to the plagioclase and lobed into the microcline where these two minerals are in contact. The ferromagnesian mineral consists of biotite (8%) occurring as lath-shaped flakes with irregular terminations and altered to chlorite pleochroic in shades of green and yellow. Accessory minerals comprise muscovite as small, narrow flakes; euhedral and anhedral apatite; pale brown subhedral titanite; and rectangular and hexagonal opaque grains of magnetite. Modal analyses of these rocks are listed in columns 2 and 3 of Table 13 and they have been plotted on the QAP diagram of Streckeisen (1976) Figure 7, which shows that they are biotite granodiorite.

Quartz Monzonite

Like the granites and granodiorites these rocks are pink on the fresh surface but are pinkish white on weathered surface. They are medium grained with estimated average size of the grains as 2 x 3 mm and their colour index is about 3.

One thin section of these rocks was studied. It shows allotriomorphic-granular texture. The felsic minerals comprise: quartz (17%) occurring as anhedral grains showing wavy extinction and sutured boundaries; microcline and microcline-perthite (string and patch perthite) (45%) occurring as subhedral grains with irregular boundaries; plagioclase (An 17) amounting to 35% and forming subhedral tabular grains, is variably sericitized and shows narrow albite twins; and myrmekite forming bulbous outgrowths on the plagioclase and lobed into the microcline. The ferromagnesium minerals comprise: biotite (3%) occurring as unaltered and chloritized flakes, pleochroic from brown to yellow; muscovite as flakes; and green chlorite. Accessory minerals comprise opaque rectangular grains of magnetite and elongated grains of colourless apatite. The modal analysis of this rock is listed in column 4 of Table 13 and when plotted on the QAP diagram of Streckeisen (1976), Figure - shows that the rock is a biotite quartz monzonite.

Monzonite and Quartz Diorite - Grey

This phase which forms two small stock-like bodies in the northwestern and northeastern parts of the batholith occur in Blackwell Township. Modal analyses of these rocks show that they are hornblende-biotite quartz monzodiorite and biotite quartz diorite respectively in the classification of Streckeisen (1976). The analyses are listed in Table 13 and plotted on Figure - .

Quartz Monzodiorite

This rock type is mottled pink and grey and black, the overall aspect is that of a dark grey rock. It is massive, medium grained with an average size of grains of 2 x 3 mm and a colour index of 20.

One thin section of this rock type was studied. It shows allotriomorphic-granular texture. The felsic minerals comprise: quartz (10%) occurring as anhedral grains showing a range of sizes, irregular boundaries and occurs interstitially; microcline (14%) as interstitial anhedral grains; and plagioclase (An15) amounting to 40%, forming subhedral tabular grains which are partially and completely sericitized, and show wavy extinction. The ferromagnesian minerals comprise: hornblende (15%) which is pleochroic from blue green to yellow and occurs as anhedral poikiloblastic grains containing irregular quartz inclusions, titanite along cleavages, and twinned on the orthopinacoid in some grains; and biotite (20%) occurring as flakes with irregular ends, pleochroic from olive green to yellow and locally enclosing apatite. Accessory minerals comprise pale brown lath-like and subhedral grains of titanite; and apatite as euhedral and subhedral grains. A modal analysis of the rock is listed in column 5 of Table 13, and when plotted on the QAP diagram of Streckeisen (1976), Figure 7, the rock is classed as a hornblende-biotite quartz monzonite.

Quartz Diorite

This rock type is a mottled grey and black rock with an overall aspect of a dark grey rock. It is massive, medium grained, with an average size of grains of 1.5 x 3 mm, some of which are elongate. It has a colour index of about 20.

One thin section of this rock type was studied. It shows hypidiomorphic-granular texture. The felsic minerals comprise: quartz (13%) occurring as anhedral, interstitial grains showing wavy extinction; no potassic feldspar; and plagioclase (An 31) amounting to 58% and consisting of partially to completely sericitized subhedral tabular grains showing narrow albite twinning and wavy extinction. The ferromagnesian minerals comprise: biotite (26%) occurring as laths pleochroic from brown to pale yellow with pleochroic haloes and enclosures of apatite; chlorite flakes pleochroic from green to yellow; and colourless muscovite laths. Accessory minerals consist of colourless euhedral apatite, colourless euhedral zircon, which, when in biotite, is surrounded by pleochroic haloes; pistacite; and opaque grains of pyrite as square and rectangular grains, locally altered to hematite. A modal analysis of the rock is listed in column 6 of Table 13, and when plotted on the QAP diagram of Streckeisen (1976), Figure 7, the rock is classed as a biotite quartz diorite.

SUNDBAR-BATWING BATHOLITH

This batholithic mass is represented in the map area by a convex-north lobe of the northeastern margin of the batholith is southwestern Laurie Township. It is intrusive into the metasediments which form part of the

Keewatin-type sequence. All the rocks encountered are pink on the fresh and weathered surfaces and two phases were observed: a medium-grained massive phase forming two-thirds of the mass and containing about 10% of dark green acicular hornblende; and a minor part forming the eastern third which is porphyritic and contains phenocrysts of grey feldspar, (microcline) up to 5 x 10 mm which forms about 5% of the rock. The ferromagnesium minerals in this porphyritic phase are biotite and hornblende which form about 7% of the rock.

Granodiorite

An example of this phase, studied in thin section is medium-grained, massive, and pale pink on the weathered and fresh surfaces. Occasionally a large phenocryst of pale grey feldspar 5 x 4 mm is observed but on the whole this phase in aphyric with the average size of the grains being about 2 x 3 mm. The colour index of the rock is about 2.

In thin section the rock shows hypidiomorphic-granular texture. The felsic minerals comprise: quartz (29%) occurring as anhedral interstitial grains of variable grain size and showing wavy extinction due to strain; anhedral microcline (19%) occurring interstitially; euhedral and subhedral tabular plagioclase (An10, albite-oligoclase) amounting to 47% and which in some grains, is completely sericitized; and bulbous outgrowths of myrmekite on the plagioclase lobed into the microcline. The ferromagnesian minerals comprise: hornblende (2%) pleochroic from blue-green to green and olive green to yellow occurring as anhedral and lath-shaped grains; and chlorite (1%) pleochroic from pale green to yellow as flakes. Accessory minerals comprise pale brown subhedral titanite some of which are enclosed in the biotite; zircon enclosed in plagioclase feldspar; pistacite as yellow elongated subhedral grains in plagioclase feldspar and along cleavages in biotite; euhedral and subhedral grains of apatite; and square opaque grains of pyrite. A modal analysis of this rock is listed in column 7 of Table 13, and when plotted on the QAP diagram of Streckeisen (1976), Figure 7, the rock is classed as a hornblende granodiorite.

Quartz Monzodiorite - Porphyritic

An example of this porphyritic rock phase studied in thin section is pink on the fresh surface and pinkish brown on the weathered surface. The phenocrysts measure up to 5 x 10 mm and are simply twinned. The rock is medium grained with average size of the grains of the matrix about 3 x 4 mm, and its colour index is about 3.

In thin section the grey phenocrysts are microcline. The texture of the rock is porphyritic-hypidiomorphic granular. The felsic minerals comprise: quartz (15%) as anhedral grains of variable size which show slight wavy extinction due to strain; microcline (25%) as rectangular phenocrysts and as anhedral groundmass grains; plagioclase (An 17, oligoclase) amounting to 50% and occurring as tabular euhedral and subhedral grains show narrow albite twinning and when partially to completely sericitized are brownish; and myrmekite (1%) growing on plagioclase into microcline as lobate masses. The ferromagnesian minerals comprise: biotite (4%) as broad laths pleochroic from brown and green to yellow; and hornblende (2%) occurring as subhedral and euhedral grains pleochroic from blue-green and green to yellow, some of which poikilitically enclose plagioclase and zircon grains with pleochroic halos and show alteration to chlorite; and chlorite (3%) as green flakes formed from both biotite and hornblende. Accessory minerals include euhedral and subhedral apatite, pale brown euhedral and subhedral titanite, and opaque magnetite and hematite. A modal analysis of the rock is listed in column 8 of Table 13, and when plotted on the QAP diagram of Streckeisen (1976), Figure 7, it is classed as a biotite-hornblende quartz monzodiorite.

STOCKS

Hornblende-Feldspar Porphyry

This is a distinctive rock type which is massive, pink on the weathered surface and mottled green and brown on the fresh surface. As contacts with its surrounding rocks were not observed, its relative age with respect to the Keewatin-type sequence is not known, but as cobbles and boulders of this rock type were found in the Timiskaming-type conglomerates of the northern belt nearby, the unit is pre-Timiskaming in age.

In hand specimen the feldspar phenocrysts are pale pink to peach in colour, are equant averaging 2 x 2 mm in cross-section and form about 7% of the rock. The ferromagnesian mineral is altered dark green chloritized hornblende which forms phenocrysts that are 2 x 1.5 mm to 5 x 2 mm in dimension, euhedral, and form about 10% of the rock. The matrix of the rock is fine-grained, greenish brown. The colour index of the rocks is about 5 and the specific gravity of a chemically analyzed sample described below is 2.79.

One thin section of these rocks was studied. It shows porphyritic-microgranular to cryptogranular texture, with phenocrysts of plagioclase and chlorite pseudomorphs after hornblende. The plagioclase phenocrysts are euhedral and subhedral, cloudy and sericitized and show lamellar albite twinning, simple twinning, as well as no twinning. The ferromagnesian mineral is chloritized hornblende, the chlorite-carbonate pseudomorphs showing the characteristic six-sided prismatic cross-section (Photo 11) of hornblende. The margins of many of these grains show rims of opaque grains indicating reaction with the matrix which suggests a volcanic to high-level of implacement. The absence of vesicles, flow textures, and the grain size of the matrix suggest a high-level plutonic emplacement rather than that of a flow. Accessory minerals in the matrix are apatite, ilmenite, leucosome, and epidote. During the mapping this rock type was observed to grade into varieties with an aphanitic matrix of volcanic aspect and this supports the suggestion that the unit is a subvolcanic intrusion.

A chemical analysis was made of this rock and the results are listed in column 1 of Table 14. Its molecular norm is listed in column 1 of Table 15. On the AFM diagram, Figure 8, the rock is calc-alkalic and in the volcanic chemical classification of Irvine and Baragar (1971) the rock is chemically equivalent to a calc-alkalic andesite.

Minor Intrusions

Feldspar Porphyry

This rock is greyish-white on the weathered surface and light grey on the fresh surface. It has a colour index of <1 and is fine grained and massive. Phenocrysts of feldspar are only with difficulty seen on the weathered surface.

In thin section the rock shows euhedral and subhedral plagioclase which is slightly cloudy due to sericitization. The phenocrysts form only about 2% of the rock and show broad and fine lamellar twinning and occasional acline-A twinning. The matrix consists almost entirely of small equant, subhedral, slightly cloudy plagioclase also showing fine and coarse lamellar twinning. Scattered throughout the matrix are epidote and irregular lens-shaped cloudy areas of leucoxene.

A chemical analysis of the rock is listed in column 2 of Table 15 and its molecular norm in column 2 of Table 16. On the AFM diagram Figure 8, the rock is calc-alkalic and in the volcanic chemical classification of Irvine and Baragar (1971) the rock is chemically equivalent to a calc-alkalic dacite. The rock is petrographically fresh and its classification is considered by the author to be reliable.

Granophyre

This rock is likewise greyish-white on the weathered surface and light grey on the fresh surface. It is massive, fine-grained, and contains flecks of dark blackish-green ferromagnesian minerals forming about 2-3% of the rock. These grains average 1.5 x 1 mm in dimensions. The colour index of the rock is about 3.

In thin section the texture of the rock is porphyritic-granophyric granular and contains phenocrysts of euhedral and subhedral quartz, some of which show the characteristic hexagonal, bipyramidal cross-sectional habit and fractures of B-quartz, with wavy extinction; subhedral phenocrysts and anhedral grains of sericitized feldspar showing broad twin lamellae, in a granular quartzo-feldspathic matrix consisting of subhedral grains of twinned and untwinned feldspar rimmed by granophyric quartzo-feldspathic intergrowths. Scattered throughout the matrix are muscovite as irregular grains with ragged ends, olive-green chlorite, carbonate, leucoxene as irregular grains and pyrite as square and rectangular grains.

METAVOLCANICS AND METASEDIMENTS (TIMISKAMING-TYPE)

METAVOLCANICS

Metavolcanic rocks belonging to the Timiskaming-type sequence comprise calc-alkalic and alkalic flows and pyroclastic rocks. The rocks assigned to the calc-alkalic suite are grey, those to the alkalic suite are purplish, brown and red. These metavolcanic rocks are interlayered with the Timiskaming-type sediments and occur both in the northern and southern belt of Timiskaming-type rocks.

SUBALKALIC METAVOLCANICS

Calc-alkalic Metavolcanics

Intermediate Flows

A medium grey, megascopically aphanitic flow with a white-weathering surface was located interlayered with the clastic metasediments and red alkalic shoshonitic rocks in the northern belt of Timiskaming-type rocks along the Shebandowan River in southwestern Blackwell Township. A chemical analysis has not been made of this rock but it lithologically resembles intermediate calc-alkalic rocks occurring in the Keewatin-type rocks.

In thin section (Photo 12) the rock shows porphyritic-cryptogranular texture, with preferred orientation of the tabular feldspar phenocrysts indicating flow. The feldspar phenocrysts, which show parallel alignment, are lath-shaped, euhedral and subhedral, are sericitized and carbonatized, and show lamellar albite twinning which suggests that they are plagioclase. The matrix which appears to be devitrified is microgranular and cryptogranular, the cryptogranular areas being dark grey and mildly cataclased. The matrix contains olive green chlorite as narrow laths, streaks and equant grains which are rectangular and are associated with leucoxene and carbonate and appear to be alteration products of a primary ferromagnesian mineral. Opaque minerals comprise ilmenite grains altered to leucoxene, which are aligned parallel to the weak foliation.

Tuff

One example of a crystal tuff was located interlayered with the clastic sediments in the southern belt of Timiskaming-type rocks in central Laurie Township. The rock is aphanitic, grey on the fresh surface and pale brownish-grey on the weathered surface.

In thin section it shows clastic texture with subhedral, broken, equant and wedge-shaped grains of variably sericitized feldspar, some of which show lamellar twinning suggesting plagioclase, and which form about 80% of the rock; and clastic, angular, subrounded, square, irregularly shaped, and triangular grains of quartz some of which show cuspate shapes and patchy extinction suggestive of divitrified bubble-wall glass shards and forming about 5% of the rock, lying in a brownish, fine-grained matrix containing pale green chlorite and irregular and lath-shaped grains of ilmenite altered to leucoxene. The rock is interpreted by the author to be a crystal tuff.

Alkalic Metavolcanics

Shoshonitic Metavolcanics

These rocks consist of flows and pyroclastic rocks that are characteristically mauve, dark reddish-brown or red in colour on the fresh surface and brown and pink on the weathered surface. They occur interlayered with the sedimentary rocks and form units approximately 40 to 60 m thick. These rocks are not voluminous and may easily be missed during routine mapping.

Mafic Flows

Examples of mafic flows were observed in southwestern Blackwell Township south of Highway 11 near the Shebandowan River, about 0.8 km east-southeast of Annex.

One sample of these rocks which was thin sectioned and chemically analyzed is dark purple on the fresh surface and dark reddish brown on the weathered surface. It is well foliated and contains thin red laminae 1 mm thick. The density of the rock is 2.74.

In thin section it shows cataclastic to mylonitic texture (Photo 13) in which discontinuous ovoid areas of sericite alternate with darker bands of sericite, chlorite and carbonate. Accessory minerals comprise apatite, leucoxene, and square, rectangular, and subrectangular pyrite. The entire rock has been hematized.

A chemical analysis of the rock is listed in column 3 of Table 13 and its molecular norm in column 3 of Table 14. In the chemical classification of Mackenzie and Chappell (1972, Figure 3) the rock is classed as a shoshonite, Figure 9.

Intermediate Flows

Intermediate flows were observed in the same area as the mafic flow described above. These rocks are brown and brick-red on the fresh surface and brown or pink on the weathered surface. They are commonly porphyritic and show phenocrysts of hornblende or chloritized, dark green hornblende measuring up to 2 x 3 mm in dimensions and forming about 7% of the rock. In some cases the dark green ferromagnesian material occurs as irregular clots up to 8 x 4 mm.

A thin section from one of these rocks shows porphyritic-flow texture (Photo 14) with a superimposed secondary foliation. Mineralogically the rock consists of euhedral and subhedral phenocrysts of hornblende, pleochroic from light yellow to yellow green, in a sericitized, hematized matrix containing apatite and streaks and small equant areas of ilmenite altered to leucoxene.

Pyroclastic Metavolcanics

Intermediate Pyroclastics

Tuff

These rocks are brown or reddish brown on the fresh surface and brown on the weathered surface. They are massive and on the fresh surface can be seen to consist of grains of pink feldspar, minor amounts of grey feldspar and dark green ferromagnesian minerals. The grains are about 1 mm x 1 mm.

In thin section one of these rocks shows clastic-foliated texture containing subhedral sericitized feldspar many of which show lamellar albite twinning and are therefore interpreted to be plagioclase; grains of euhedral and subhedral hornblende pleochroic from pale green to yellow, some of which occur as laths with ragged terminations, and pale green chlorite. Accessory minerals comprise leucoxene after ilmenite occurring as semi-opaqüe, equant grains and as streaks emphasizing the foliation, and apatite. These minerals lie in a red, hematized, feldspathic matrix.

Lapilli-Tuff

This rock type is exposed in an area immediately west of the middle part of Mabella Road. The unit, exposed in a stripped, 12 m section on the west side of the road, consists of a graded unit reddish brown on weathered surface and comprising angular fragments measuring from 3 x 5 mm to 30 x 15 mm of red hornblende latite, pink feldspar porphyry, and quartz porphyry at the base passing upwards (southwestwards) into crystal tuff containing ovoid, black, flattened fragments of chert and pale greenish flattered pumice fragments measuring 30 mm x 5 mm. The simple graded nature of the deposit and the banding suggests a pyroclastic fall deposit.

A thin section was made of the red hornblende-feldspar porphyry fragment of a breccia unit located 140 m west of the outcrop at the western part of Mabella Road described above. It shows (Photo 15) porphyritic texture with phenocrysts of euhedral and subhedral laths of feldspar, which are turbid, sericitized, and brownish in colour. Some of the feldspar show simple twinning and lamellar twinning suggesting plagioclase. Also present are euhedral and subhedral prismatic and lath-shaped phenocrysts of hornblende, pleochroic from yellowish brown to pale yellow, some of which are epidotized; lath shaped and prismatic grains of actinolite and chlorite pseudomorphs after hornblende, in a hematized, fine-grained, feldspathic matrix containing apatite and leucoxene after ilmenite. The density of the rock is 2.72.

The chemical analysis of the rock is listed in column 4 of Table 11 and its molecular norm in column 4 of Table 12. In the chemical classification of Mackenzie and Chappell (1972, Figure 3) the clast is a latite (Figure 3).

Debris Flows (coarse-grained)

Debris flows occur at outcrops on both sides of Highway 11, 2 km east of its intersection with Mabella Road and at an outcrop along the Canadian National Railway track 1.1 km southwest of the same intersection. The colour of the fresh surface of the rock is red or mottled red and green and that of the weathered surface is dull red-brown mottled with dark green. The clasts are angular, subangular, subround and round and comprise red hornblende-porphyry, red hornblende-feldspar porphyry and red feldspar porphyry forming about 80% of the clasts, and 1-5% of subrounded clasts of dark green mafic metavolcanics in a matrix of altered green mafic minerals and pink feldspar forming 15-19% of the rock. The rock is completely unsorted, matrix supported and the large clasts range from 5 x 5 cm to 10 x 12 cm. Some of the clasts show a bleached rim of lighter colour about 0.5 - 1 cm wide and appear to have been hot when deposited. The red and brown clasts in the tuff-breccia are similar to the rocks forming the flows described earlier.

Metasediments

These rocks comprise the more voluminous part of the Timiskaming sequence in the map area and occur in two subparallel belts about 1.5 km wide and trending east-southeast across the map area. The centres of these belts are about 6.7 km apart. The rocks comprise conglomerate, arenite, siltstone, mudstone, and ironstone.

Clastic Metasediments

Conglomerate

Conglomerates occur in both belts and in an area of Timiskaming-type sediments outcropping in southwest Laurie Township. However, the rock type is most abundant in the northern belt. The conglomerate is polymictic, matrix supported and the matrix can be fine grained and chloritic, pale grey-green when it is coarse sand to granule sized, and reddish brown and feldspathic when it is sand sized. The clasts comprise pink hornblende-feldspar porphyry, pink hornblende latite, feldspar porphyry, quartz-feldspar porphyry, pink felsite, grey tonalite, dark green mafic metavolcanic rocks, grey and black chert, red jasper and quartz pebbles. The conglomerate is completely unsorted with fragments ranging from 1 cm to 30 cm, but the chert and jasper are usually smaller, ranging from 0.4 to 1 cm, and the vein-quartz pebbles average 2-3 cm. The clasts are subangular to rounded. Jasper is almost always present in these conglomerates and serves to distinguish them from pyroclastic rocks which can commonly look very similar. In places the conglomerate contains tabular units ranging from 1 to 3 m of fairly well-sorted, arkosic sediment interlayered with it. These can be bedded and graded and serve to establish the attitude and local younging direction of the conglomerates.

Arkose and Arenite

Arkose comprises three varieties: a red arkose, a green arkose and a grey arkose and they occur in both belts. The red arkose is either massive or shows cross-bedding locally. The grains average 1-1.5 mm and the rock is moderately to well sorted. The feldspars are red in colour, comprise about 80% of the rock and are angular to subangular grains. Quartz occurs as clear angular to subangular grains forming up to 7% of the rock. In the green arkose some of the grains present may be pink but the overall colour of the fresh surface of the rock is green to grey-green. The green colour is due to the presence of chlorite in the matrix of the rock. The feldspar comprises about 50-60% of the rocks, with quartz either absent or forming about 15% of the rock. These arkoses are not as well sorted as the red arkose and can be classed as poor to moderately sorted. Bedding is not common in these rocks. The grey arkose is similar to the others in sorting and grain size. Quartz is usually absent and the rocks are massive. Some of these rocks may be crystal tuffs.

Arenite was encountered in one area only in the southwestern corner of Blackwell Township as a small outlier. The rock is quartzitic in appearance, massive and yellow on the fresh surface weathering to a buff-coloured surface. Owing to fine disseminated pyrite amounting to 7%, a brown weathering limonitic layer underlies the weathered surface. No bedding was observed in this rock. Analysis of the rock for its gold and silver content by the Geoscience Laboratories, Ontario

Geological Survey yielded <0.01 ounce gold per ton and <0.10 ounce silver per ton.

Siltstone and Mudstone

Siltstones and mudstones occur predominantly in the southern belt of Timiskaming rocks and occur either as separate or interlayered units and sometimes are associated with arkose. They are dark grey and black on the fresh surface and pale brownish on the weathered surface. They occur in units up to about 200 m thick and where bedded the beds are about 0.6 m thick. Siltstone-mudstone units form graded or non-graded couplets.

Chemical Metasediments

Chemical metasediments within the Timiskaming-type rocks consist entirely of ironstone comprising combinations of magnetite with siltstone, green and red arkose, mudstone, slate, and red jasper. This ironstone is restricted to the southern belt and forms a linear belt mapped continuously, except for a 2 km gap, for a strike length of about 9.5 km across the central part of Laurie Township. It appears to be a single unit repeated by tight, steep to isoclinal folding, about a sinuous east-west axis. This ironstone unit is associated with an aeromagnetic anomaly throughout its length in Laurie Township and forms part of the Matawin Iron Range.

The ironstone units comprise magnetite occurring as black, very fine-grained, thinly bedded material forming bands 0.2-10 cm thick interlayered with jasper, arkose, siltstone and mudstone bands 0.2-8 cm thick. These laminae are parallel sided and fine-graded bedding can be observed in the siltstone units, though it is difficult to determine the top of the sequences unequivocally. These composite units are separated by the clastic sedimentary units mentioned above ranging up to 40 m thick. The ironstone units form mappable units about 50 m thick. In one place, about 800 m northwest of Middle Falls on the Matawin River, a band of pure magnetite about 80 m thick was observed. Locally the magnetite bands show complex microfolding and bed disruption interpreted by the author to be soft-sediment, primary deformation. This can be observed at Middle Falls, Matawin River. Primary brecciation has also been observed locally with fragmented bands of magnetite and jasper forming angular clasts up to 3 x 15 cm. In some cases small, dark green to black fragments of magnetite 1.5 x 2 mm occur in the interlayered arkose. The ironstone units of this Timiskaming-type sequence have been described in greater detail or referred to by: Grady (1893, p. 66-67); Williams (1893, p. 67-68), Conmee (1893, p. 69), Smith (1893, p. 78), Blue (1893, p. 86; 1895, p. 123; 1896, p. 130-132), Coleman (1896, p. 82-84, 1900, p. 154; 1902, p. 128-129), Dawson (1897, p. 49A), McInnes (1899, p. 57H), Bow (1900, p. 88), Gibson (1901, p. 35; 1902, p. 25, 60), Hille (1908, p. 5-9, p. 28-40), Lindeman and Bolton (1917, p. 56-60), and Tanton (1925, p. 12c-15c) during the early phases of exploration after the discovery of the ironstone in 1889; and more recently in company reports by Bartley (1952, AFRO, Toronto), Morrison and Ogden (1958, AFRO, Toronto), for Monpre Mining Company Limited, and Halet (1972, AFRO, Toronto), for Monpre Iron Mines Limited. The results of this more recent company exploration work are summarized in the property descriptions for Monpre Iron Mines Limited (Property No. 14) and Jalna Resources Limited (Property No. 11, Northeastern Area).

LATE ARCHEAN TO PROTEROZOIC

MAFIC INTRUSIVE ROCKS (DIKES)

Lamprophyre

Two types of lamprophyres were observed in the map area - a reddish to pinkish brown biotite lamprophyre and a grey-green hornblende lamprophyre. The biotite lamprophyres intrude the Timiskaming-type sediments in west-central Blackwell Township in the area about 0.8-1.3 km north-northwest of Mabella, and the Keewatin-type calc-alkalic and shoshonitic rocks in southwestern Laurie Township. In two of the three exposures located, they were dikes, one of which, exposed along Highway 11 about 1.9 km east of Annex, trends 90° and is 3 m wide. In the other two cases no trend was determinable. The hornblende lamprophyre is intrusive into the Keewatin-type mafic tholeiitic basalts, but no trend could be determined.

Biotite Lamprophyre

These rocks are brown and pinkish on the weathered surface and mottled dark green and pink on the fresh surface. The dark green represents biotite phenocrysts, which range in size from 0.5 x 1 mm to 3 x 3 mm. The pink is due to hematite and/or pink carbonate. Both massive and foliated varieties occur. Both are medium grained.

Three thin sections of these rocks were studied. The textures observed are porphyritic-allotriomorphic granular (Photo 16), cataclastic, and granoblastic-decussate. The ferromagnesian phenocrysts comprise pleochroic olive-green to yellow biotite which occurs in equant or elongate grains parallel to the foliation. In the rock showing decussate texture, the direction of the cleavage of the biotite grains is randomly oriented, whereas in the foliated rocks it is either parallel to the length of the grains or across the length, and arranged in an S-shaped sigmoidal form. It shows wavy extinction and is altered to pale green chlorite locally, which also shows wavy extinction. The carbonate occurs in equant or elongate grains with irregular boundaries and shows lamellar twinning. Feldspar occurs as anhedral grains, and is restricted to the matrix. It shows sutured boundaries, can be twinned or untwinned, and shows wavy extinction. The twinning is lamellar in narrow and broad bands. Accessory minerals comprise anhedral quartz, magnetite, ilmenite, leucoxene, and apatite. Staining shows the feldspar to be plagioclase.

Hornblende Lamprophyre

Only one outcrop of this rock type was located. It occurs in northeastern Laurie Township. The rock is intrusive into Keewatin-type tholeiitic basalts. In thin section it shows porphyritic-microgranular texture (Photo 17). The only phenocrysts are of hornblende which shows pleochroism from olive-green to pale yellow-green and occurs as subhedral laths and euhedral cross-sections. The grains are twinned on the orthopinacoid and some show twin seams. Carbonate occurs as anhedral grains and shows lamellar twinning. The matrix consists of anhedral microgranular plagioclase and anhedral epidote.

Diabase

Diabase dikes intrude the Keewatin-type rocks, the granitic rocks and the Timiskaming-type rocks. Where the trend of the dikes could be observed or deduced it was found to be north-northwesterly in the southern part of Blackwell Township where they intrude the granitic rocks and the Timiskaming-type sequence; north-northeasterly near the central part of the western boundary of Laurie Township where they cut Keewatin-type calc-alkalic and shoshonitic rocks; and east-west where they intrude the Keewatin-type tholeiitic mafic metavolcanics on the Matawin River in the central part of southern Laurie Township. The diabase dikes range from 2 m to about 40 m wide and dip vertically. The diabase is aphyric or porphyritic.

Aphyric Diabase

This is the most common type of diabase. The rocks are brown or red brown on their weathered surfaces and black on their fresh surfaces. They are of medium grain and are massive.

Two thin sections of two examples of these rocks were examined, one from a diabase believed to be intrusive into Timiskaming-type rocks in southeastern Blackwell Township, and one intrusive into the Keewatin-type calc-alkalic and shoshonitic rocks in southwestern

Laurie Township. In thin section they show coarse intergranular texture displayed by disoriented laths of plagioclase and clinopyroxene enclosing irregular areas composed of shorter, stubbier plagioclase and clinopyroxene. The lath-shaped plagioclase (An56-59, labradorite) is subhedral and euhedral, shows lamellar albite twinning and is variably sericitized. The clinopyroxene is colourless, lath-shaped, and variably marginally and centrally altered to olive-green uralite, hornblende and chlorite. It is, in places, twinned on the orthopinacoid and this combined with the salite parting gives rise to grains showing herringbone structure. The plagioclase and clinopyroxene enclose irregular areas of granophyre and myrmekite growing on the plagioclase, and interstitial pyrite, ilmenite, quartz and a second generation of plagioclase and clinopyroxene. Some of the granophyre and myrmekite is interstitial.

Porphyritic Diabase

This rock type occurs as dikes in southwestern Laurie Township. It comprises pale yellow phenocrysts of feldspar measuring 0.8 x 1-2 cm and forming 5-7% of the rock. These dikes trend north-northeasterly. Specimens of these rocks have not been examined in thin section. Apart from the phenocrysts they resemble the aphyric diabase described above.

PHANEROZOIC

CENOZOIC

QUATERNARY

Pleistocene and Recent

The Pleistocene geology of the map area was mapped at a reconnaissance scale by S.C. Zoltai between 1958 and 1960 (Zoltai, 1965), and later, in more detail by Mollard (1979a, b, 1980a, b). Within the map area Pleistocene deposits comprise morainal, glaciofluvial and glaciolacustrine accumulations and Recent deposits comprise organic material.

Pleistocene

Ground morainal deposits occur in the northwestern and northeastern corners of Blackwell Township and across most of its central part, but these deposits were observed only in the former two areas referred to during the current survey as traversing had not been carried out in the central part of Blackwell Township. In these areas the deposits consist of an unsorted mixture of rounded granitic cobbles, wacke and gneiss with minor amounts of flat, subrounded pebbles of mafic metavolcanic rocks in a matrix consisting of a mixture of yellow sand and clay. The deposit is more easily seen on a small, low, undulating ridge. No major gravel pits in this material were observed.

Glaciofluvial deposits comprise sand and gravel occurring as an esker ridge crossing the southeastern part of the map area in a south-southwesterly direction.

The esker forms a sinuous, steep ridge about 5.5 km long with about 30 m of relief. It is breached by a southeasterly-draining stream in the southeastern corner of Laurie Township. The esker material consists of sand and pebbles and rounded cobbles, the latter measuring about 15 x 5 cm. The pebbles and cobbles consist of intermediate volcanic and minor, grey granitic rocks. The sand is pale yellowish brown.

Glaciolacustrine deposits occur in northeastern Blackwell Township; in southeastern Blackwell Township at Shabaqua Corners; in the northeastern and southeastern corners of Laurie Township, and in northwestern Laurie Township centred in an area about 1 km south of Sand Lake (local name). Areas underlain by these deposits are usually flat to gently undulating and range from areas of low outcrop density to areas devoid of any outcrops. The material consists of a fine red clay which can be well observed in the northeastern part of Blackwell Township and southeastern Laurie Township, where it forms low areas. At the edge of the southern limit of an exposure of this type of deposit occurring at Shabaqua Corners, a gravel pit excavated in them located along the logging road south of Shabaqua Station showed a section (Photo 18) consisting from the top downwards of: 1 m of pale buff and red varved clay underlain by 5 cm of sand, which in turn is underlain by till comprising cobbles and pebbles of pale grey granitic rocks in a sand matrix. At Shabaqua Corners, at the junction of Highway 11 and 17, in the southeastern corner of Blackwell Township, these deposits are well exposed in large gravel pits. Here the deposits consist of red clay and outwash sand and gravel.

Recent

Recent deposits comprise organic accumulations of peat and muck overlying Pleistocene deposits and Precambrian rocks along stream courses and in low-lying areas of open and treed swamps, muskegs and black spruce bogs in central Laurie Township; and fine alluvium and coarse gravel in streams and rivers.

Organic deposits occur along the stream running parallel to and about 1 km south of the Shabandowan River and along the upper reaches of the Matawin River above Middle Falls and its west bank tributaries.

Fine alluvium and coarse gravel occur in discontinuous patches along the Shebandowan River. The alluvium occurs in the shallow low-energy reaches of the river, the gravels in areas where rapids occur.

STRUCTURAL GEOLOGY

Structurally the map area is characterized by an east to east-southeasterly grain which reflects the folding and foliation within the Keewatin-type and Timiskaming-type supracrustal rocks.

Folding

Folding in the Keewatin-type metavolcanic-metasedimentary rocks is based on bedding attitudes and facing criteria obtained from sediments, interflow sediments and tuffs, and facing data from pillow shapes in pillowed metavolcanic rocks, and the results of similar data from Goldie and Horne Townships adjoining the area to the east (Carter, 1985). Folding is about curvilinear axes convex to the northeast which veer from westerly in the western part of the map area to southeasterly in the eastern part of the region. In the southern part of the map area, in southern Laurie Township a curvilinear synclinal axis is deduced convex to the north. The stratigraphic progression from a mafic basal to a felsic upper part, the occurrence of anticlinal and synclinal fold axes within the sequence, and a synclinal axis within the upper part of the sequence indicate a regional synclinorium with its central axis located in the upper-Keewatin-type rocks located in south-central Laurie Township. Figure 10, which is an equal area plot of the poles to bedding in the Keewatin-type rocks summarizes the fold pattern in the area. It shows the steep, isoclinal character of the folding with an axial plane trending ESE. This, combined with Figure 11 which is an equal area plot of the poles to mineral lineations obtained mainly in southwestern Laurie Township, shows a steep plunge of the structure to the west-southwest, assuming that the lineations represent the trend of the fold axes.

Folding in the Quetico-type metasediments which underlie the northern part of the map area is about curvilinear axes which are slightly convex to the south. The axes veer from west-northwesterly in the western part of the area, through east-west in the central part of the map area, to east-northeasterly in the eastern part of the region. The folding is tight and steep to isoclinal, the dips averaging about 80°. The characteristics of the folding are shown in Figure 11 which is an equal area plot of poles to bedding. This diagram likewise shows the steep isoclinal nature of the folding with an ESE-trending axial plane. The Keewatin-type and Quetico-type rock groups appear to be penecontemporaneous as interlayered metavolcanic rocks in their boundary area are similar to the Keewatin-type rocks.

Folding in the Timiskaming-type metasedimentary-metavolcanic sequence using the same criteria as above is also about a curvilinear but generally east-west axis best observed in the southern belt. In this southern belt the major axis is convex to the northeast. In the northern belt folding is observed only in the extreme eastern part of the belt where it is about easterly axes. The folding is tight and steep to isoclinal. The characteristics of this folding are summarized in Figure 12 which is an equal area plot of poles to bedding. As for the Keewatin-type, and Quetico-type sequences, the folding is steep isoclinal with a SE-trending axial plane. Although the Timiskaming-type sequence is later than the Keewatin-type sequence the general parallelism of their fold axes is apparent on the map face.

Foliation

A regional penetrative foliation is well developed in the Keewatin-type and Timiskaming-type rocks, which becomes more marked in the Keewatin-type rocks in the southern part of the map area as the north-eastern boundary of the Sundbar-Batwing Batholith is approached.

In the Keewatin-type rocks, the foliation trends east-southeasterly, with near-vertical dips on the northern part of the volcanic edifice. In southern Laurie Township, however, the foliation trend of the rocks on the southern flank of the volcanic edifice is arcuate, convex to the north. The author believes that this pattern is related to deformation associated with the intrusion of the Sundbar-Batwing batholith located to the southwest of the map area. Within the Keewatin-type rocks of the central facies, a northeasterly trend is dominant in the western part, and east-west foliation trends occur further east in the neighborhood of the Matawin River. This pattern is also probably related to the intrusion of the batholith. The characteristics of the foliation pattern are shown on an equal area plot, Figure 13.

Figure 14 is an equal area plot of the poles to foliation in the Quetico-type rocks. This foliation is better developed in the contact region of these rocks with the Keewatin-type rocks; the actual contact, however, is covered by the overlying Timiskaming-type rocks. The plot shows the almost vertical attitude of the foliation and its east-southeasterly trend.

In the Timiskaming-type rocks the foliation is more strongly developed in the northern belt and is generally east-southeasterly with steep to vertical dips. The foliation dips both to the north and south and its trend is parallel and subparallel to the bedding. Figure 15 is an equal area plot of the poles to the foliation. It shows a concentration of poles near the perimeter of the diagram at its north-northeast and south-southwest antipodes, indicating an east-southeasterly trend for the foliation.

Lineation

Mineral lineation defined by acicular hornblende and actinolite crystals is well developed in the rocks of the upper Keewatin-type metavolcanics in southwestern Laurie Township. It plunges steeply to the northwest at 60° to 80°. This type of lineation is not as well developed in the eastern part of the central volcanic facies, but a single plunge measurement of 65° to the east-northeast was made in this area. Figure 16 is a plot of these mineral lineations and displays the near vertical attitude with a west-northwesterly trend.

Faults, Lineaments

Photolineaments trend east-southeasterly, northwesterly, northerly and northeasterly across the map area and range in length from about 0.4 to 10 km. In most of these no evidence on the ground could be obtained for determining whether they are faults, shears or dikes and they have been indicated on the map face as lineaments.

The major fault of the map area is the Postans Fault located across central Blackwell Township. It is so named as it is an extension of the Postans Fault mapped by Morin (1973) in Conacher Township which adjoins Blackwell Township immediately to the west. This faut is deduced from the coincidence of a photolineament, best seen on 1:50 000 aerial photographs of Blackwell Township, with intense shearing and microfolding of foliation developed in outcrops of gabbro and Quetico-type metasediments along its length. Shear zones up to 7 m in width were observed in gabbro which is also mylonitized locally to produce rocks resembling basalt. In foliated Quetico-type metasediments minor folding of foliation indicate sinistral movement. Minor fold axes plunge 75° to the east-southeast.

At Shebandowan River, however about 2.5 km east of Mabella in southern Blackwell Township; at Middle Falls; and at a point 2.5 km south of these falls in east-central Laurie Township on the Matawin River, these lineaments are interpreted as faults by the author. In the first case, on the Shebandowan River, the lineament is associated with intense shearing and an abrupt right-angled change in the course of the river at this point. This northwesterly reach of the river is thus interpreted to be fault-controlled and the lineament as a fault. Along the Shabaqua Road, on the west bank of the Matawin River at Middle Falls on the west side of the road, a shear coincides with a northeasterly lineament. On the exposed rock face the shear, which trends N55-60°E and dips 80° southwest shows slickensides on magnetite-chert ironstone which plunge 50°NE. The rocks are well foliated and the slickensides indicated east-side down. S-shaped drag folds in the ironstone at an outcrop located about 200 m west of this outcrop, shows steep plunges to the east. This lineament is thus interpreted by the writer to be a normal fault. The Keewatin-type bedded tuffs in the neighborhood of this fault are also complex folded, a feature interpreted to result from movement on the fault. At the third locality mentioned above, on the Matawin River, a photo lineament coincides with a northeasterly-trending shear in rhyolite. In the area of this shear the rhyolite and dacite on the east side of the river could not be matched with rocks on the west bank of the river. Because of this loss of continuity across the river, and the shearing, the lineament is interpreted as a fault.

Shears

Shear zones, ranging from 1 to 10 m in width, occur within the lower Keewatin-type and Timiskaming-type rocks, principally along the Shebandowan River south of Highway 11, and in the upper Keewatin-type volcanic sequence in southwestern Laurie Township. In the former area, the shear zones trend easterly, whereas in the latter, they trend northeasterly. In the latter area they range from 300 m to 2.2 km in length. Many of them are associated with intense shearing in an area which is highly deformed and well foliated.

Unconformity

In the northern Timiskaming-type belt an unconformity is deduced between the Timiskaming-type metasediments and the Quetico-type rocks at the northern boundary of the belt because of the truncation of fold axes in the Quetico-type rocks by the outcrop pattern distribution of the Timiskaming-type sequence.

In the southern Timiskaming-type belt an unconformity is also deduced between the Timiskaming-type rocks and the Keewatin-type rocks because of the occurrence of pebbles and cobbles of volcanic rocks of late Keewatin-type, granules and pebbles of jasper, and granitic cobbles in the conglomerates of the Timiskaming-type rocks. This is further supported by the discordant nature of the contact between the Keewatin-type and Timiskaming-type rocks. The actual contact was not observed but at Middle Falls, on the Matawin River the two rock groups can be observed in close proximity but details of the contact are obscured by faulting and a shear zone. The general trend of folding in the two rock groups in the map area is parallel.

CORRELATION OF GEOLOGY AND AEROMAGNETIC DATA

Aeromagnetic maps 1102G and 2097G, (ODM-GSC, 1961 and 1962) cover the Blackwell-Laurie areas and can be used in some cases to delineate some of the major lithologic units within the major rock groups and also to separate major rock groups of the map area.

The Keewatin-type sequence consisting of ultramafic to felsic metavolcanic rocks can be separated from the Quetico-type and Timiskaming-type rocks in the northern half of the map area fairly clearly by a change in the relative density of spacing of the aeromagnetic contours north and south of a region about 1 km south of Highway 11. North of this region the Timiskaming-type and Quetico-type metasediments are characterized by low levels of magnetic susceptibility whereas, south of this border zone, the Keewatin-type sequence is characterized by higher levels of magnetic susceptibility and greater relative changes. Within the Keewatin-type sequence some ironstone units can be separated from the metavolcanic rocks, e.g. the magnetite-jasper unit occurring about 1 km south-southeast of Shabaqua Station is associated with an aeromagnetic anomaly. This anomaly trends west-northwesterly and contains locally high magnetic susceptibility values and may also indicate unmapped ironstone units. Other than this, the aeromagnetic contours could not be used with assurance to separate the various lithological subunits within the Keewatin-type rocks, except in a general way to show the metasedimentary wacke-mudstone unit interlayered with the metavolcanics in southern Laurie Township which is associated with low susceptibility values.

Metamorphosed Mafic Intrusive Rocks located in southern Blackwell Township are associated with high local magnetic susceptibility values and areas of high anomalous values cannot therefore be ascribed only to ironstone units occurring within the Keewatin-type rocks. Thus a broad area of high anomalous values straddling the Matawin River at the central part of the southern boundary of Laurie Township can represent ironstone or intrusive gabbro. However, because of its lower absolute value, which is characteristic of the gabbro units in southern Blackwell Township, this anomaly is interpreted to represent a gabbroic intrusive in this area by the author. No rock exposures were observed in that region.

The area of outcrop of the Felsic Intrusive Rocks exposed in northern Blackwell Township can be accurately outlined forming a region lying north of a generally east-west trending line marking a clear change in magnetic susceptibility as shown by higher values in the zone underlain by the granitic rocks. This line of change coincides fairly accurately with the contact deduced by the current mapping. The area south of this boundary is underlain by Quetico-type metasediments which show low magnetic susceptibility values.

The Quetico-type rocks, as indicated above, are characterized by low magnetic susceptibility and can be delineated from the Keewatin-type rocks to the south, and the Felsic Intrusive Rocks to the north of them. They cannot, however, be separated from the adjacent Timiskaming-type sediments on the basis of the aeromagnetic data.

The Timiskaming-type rocks of the southern belt can be separated from the surrounding Keewatin-type rocks by high magnetic susceptibility values associated with included magnetite ironstone units. The general east-west trend of this unit can thus be delineated on the map. However, owing to the low magnetic response of these sediments in the absence of interlayered magnetic ironstone units, the outline of the contacts of the Timiskaming-type sequence cannot be clearly delineated where it abuts the Quetico-type rocks in the southern part of Blackwell Township.

The aeromagnetic map could not be used to delineate diabase and lamprophyre dikes of the Mafic Intrusive Rocks group, nor the ultramafic flows within the Keewatin-type sequence.

Major faulting is not a characteristic feature of the map area and the only correlation of aeromagnetic contour trend with shearing was that associated with a northeasterly trend of the contours with a mapped northeasterly-trending shear zone on the Matawin River about 2.1 km south-southwest of Middle Falls in southeastern Laurie Township. Here the general regional trend of the contours is east-west.

ECONOMIC GEOLOGY

Introduction

The map area straddles the Abitibi-Quetico Subprovince boundary and about two-thirds of the area, the southern part, lies within the Shebandowan Belt of the Abitibi Subprovince. Accordingly most of the exploration activity has been carried out in the southern third of Blackwell Township and all of Laurie Township, which are areas of outcrop of the Keewatin-type volcanic sequence and associated intrusives. Most of the following summary of exploration activity, unless otherwise stated, has been summarized from the files of the Resident Geologist, Ontario Ministry of Northern Development and Mines, Thunder Bay, and the Assessment Files Research Office, Ontario Geological Survey, Toronto.

Early exploration activity was carried out mainly for iron ore deposits in the 1890s and 1900s as the southern part of the map area lies astride the Matawin Iron Range. Exploration for gold, base-metal sulphide mineralization, and nickel became important in the second quarter of the present century. Recently, with favourable gold prices, considerable gold exploration has occurred in the south-central part of Laurie Township. Overall, most of the exploration activity has taken place in southern Blackwell Township and in Laurie Township, areas underlain by Keewatin-type metavolcanics.

BASE-METAL SULPHIDE MINERALIZATION

In 1956, Three Brothers Exploration carried out a diamond drill program along the northern shore of the Shebandowan River between Mabella and the confluence of the Oskondaga and Shebandowan Rivers. This area lies south of Highway 11 in southern Blackwell Township and exploration was carried out on a calc-alkalic lapilli-tuff to tuff-breccia unit mineralized with nodular pyrite and pyrrhotite. Five diamond drill holes were put down, totaling 3595 feet (1096 m).

At various times between 1967 and 1979, Noranda Exploration Company Limited carried out a series of ground electromagnetic and magnetic surveys in parts of southwestern and west-central Laurie Township. One of the many conductors found was intersected by a diamond drill hole 216.7 feet (66.1 m) long in 1967.

In the period March 1972 to March 1973, J.C. Byrne (Caltor Syndicate) drilled nine diamond drill holes for a total length of 3371 feet (1027 m) in south-central Laurie Township.

GOLD

In 1937, Hialeah Gold and Metals Limited, conducted a program of stripping and trenching in an area about 2.4 km south of Shabaqua Station in northeastern Laurie Township. This work was prompted by the discovery of free gold in blue quartz veins occurring in oxidized schist, rhyolite, and feldspar porphyry. This area could not be relocated during the current mapping project.

In 1945, gold was discovered at the Kaspar Occurrence in southeastern Blackwell Township and trenches and pits were excavated. In the same year, Sylvanite Gold Mines Limited carried out detailed geological mapping and sampling. The occurrence was also examined by M.W. Bartley at an unknown time. In 1976, Noranda Exploration Company Limited carried out geophysical, geochemical, and geological surveys in an area which included this occurrence. The geochemical survey, which was carried out on soils overlying several airborne conductors, indicated several copper anomalies and two zinc anomalies. Subsequently, in 1982, Lacana Mining Corporation carried out a geological and geophysical survey on a property which also included the Kaspar Occurrence. The geophysical work indicated that the property was underlain by numerous conductive zones indicative of graphitic interflow sedimentary rocks. Grab samples were taken from pits located on the property during the current survey for gold and silver assays.

In 1958, George Chilian drilled ten diamond drill holes for a total of 564 feet (172 m) and dug four trenches in an area located in northwestern Laurie Township at Sand Lake (local name). The occurrence was not relocated during the current survey.

In 1983, Corporate Oil and Gas Limited carried out geological and geochemical surveys on two claim groups:

one in southeastern Blackwell Township, and the other in northeastern Laurie Township. The geochemical survey detected gold anomalies in the soil horizons sampled in both claim groups.

From January to March 1985, Jalna Resources Limited had airborne magnetic and electromagnetic geophysical surveys flown over their property in an area which straddled the Duckworth-Laurie Township boundary and covered part of southwestern Laurie Township. Grab samples were taken during the current survey from old pits found on the property for gold and silver assay.

During the current survey, two pits were found on the Edwin Kukkee property located at Middle Falls, Matawin River, from which channel samples from mineralized quartz-carbonate veins in the pits were previously taken for assay. Some of the pits on the Kaspar Occurrence were also re-located during this survey. Grab samples were taken during the current survey from these pits, and also from pyritized and/or gossanous rock and quartz vein material in various parts of the townships for assay for their gold and silver contents.

IRON

In 1952, M.W. Bartley carried out a geological survey of a claim group located in east-central Laurie Township, to evaluate the economic potential of local ironstone units of the Matawin Iron Range, occurring in Timiskaming-type metasediments at Middle Falls, Matawin

River. Metallurgical tests were carried out which confirmed the unfavourable physical characteristics of the ironstone. The grade was also found to be inadequate for concentrating ore.

During the period 1956-1957, Monpre Mining Company Limited carried out geological mapping in a search for structural concentrations of ironstone in the same Timiskaming-type host sediments, and had Bartley, Greer and Associates supervise a dip-needle survey and a program of diamond drilling on their property lying across the central part of Laurie Township over these same deposits. Nineteen diamond drill holes were drilled on the ironstone, described as a true taconite (R.A. Halet, Monpre Iron Mines Limited, 1972, AFRO), for a total of 10,592 feet (3228 m). Metallurgical laboratory tests on the material were carried out in 1957 and 1967 by H.V. Ross, and late in 1967 a 250-pound (114 kg) sample was sent by the company for pilot-plant scale testing. During 1968, further tests involving stage grinding, magnetic separation and flotation were done on the material.

NICKEL

In 1962, Falconbridge Nickel Mines Limited diamond drilled one 651-foot (198 m) hole in southeastern Blackwell Township, presumably in a search for nickel mineralization.

In late 1967 and early 1968, the Canadian Nickel Company Limited carried out ground magnetometer surveys with follow-up ground electromagnetic surveys in southwestern Blackwell Township and northwestern Laurie Township, southwest of the Shebandowan River, in a search for nickel mineralization. Several magnetic anomalies were interpreted by the company to be caused by ironstone and peridotite. In 1969, the same company drilled four diamond drill holes for a total length of 2,043 feet (623 m) on three different claims in the same area.

In the summers and later parts of 1968 and 1969, the International Nickel Company of Canada Limited drilled a total of eight diamond drill holes for a total length of 4,396 feet (1,340 m) in southwestern Blackwell Township, and two diamond drill holes for 1,318 feet (402 m) in northwestern Laurie Township, in an area southwest of the Shebandowan River.

DESCRIPTION OF PROPERTIES, DEPOSITS AND EXPLORED AREAS

Blackwell Township

Abex Mines Limited (1953) (1)[2]

In 1953 Abex Mines Limited held a group of five, contiguous, unsurveyed and unpatented claims at the middle part of the western boundary of Blackwell Township. The property was not in good standing as of December 31st 1986.

In 1954, apparently, Mining Geophysics Corporation Limited carried out a ground magnetometer survey over the property. A northwest-trending magnetic high was outlined in the northern section of the property. It was

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2 The number in parentheses refers to property list on

believed by the survey company that the magnetic anomaly was caused by a basic intrusive. Current mapping by the author has shown that a northwesterly-trending gabbroic body occurs along the Hydro Electric Power Commission transmission line in the northern part of the property and supports the suggestion made by the company.

Canadian Nickel Company Limited (1967-69) (2)

During the period 1967 to 1968 the Canadian Nickel Company Limited carried out ground magnetometer surveys with follow-up ground electromagnetic surveys in southwestern Blackwell Township and northwestern Laurie Township, southwest of the Shebandowan River, in a search for nickel mineralization and ultramafic rocks. Several magnetic anomalies and four conductive zones were outlined. The magnetic anomalies were interpreted by the company to be caused by ironstone and peridotite. In 1969, the company drilled four diamond drill holes for a total length of 2,043 feet (623 m) on three different claims in the same area in Blackwell Township on the four conductive zones discovered. Intermediate to basic metavolcanics, ironstone, graphitic schist, and pyrite, pyrrhotite and chalcopyrite were encountered in the drilling. No assays from samples in any mineralized areas encountered were given. Current mapping has shown that the area immediately to the east is underlain by mafic and intermediate tholeiitic and calc-alkalic rocks, komatiitic metavolcanics, and gabbro.

J.J. Chilebovec et al. (3)

J.J. Chilebovec et al. held one patented, surveyed claim, number TB 26121 located in southeastern Blackwell Township on the north bank of the Shebandowan River. The claim was in good standing on December 31st 1986.

No record of exploration work is on file, but current mapping shows that the claim is underlain by calc-alkalic mafic to intermediate metavolcanic rocks.

Corporate Oil And Gas Limited (1983) (4)

In 1983 Corporate Oil and Gas Limited held a total of 148 claims in two claim groups: one located in southeastern Blackwell Township, the other in northeastern Laurie Township. The claim groups were not in good standing on December 31st 1986.

The company carried out geological and geochemical surveys on both claim groups in 1983. The geological survey encountered mafic, intermediate and felsic metavolcanics, metasedimentary rocks, mafic to ultramafic intrusive rocks and felsic to intermediate intrusive rocks. In the geochemical survey the B soil horizon was preferentially sampled. Humus samples were taken only in swampy areas where the humus was too deep to allow sampling of the B horizon. The samples were analyzed directly for their gold content and the results were reported as parts per billion of gold.

Current mapping shows that the northern group of claims straddles, from north to south, the Quetico-type, Metamorphosed Intrusive, Timiskaming-type and Keewatin-type rock groups. The geological survey carried out by the company indicated that in the northern half of the northern claim group, the claim block is underlain mainly by sedimentary rocks comprising arkoses and grey-wackes, which are associated with coarse fragmental rocks containing a large volcanic content. Current mapping shows that this northern half of the claim group is underlain by Quetico-type and Timiskaming-type metasediments. Mineralization was not observed in the rocks by the company, who reported that electromagnetic survey results did not reveal any anomalies. This part of the claim group was thus not considered worthwhile for mineral exploration. The southern part of the claim group south of Highway 11, which follows the boundary between two different rock suites, was found by the company to be underlain by "a thick sequence of greyish green felsic to intermediate fragmental volcanic rock with interbands of cherty, green to greenish grey rhyolite, and minor green to dark grey slatey metapelitic interbands......bounded to the south by a fissile, greenish, commonly phyllitic metapelite, more structural deformation, shown by numerous shears, fractures, and brecciation commonly mineralized by small pyrite bearing quartz veins.... (and) ..... is attractive for further work because of the evidence of nearby faulting, the presence of V.L.F. anomaly zones indicated by reconnaissance traverses, and by a modest anomalous concentration of gold in the soils" (Assessment Files Research Office, Toronto, Ontario). The rock units found by the company in the southern claim group in northeastern Laurie Township were not specifically described but current mapping by the author shows that it is underlain by Keewatin-type ultramafic komatiitic flows, tholeiitic and calc-alkalic flows, clastic metasediments and ironstone, and Timiskaming-type metasediments.

The geochemical survey indicated that gold anomalies extended over larger areas than were expected and the company geologists interpreted them to be real and not controlled by glaciation. Four of the geochemical anomalies occurring in both claim groups were selected for detailed sampling. Accordingly, four grids were cut, one over the volcanic rocks in the southern part of the northern claim group, and three over the southern claim group in Laurie Township. The results of this work have not been reported in the assessment files.

During the current survey a grab sample taken from sheared and silicified Keewatin-type mafic tholeiitic metavolcanic rock containing pyrrhotite from an outcrop located 0.9 km north-northeast of Lower Falls, Matawin River in the northeastern part of Laurie Township in the southern claim block, yielded 0.02 ounce gold per ton and <0.10 ounce silver per ton when assayed by the Geoscience Laboratories, Ontario Geological Survey, Toronto.

R.W. Docking et al. (5)

During 1986 R.W. Docking et al. held one patented surveyed claim, T.B. 5139, located 1 km southeast of

Mabella. The claim was still in good standing on December 31st 1986.

No exploration work is on file for the property but current mapping has shown that it is underlain by mafic to intermediate calc-alkalic metavolcanic rocks.

Falconbridge Nickel Mines Limited [1962] (6)

In 1962, Falconbridge Nickel Mines Limited diamond drilled one 651-foot (198 m) hole on a claim in southeastern Blackwell Township, for an undisclosed exploration reason. Lime-amphibole rock, argillite, graphite schist and chert were encountered in the drilling. Current mapping shows that the drill hole was sunk in an area underlain by mafic to intermediate calc-alkalic metavolcanic rocks which include a tuff-breccia unit containing globular and sub-rectangular fragments of pyrrhotite ranging from 0.5 mm to 1.5 cm and forming about 2% of the rock, and ellipsoidal pyrite up to 10 cm x 5 cm forming 5-10% of the rock in an area from 2 km to 5.5 km west of the drill hole. The claim was not in good standing on December 31st 1986.

International Nickel Company of Canada Limited [1966, 1969] (7)

In the summers and later parts of 1968 and 1969, the International Nickel Company of Canada Limited drilled a total of eight diamond drill holes for a total length of 4,396 feet (1,340 m) in southwestern Blackwell Township, and two diamond drill holes for 1,318 feet (402 m) in northwestern Laurie Township, in an area southwest of the Shebandowan River. The aim of the drilling was not stated, but current mapping shows that in the areas drilled ultramafic komatiitic flows occur interlayered with the tholeiitic and calc-alkalic metavolcanics. Rocks encountered in the drilling are graphitic shale and graphitic schist, intermediate metavolcanics, ironstone, lamprophyre, peridotite, pyroxenite, and gabbro. Pyrite and pyrrhotite were also encountered. The claims on which the drilling was carried out were not in good standing on December 31st, 1986.

Allan Lofgren (8)

In 1986 Allan Lofgren held one patented surveyed claim, TB 15042, located in the southeastern part of Blackwell Township and centred 300 m north of Highway 11 at the eastern boundary of the township. The claim was in good standing on December 31st, 1986.

No exploration work is on record for the property and current mapping shows that it is underlain by Timiskaming-type metasediments. No mineral occurrences are known to be located on the claim.

John Nabigon [Kaspar Occurrence] (9)

In December 1986 John Nabigon held 10 contiguous, unpatented, unsurveyed claims in southeastern Blackwell Township, one of which restaked the former patented surveyed claim, TB 17044 forfeited in 1974. The claims partly cover the former Kaspar-Sutherland (1945) property that of Noranda Exploration Company Limited in 1976; and those of Belore Mines Limited in 1981, and M.A. Stewart and Harry Lundmark 1984-86. The claims were in good standing on December 31st, 1986.

The Kaspar Occurrence is located on the property on former patented claim TB 17044. In 1940 M.W. Bartley obtained grab samples from mineralized material in trenches on the claim. This sampling represented the earliest recorded reference to the occurrence which Bartley described as "a sheared and shattered iron formation which is in contact with a diorite on the east. The iron formation is veined by quartz stringers and impregnated with arsenopyrite and pyrite. The heavy sulphide section is two feet wide in six feet of shattered iron formation. The diorite on the east is shattered and contains a stockwork of quartz veins, all carrying visible gold" (Assessment Files, Resident Geologist's Office, MNDM, Thunder Bay). Grab samples were taken from the most favourable-appearing material which were then sent for assay by M.W. Bartley. The results obtained by assay were as follows: "Two specimens returned 35¢ per ton in gold. Four specimens returned 70¢ per ton in gold. One specimen returned $1.05 per ton in gold. One specimen returned $8.40 per ton in gold. The latter assay ($8.40) was from a specimen of the arsenopyrite-bearing shattered iron formation" (Assessment Files, Resident Geologist's Office, Ministry of Northern Development and Mines, Thunder Bay).

By 1945 considerable trenching and sampling had been done by various concerns, at which time Sylvanite Gold Mines Limited carried out a program of trenching, sampling and detailed geological mapping of the trenches. This company substantiated the fact that the main occurrence was located on patented claim TB 17044 and described it as consisting of two bands of altered rhyolite interlayered with two alternating bands of sheared andesite, and intruded by quartz diorite. The trend of the volcanics was described as N65°W, and parallel to the diorite contact with the diorite located to the northeast of the metavolcanics. At the contact with the diorite there were "a number of narrow quartz stringers from 4 to 12 inches in width and from 5 to 45 feet in length, which appear to be all cut off by the later intrusive diorite and are not close enough to become of any importance. V.G. (visible gold) was noticed in spots in two of the stringers, but are free of all other minerals" (Assessment Files, Resident Geologist's Office, MNDM, Thunder Bay). Pyrite, pyrrhotite and arsenopyrite were said to occur in the rhyolite. Four trenches were blasted into the metavolcanics at right angles to the foliation, along a picket line oriented N65°W, parallel to the foliation direction, over a strike length of about 460′ (140 m), across the centre of the claim. Thirty-two channel samples were taken from the metavolcanic rocks and the best assay was 10.40 dwt (0.502 oz) gold over 3.7′ (1.1 m), (Assessment files, Resident Geologist's Office, MNDM, Thunder Bay). The mineralized zone was described as being 80 feet (24 m) wide.

In 1976 Noranda Exploration Company Limited carried out geological, geophysical, and geochemical surveys over their property which included the above mentioned occurrence, to determine whether there were any volcanogenic, massive sulphide, base-metal deposits on property. The geological survey indicated that the property is underlain by "a sequence of intermediate and felsic metavolcanic tuffs and flows which strike 110° and dip nearly vertically. Iron formation and minor mafic flows and tuffs also occur. The volcanic sequence is intruded by a diorite sill, quartz veins, and rare granitic veins. Seven major units have been identified.

Small scale shear zones are common but major structural deformation is absent. Metamorphism to lower greenschist facies has subsequently occurred" Assessment Files, Resident Geologist's Office, MNDM, Thunder Bay). Surface exposures of potentially economic minerals were not found but a small pyritic body was located which the company considered as an indication that conditions were favourable for massive sulphide formation. The geophysical survey consisted of ground electromagnetic and magnetic surveys. Anomalies were found in both surveys, and the trend of most of the anomalies was parallel to the regional strike of the rocks of the area. The electromagnetic survey indicated several conductive zones which were thought by the company to be caused in part by graphite. Magnetic zones found during the magnetic survey were not conductive, and it was thus concluded that disseminated magnetite and pyrrhotite were probably responsible for the magnetic zones.

Correlation between the ironstone and anomalous magnetic areas was good. The geochemical survey was carried out "to trace secondary dispersion patterns of copper, lead and zinc in soils overlying several airborne conductors" (Assessment Files, Resident Geologist's Office, MNDM, Thunder Bay). Several copper, but only two zinc anomalies were associated with the copper anomalies, and the latter had little relationship with the electromagnetic conductors. However, two of the copper anomalies were considered noteworthy by the company, one of which was coincident with an east-west striking electromagnetic conductor. A geochemical zinc halo was located which was considered by the company to warrant further investigation.

In 1982 Lacana Mining Company carried out geological mapping, sampling of some of the trenches including those sampled previously by Sylvanite Gold Mines Limited, and an electromagnetic survey on the property to evaluate its base-metal, massive-sulphide and gold potential. The mapping showed that the property is underlain by submarine massive, pillowed and brecciated basalt flows, feldspar arenites, argillaceous interbeds, oxide-facies ironstone, chert, chloritic tuffs, feldspar crystal tuffs, and volcanic breccias striking N60°W, and dipping steeply northeastwards. Coarser-grained parts of flows were observed and described as dioritic. The geophysical work indicated that the property is underlain by numerous conductive zones indicative of graphitic interflow sedimentary rocks. The highest gold assay obtained from an unknown type of sample by the company was 421 ppb Au from a trench in the diorite.

During the current mapping project grab samples were taken from some of the pits located on the property, but not those sampled by Sylvanite Gold Mines Limited. These were assayed for gold and silver by the Geoscience Laboratories, Ontario Geological Survey, Toronto. Three of the samples returned values of 0.01 ounce or more gold per ton, viz: 0.01 oz gold per ton from a 10 cm wide gossanous shear zone in mafic metavolcanics in a trench located 2 km west-southwest of the confluence of the Shebandowan and Oskondaga Rivers, southeastern Blackwell Township; 0.02 oz gold per ton from carbonatized, gossanous, brecciated mafic metavolcanic from the same trench mentioned above; and 0.01 oz gold per ton from a massive sulphide zone 5 m wide in silicified and pyritized intermediate volcanic breccia in a trench located 2.5 km west-southwest of the confluence of the Shebandowan and Oskondaga Rivers, southwestern Blackwell Township.

Selma Rantatalo (10)

In 1986 Selma Rantatalo held one surveyed and patented mining claim, TB 26120, located in the southeastern corner of Blackwell Township. The claim was in good standing on December 31st, 1986.

No exploration work is on file for the property and no exposures were located on the property during the current survey, but the claim is interpreted by the author to be underlain by Timiskaming-type sediments and Keewatin-type intermediate calc-alkalic metavolcanic rocks.

Glougie Ross (11)

In 1986 Glougie Ross held one surveyed, patented mining claim, TB 27964, located near Annex near the middle part of the western boundary of Blackwell Township. The claim was in good standing on December 31st, 1986.

No exploration work is on file for the property and no outcrops were located on it during the current survey but it is interpreted by the author to be underlain by Timiskaming-type sediments.

W.E. Ross (12)

During 1986 W.E. Ross held one surveyed, patented mining claim, TB 3802, located at Mabella in southwestern Blackwell Township. The claim was in good standing on December 31st, 1986.

No exploration work is on file for the property and outcrop is sparse, but during the current survey outcrops of Timiskaming-type shosonitic mafic to intermediate porphyritic flows and pyroclasts and tuff-breccia were found on the northern boundary of the claim. The rest of the claim is interpreted by the writer to be underlain by

Timiskaming-type metasediments and Keewatin-type calc-alkalic metavolcanic rocks.

D. Swazey (13)

In 1986 D. Swazey held one surveyed, patented mining claim, TB 3725, located in southwestern Blackwell Township at Mabella. The claim was in good standing on December 31st, 1986.

No exploration work is on file for the property and no outcrops have been located on claim during the current survey but it is interpreted by the writer to be underlain by Timiskaming-type metasediments.

G.R. Tees (14)

In 1986 G.R. Tees held one surveyed, patented mining claim, TB 4800, located in southwestern Blackwell Township at Mabella. The claim was in good standing on December 31st, 1986.

No exploration work is on file for the property and no outcrops were found on the claim but it is interpreted by the author to be underlain by Keewatin-type komatiitic and calc-alkalic metavolcanics.

Three Brothers Mining Exploration Limited [1956] (15)

In the summer of 1956 Three Brothers Exploration Limited carried out a drill program on three claims located along the northern shore of the Shebandowan River south of Highway 11 between Mabella and the confluence of the Oskondaga and Shebandowan Rivers. Five diamond drill holes were put down, totaling 3595 feet (1096 m). Current mapping shows that the drilling was carried out in part on a Keewatin-type intermediate pyroclastic tuff-breccia and lapilli-tuff unit mineralized with pyrrhotite and graphite. Wacke, conglomerate, graphitic slate, pyroclastic felsic metavolcanics, intermediate metavolcanics, serpentinized and sheared peridotite, pyrite and pyrrhotite were recorded in the drill logs of the holes. No assay results from samples taken from the drilling are on record in the files. The claims were not in good standing on December 31st, 1986.

Laurie Township

Canadian Nickel Company Limited [1967] (16)

See text for Blackwell Township

Corporate Oil and Gas [1983] (17)

See text for Blackwell Township

William Deperry (18)

In December 1986 William Deperry held four contiguous, unsurveyed, unpatented mining claims along the northern border of Laurie Township in the northeastern part of the township. The claim group was in good standing on December 31st, 1986.

No exploration work by the current holder is on file for the claims, but they form part of the southern boundary of a property held by Noranda Exploration Company Limited in 1976 when geological, geochemical and geophysical surveys were carried out on the property.

This work is described under property No. 9 (John Nabigon).

Great Lakes Forest Products Limited (19)

During 1986 Great Lakes Forest Products Limited held four contiguous patented claims, numbers TB 8000, TB 8001, TB 4871 and TB 4872, located in east-central Laurie Township and centred about 0.9 km southwest of McGraw Falls on the Matawin River. The claims were in good standing on December 31st, 1986.

No exploration work is on file for the property but current mapping shows that the claim group is underlain by Timiskaming-type arkose, chloritic mudstone, magnetite-jasper ironstone and intermediate flows and pyroclastics, though only two outcrops were observed on the property.

W. Hayne (1979) (Shabaqua Occurrence) (20)

In 1979 W. Hayne carried out prospection work of an unspecified type on this occurrence located in the northeastern corner of Laurie Township. The occurrence was not visited by the author during the current survey but was visited in November 1979 during the Atikokan Economic Geologists Program, where it was reported that several small test pits are located on it (Schnieders and Dutka, 1985, p. 444). Current mapping shows that the occurrence is located in an area underlain by steeply-dipping tholeiitic mafic to intermediate flows folded into a southeasterly-trending syncline. The occurrence has been described as follows:

"A shear zone and associated veins strike 145 degrees and dip 70 degrees north to vertical. The veins are composed of carbonate with some brecciated quartz. The veins range in width up to 31 centimetres with a traceable strike length of 12 metres. Visible mineralization includes chalcopyrite, malachite, azurite and pyrite. Accessory minerals consist of chlorite and sericite" (Schnieders and Dutka, 1985, p. 444).

An assay from an unknown kind of sampling yielded 0.01 oz gold per ton from one sample, and 2.11% copper and 0.03% zinc from another sample of an unknown type as analyzed by the Geoscience Laboratories, Ontario Geological Survey, Toronto (Schnieders and Dutka, 1985, p. 444).

International Nickel Company of Canada Limited [1969] (21)

See text for Blackwell Township.

Jalna Resources Limited (22)

During 1986 Jalna Resources Limited held a block of 232 unsurveyed, unpatented, contiguous claims covering most of the southern and part of the northwestern part of Laurie Township extending westward into neighboring Duckworth Township. This property restaked properties formerly held by George Chilian in 1958, Noranda Exploration Company Limited 1967, 1970 and 1979; J.C.

Byrne (Caltor Syndicate) 1972-1973; and Edwin Kukklee up to 1985. Exploration work was carried out in the northwestern, southern and northeastern parts of the property located in Laurie Township in 1958, 1967, 1970, 1972-1973, 1978-79 and 1985 by the then owners of the various properties, and over the entire property in 1985 by Jalna Resources Limited. The property was in good standing on December 31st, 1986.

Northwestern Section of Property

In 1958 George Chilian drilled ten short, diamond drill holes for a total of 564 feet (172 m) and dug four trenches on his claim located at Sand Lake (local name) in northwest Laurie Township at the northwestern part of the current claim group occurring in this township. This area was not mapped during the current survey but andesite, carbonatized andesite, quartz-feldspar porphyry, feldspar porphyry, quartz porphyry, lamprophyre, peridotite and an acid dike were reported intersected by the drilling. Mineralization consisted of disseminated and massive pyrite, minor galena and chalcopyrite. Mariposite, ankerite and quartz stringers and veins were also reported in the drill logs. Sampling of an unknown kind by George Chilian in 1958, returned a value of 9.45 ounces of gold per ton Assessment Files Research Office, Toronto) from a trench sunk on carbonatized andesite, containing mariposite alteration, a quartz vein, and a felsic dike.

In 1970 Noranda Exploration Company Limited carried out ground electromagnetic and ground magnetic surveys on their property centred about 1.3 km southwest of Sand Lake (local name) in northwestern Laurie Township, 1.3 km south of the Chilian Occurrence. The purpose of the electromagnetic survey was to determine whether there was any sulphide mineralization on the property. The instrument being used was capable of detecting disseminated sulphide deposits and small sulphide bodies. The property was known to enclose five airborne anomalies and the ground survey located these and indicated that there was a series of conductors stretching across the entire property in an easterly direction. The trend of the conductors was east-west. The magnetometer survey was carried out to supplement the electromagnetic surveys but there was no correlation found between the data of the two surveys. The company found that the entire property was underlain by swamp and Pleistocene deposits. This area was not mapped during the current survey.

Southern Section of Property

In the southern part of the claim group in Laurie Township, exploration activity was carried out over the western, central and eastern parts of the property.

In the western part of this southern section of the present property of Jalna Resources Limited, Noranda Exploration Company Limited in 1970 carried out ground geophysical surveys in the southwestern corner of Laurie Township to locate sulphide mineralization. The survey comprised ground electromagnetic and ground magnetic surveys. The electromagnetic survey did not detect any conductors, but the magnetometer survey showed anomalies in the area where an airborne conductor was located. Current mapping shows that this claim group is underlain by felsic and mafic metavolcanics and metasediments. In the period late 1983 to early 1984, Jalna Resources Limited had GML Minerals Consulting Limited carry out geological, geophysical and geochemical surveys over seven claims along the western boundary of Laurie Township in the middle of the western part of this southern section of the property. The records of the results of this work are not on file at the Assessment Files Research Office, MNDM, Toronto. During the current survey it was observed that this work was carried out over an area in which an old pit is located. No description of exploration work on the pit is available but pits in this general location are shown on the map by Tanton (1938). The pit observed by the author has since become known as the Page Occurrence. A grab sample taken from a 15 cm-wide quartz vein mineralized with chalcopyrite, bornite, secondary malachite and azurite in sericitized, mafic to intermediate, Keewatin-type, hornblende-rich shoshonitic tuff-breccia, in the pit located 3 km north-northeast of the southwestern corner of the township, yielded 0.14 oz gold and 0.40 oz silver per ton when assayed by the Geoscience Laboratories, Ontario Geological Survey, Toronto.

In the central part of this southern section of the Jalna property, 2.2 km northeast of the area just described, Noranda Exploration Company Limited held a claim group in 1970 which lay over three airborne conductors. Ground geophysical surveys were carried out in 1970 by the company. The ground electromagnetic survey did not detect any conductors, however. A previous airborne survey had detected two magnetic anomalies directly associated with airborne electromagnetic anomalies. The ground survey located the airborne magnetic anomalies which were considered by the company geologists to be caused by a ferromagnesian mineral rather than by an ironstone unit. Current mapping has shown that the magnetic anomalies occur in clastic metasediments comprising mudstone, graphitic siltstone, and that the immediate neighborhood is underlain by felsic metavolcanics, minor intermediate metavolcanics, and metasediments. An ironstone unit was mapped during the current survey interlayered with the felsic metavolcanics in the northwestern half of the property, but it was not shown on the ground magnetic survey map. In 1978 and 1979 the Noranda Exploration Company Limited carried out another ground magnetic survey over this same area. A strong northeasterly-trending anomalous magnetic zone was discovered and interpreted by the company geophysicist to be caused by a narrow zone of graphite and pyrrhotite. Current mapping shows that this area associated with the anomaly is underlain by mudstone, graphitic siltstone and wacke as described before. These two surveys show that anomalous zones trend generally northeasterly, co-linear with a metasedimentary unit containing graphitic material. In the period from March 1972 to March 1973, J.C. Byrne (Caltor Syndicate) drilled nine diamond drill holes for a total length of 3371 feet (1027 m), along a northeasterly strike length of 3.3 km in this central part of the southern area. On the basis of the current mapping the holes were collared in felsic and intermediate, calc-alkalic and shoshonitic metavolcanics and clastic metasediments. Rocks intersected in the hole were described as slate, wacke, argillite, conglomerate, graphitic argillite, graphitic slate, felsic tuff, felsic fragmental, andesite, garnetiferous andesite and feldspar porphyry. Mineralization consisted mainly of massive and disseminated pyrrhotite and pyrite with minor sphalerite, chalcopyrite and galena, and in one hole a 1" (2.54 cm) zone of massive sphalerite was intersected. Assays carried out by the company yielded nil in gold. The best assay values obtained were Ag 0.04 oz per ton, Cu 0.02%, Pb 0.01% and Zn 0.30% (Assessment Files Research Office, MNDM, Toronto) over 2.6 feet (0.8 m) from a sample of black graphite from a hole collared in the metasediments (Assessment Files Research Office, MNDM, Toronto).

In the eastern part of this southern section of the Jalna Resources Limited property, Noranda Exploration Company Limited in 1967 drilled one diamond drill hole in a northerly direction for a length of 216.7 feet (66.1 m) in the southwestern part of Laurie Township near the common boundary with Horne Township, in an area underlain by calc-alkalic to shoshonitic metavolcanic rocks. Rocks encountered in the drilling were described by the company as felsic and intermediate metavolcanics, and sericite schist. Massive graphite and disseminated, stringer and massive pyrite were encountered in the drilling. Also in this eastern part of the property at an outcrop of ankeritized and sheared Timiskaming-type metasediment, and at an outcrop of sheared Timiskaming-type conglomerate located 1.4 km and 1.9 km respectively from the bridge on the Matawin River at McGraw Falls, grab samples collected during the current survey and assayed for gold and silver by the Ontario Geoscience Laboratories, Toronto, yielded 0.02 ounce gold per ton and 0.12 ounce silver per ton and 0.01 ounce gold per ton and <0.10 silver per ton respectively.

Entire Property

In 1985 Jalna Resources Limited had airborne magnetic and airborne electromagnetic geophysical surveys flown over their entire property which straddles the Duckworth-Laurie Townships boundary, the eastern half of which covers the extreme northwestern part and most of the southern part of Laurie Township. The purpose of the survey was to prospect for base-metal, sulphide-related gold mineralization. The magnetic survey detected the oxide-facies ironstone unit associated with the Timiskaming-type sediments mapped during the current survey near the central part of the western boundary of

Laurie Township, that is, in the northwestern part of the property; as well as features characteristic of the mafic to felsic surrounding metavolcanic rocks. The anomalies in Laurie Township had a NE-SW to ENE-WSW strike similar to the direction of the lithological trends. The electromagnetic survey confirmed the presence of a sulphidic conductive belt trending NE-SW previously indicated by geophysical surveys by Noranda Exploration Company Limited in 1978-79 as described above, in the central part of the property in Laurie Township. This area is that underlain by metasediments as described above, and was recommended by the company for follow-up work. The conductor is about 1 km long. A major east-west shear zone was also located by the geophysical surveys crossing the conductor. In the northwestern part of the property in Laurie Township, at a location 1.2 km southwest of Sand Lake (local name), a conductor rated as excellent by the consulting geophysicist trending east-west and 0.9 km long was detected. The conductor was interpreted by the consulting geophysicist to probably correlate with a massive sulphide conductor within the underlying rocks. This area was the same as that geophysically surveyed by Noranda Exploration Company Limited in 1970 described above under Northwestern Area, in Laurie Township, southwest of Sand Lake (local name). Follow-up work was also recommended for this conductor.

In addition to detecting geophysical conductors and magnetic anomalies, several northeasterly and east-west intersecting shear zones were interpreted from the geophysical data by the consulting geologist. During the current survey several shear zones were observed on the property. Grab samples from two yielded <0.01 ounce in gold but >0.10 ounce silver per ton. One of these samples was from a sheared and carbonatized latite located 0.8 km west of the Matawin River and 2.2 km southwest of the dam on the same river at McGraw Falls. It yielded <0.01 oz gold per ton but 0.28 oz silver per ton on analysis by the Geoscience Laboratories, Ontario Geological Survey, Toronto. The other sample was taken from a polymictic volcanic breccia, a gossanous laharic deposit containing pyrite nodules and located on the west bank of the Matawin River 2.3 km south-southwest of the dam on the river at McGraw Falls. This sample, on analysis by the Geoscience Laboratories, Ontario Geological Survey, Toronto yielded <0.01 oz gold per ton but 0.24 oz silver per ton. Although the sample is unsheared it is close to a northeasterly-trending shear zone.

In the summer of 1986 during the current survey, preparatory signs for grid cutting for follow-up surveys were observed in the claim group in south-central Laurie Township.

H.E. Lashin (23)

In 1986 H.E. Lashin held a block of five contiguous surveyed and patented claims, TB 3260, TB 5215, TB 5216, JB 5219, and TB 26200 in the northeastern corner of

Laurie Township. The claims were in good standing on December 31st, 1986.

No exploration work is on file for the property but current mapping shows it to be underlain by mafic to intermediate tholeiitic and calc-alkalic metavolcanic rocks.

Monpre Iron Mines Limited (1968) (24)

In 1956 Monpre Iron Mines Limited staked a group of 408 claims forming a strip 4 claims wide and 25 miles (40 km) long extending from the centre of Horne Township, immediately east of Laurie Township, through the central part of Laurie Township, and westward beyond Duckworth Township, immediately west of Laurie Township, to Greenwater Lake in Begin Township. Sixty-nine full and parts of four claims located in Laurie Township, were surveyed and brought to patent in 1957. The rest were allowed to lapse. The company was originally incorporated as Monpre Uranium Exploration Limited in 1953, but its name was changed in 1956 to Monpre Mining Company Limited and then to Monpre Iron Mines Limited in 1967. The property included that originally held by M.W. Bartley which, in Laurie Township, comprised six claims at Middle Falls, Matawin River, and which were staked in the winter of 1951-52. The claims of Monpre Iron Mines Limited were forfeited on January 1st, 1983.

The claim group straddles the Matawin Iron Range and exploration activity was carried out to assess the economic iron potential of the range. In July 1952 M.W.

Bartley carried out a geological survey on his property in the eastern part of the Monpre Iron Mines Limited property and recorded clastic metasediments, siliceous magnetic ironstone, and mafic and felsic metavolcanics. Bartley described the ironstone thus: "The iron formation, where observed, is thinly-banded, fine-grained and consists principally of bands of jasper and felsite. The magnetite distribution is erratic and too sparse to be classed as ore. Secondary alteration has transformed some of the magnetite to hematite" (Resident Geologist's Files, Ontario Ministry of Northern Development and Mines, Thunder Bay). Bartley also collected hand specimens for chemical and metallurgical testing. The metallurgical results confirmed the field observation that "the iron formation from the central Matawin Range is uneconomic because it is extremely fine-grained, very thin-banded, and narrow and irregular in width" (Resident Geologist's Files, Ontario Ministry of Northern Development and Mines, Thunder Bay). It was concluded by Bartley that: "The grade of Matawin iron formation is too low, and its physical characteristics are too unfavourable for it to become a concentrating ore within the limitations of foreseeable methods of treatment" (Resident Geologist's Files, Ontario Ministry of Northern Development and Mines, Thunder Bay). Later, in the period 1956-1957, Monpre Mining Company Limited put down an exploration grid on their property, carried out a dip needle survey and a diamond drilling program under the supervision of Bartley, Greer and Associates during which time nineteen diamond drill holes were drilled for a total of 10,592 feet (3228 m). In 1957 a geological survey of the property was carried out by Halet, Broadhurst and Ogden Engineering Limited to obtain information on the geology and structure of the area in a search for structural environments favourable to the concentration or emplacement of hematite ore bodies. Metallurgical laboratory tests on the material were carried out in 1957 and 1967 by H.V. Ross. Late in 1967 a 250-pound (114 kg) sample of chiefly diamond drill core material was sent by the company to Lakefield Research of Canada Limited for further laboratory testing, which was carried out in 1968. This testing involved stage grinding, magnetic separation and flotation. Following this, pilot-plant scale tests were then recommended. No further record of development is on file for the property.

The geological survey of the property by the company indicated that the claim group is underlain by sedimentary rocks comprising four main rock types referred to as black slate, green slate, grey slate and greywacke. These rocks were considered by the company geologists to overlie an older quartz-sericite schist and porphyry sequence which represented an older rock group, upon which the sediments were deposited. The younger sedimentary sequence was reported to be intruded by small dikes of granite, diabase, gabbro and aplite. These sediments were previously placed in the Windigokan series by T.L. Tanton (1925). The black slate, which forms the ironstone unit, contains extremely fine-grained disseminated magnetite, is somewhat siliceous, and is interlayered with cherty and hematite bands. It occurs as well defined bands ranging from 100 to 600 feet (30-183 m) in width within the rocks which are grouped by the writer with the Timiskaming-type rocks. The regional strike of the formation as mapped by the company is N75° W to N85° W with dips described as predominantly vertical. Three probable faults were located during that survey. It was concluded from the geological survey that the origin of most, if not all of the iron-bearing formations is sedimentary with no evidence of post-depositional leaching of silica or hydrothermal addition of iron. No major concentrations of hematite were found and the probability of a hematite ore body existing within the surveyed area was considered by the company to be low.

The ironstone unit was later described by R.A. Halet (R.A. Halet, 1972, of Halet Broadhurst and Ogden Engineering Limited, AFRO) in 1972 viz:

"The iron formation is a true taconite, i.e. a very fine grained mixture of silica and iron oxides (magnetite and hematite) that must be ground finer than 100 mesh to separate the iron minerals from the silica.

"The iron formation is brownish black to black, and where the content of hematite is relatively high it is reddish. It is thinly bedded and commonly has fine grained interbeds of greywacke, averaging one-eighth inch or less in thickness. Thin cherty beds are common. The iron formation occurs for the most part as well defined bands with widths ranging from 100 to 600 feet. Contacts with the greywacke and other rock types are usually quite sharp.

"The iron content ranges up to 40 percent in certain narrow bands, but there is a continuous core of the iron formation on the eastern part of Duckworth Township which has a length of approximately three miles, with an iron content of more than 25 percent over widths ranging from 50 to 500 feet. There appears to be only minor cross-faulting and there are no important bodies of intrusive rock to interrupt the continuity of the formation in this area."

Delay in the development of the ironstone was due to the difficulty in developing an economical process for removal of the silica gangue from the iron minerals in the material and to produce a concentrate acceptable to the iron and steel industry. Extremely fine grinding was necessary to separate the iron minerals from the silica gangue, and it was early discovered that the iron bearing material was not amenable to beneficiation by the standard methods of magnetic concentration. Continued metallurgical research was therefore considered an important factor in establishing the economic viability of production.

The results of the metallurgical testing and the drilling by Monpre Mining Company Limited in 1956-57 in Laurie Township indicated a zone 1200 feet (366 m) long and 100 to 500 feet (30 m to 152 m) wide, containing

17,000,000 tons of 26% soluble iron material which could be recovered by an open-pit operation, with a waste to ore ratio of 1.07:1. The laboratory tests done on the material in 1968 indicated that a product grading 68% soluble iron could be obtained from raw material containing 29% soluble iron with a recovery of 63% of the original iron. To produce 1.0 ton of concentrate, 3.57 tons of raw material would be required.

Noranda Exploration Company Limited [1967] (25)

In 1967 Noranda Exploration Company Limited carried out a ground electromagnetic and a ground magnetic survey over a claim group, the extreme northwesterly claim of which was located at the extreme southeasterly corner of Laurie Township. The claim was not in good standing on December 31st, 1986.

The purpose of the electromagnetic survey was to locate electromagnetic anomalies characteristic of sulphide ore deposits. Results indicated that only the northwesterly termination of a broad northwesterly-trending conductive zone occurred in the extreme southeastern part of the claim which corresponded with anomalies indicated by a previous airborne geophysical survey. The trend of the ground electromagnetic conductor was parallel to the strike of the rocks mapped in southwesterly Horne Township (Carter in preparation a). The magnetometer survey was carried out to provide additional information on the electromagnetic anomalies. Although minor anomalies occurred in the southeastern known surface geology. Current mapping shows the claim to be underlain by Timiskaming-type metasediments and Keewatin-type mafic metavolcanic rocks.

No record of development and production from the deposits are in the files on the deposits.

Ontario Incorporated (26)

During 1986 Ontario Incorporated held a block of 28 unsurveyed, unpatented claims straddling the Matawin River at Middle Falls and McGraw Falls in east-central Laurie Township. The claims restaked parts of the former properties of Monpre Iron Mines Limited and of Edwin Kukkee. The property was in good standing on December 31st, 1986.

No exploration activity by this company is on file but at McGraw Falls where the property restakes that of Edwin Kukkee on the northern shore of the Matawin River below the dam, two pits were observed excavated on a magnetite-pink arkose ironstone unit mapped as Timiskaming-type by the author. The strike of the ironstone is N60° W and the dip is 85° NE. The ironstone is cut by quartz-carbonate veins about 10-15 cm thick which strike N65° E, dip about 80° NW and are mineralized with pyrite. The veins had been channel sampled in the past. A grab sample from the pits submitted to the Resident Geologist's Office, Thunder Bay and analyzed by the Geoscience Laboratories, Toronto, yielded 1.43 ounces of gold per ton (Resident Geologist's Files, Ontario Ministry of Northern Development and Mines, Thunder Bay).

A grab sample of pyritized quartz vein material and the ankeritized rock collected during the current survey and analyzed by the Geoscience Laboratories, Ontario Geological Survey, Toronto, yielded 0.01 ounces per ton gold.

At an outcrop on the property of pinkish grey ankeritized Timiskaming-type arkose cut by a pyritized quartz vein of unknown width and indeterminate trend located at the south side of the Shabaqua Road immediately on crossing the bridge at McGraw Falls, Matawin River, and proceeding southwards, a grab sample was collected during the current survey and analyzed by the Geoscience Laboratories, Ontario Geological Survey, Toronto. It yielded 0.01 ounce per ton gold and <0.10 ounce per ton silver.

At an outcrop 180 m southwest of the outcrop mentioned in the above paragraph several small pits excavated in red arkose were observed during the current survey. No mineralization was observed in the pits and no samples from them were assayed by this survey.

G.E. Ross (27)

In 1986 G.E. Ross held one surveyed patented claim, TB 3499, located in the northeastern corner of Laurie Township. The claim was in good standing on December 31st, 1986.

No exploration work is on file for the property and current mapping shows it to be underlain Keewatin-type tholeiitic and calc-alkalic mafic to intermediate metavolcanic rocks and a unit of siltstone.

Christoph Tscharnjke (28)

In 1986 Christoph Tscharnjke held three, contiguous, surveyed and patented claims, TB 26518, TB 26519, and TB 26520, located near the middle part of the eastern boundary of Laurie Township. The claims were in good standing on December 31st, 1986.

No exploration work is on file for the property and no outcrops were located on it during the current survey but metasediments and ironstone units of the Timiskaming-type group are interpreted by the author to occur on the claim group.

RECOMMENDATIONS FOR FUTURE EXPLORATION

Base Metal Sulphides

The southern two thirds of the map area are underlain by a subaqueous to emergent subaerial ultramafic to felsic metavolcanic sequence, the Keewatin-type sequence, consisting of interlayered flows and pyroclastic rocks interpreted by the writer as a stratavolcanic sequence. The lower part of this sequence consists predominantly of ultramafic, mafic and intermediate komatiitic, tholeiitic and calc-alkalic metavolcanics and underlies the southern part of Blackwell Township and the northern and southern parts of Laurie Township. The upper part of the sequence occurs in south-central Laurie Township and is characterized by a predominance of intermediate and felsic calc-alkalic and shoshonitic pyroclastic breccia and tuff and is interpreted by the author as an eroded volcanic centre, because of the abundance of pyroclastic material and small subvolcanic feldspar and quartz-feldspar porphyries. On the basis of this regional volcanic setting two regions are recommended for further exploration for base metal sulphides. One is a variably medium to coarse pyroclastic breccia unit crossing the map area from east to west about 0.5 to 1.3 km south of and parallel to Highway 11 in the lower part of the sequence. This unit consists locally of coarse angular calc-alkalic intermediate calc-alkalic intermediate tuff-breccia containing nodules of pyrite and pyrrhotite up to

3 x 3 cm and graphite. Drilling of this unit has already been carried out by Three Brothers Mining Exploration Limited and Falconbridge Nickel Mines Limited and although no base-metal sulphide mineralization has been found it represents a good potential target. The occurrence of this pyroclastic breccia unit in a subaqueous environment surrounded by finer-grained metavolcanics and also by pillowed flows suggests a local subaqueous volcanic centre and it is therefore recommended that the unit be further explored for its stratabound, base-metal sulphide potential.

The second area recommended is in south-central Laurie Township and is dominated by pyroclastic rocks. Associated with these pyroclastics is a pyritic, sulphidic, graphitic mudstone unit which, on the basis of drilling by Caltor Syndicate, is mineralized with sphalerite, chalcopyrite, galena and silver. The geological setting and the type of mineralization encountered suggests an exhalative volcanic subaqueous centre where base metal sulphides with associated gold and silver can occur. It is suggested that the areas within this upper sequence where coarser pyroclastics have been mapped and coded on the map face be further prospected for their base metal potential.

Gold and Silver

Gold and silver have been found in numerous parts of the map area in both the Keewatin-type and Timiskaming-type sequences.

In the Keewatin-type sequence gold has been found in tholeiitic metavolcanic rocks, e.g. at the Kaspar and Hayne Occurrences in the same unit, and in a mafic tholeiitic unit about 2 km south-southwest of Shabaqua Station; in sheared Keewatin-type metavolcanic rocks at the Chilian Occurrence; in a pit in mafic tholeiitic metavolcanics in the upper part of the Keewatin-type sequence in southwestern Laurie Township; and in a sulphidic, pyritized laharic unit also in this upper sequence located on the Matawin River. Within this Keewatin-type sequence the gold-silver occurrences do not show any preferred stratigraphic horizon, or rock type, but occur where the rocks have been sheared or tectonically brecciated and are therefore considered to be structurally controlled. The lithologic units comprising the Keewatin-type rocks have been shown separately on the map face and zones of shearing have also been delineated where observed. Photolineaments have also been shown on the map face and mapping has shown that some of these are associated with shearing. It is recommended that the shear zones and lineaments transecting the Keewatin-type sequence be studied for signs of mineralization and shearing and carbonate or sericitic alteration, and where this is observed these areas should be sampled. As shear zones are associated with areas of considerable deformation, and as such an area has been observed in southwestern Laurie Township where a larger concentration of shear zones have been observed, it is recommended that this area receive special attention in the exploration for gold mineralization. Areas of known gold occurrences, e.g. the Chilian and Kaspar Occurrences should also receive renewed exploration activity to test them for their viability as workable gold deposits.

In the southern belt of the Timiskaming-type sequence gold has been found in carbonatized arenaceous and rudaceous sediments, in quartz veins in an arenaceous sediment, and in magnetite-jasper ironstone intruded by quartz veins. All these occurrences are located in the neighborhood of Middle Falls on the Matawin River. This sequence has been shown by mapping to be later than the Keewatin-type sequence which is auriferous. The nature of the Timiskaming-type sediments show that they are terrigenous, very immature and of very local provenance and that the rocks of the northern belt are of a fluvial origin. This suggests that auriferous paleoplacers derived from the underlying Keewatin-type sequence could be present within the Timiskaming-type sequence. A detailed sedimentological study of the coarser detrital sediments of these rocks should therefore be carried out in a search for such deposits. Current mapping has shown that the Timiskaming-type sequence has been deformed, is tightly folded and is crossed by minor shear zones. These shear zones have been shown separately on the map face. The rocks have been affected by hydrothermal alteration to produce carbonatized and gossanous areas and where sampled some of them are gold bearing. These areas are concentrated in the southeastern part of Laurie

Township and it is recommended that they receive further detailed study for their gold potential. Thirdly, at Middle Falls on the Matawin River in Laurie Township magnetite-jasper ironstone has been intruded by quartz veins and pyritized. Channel samples from pits in this area showed that the unit is auriferous. This ironstone unit extends both eastward and westward of this locality and has received detailed study when it was being assessed for its iron potential. It is recommended that the ironstone unit be tested for its gold potential where cut by quartz or quartz-carbonate veins and/or mineralized with pyrite and arsenopyrite. The rocks in this area have been tectonized and this would provide fractures permitting the ingress of quartz veins and fluids for mineralization.

Iron

Iron occurs as oxide facies magnetite-jasper and magnetite-terrigenous sediment units in both the Keewatin-type and Timiskaming-type sequences. The units in the Keewatin-type sequence are narrow and discontinuous. The most voluminous body occurs within the Timiskaming-type sequence within the southern belt. Iron deposits are not of commercial significance at the present time and therefore, it is not recommended that, at present, it be further explored for its iron potential. The unit has, however, been previously assessed by Monpre Mining Company Limited and Monpre Iron Mines Limited in the period 1957-1968, when a zone 1200 feet (366 m) long and 100 to 500 feet (30 m to 152 m) wide was outlined, containing 17,000,000 tons of 26% soluble iron material which could be recovered by an open-pit operation, with a waste to ore ratio of 1.07:1. Laboratory tests done in 1968 on the material, indicated that a product grading 68% soluble iron could be obtained from raw material containing 29% soluble iron with a recovery of 63% of the original iron. To produce 1.0 ton of concentrate, 3.57 tons of raw material would be required.

Nickel-Chromium-Platinum Group Elements

No assays for nickel have been recorded in the assessment work files from areas of drilling where gabbros or ultramafic rocks occur; nor have any areas of nickel mineralization been located. During the current mapping program units of ultramafic and mafic komatiitic flows have been mapped in the southern part of Blackwell Township south of Highway 11; and in northern Laurie Township interlayered with the tholeiitic and calc-alkalic metavolcanics. These flows show both spinifex-textured subunits, flow-top breccias and basal olivine-cumulus subunits. As komatiitic flows are associated with nickel and platinum-group elements (Naldrett and Cabri 1976) and are one of the most important sources of nickel deposits (Naldrett and Campbell 1982), it is recommended that the thicker of these flows shown on the map face be prospected for their nickel and possibly associated chromium and platinum-group element potential.

During the current mapping mineralized zones within these rocks were not encountered and specific local areas therefore cannot be listed.

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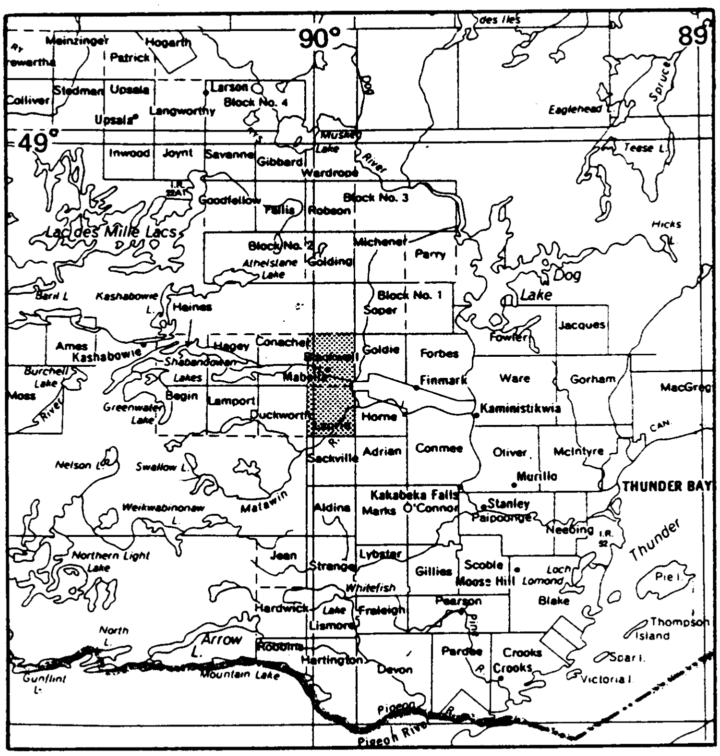
Figure 1



LOCATION MAP

Scale : 1 : 1 584 000
or 1 inch to 25 miles

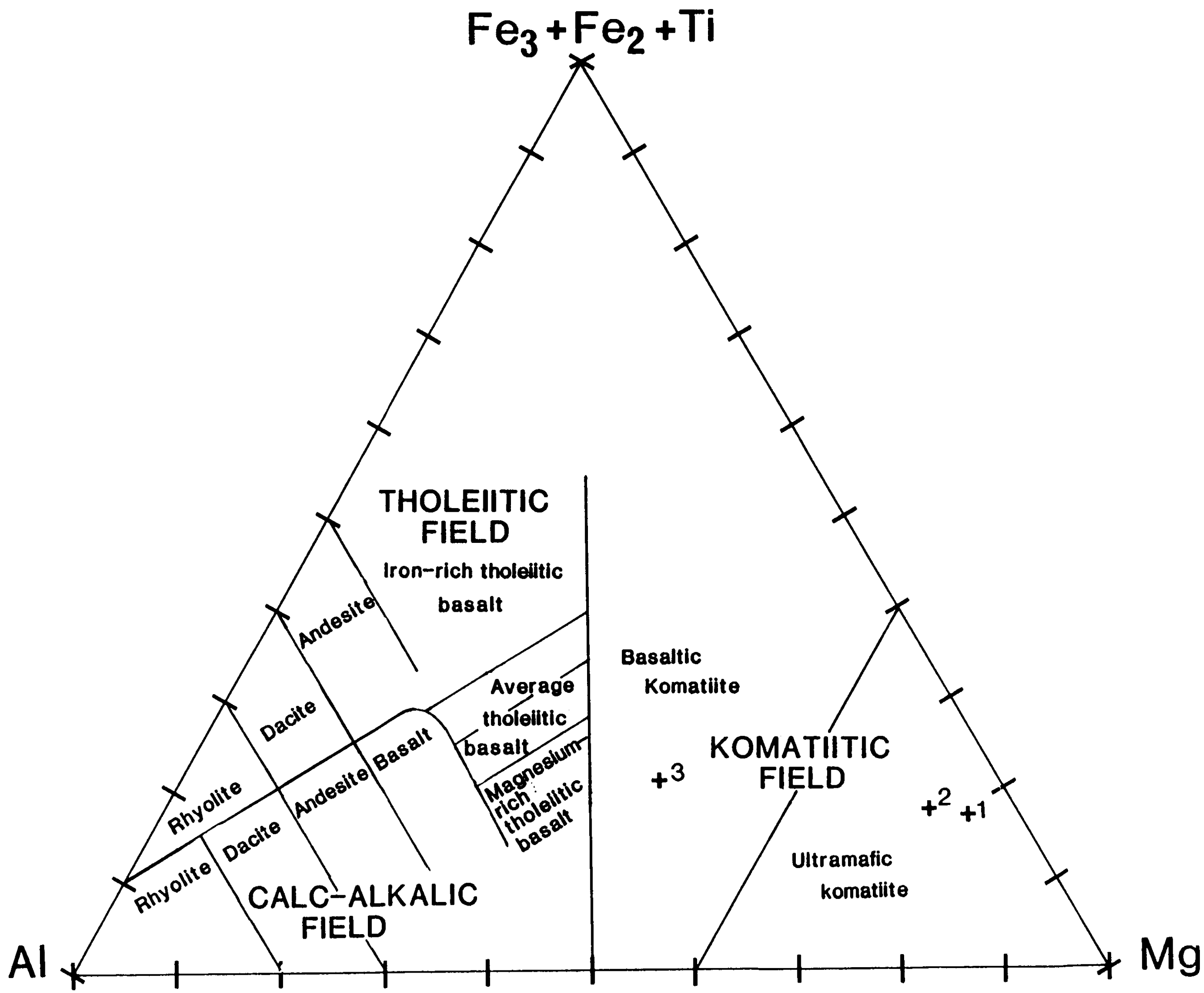


FIGURE 2 - Jensen Cation Plot of Keewatin-type komatiitic metavolcanic rocks of Blackwell and Laurie Townships. Parameters in cation percentages (after Jensen 1976, modified by Grunsky 1981).

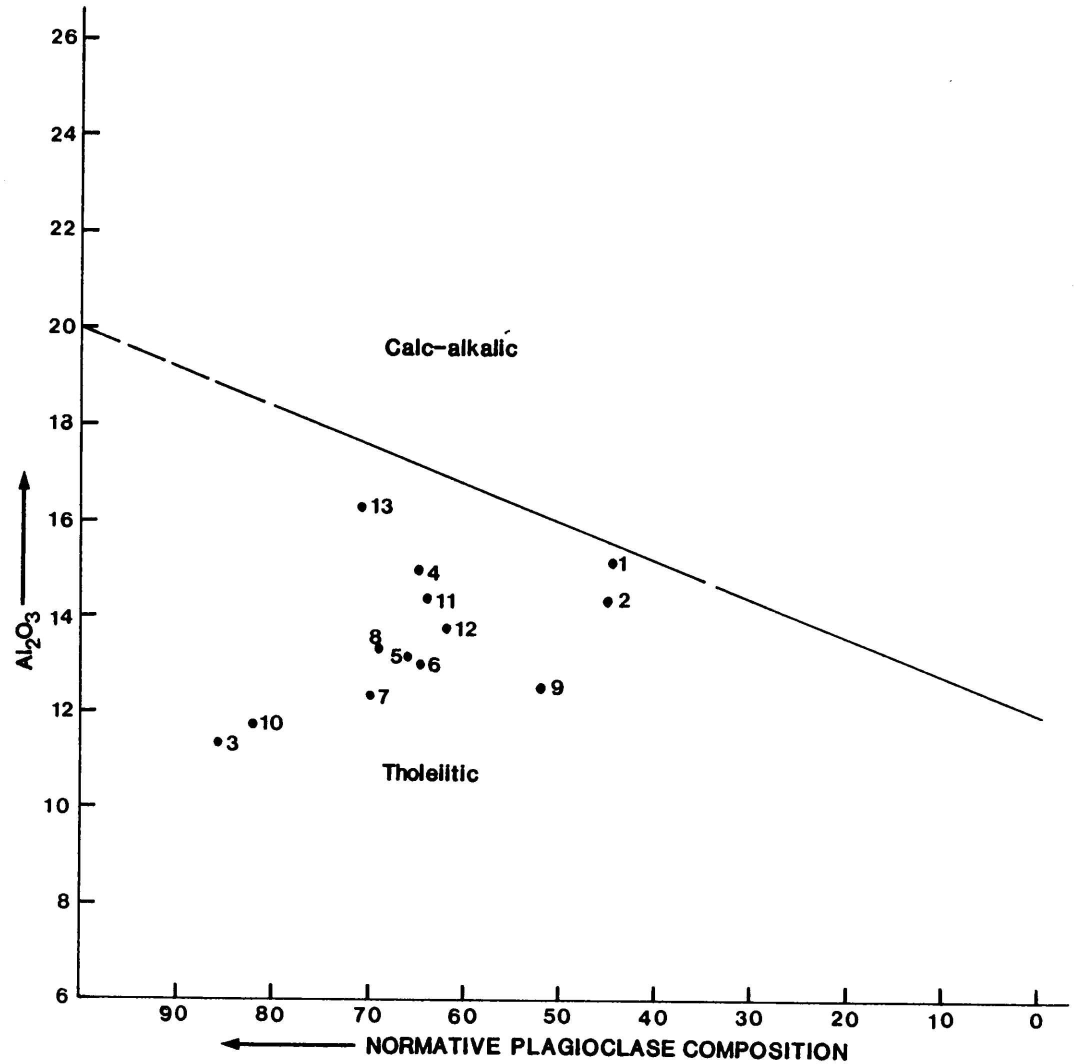


FIGURE 3 – Al_2O_3 vs. normative plagioclase composition of tholeiitic mafic metavolcanic rocks. Al_2O_3 in weight percent, plagioclase composition in equivalent percent. (Irvine and Baragar 1971)

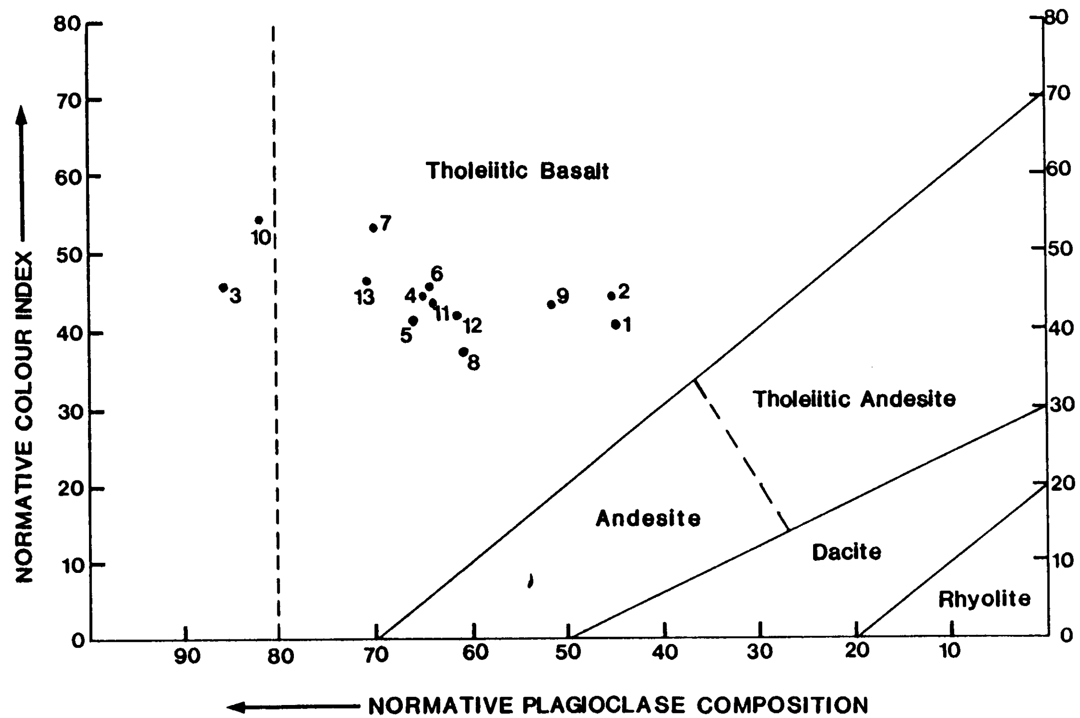


FIGURE 4 – Normative colour index vs. Normative plagioclase composition for Keewatin-type tholeiitic metavolcanic rocks. Parameters in per cent cation equivalents, anhydrous basis. After Irvine and Baragar (1971), modified by the Ontario Geological Survey. Dashed vertical line is upper plagioclase limit in Irvine and Baragar's classification.

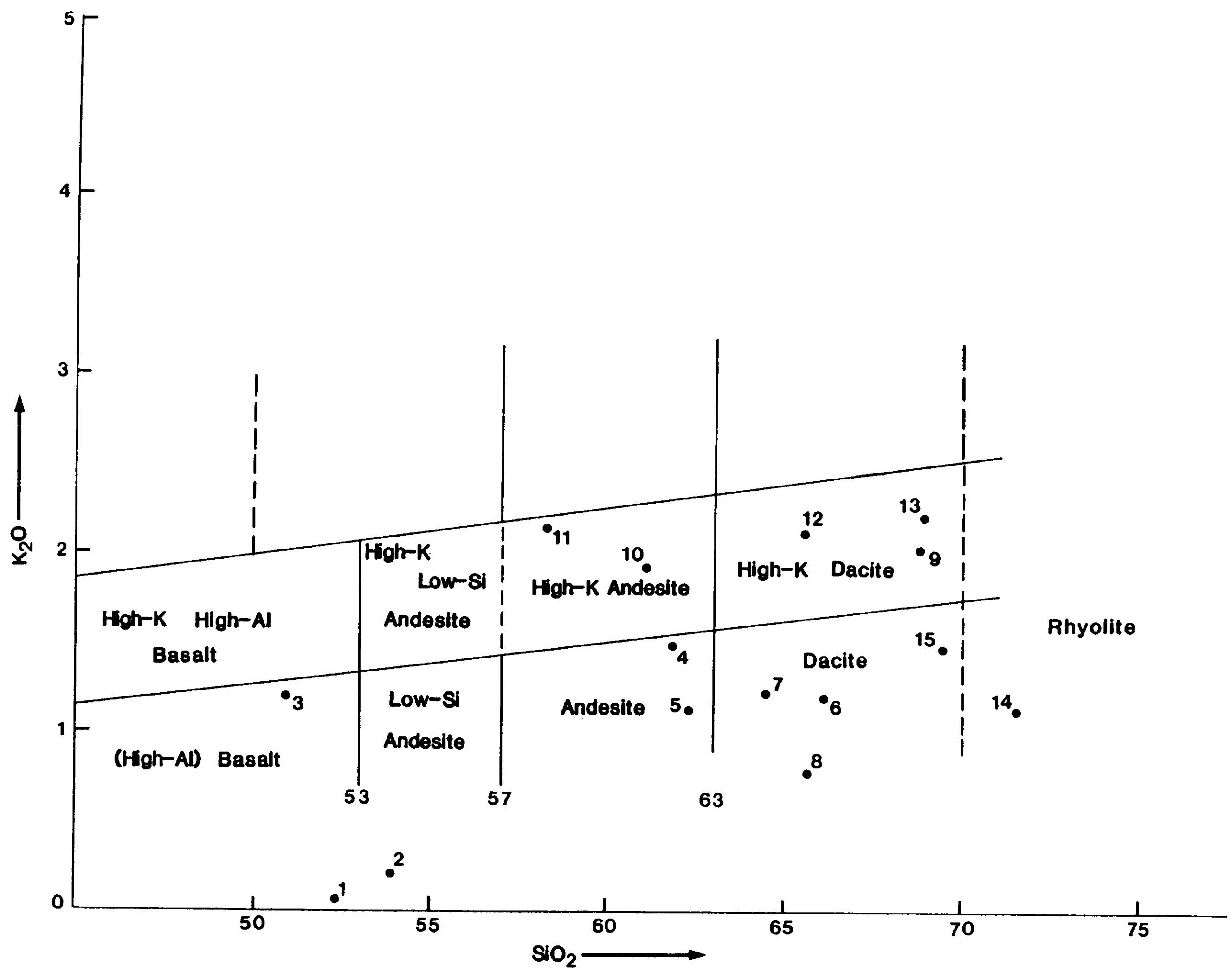


FIGURE 5 - K_2O vs. SiO_2 plot of Keewatin-type calc-alkalic metavolcanic rocks. Parameters in weight percent. After Mackenzie and Chappell(1972).

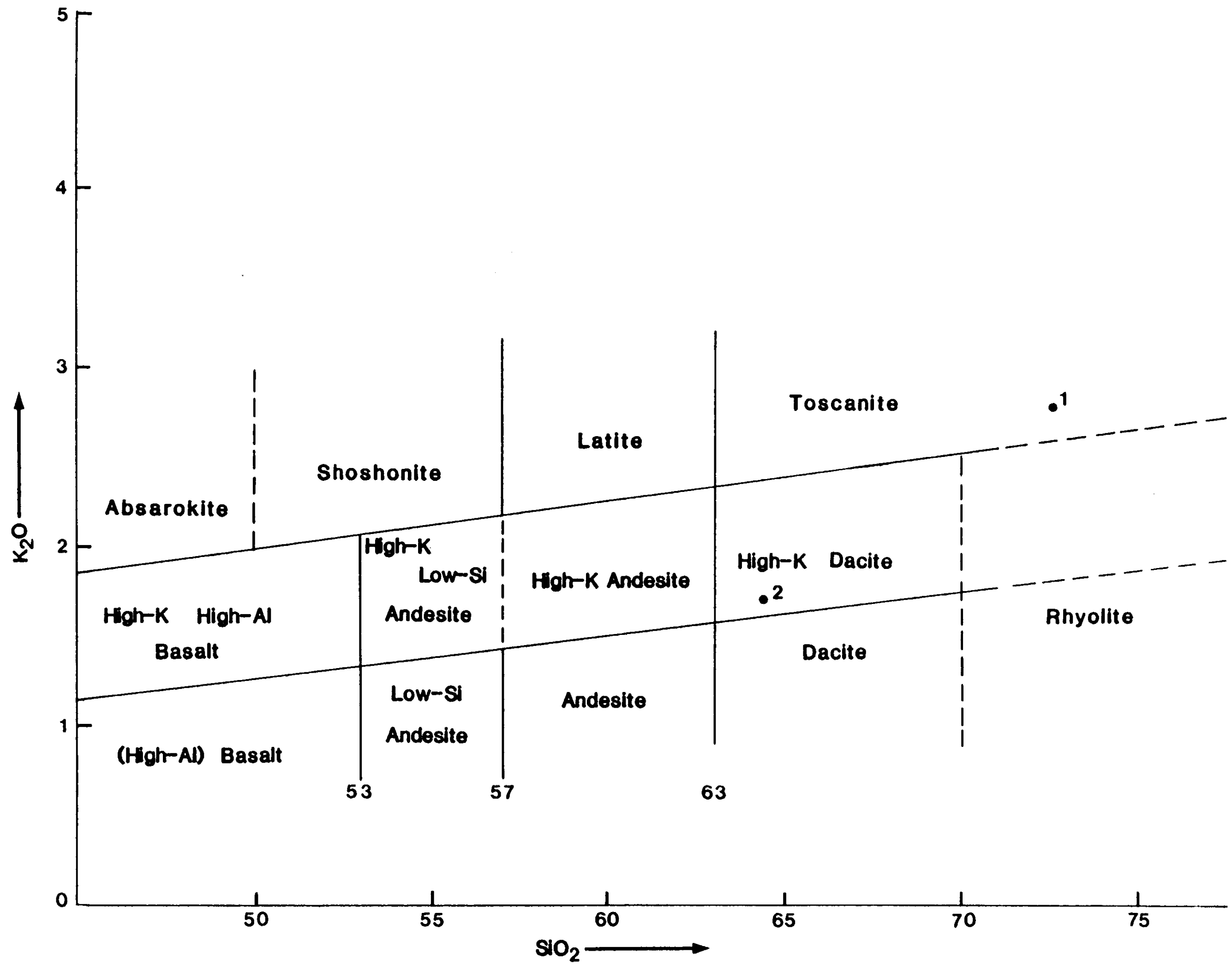


FIGURE 6 - K_2O vs. SiO_2 plot of Keewatin-type Shoshonitic metavolcanic rocks. Parameters in weight percent. After Mackenzie and Chappell(1972).

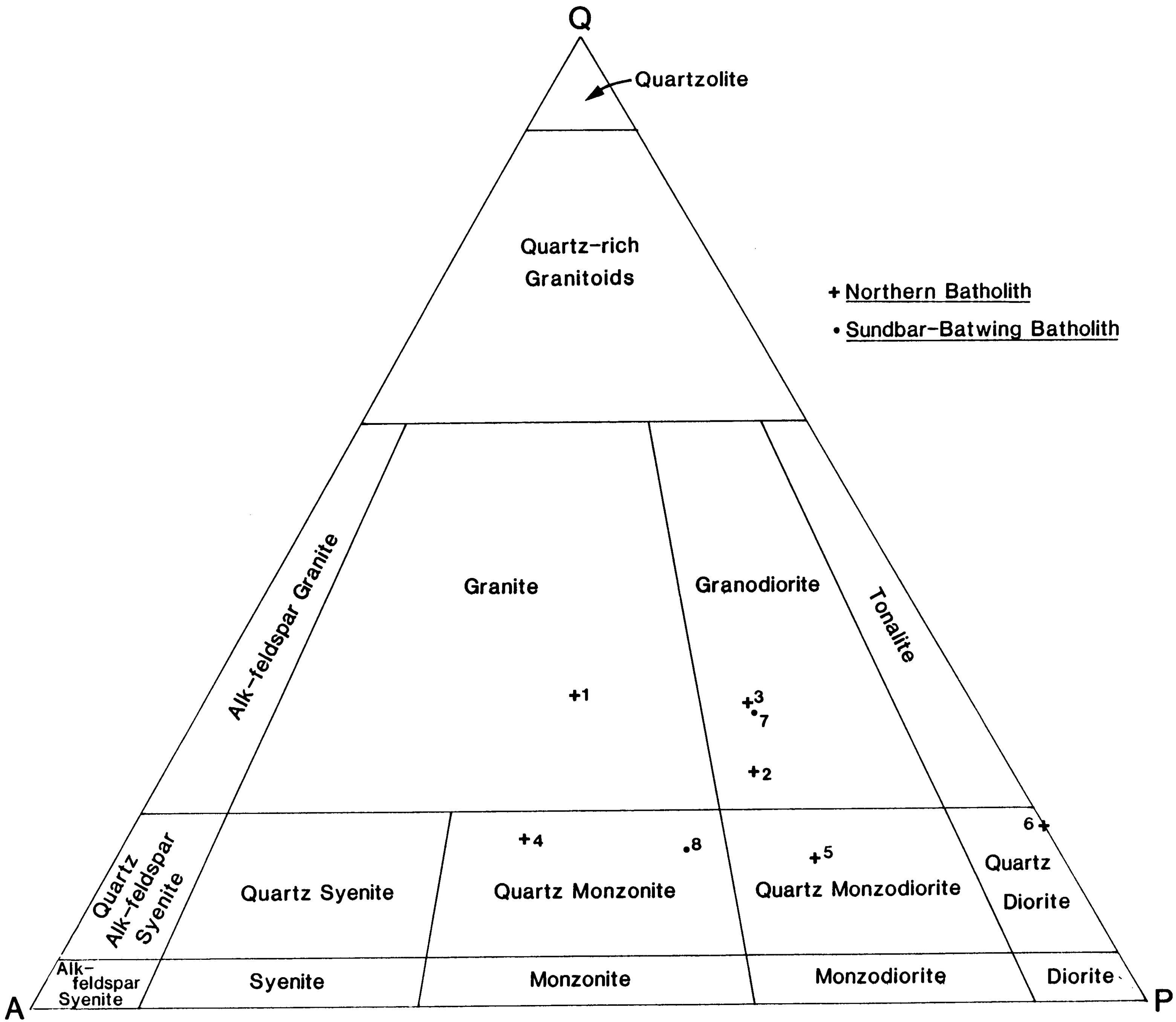


FIGURE 7 – Q–A–P plot of Felsic Intrusive Rocks. Parameters in volume percent. Q: quartz, A: alkali feldspar, P: plagioclase feldspar. After Streckeisen (1976).

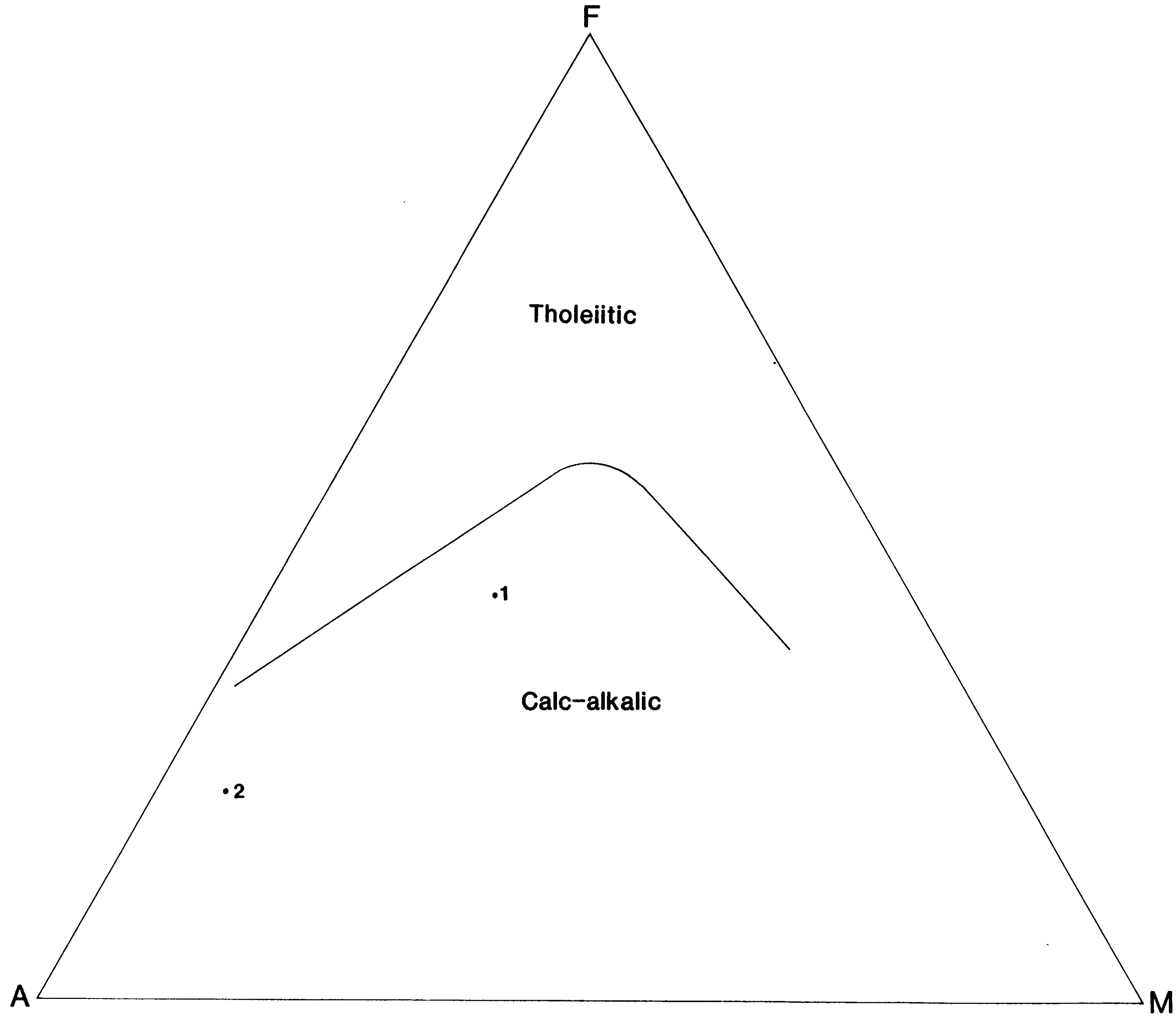


FIGURE 8 – AFM plot of Felsic Intrusive Rocks. A=Na_2O+K_2O, F=$FeO+0.8998Fe_2O_3$, M=MgO, all in weight percent. After Irvine and Baragar (1971).

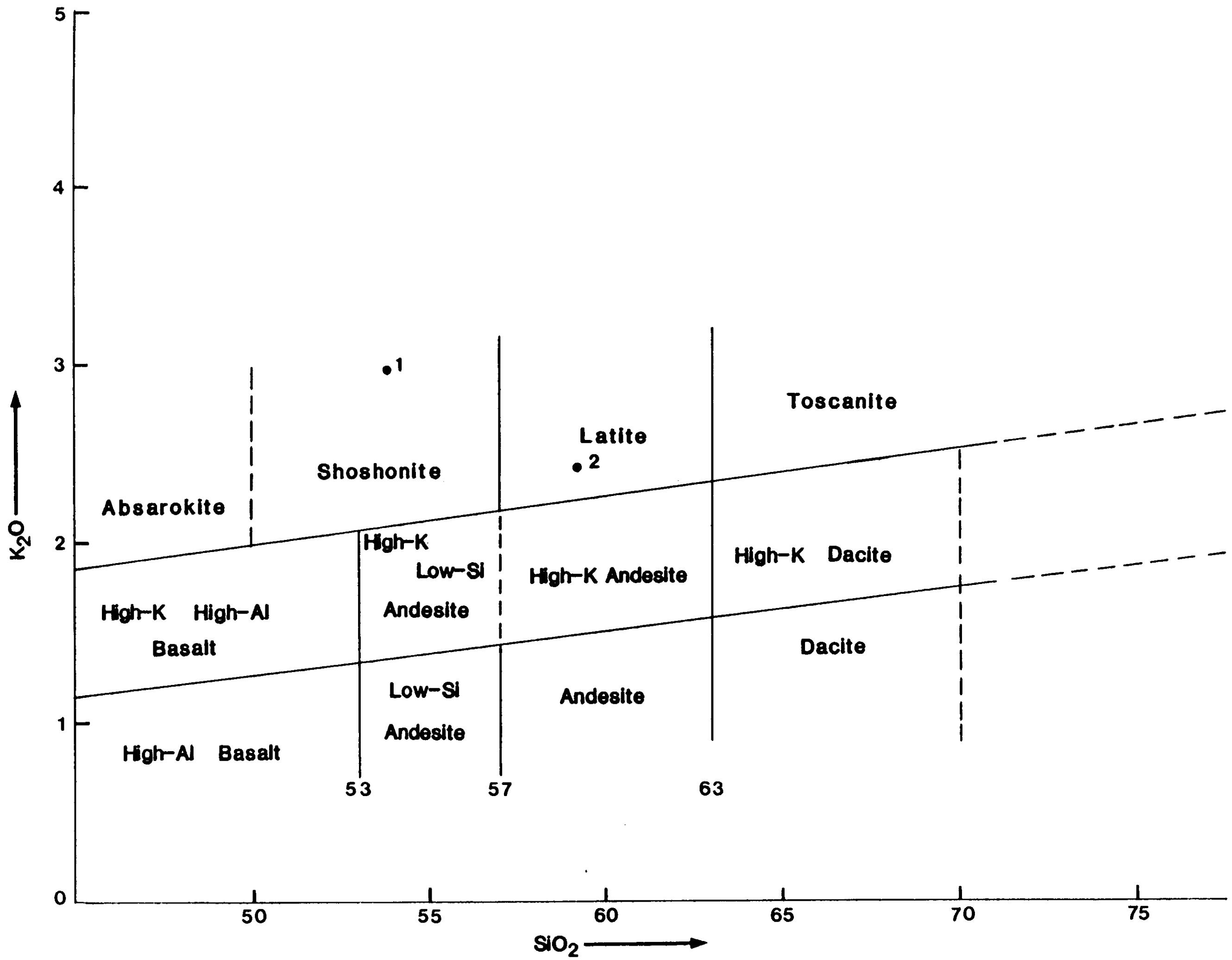


FIGURE 9 - K_2O vs. SiO_2 plot of Timiskaming-type shoshonitic metavolcanic rocks. Parameters in weight percent (anhydrous). After Mackenzie and Chappell (1972).

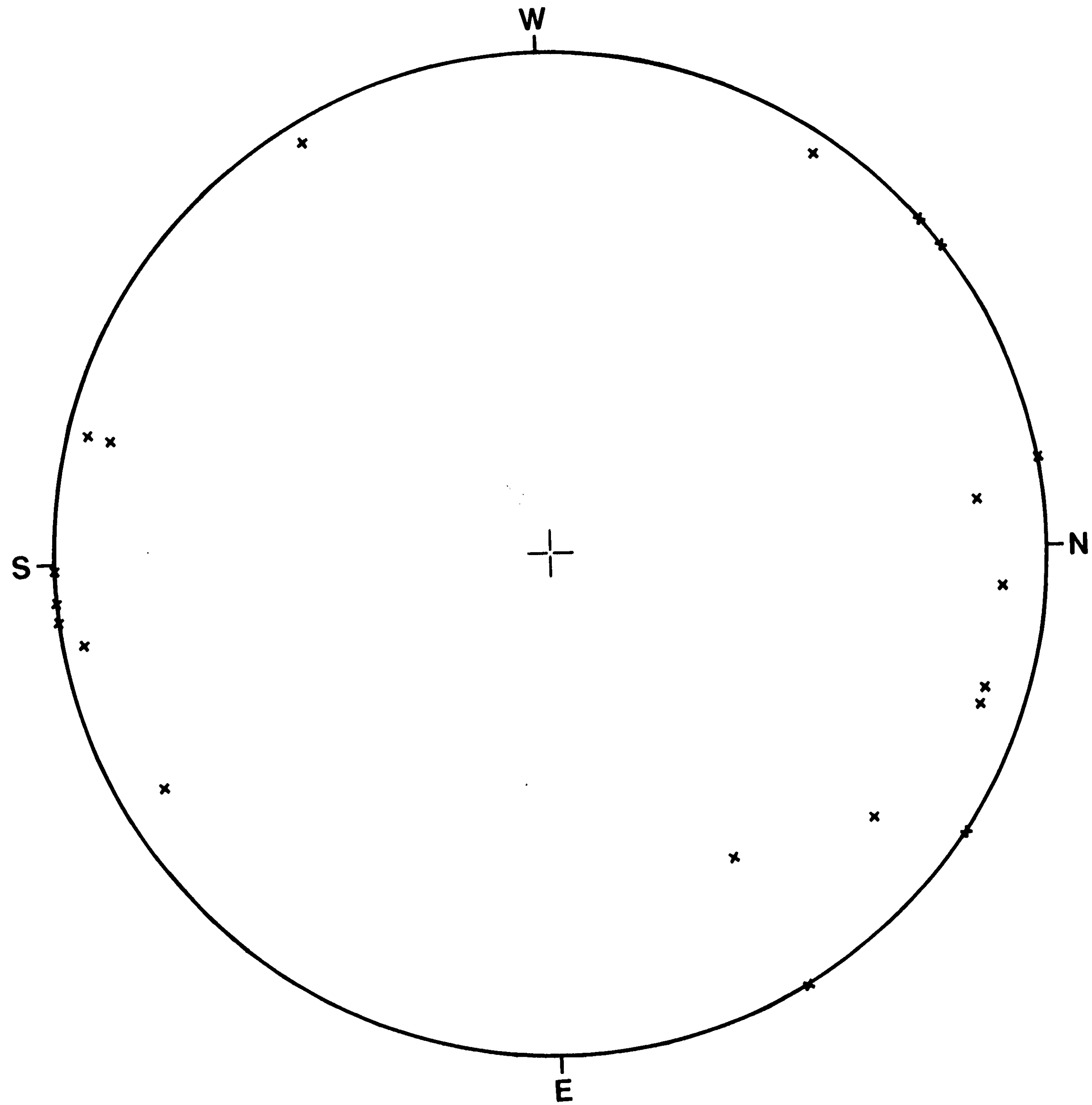


FIGURE 10. pi–diagram of poles of bedding in the Keewatin–type metasedimentary rocks, Blackwell and Laurie Townships. Equal area plot of 22 measurements.

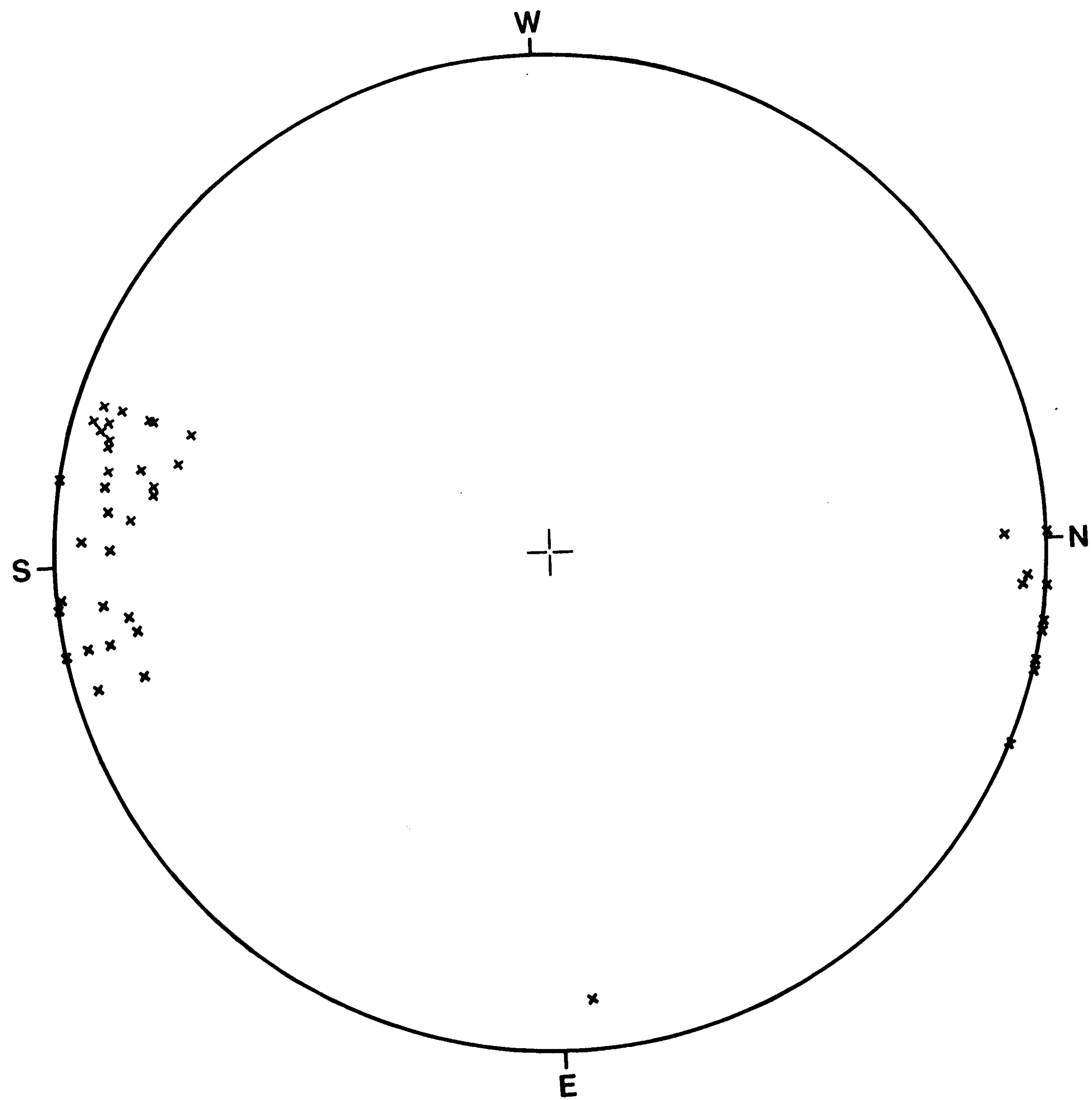


FIGURE 11. pi-diagram of poles to bedding in the Quetico-type metasedimentary rocks, Blackwell and Laurie Townships. Equal area plot of 48 measurements.

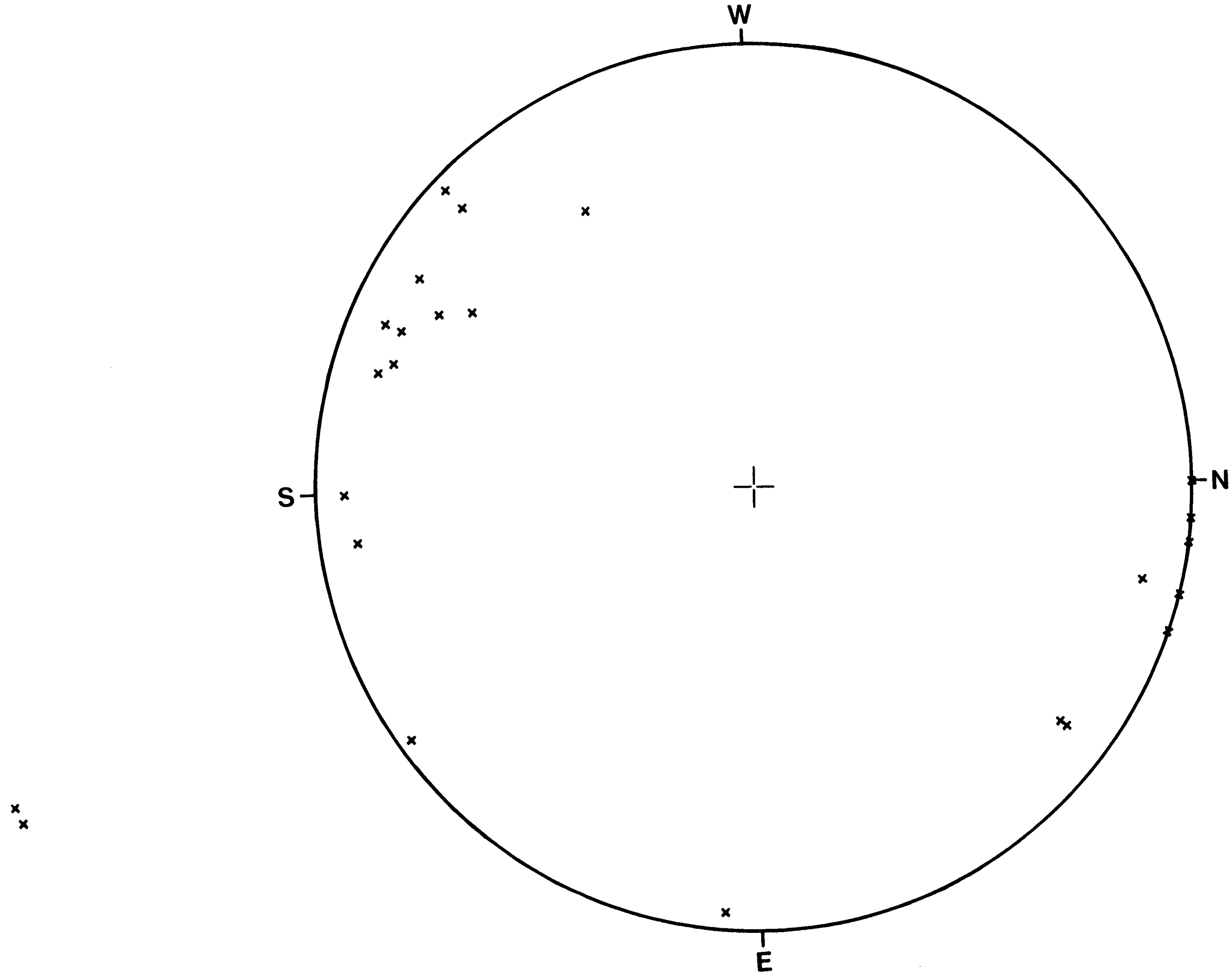


Figure 12. pi-diagram of poles to bedding in the Timiskaming-type metasedimentary rocks, Blackwell and Laurie Townships. Equal area plot of 22 measurements.

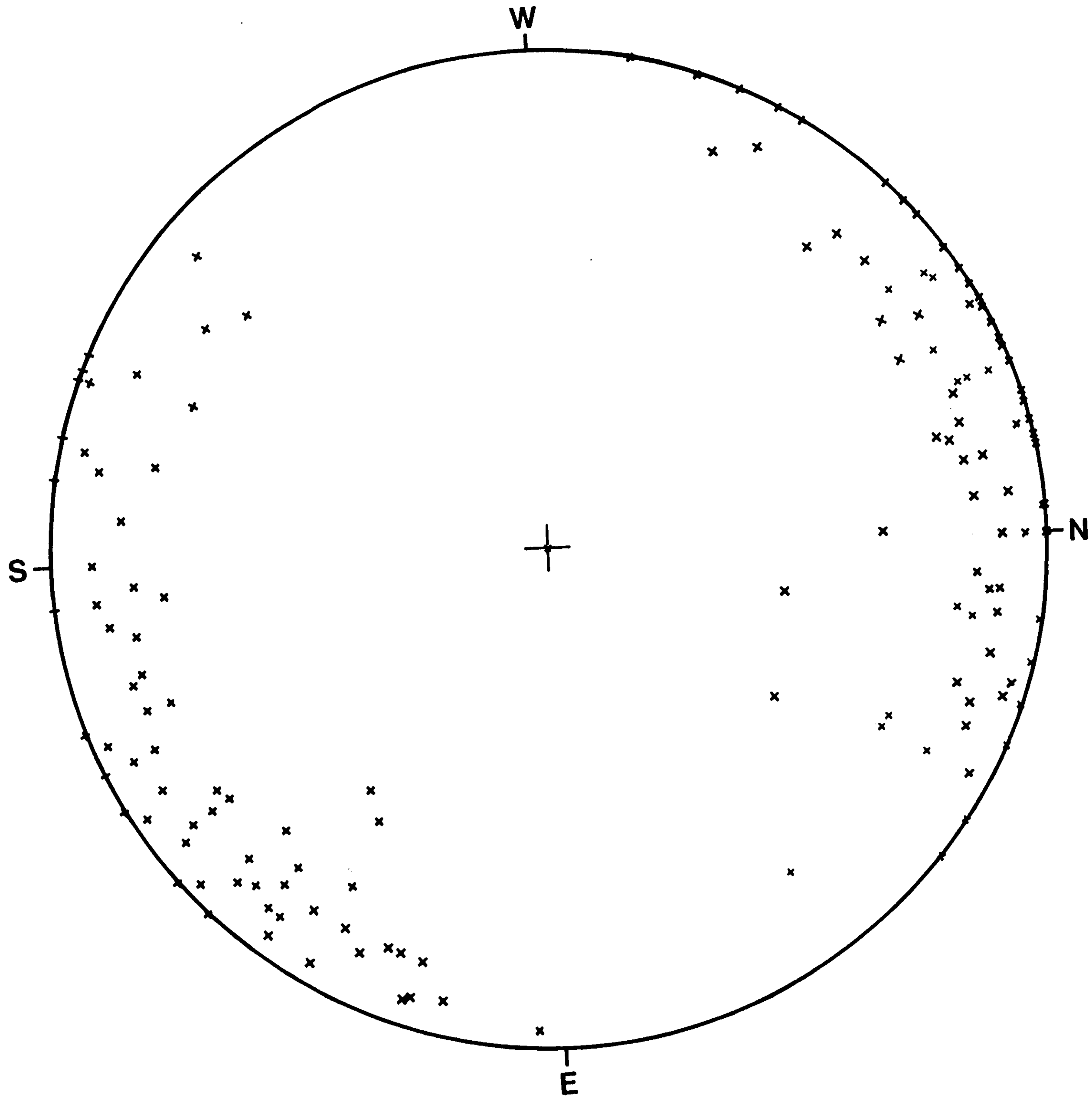


FIGURE 13. pi-diagram of poles to foliation in the Keewatin-type sequence, Blackwell and Laurie Townships. Equal area plot of 165 measurements.

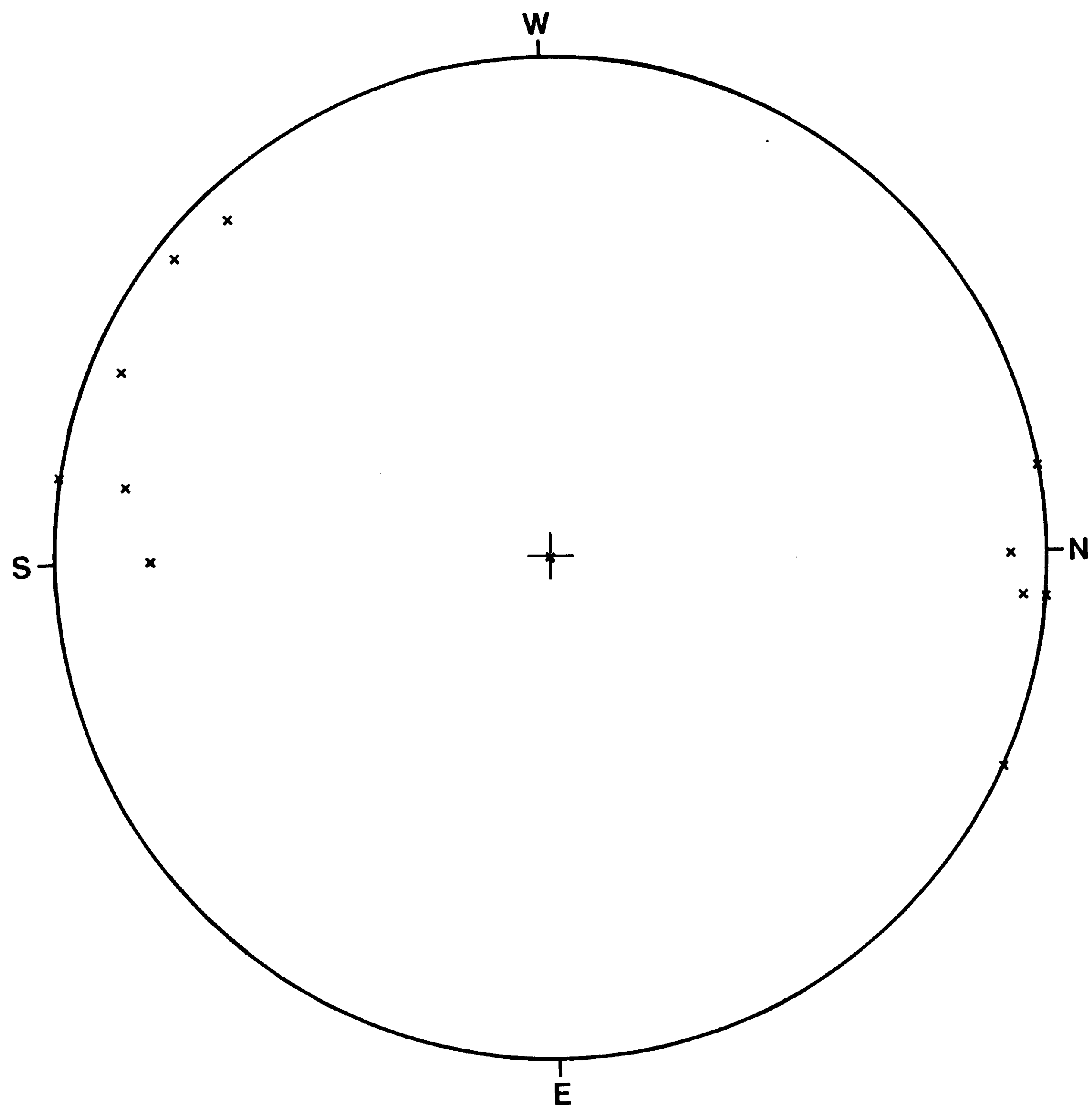


FIGURE 14. pi-diagram of poles to foliation in the Quetico-type sequence, Blackwell and Laurie Townships. Equal area plot of 13 measurements.

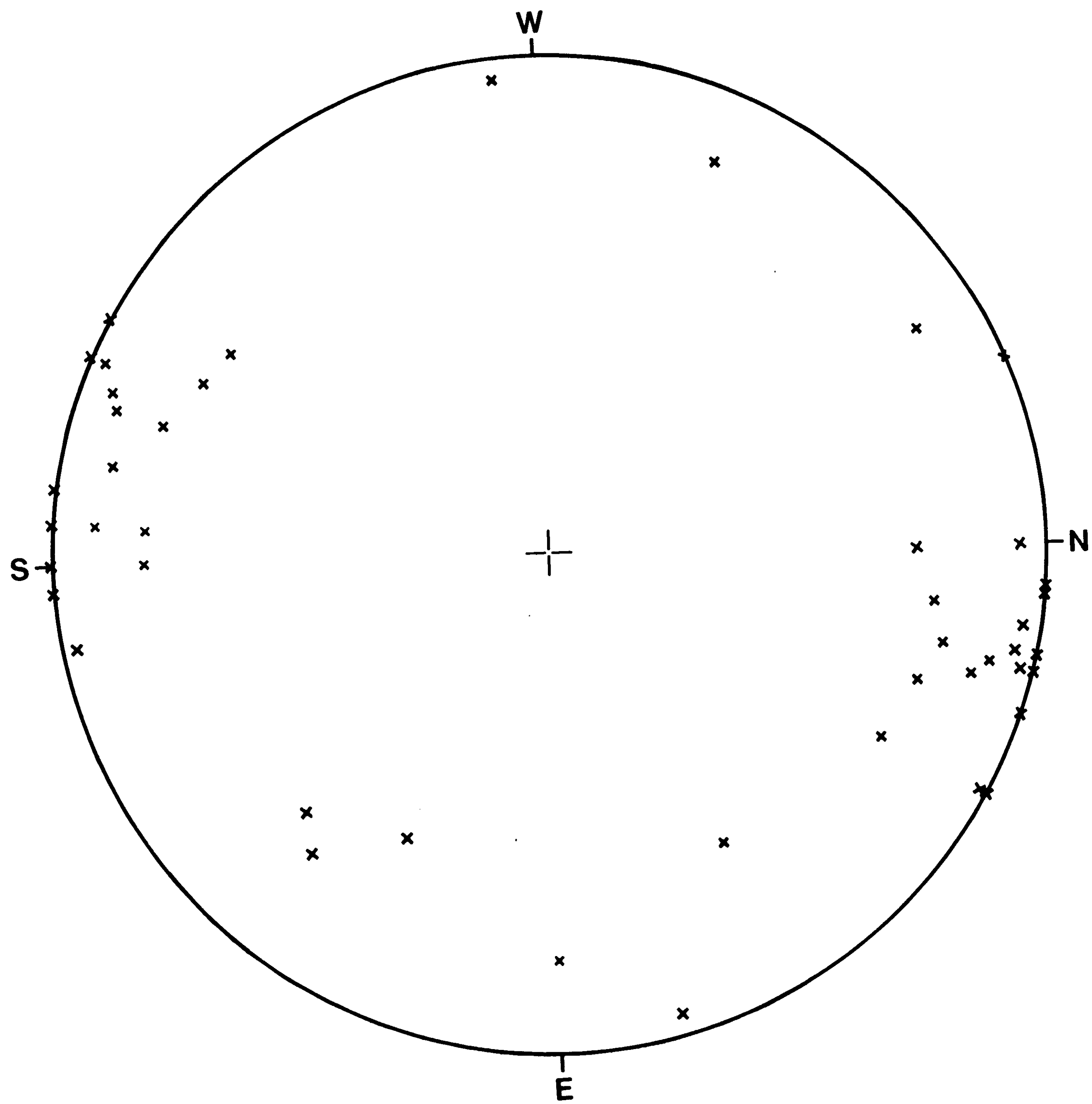


FIGURE 15. pi–diagram of poles to foliation in the Timiskaming–type sequence, Blackwell and Laurie Townships. Equal area plot of 53 measurements.

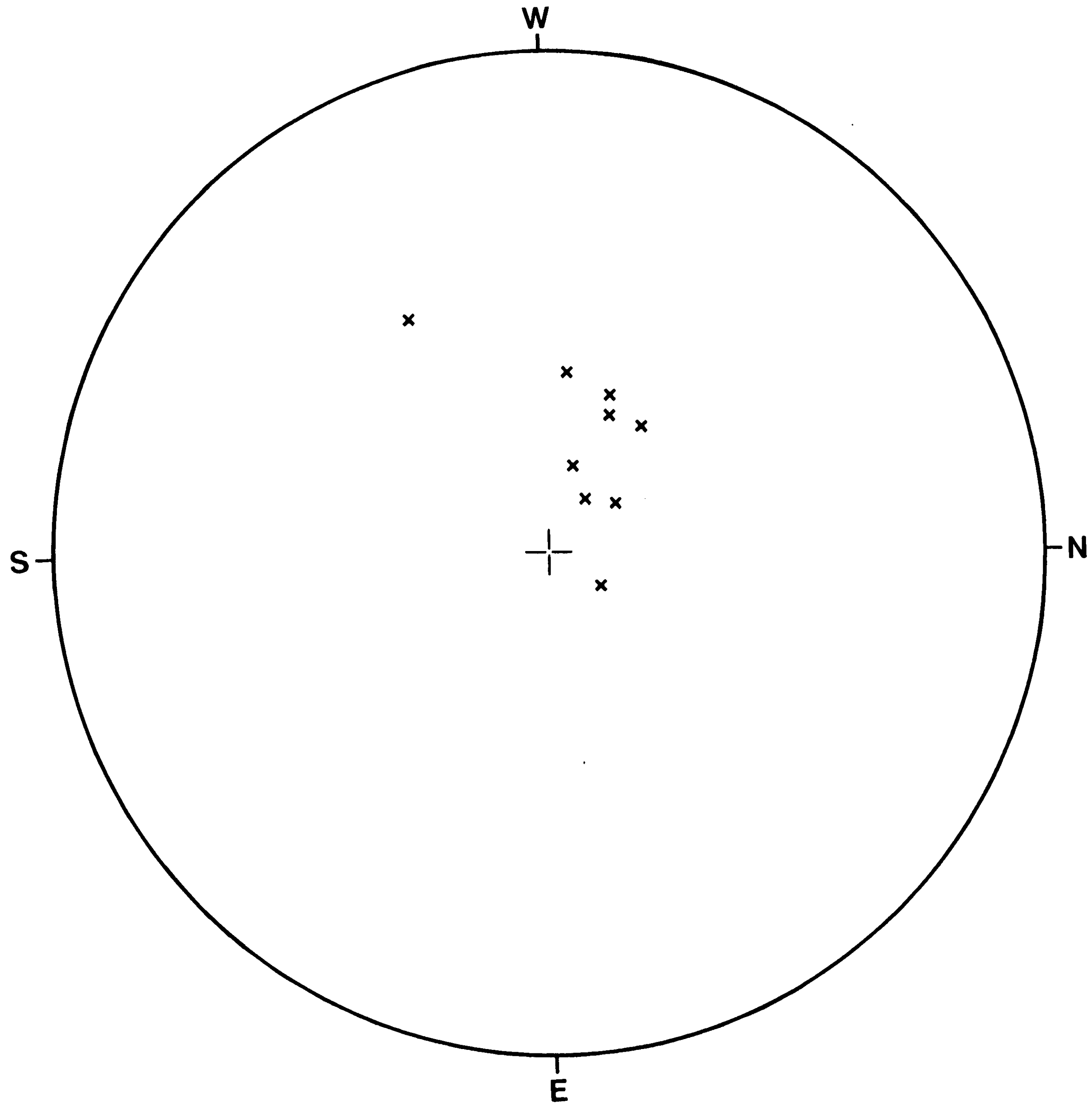


FIGURE 16. pi-diagram of poles of mineral lineation in the Keewatin-type rocks, Blackwell and Laurie Townships. Equal area plot of 9 measurements.

Photo: 1. Pillowed Keewatin-type ultramafic komatite flow, from outcrop located in northeastern Laurie Township, 2.7 km southwest of Shabaqua Station

Photo: 2. Photomicrograph of polysutured part of Keewatin-type ultramafic komatiitic flow, from outcrop located 2.2 km southeast of the southern end of Sand Lake (local name), northwestern Laurie Township

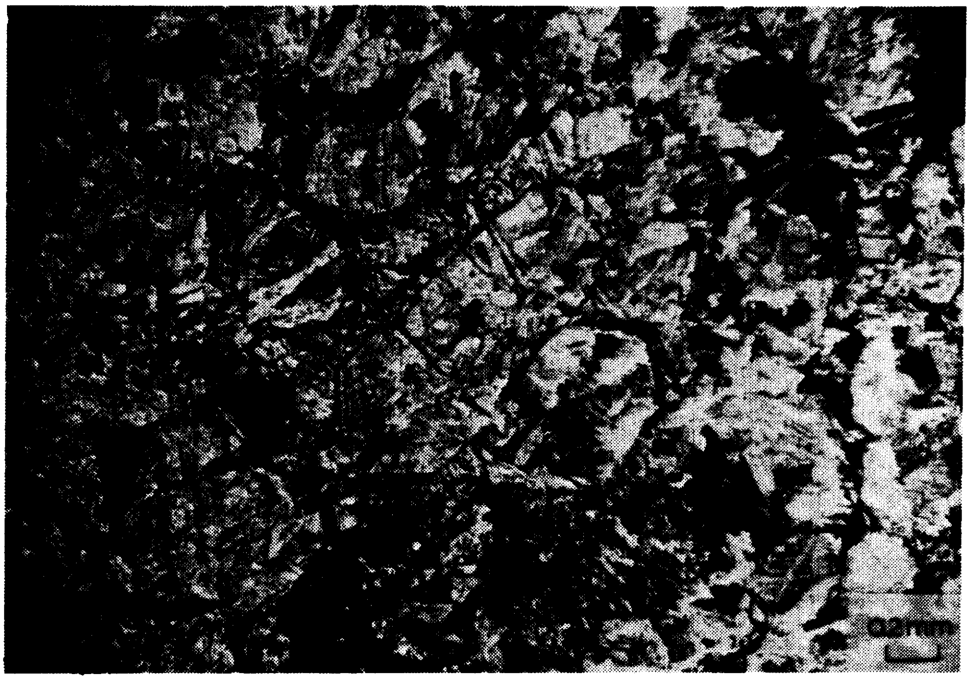


Photo: 3. Photomicrograph of polysutured part of Keewatin-type ultramafic komatiitic flow, from outcrop at the falls at Mabella, southwestern Blackwell Township

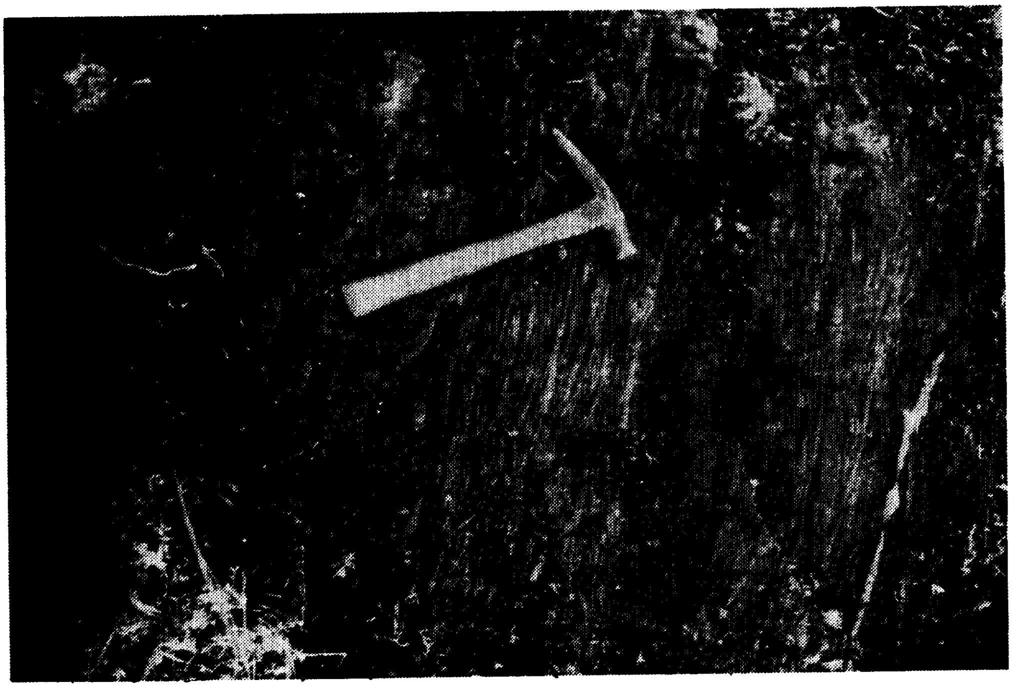


Photo: 4. Foliated and banded Keewatin-type tholeiitic mafic metavolcanic rock from outcrop located in the southwestern corner of Laurie Township, 0.7 km north of the southwestern boundary corner of the Township

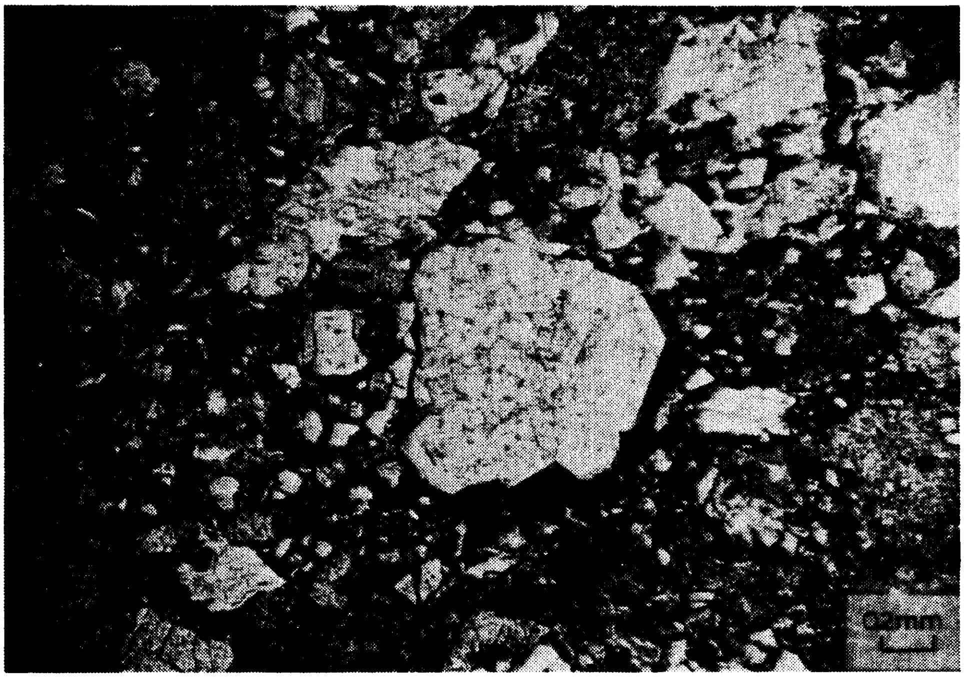


Photo: 5. Photomicrograph of Keewatin-type tholeiitic basalt tuff showing adhering devitrified glass, from rock taken from outcrop located 3.5 km west-southwest of Middle Falls, Matawin River, in east-central Laurie Township

Photo: 6. Photomicrograph of Keewatin-type high-K calc-alkalic hornblende basalt, from rock taken from outcrop located 2.1 km east-southeast of the southeastern end of Sand Lake (local name), north-western Laurie Township

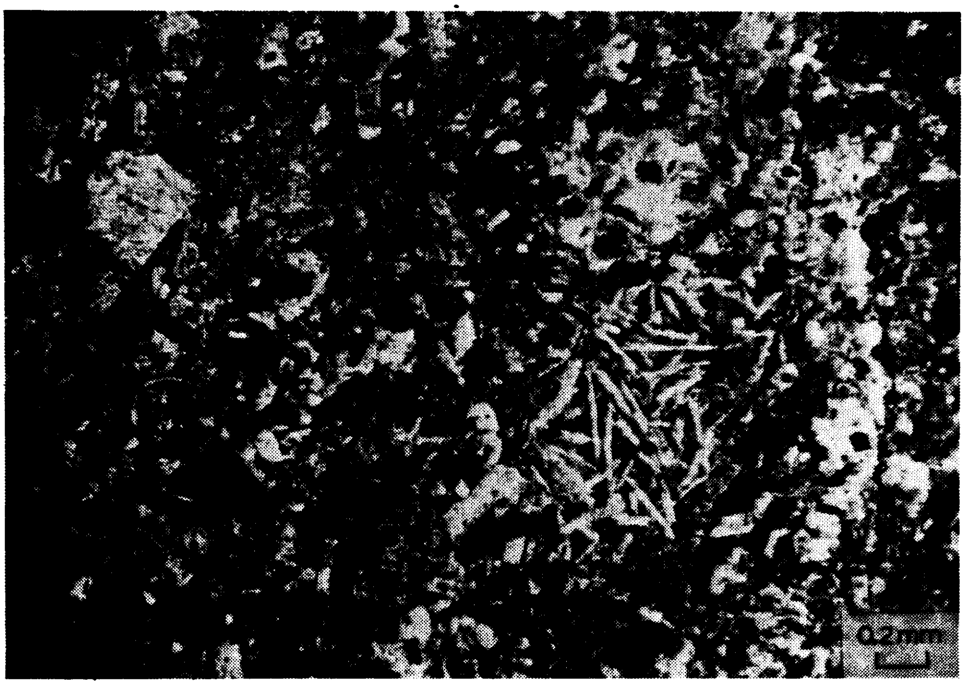


Photo: 7. Photomicrograph of Keewatin-type high-K calc-alkalic andesitic crystal tuff showing clastic texture, from outcrop located in southeastern Blackwell Township, 2.3 km west-southwest of the southeastern corner of the Township

Photo: 8. Photomicrograph of Keewatin-type high-K calc-alkalic andesite crystal tuff showing clastic texture with devitrified glass adhering to a plagioclase crystal, from outcrop located in east-central Laurie Township on the west side of the Shabaqua Road, 0.4 km northeast of the dam on the Matawin River at Middle Falls

Photo: 9. Keewatin-type, foliated, calc-alkalic lapilli-tuff from outcrop located in west-central Laurie Township, 4 km north of the southwestern corner of the Township

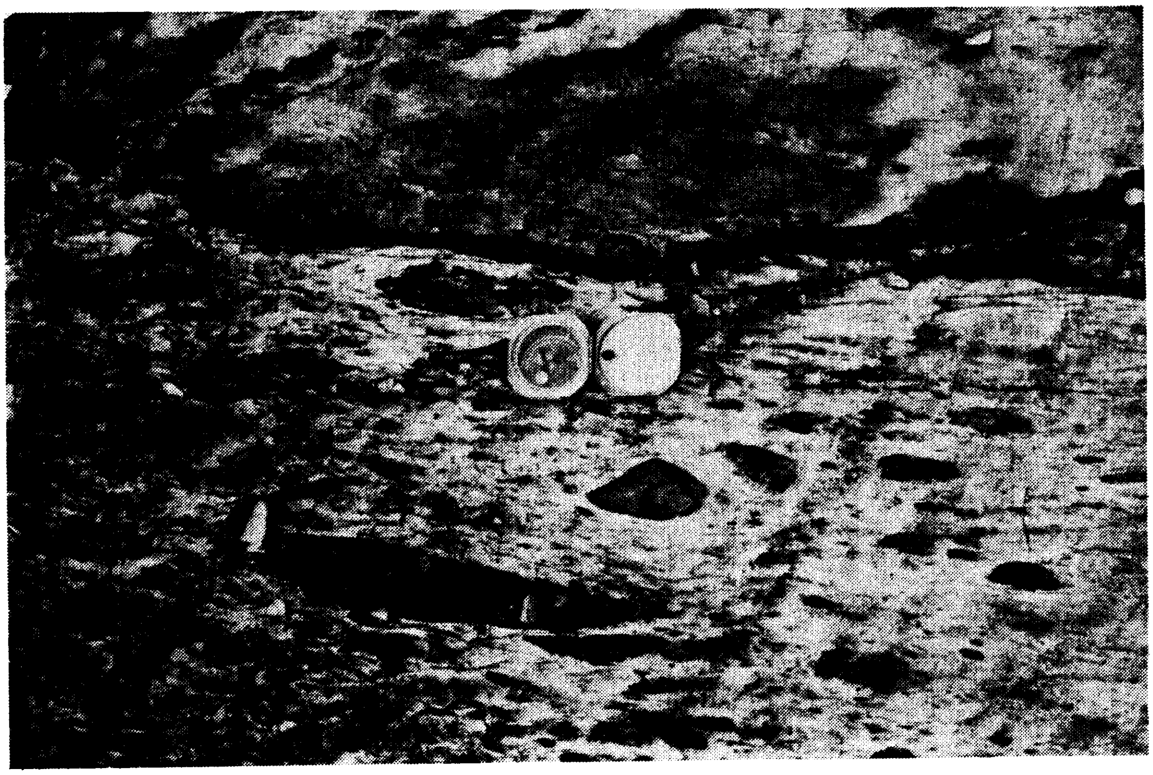


Photo: 10. Keewatin-type, weakly foliated, calc-alkalic debris flow from outcrop located in west-central Laurie Township, 4.2 km north-northeast of the southwestern corner of the Township

Photo: 11. Photomicrograph of hornblende-feldspar porphyry of the Felsic Intrusive Rocks, from outcrop located in west-central Blackwell Township, 0.4 km northeast of Annex on Highway 11

Photo: 12. Photomicrograph of Timiskaming-type grey calc-alkalic intermediate metavolcanic rock showing flow-oriented porphyritic-cryptogranular texture, from outcrop located in southwestern Blackwell Township, 0.7 km southeast of Annex on Highway 11 near the western boundary of the Township

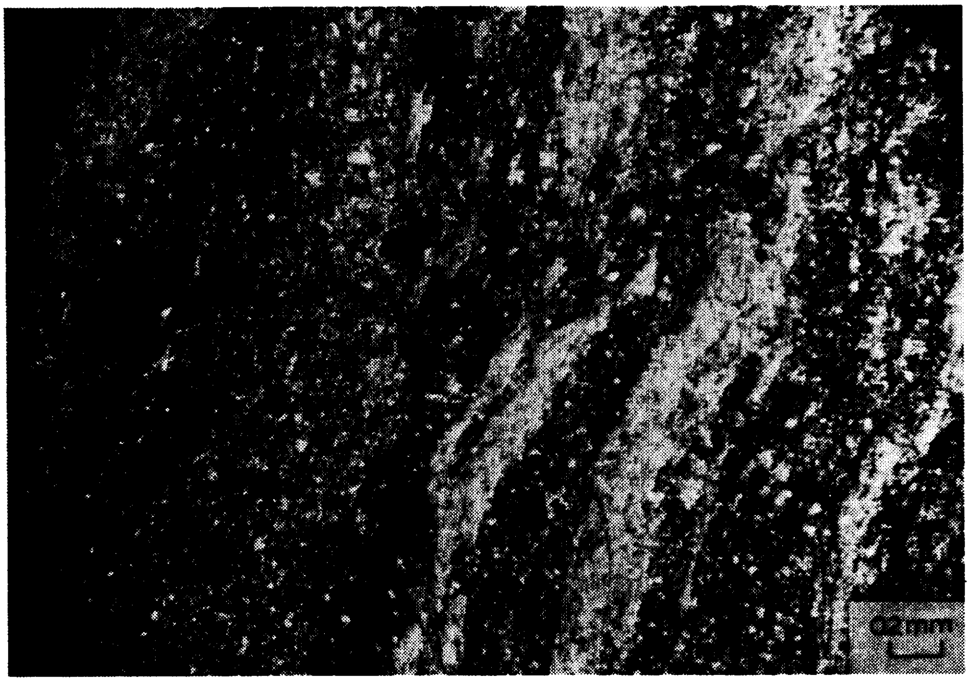


Photo: 13. Photomicrograph of mylonitized Timiskaming-type shoshonite from outcrop located in southwestern Blackwell Township, 0.7 km southeast of Annex on Highway 11 near the western boundary of the township

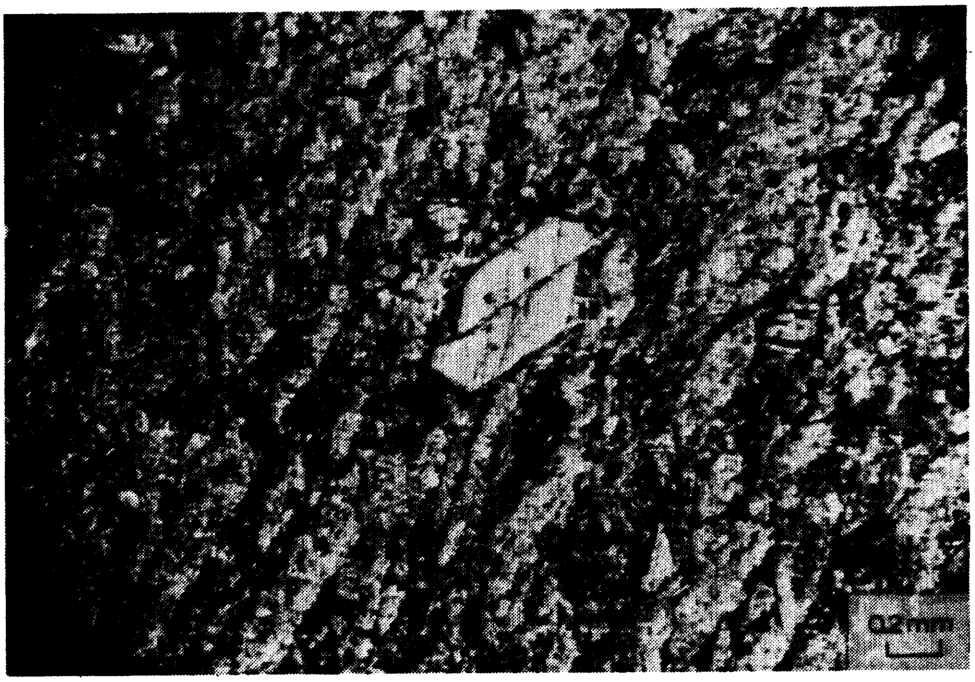


Photo: 14. Photomicrograph of foliated hornblende-phyric Timiskaming-type intermediate shoshonitic flow from outcrop located in south-eastern Blackwell Township, 0.9 km east-southeast of Annex on Highway 11 near the western boundary of the township

Photo: 15. Photomicrograph of Timiskaming-type shoshonitic hornblende latite clast in lapilli-tuff, from outcrop located in southeastern Blackwell Township at Mabella

Photo: 16. Photomicrograph of red biotite lamprophyre of the Mafic Intrusive Rocks from dike outcrop located in southwestern Laurie Township, 4.3 km northeast of the southwestern corner of the township

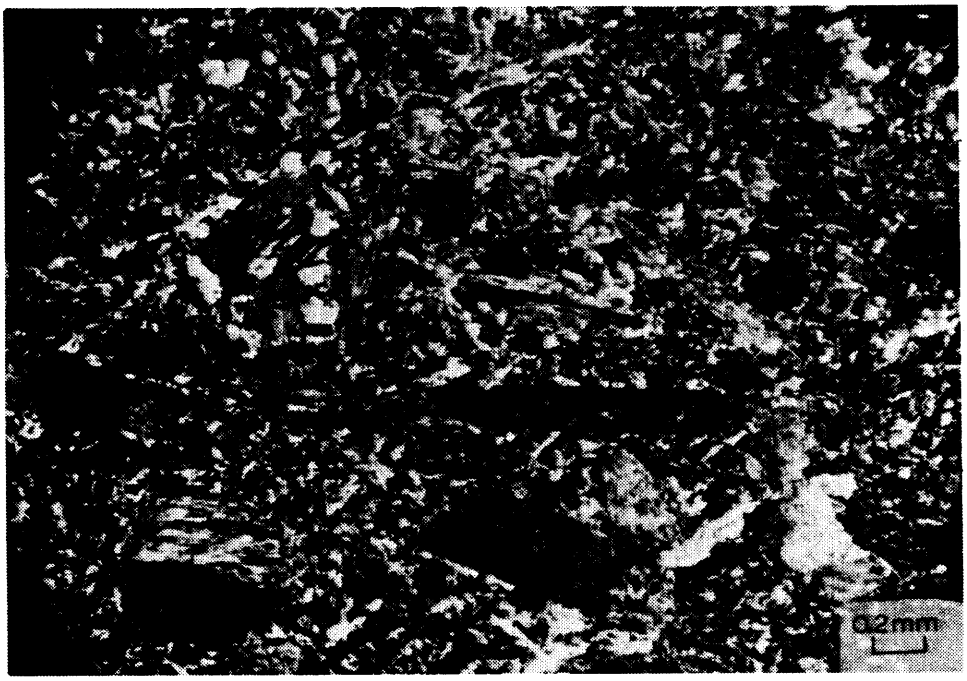


Photo: 17. Photomicrograph of hornblende lamprophyre (spessartite) of the Mafic Intrusive Rocks from an outcrop located in northeastern Laurie Township, 2 km southwest of the northeastern corner of the township

Photo: 18. Pleistocene glaciolacustrine varved clay overlying till, at gravel pit on the west side of the Shabaqua Road, 1.7 km south-southwest of the northeastern corner of Laurie Township

Table 1: Table of Lithologic Units for Blackwell and Laurie Townships

Phanerozoic

Cenozoic

Quaternary

Pleistocene and Recent

Sand, gravel, swamp and stream deposits

Unconformity

Precambrian

Late Archean to Proterozoic

Mafic Intrusive Rocks

Prophyritic and aphyric diabase, hornblende lamprophyre, biotite lamprophyre

Intrusive Contact

Late Archean

Metavolcanics and Metasediments (Timiskaming-type)

Metasediments

Clastic Metasediments

Conglomerate, arkose, wacke, mudstone, siltstone, breccia, arenite, chlorite schist, chlorite-sericite schist

Chemical Metasediments

Magnetite-jasper ironstone, magnetite-arkose-slate ironstone, magnetite-siltstone ironstone, magnetite ironstone, magnetite-mudstone ironstone

Metavolcanics

Shoshonitic Metavolcanics

Mafic to Felsic Metavolcanics

Tuff, lapilli-tuff, hornblende-feldspar porphyry, hornblende-phyric flow, debris flows

Calc-Alkalic Metavolcanics

Intermediate Metavolcanics

Tuff, feldspar-phyric flow

Indeterminate Contact

Felsic Intrusive Rocks

Biotite felsite, feldspar-biotite-hornblende granodiorite, biotite quartz diorite, biotite syenite, hornblende granodiorite, biotite-muscovite granite, hornblende-biotite quartz monzodiorite, biotite quartz monzonite, granophyre, feldspar porphyry, hornblende-feldspar porphyry.

Indeterminate Contact

Metamorphosed Mafic Intrusive Rocks

Fine-, medium-, and coarse-grained gabbro

Intrusive Contact

Metasediments (Quetico-type)

Wacke, mudstone, garnetiferous wacke, siltstone, wacke-pegmatite migmatite, wacke-granite and wacke-diorite migmatite, wacke-tonalite migmatite, medium-and coarse-grained gneiss

Metavolcanics and Metasediments (Keewatin-type)

Metasediments

Chemical Metasediments

Magnetite-jasper ironstone, jasper

Clastic Metasediments

Siltstone, mudstone, laharic breccia, wacke, pyritized, graphitic and argillaceous siltstone

Metavolcanics

Alkalic (shoshonitic) Metavolcanics

Mafic to Felsic Metavolcanics

Sericite schist, tuff, hornblende porphyry, quartz-feldspar porphyry, feldspar porphyry, lapilli-tuff, aphanitic flows, amygdaloidal flows, carbonatized flows, debris flows, glomeroporphyritic flows, quartz latite.

Calc-alkalic and High-K Calc-alkalic Metavolcanics

Felsic Metavolcanics

Feldspar porphyry, tuff, fine-grained, debris flows, aphanitic flows, quartz-feldspar porphyry.

Mafic to Intermediate Metavolcanics

Aphanitic flows, fine-grained flows, feldspar-phyric flows, tuff, lapilli tuff, fine-grained and coarse-grained debris flowsts, carbonatized volcanics, autoclastic (flow-top) breccia, hornblende-phyric flows, amygdaloidal flows, quartz- and feldspar-phyric flows, glomeroporphyritic flows, silicified flows or pyroclastics.

Tholeiitic Metavolcanics

Basaltic and Andesitic Metavolcanics

Aphanitic flows, fine-grained flows, medium-grained flows, coarse-grained flows, carbonatized flows, andesitic flows, silicified flows, tuff, blastoporphyritic flows (hornblende pseudomorphs), mafic flow with granitic bands, amphibolite with feldspar porphyroblasts, autoclastic (flow-top) breccia, lapilli-tuff, tuff-breccia

Komatiitic Metavolcanics

Ultramafic flows, basaltic flows, spinifex-textured flows, polyhedrally-jointed flows, carbonatized flows, variolitic flows, autoclastic (flow-top) breccia, pillowed flows, string-beef-textured flows, peridotitic flows

Table 2: Chemical analysis and specific gravity of Keewatin-type komatiitic metavolcanics from Blackwell and Laurie Townships

Major Components (weight percent):

Column No.	1	2	3
Specimen No.	86MWC-0014	86MWC-0039	86MWC-0019
Field No.	4D23-6	4F28-5	4H25-5
SiO2	35.00	31.70	49.70
TiO_2	0.26	0.17	0.67
Al2O3	3.58	2.56	10.80
Fe2O3	11.40	13.40	10.20
FeO	0.0	0.0	0.0
MnO	0.15	0.14	0.17
MgO	24.70	31.50	12.00
CaO	9.55	6.25	11.60
Na2O	0.40	0.13	1.43
K2O	0.01	0.01	0.44
P2O5	0.04	0.03	0.20
CO2	7.00	4.76	0.29
S	0.03	0.11	0.01
H2O+	0.0	0.0	0.0
H2O-	0.0	0.0	0.0
TOTAL	92.12	90.76	97.51
LOI	14.80	14.40	1.50
SP. GR.	2.71	2.70	3.04

TRACE ELEMENTS IN PPM			
Pt	4 ppb	2 ppb	-
Pd	4 ppb	2 ppb	-
Co	106	113	47
Ni	1610	1920	196
Cr	1420	665	1030
Mo	-	-	-
W	-	-	-
Sn	-	-	-
Cu	34	23	13
Pb	-10	-10	-10

Zn	59	49	95
Y	-	-	-
Zr	-	-	-
Nb	-5	-5	-
V	-	-	-
Li	22	5	-
Rb	-	-	-
Ca	-	-	-
Sr	71	44	-
Ba	71	38	-
La	-	-	-
Ce	-35	-35	-

Notes:
1. Negative value denotes detection limit.
2. Dash alone (-) means not analyzed for.
3. Classification according to Jensen (1976).

Name and location of specimen:
1. Ultramafic komatiite; very dark green, fine-grained flow: from outcrop located on west bank of Shebandowan River, at falls 0.4 km southwest of Mabella Station western Laurie Township.

2. Ultramafic komatiite; very dark green, medium-grained flow: from outcrop located 2.2. km east-southeast of the southern end of Sand Lake (local name), northwestern Laurie Township.

3. Mafic komatiite; dark green, fine-grained flow; from outcrop located on east bank of Matawin River, 1.1 km downstream from central part of southern boundary of Laurie Township.

Table 3: Molecular norm, normative colour index, and normative plagioclase composition of Keewatin-type komatiitic metavolcanic rocks from Blackwell and Laurie Townships.

Column No.	1	2	3
Specimen No.	86MWC-0014	86MWC-0039	86MWC-0019
Field No.	4D23-6	4F28-5	4H25-5
Apatite	0.1	0.1	0.5
Pyrrhotite	0.1	0.3	0.0
Ilmenite	0.4	0.3	1.0
Orthoclase	0.0	0.0	2.7
Albite	0.0	0.0	13.3
Anorthite	8.9	6.9	22.5
Magnetite	2.1	1.9	2.3
Enstatite	0.0	0.0	23.0
Ferrosilite	0.0	0.0	6.2
Diopside	17.3	0.0	22.4
Quartz	0.0	-1.5	0.1
Forsterite	51.0	71.0	0.0
Fayalite	9.0	12.2	0.0
Nepheline	2.4	0.8	0.0
*Casi	5.6	8.0	0.0
Hedenbergite	3.1	0.0	6.1
Total	100.0	100.0	100.1
Colour Index	83.0	85.7	61.0
Plagioclase Composition (% An)	100	100	62.8

Name and location of specimen:

1. Ultramafic komatiite; very dark green, fine-grained flow; from outcrop located on west bank of Shebandowan River, at falls 0.4 km southwest of Mabella Station, western Blackwell Township.

Note: * Casi = calcium orthosilicate (Ca_2SiO_4)

2. Ultramafic komatiite; very dark green, medium-grained flow: from outcrop located 2.2 km east-southeast of the southern end of Sand Lake (local name), northwestern Laurie Township.

3. Mafic komatiite; dark green, fine-grained flow; from outcrop located on east bank of Matawin River, 1.1. km downstream from central part of southern boundary of Laurie Township.

Table 4: Chemical analysis of Keewatin-type tholeiitic metavolcanic rocks from Blackwell and Laurie Townships

Major Components (weight percent):

Column No.	1	2	3	4	5	6
Specimen No.	86MWC-0009	86MWC-0003	86MWC-0032	86MWC-0006	86MWC-0027	86MWC-0001
Field No.	4E27-6	4F1-4	4G21-4b	4H1-4	4G22-43	4E1-5
SiO_2	47.70	48.60	50.70	48.20	49.40	50.80
TiO_2	0.82	0.82	0.43	0.85	0.48	1.12
Al_2O_3	14.60	14.00	10.50	14.40	11.90	12.60
Fe_2O_3	14.50	14.10	17.40	13.60	13.10	13.60
FeO	0.0	0.0	0.0	0.0	0.0	0.0
MnO	0.22	0.21	0.20	0.21	0.30	0.19
MgO	6.64	6.59	5.75	6.69	4.27	6.26
CaO	7.66	9.64	5.67	9.90	8.79	9.76
Na_2O	3.36	3.13	0.49	1.84	1.43	1.64
K_2O	0.09	0.37	0.18	0.24	0.38	0.16
P_2O_5	0.10	0.08	0.18	0.09	0.16	0.12
CO_2	0.49	0.36	4.82	0.82	6.36	0.39
S	0.03	0.05	0.01	0.03	0.01	0.15
H_2O+	0.0	0.0	0.0	0.0	0.0	0.0
H_2O-	0.0	0.0	0.0	0.0	0.0	0.0
Total	96.21	97.95	96.33	96.87	96.58	96.79
LOI	3.10	2.10	7.60	3.00	9.80	2.70
SP. Gr.	2.95	3.02	2.84	2.99	2.80	3.00

Trace Elements (ppm)

	1	2	3	4	5	6
Co	49	47	60	46	25	47
Ni	60	74	188	63	60	64
Cr	70	289	152	288	82	120
Sn	-	-	-	-	-	-
Cu	128	165	70	105	28	94
Pb	-10	16	-10	-10	12	-10
Zn	121	128	130	113	90	116
Y	-	-	-	-	-	-
Zr	-	-	-	-	-	-
Nb	-	-	-	-	-	-
V	-	-	-	-	-	-
Li	-	-	-	-	-	-
Rb	-	-	-	-	-	-
Ca	-	-	-	-	-	-
Sr	-	-	-	-	-	-
Ba	-	-	-	-	-	-
La	-	-	-	-	-	-
Ce	-	-	-	-	-	-

Column No	7	8	9	10	11	12	13
Specimen No.	86MWC-0037	86MWC-0034	86MWC-0002	86MWC-0026	86MWC-0004	86MWC 0018	86MWC-0016
Field No	4G24-25	4G21-10	4E29-26	4F29-5	4F30-9	4H25-3	4H26-106
	49.80	57.80	48.60	50.50	51.20	51.70	46.90
	0.53	0.28	2.02	0.65	0.65	1.15	0.74
	11.90	12.70	12.00	11.40	14.00	13.70	15.90
	10.40	16.70	16.80	13.20	11.70	17.50	12.60
	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.17	0.17	0.28	0.29	0.18	0.24	0.20
	9.27	4.16	4.09	8.32	7.82	4.79	8.72
	11.00	2.01	7.98	10.50	8.08	8.22	10.40
	1.19	0.62	2.19	0.60	1.73	1.96	1.62
	0.76	0.34	0.64	1.26	1.05	0.20	0.21
	0.19	0.19	0.25	0.07	0.06	0.27	0.08
	1.52	1.19	1.88	0.71	0.30	0.11	0.19
	0.02	0.01	0.12	0.02	0.06	0.12	0.01
	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	96.75	96.17	96.85	97.52	96.83	99.96	97.57
	3.50	4.20	3.50	2.40	2.60	0.20	2.10
	2.98	2.81	2.99	3.07	2.95	3.06	2.99
	-	40	43	67	56	40	51
	-	74	7	202	81	30	122
	-	40	-10	875	320	81	333
	-35	-	-	-	-	-	-
	-	34	47	110	128	57	72
	-	18	-10	10	-10	-10	-10
	-	170	180	104	120	205	97
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-5	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	503	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-20	-	-	-	-	-	-
	-35	-	-	-	-	-	-

Notes:

1. Negative value denotes detection limit.
2. Dash alone (-) means not analyzed for.
3. Classification according to Irvine and Baragar (1971), except where stated otherwise.

Name and location of specimen:

1. Tholeiitic basalt, dark green, fine-grained flow; from outcrop located 1.5 km south-southeast of Mabella Station, southwestern Blackwell Township.

2. Tholeiitic basalt, dark green, fine-grained flow; from outcrop docated 1.1 km south-southwest of Shabaqua Station, northeastern Laurie Township.

3. Tholeiitic basalt, dark green, amygdaloidal fine-grained flow; from outcrop located 3.1 km north-northwest of southwestern boundary corner of Laurie Township, near its western boundary.

4. Tholeiitic basalt, medium green, fine-grained flow; from outcrop located 1.7 km northwest of the southeastern boundary corner of Laurie Township.

5. Tholeiitic basalt, very dark green, fine-grained flow; from outcrop located 4.6 km northwest of the southwestern boundary corner of Laurie Township.

6. Tholeiitic basalt, very dark green, fine-grained flow; with dark green phenocrysts; from outcrop located 0.5 km north-northeast of Shabaqua Station, northeastern Laurie Township.

7.* Tholeiitic basalt, medium green, fine-grained tuff; from outcrop located 7.5 km northwest of the southeastern boundary corner of Laurie Township in central Laurie Township.

8.+ Tholeiitic basalt, dark green, fine-grained tuff; from outcrop located 3.3 km north along the western border of Laurie Township from the southwestern boundary corner, in southwestern Laurie Township.

9. Tholeiitic basalt, very dark green, fine-grained flow; from outcrop located 0.8 km northwest of Shabaqua Station, northeastern Laurie Twonship.

10. Tholeiitic basalt, black aphanitic flow; from outcrop located 3.7 km southwest of Shabaqua Station, northeastern Laurie Township.

11. Tholeiitic basalt, medium greenish-grey aphanitic flow; from outcrop located 2.1 km southwest of Shabaqua Station, northeastern Laurie Township.

12. Tholeiitic basalt, very dark green, aphanitic flow; from outcrop located 4.8 km west-northwest of the southeastern boundary corner of Laurie Township.

13. Tholeiitic basalt, very dark green, fine-grained flow; from outcrop located 3.4 km northwest of the southeastern boundary corner of Laurie Township.

* Calc-alkalic basalt (Miyashiro 1974).
\+ Tholeiitic andesite (Miyashiro 1974).

Table 5: Molecular norm, normative colour index, and normative plagioclase composition of Keewatin-type tholeiitic metavolcanic rocks from Blackwell and Laurie Townships

Column No	1	2	3	4	5	6
Specimen No.	86MWC-0009	86MWC-0003	86MWC-0032	86MWC-0006	86MWC-0027	86MWC-0001
Field No.	4E27-6	4F1-4	4G21-4b	4H1-4	4G22-43	4E1-5
Apatite	0.3	0.2	0.5	0.2	0.4	0.3
Pyrrhotite	0.1	0.1	0.0	0.1	0.0	0.4
Ilmenite	1.2	1.2	0.7	1.3	0.8	1.7
Orthoclase	0.6	2.3	1.2	1.5	2.6	1.0
Albite	32.1	29.4	5.1	17.7	14.9	14.1
Anorthite	26.1	24.1	30.2	32.5	28.9	29.8
Corundum	0.0	0.0	0.0	0.0	0.0	0.0
Magnetite	2.6	2.5	2.4	2.6	2.4	2.9
Enstatite	9.2	5.5	18.3	15.2	9.9	13.8
Ferrosilite	7.3	4.2	22.9	10.8	11.7	9.2
Diopside	6.1	11.5	0.4	9.1	7.5	10.3
Quartz	0.0	0.0	17.7	2.5	12.0	9.7
Forsterite	5.4	5.8	0.0	0.0	0.0	0.0
Fayalite	4.3	4.5	0.0	0.0	0.0	0.0
Hedenbergite	4.8	8.8	0.5	6.5	8.9	6.8
Total	100.1	100.1	99.9	100.0	100.0	100.00
Colour Index	41.1	44.1	45.2	45.7	41.2	45.5
Plagioclase Composition (%An)	44.8	45.0	85.6	64.7	65.98	64.3

Column No.	7	8	9	10	11	12	13
Specimen No.	86MWC-0037	86MWC-0034	86MWC-0002	86MWC-0026	86MWC-0004	86MWC-0018	86MWC-0016
Field No.	4G24-25	4G21-10	4E29-26	4F29-5	4F30-9	4H25-3	4H26-106
	0.5	0.5	0.7	0.2	0.1	0.7	0.2
	0.1	0.0	0.3	0.1	0.2	0.3	0.0
	0.8	0.4	3.1	1.0	1.0	1.7	1.1
	4.8	2.3	4.2	7.9	6.5	1.2	1.3
	11.4	6.3	21.8	5.8	16.4	18.5	15.2
	26.5	9.8	23.3	26.4	28.9	29.5	37.0
	0.0	10.0	0.0	0.0	0.0	0.0	0.0
	2.3	2.1	4.1	2.4	2.4	2.9	2.4
	18.5	12.9	9.1	17.3	19.3	11.9	16.7
	7.0	21.9	10.9	10.1	9.9	15.7	8.4
	17.6	0.0	6.9	14.5	6.9	4.0	8.6
	3.9	33.8	7.5	6.0	4.9	8.3	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	3.0
	0.0	0.0	0.0	0.0	0.0	0.0	1.5
	6.7	0.0	8.2	8.5	3.5	5.3	4.4
	100.1	100.0	100.1	100.2	100.0	100.0	99.8
	53.0	37.3	42.6	53.8	43.3	41.8	46.3
	69.9	60.9	51.7	81.98	63.8	61.5	70.9

Notes:
1. Negative value denotes detection limit.
2. Dash alone (-) means not analyzed for.
3. Classification according to Irvine and Baragar (1971), except where stated otherwise.

Name and location of specimen:

1. Tholeiitic basalt, dark green, fine-grained flow; from outcrop located 1.5 km south-southeast of Mabella Station, southwestern Blackwell Township.

2. Tholeiitic basalt, dark green, fine-grained flow; from outcrop located 1.1. km south-southwest of Shabaqua Station, northeastern Laurie Township.

3. Tholeiitic basalt, dark green, amygdaloidal fine-grained flow; from outcrop located 3.1 km north-northwest of southwestern boundary corner of Laurie Township, near its western boundary.

4. Tholeiitic basalt, medium green, fine-grained flow; from outcrop located 1.7 km northwest of the southeastern boundary corner of Laurie Township.

5. Tholeiitic basalt, very dark green, fine-grained flow; from outcrop located 4.6 km northwest of the southwestern boundary corner of Laurie Township.

6. Tholeiitic basalt, very dark green, fine-grained flow; with dark green phenocrysts; from outcrop located 0.5 km north-northeast of Shabaqua Station, northeastern Laurie Township.

7.* Tholeiitic basalt, medium green, fine-grained tuff; from outcrop located 7.5 km northwest of the southeastern boundary corner of Laurie Township in central Laurie Township.

8.+ Tholeiitic basalt, dark green, fine-grained tuff; from outcrop located 3.3 km north along the western border of Laurie Township from the southwestern boundary corner, in southwestern Laurie Township.

9. Tholeiitic basalt, very dark green, fine-grained flow; from outcrop located 0.8 km northwest of Shabaqua Station, northeastern Laurie Township.

10. Tholeiitic basalt, black aphanitic flow; from outcrop located 3.7 km southwest of Shabaqua Station, northeastern Laurie Township.

11. Tholeiitic basalt, medium greenish-grey aphanitic flow; from outcrop located 2.1 km southwest of Shabaqua Station, northeastern Laurie Township.

12. Tholeiitic basalt, very dark green, aphanitic flow; from outcrop located 4.8 km west-northwest of the southeastern boundary corner of Laurie Township.

13. Tholeiitic basalt, very dark green, fine-grained flow; from outcrop located 3.4 km northwest of the southeastern boundary corner of Laurie Township.

* Calc-alkalic basalt (Miyashiro 1974).
\+ Tholeiitic andesite (Miyashiro 1974).

Table 6: Chemical analysis of average-K and high-K Keewatin-type calc-alkalic metavolcanic rocks from Blackwell and Laurie Townships

Column No.	1	2	3	4	5	6
Specimen No.	86MWC-0011	86MWC-0013	86MWC-0038	86MWC-0012	86MWC-0028	86MWC-0020
Field No.	4E1-2	4D23-7	4F28-4	4G1-20	4G21-35	4G23-17
SiO_2	49.80	51.40	49.20	57.10	58.30	65.10
TiO_2	0.65	0.90	0.62	0.70	0.72	0.64
Al_2O_3	14.80	17.40	15.90	14.30	14.20	16.10
Fe_2O_3	11.40	8.32	9.33	5.32	6.65	4.86
FeO	0.0	0.0	0.0	0.0	0.0	0.0
MnO	0.19	0.24	0.09	0.11	0.12	0.08
MgO	4.47	2.47	7.04	2.97	3.46	1.33
CaO	10.80	12.20	7.41	5.28	5.49	3.61
Na_2O	2.97	1.59	3.33	4.87	1.78	3.65
K_2O	0.05	0.19	1.14	1.36	1.04	1.17
P_2O_5	0.06	0.09	0.29	0.16	0.19	0.17
CO_2	2.56	3.28	1.32	6.77	4.36	0.40
S	0.05	0.12	0.49	0.02	0.02	0.01
H_2O+	0.0	0.0	0.0	0.0	0.0	0.0
H_2O-	0.0	0.0	0.0	0.0	0.0	0.0
Total	97.80	98.20	96.16	98.96	96.33	97.12
LOI	4.80	4.80	3.40	7.70	6.50	1.40
SP. Gr.	2.91	2.88	2.87	2.71	2.75	2.73

Trace Elements (ppm)

	1	2	3	4	5	6
Co	50	48	-	-	-	-5
Ni	130	109	-	-	-	-
Cr	262	244	-	-	-	-
Sn	-	-	37	51	71	57
Cu	145	101	-	-	-	-
Pb	-10	11	-	-	-	-
Zn	87	73	-	-	-	-
Y	-	-	-	-	-	-
Zr	-	-	-	-	-	-
Nb	-	-	-5	-5	-5	-5
V	-	-	-	-	-	-
Li	-	-	-	-	-	-
Rb	-	-	-	-	-	-
Ca	-	-	-	-	-	-
Sr	-	-	682	244	169	273
Ba	-	-	-	-	-	-
La	-	-20	-20	-20	-20	-20
Ce	-	-	-35	-35	35	-35

Column No	7	8	9	10	11	12	13
Specimen No.	86MWC-0025	86MWC-0035	86MWC-0024	86MWC-0010	86MWC-0005	86MWC 0022	86MWC-0015
Field No.	4G21-57	4G21-25	4G23-4	4E28-9	4G25-1	4G23-21	4G25-16
	62.60	64.50	66.50	60.30	55.90	63.40	67.10
	0.55	0.54	0.53	0.60	0.34	0.74	0.84
	14.70	14.70	15.70	16.60	16.80	16.10	15.50
	4.98	7.22	2.82	5.76	8.85	5.01	2.37
	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.07	0.13	0.05	0.09	0.10	0.06	0.05
	3.39	2.55	0.68	2.47	5.04	1.33	1.03
	4.14	4.33	2.75	4.15	1.86	2.12	2.16
	3.38	1.53	3.70	4.80	3.78	3.83	4.13
	1.17	0.76	1.95	1.89	2.05	2.05	2.15
	0.17	0.14	0.15	0.26	0.22	0.21	0.16
	1.76	0.37	2.10	0.54	1.01	1.66	1.58
	0.01	0.02	0.01	0.07	0.04	0.01	0.01
	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	96.92	96.79	96.94	97.53	95.99	96.52	97.08
	3.00	1.80	3.30	1.50	4.10	3.40	2.70
	2.73	2.77	2.71	2.75	2.72	2.72	2.68
	-	13	-	-	29	-	-
	-	47	-	-	73	-	-
	-	70	-	-	226	-	-
	-35	-	61	98	0	68	65
	-	17	-	-	41	-	-
	-	-10	-	-	-10	-	-
	-	97	-	-	91	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-5	-5	-5	-5	-	-5	-5
	-	-	-	-	-	-	-
	-	50	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	303	416	189	1262	-	184	209
	-	261	-	-	-	-	-
	-20	-	-20	36	-	-20	-20
	-35	35	-35	-35	-	-35	-35

Notes:
1. Negative value denotes detection limit.
2. Dash alone (-) means not analyzed for.
3. Classification according to Irvine and Baragar (1971), except where stated otherwise.

Name and location of specimen:

1. *Calc-alkalic basalt: medium grey, aphanitic flow; from outcrop located 1.5 km north-northeast of Shabaqua Station, extreme western end of the Dawson Road Lots.

2. Tholeiitic basalt: medium grey, fine-grained, feldspar-phyric flow; from outcrop located 1.3 km southwest of Mabella Station, southwestern Blackwell Township.

3. Calc-alkalic basalt: medium green, gine-grained flow; from outcrop located 4.3 km southeast of the northwestern boundary corner of Laurie Township.

4. Calc-alkalic andesite: light grey green, fine-grained, porphyritic flow; from outcrop located 1 km south of Middle Falls, east-central Laurie Township.

5. *+Calc-alkalic andesite: mottled pink and green, fine-grained flow; from outcrop located 3.3 km north-northeast of the southeastern boundary corner of Laurie Township, near its western boundary.

6. Calc-alkalic dacite: mottled green and pink, aphanitic flow; from outcrop located 4 km northeast of the southwestern boundary corner of Laurie Township, in central Laurie Township.

7. +Calc-alkalic dacite: dark grey, fine-grained flow; from outcrop located 3.4 km north-northeast of the southwestern boundary corner of Laurie Township near its western boundary.

8. +Calc-alkalic dacite: medium green, aphanitic flow; from outcrop located 2.3 km north-northeast of the southwestern boundary of Laurie Township, 300 m east of the western boundary.

9. °Calc-alkalic dacite: high-K, light grey, aphanitic flow; from outcrop located 4.3 km west-southwest of Middle Falls on the Matawin River, in central Laurie Township.

10. Calc-alkalic dacite: high-K, light grey, fine-grained; from outcrop located 3.6 km southeast of Mabella Station, south-eastern corner of Blackwell Township.

11. °Calc-alkalic andesite tuff: high-K medium green; from outcrop located on the west side of the Shabaqua Road, 300 m north of Middle Falls on the Matawin River, east-central Laurie Township.

12. °Calc-alkalic dacite tuff: high-K, pinkish grey; from outcrop located 3.4 km southwest of Middle Falls on the Matawin River, in central Laurie Township.

13. °Calc-alkalic dacite tuff: high-K, pinkish grey; from outcrop located 1.5 km south-southwest of Middle Falls on the Matawin river, in east-central Laurie Township.

Major Components (weight percent):

Column No.	14	15
Specimen No.	86MWC 0017	86MWC 0023
Field No.	4G25-40	4G23-22
SiO_2	69.90	67.10
TiO_2	0.40	0.48
Al_2O_3	14.30	14.80
Fe_2O_3	1.57	3.20
FeO	0.0	0.0
MnO	0.06	0.07
MgO	0.67	0.74
CaO	1.64	3.14
Na_2O	5.33	4.21
K_2O	1.08	1.41
P_2O_5	0.11	0.17
CO_2	1.78	2.45
S	0.51	0.12
H_2O+	0.0	0.0
H_2O-	0.0	0.0
Total	97.35	97.89
LOI	2.50	3.50
Sp.Gr.	2.63	2.69
Trace Elements (ppm)		
Sn	77	48
Nb	-5	-5
Sr	264	183
La	-20	-20
Ce	-35	-35

Notes:
1. Negative value denotes detection limit
2. Dash alone (-) means not analyzed for
3. Classification according to Irvine and Baragar (1971) unless otherwise indicated

Name and location of specimen:

14. Calc-alkalic rhyolite, very light grey aphanitic flow; from outcrop located 2.2 km south-southwest of Middle Falls, on the east bank of the Matawin River, southeastern Laurie Township.

15. Calc-alkalic dacite, light grey feldspar-phyric flow; from outcrop located 3.1 km southwest of Middle Falls on the Matawin River, in central laurie Township.

* Classification after Jensen (1976).
\+ Classification after Miyashiro (1974).
° Classification after Mackenzie and Chappell (1972).

Table 7: Molecular norm, normative colour index and normative plagioclase composition of average-K and high-K Keewatin-type calc-alkalic metavolcanic rocks from Blackwell and Laurie Townships

Column No.	1	2	3	4	5	6
Specimen No.	86MWC-0011	86MWC-0013	86MWC-0038	86MWC-0012	86MWC-0028	86MWC-0020
Field No.	4E1-2	4D23-7	4F28-4	4G1-20	4G21-35	4G23-17
Apatite	0.2	0.2	0.7	0.4	0.5	0.4
Pyrrhotite	0.1	0.3	1.3	0.1	0.1	0.0
Ilmenite	1.0	1.4	0.9	1.1	1.1	0.9
Orthoclase	0.3	1.2	7.1	8.7	6.9	7.3
Albite	28.6	15.5	31.3	47.2	17.8	34.4
Anorthite	28.9	43.2	26.3	14.2	29.0	17.6
Rutile	0.0	0.0	0.0	0.0	0.0	0.0
Corundum	0.0	0.0	0.0	0.0	0.8	3.1
Magnetite	2.4	2.7	2.3	2.5	2.6	2.3
Hematite	0.0	0.0	0.0	0.0	0.0	0.0
Enstatite	7.2	2.6	12.4	4.7	10.7	3.9
Ferrosilite	6.2	2.1	4.4	1.1	4.2	1.6
Diopside	12.1	9.7	6.0	8.4	0.0	0.0
Quartz	2.6	13.3	0.0	9.8	26.4	28.5
Forsterite	0.0	0.0	3.7	0.0	0.0	0.0
Fayalite	0.0	0.0	1.3	0.0	0.0	0.0
Hedenbergite	10.5	7.8	2.2	2.0	0.0	0.0
Total	100.1	100.0	99.9	100.2	100.1	100.00
Colour Index	39.5	26.6	34.5	19.9	18.7	8.7
Plagioclase Composition (%An)	50.3	73.2	45.7	23.1	62.0	33.8

Column No.	7	8	9	10	11	12	13
Specimen No.	86MWC-0025	86MWC-0035	86MWC-0024	86MWC-0010	86MWC-0005	86MWC-0022	86MWC-0015
Field No.	4G21-57	4G21-25	4G23-4	4E28-9	4G25-1	4G23-21	4G25-16
	0.4	0.4	0.4	0.6	0.5	0.5	0.4
	0.0	0.1	0.0	0.2	0.1	0.0	0.0
	0.8	0.8	0.8	0.9	0.5	1.1	0.1
	7.3	4.8	12.3	11.5	12.8	12.9	13.4
	32.2	14.8	35.4	44.4	35.8	36.7	39.0
	20.6	22.1	13.5	18.7	8.2	9.8	10.2
	0.0	0.0	0.0	0.0	0.0	0.0	0.6
	0.9	4.5	3.3	0.0	6.3	4.9	3.3
	2.3	2.3	0.7	2.3	2.0	2.5	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	1.7
	9.9	7.6	2.0	6.8	14.7	3.9	3.0
	2.1	5.6	0.0	2.8	8.5	1.4	0.0
	0.0	0.0	0.0	0.4	0.0	0.0	0.0
	23.5	37.1	30.6	11.4	10.6	26.3	28.4
	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.2	0.0	0.0	0.0
	100.0	100.1	100.1	100.2	100.1	100.0	100.1
	15.1	16.6	4.6	13.6	25.8	9.0	5.4
	39.0	59.9	27.6	29.6	18.6	21.1	20.7

Name and location of specimen:

1. *Calc-alkalic basalt: medium grey, aphanitic flow; from outcrop located 1.5 km north-northeast of Shabaqua Station, extreme western end of the Dawson Road Lots.

2. Tholeiitic basalt: medium grey, fine-grained, feldspar-phyric flow; from outcrop located 1.3 km southwest of Mabella Station, southwestern Blackwell Township.

3. Calc-alkalic basalt: medium green, fine-grained flow; from outcrop located 4.3 km southeast of the northwestern boundary corner of Laurie Township.

4. Calc-alkalic andesite: light grey green, fine-grained, porphyritic flow; from outcrop located 1 km south of Middle Falls, east-central Laurie Township.

5. *+Calc-alkalic andesite: mottled pink and green fine-grained flow; from outcrop located 3.3 km north-northeast of the southeastern boundary corner of Laurie Township, near its western boundary.

6. Calc-alkalic dacite: mottled green and pin, aphanitic flow; from outcrop located 4 km northeast of the southwestern boundary corner of Laurie Township, in central Laurie Township.

7. +Calc-alkalic dacite: dark grey, fine-grained flow; from outcrop located 3.4 km north-northeast of the southwestern boundary corner of Laurie Township near its western boundary.

8. +Calc-alkalic dacite: medium green, aphanitic flow; from outcrop located 2.3 km north-northeast of the southwestern boundary of Laurie Township, 300 m east of the western boundary.

9. °Calc-alkalic dacites: high-K, light grey, aphanitic flow; from outcrop located 4.3 km west-southwest of Middle Falls on the Matawin River, in central Laurie Township.

10. Calc-alkalic andesite tuff: high-K, light grey, fine-grained; from outcrop located 3.6 km southeast of Mabella Station, southeastern corner of Blackwell Township.

12. °Calc-alkalic dacite-tuff: high-K, pinkish grey; from outcrop located 3.4 km southwest of Middle Falls on the Matawin River, in central Laurie Township.

13. °Calc-alkalic dacite tuff: high-K, pinkish grey; from outcrop located 1.5 km south-southwest of Middle Falls on the Matawin River, in east-central Laurie Township.

Column No.	14	15
Specimen No.	86MWC 0017	86MWC 0023
Field No.	4G25-40	4G23-22
Apatite	0.3	0.4
Pyrrhotite	1.4	0.3
Ilmenite	-0.8	0.7
Orthoclase	6.6	8.8
Albite	49.8	39.9
Anorthite	7.7	15.3
Rutile	0.7	0.0
Corundum	1.9	1.2
Magnetite	0.0	1.5
Hematite	1.1	0.5
Enstatite	1.9	2.2
Ferrosilite	0.0	0.0
Diopside	0.0	0.0
Quartz	29.4	29.2
Forsterite	0.0	0.0
Fayalite	0.0	0.0
Hedenbergite	0.0	0.0
Total	100.0	100.0
Colour Index	4.3	3.7
Plagioclase Composition (%An)	13.4	27.7

Name and location of specimen:

14. Calc-alkalic rhyolite, very light grey aphanitic flow; from outcrop located 2.2 km south-southwest of Middle Falls, on the east bank of the Matawin River, southeastern Laurie Township.

15. Calc-alkalic dacite, light grey feldspar-phyric flow; from outcrop located 3.1 km southwest of Middle Falls on the Matawin River, in central Laurie Township.

* Classification after Jensen (1976).
\+ Classification after Miyashiro (1974).
° Classification after Mackenzie and Chappell (1972).

Table 8: Chemical analysis and specific gravity of Keewatin-type shoshonitic metavolcanics from Blackwell and Laurie Townships

Major Components (weight percent):	
Column No.	1
Specimen No.	86MWC-0029
Field No.	4G21-9
SiO_2	71.10
TiO_2	0.30
Al_2O_3	16.20
Fe_2O_3	2.67
FeO	0.0
MnO	0.03
MgO	0.64
CaO	0.69
Na_2O	2.38
K_2O	2.72
P_2O_5	0.12
CO_2	0.42
S	0.01
H_2O+	0.0
H_2O-	0.0
Total	97.28
LOI	2.00
Sp.Gr.	2.71
Trace Elements (ppm)	
Sn	52
Nb	-5
Sr	144
La	-20
Ce	-35

Notes:
1. Negative value denotes detection limit
2. Dash alone (-) means not analyzed for
3. Classification according to Brooks et al. (1982), modified from Mackenzie and Chappell (1982)

Name and location of specimen:
1. Toscanite, pink quartz-phyric flow; from outcrop located on the western township boundary line of Laurie Township, 3.3 km north of the southwest boundary corner of the township.

Table 9: Molecular norm, normative colour index and normative plagioclase composition of Keewatin-type shoshnitic metavolcanics from Blackwell and Laurie Townships

Column No.	1
Specimen No.	86MWC 0029
Field No.	4G21-9
Apatite	0.3
Ilmenite	0.4
Orthoclase	17.0
Albite	22.5
Anorthite	2.8
Corundum	9.6
Magnetite	1.3
Hematite	0.5
Enstatite	1.9
Ferrosilite	0.0
Quartz	43.7
Total	100.0
Colour Index	4.1
Plagioclase Composition (%An)	11.1

Name and location of specimen:

1. Toscanite, pink quartz-phyric flow; from outcrop located on the western township boundary line of Laurie Township, 3.3 km north of the southwest boundary corner of the township.

Table 10: Modal Analysis (volume percent) of minerals in phases of the Felsic Intrusive Rock, Blackwell and Laurie Townships

Column Number	1	2	3	4	5	6	7
Specimen Number	4B15-7	4B11-2	4B15-6	4B15-2	4B12-1	4B16-1	4H23-1
Quartz	29	22	29	17	10	13	29
Potassic feldspar	32	21	19	45	14	0	19
Plagioclase	31	47	47	35	40	58	47
Perthite	1	0	0	0	0	0	0
Myrmekite	X	1	X	0	0	0	0
Hornblende	0	0	0	0	15	0	2
Biotite	5	8	x	3	20	26	x
Muscovite	1	0	x	x	0	1	0
Chlorite	1	0	0	x	0	x	1
Epidote	0	0	0	0	0	x	1
Zircon	0	0	0	0	0	x	x
Titanite	x	0	0	0	1	0	1
Apatite	x	0	x	x	x	1	x
Tourmaline	x	0	0	0	0	0	0
Pyrite	x	0	x	x	0	1	x
Ilmenite	0	1	x	0	0	0	0
Total	100	100	100	100	100	100	100
Plagioclase Composition (%An)	21	21	21	17	15	31	10
Points Counted	489	491	493	491	491	491	492

Northern Batholith

Pink Phase

1. Granite: biotite-muscovite bearing, pink; from outcrop located 3.2 km west-southwest of the northeastern boundary corner of Blackwell Township.

2. Granodiorite: biotite bearing, pink; from outcrop located 0.5 km east-southeast of the northwestern boundary corner of Blackwell Township.

3. Granodiorite: biotite bearing, pink; from outcrop located 3.2 km west-southwest of the northeastern boundary corner of Blackwell Township.

4. Quartz monzonite: biotite bearing, pink; from outcrop located 2.3 km southwest of the northeastern boundary corner of Blackwell Township.

Grey Phase

5. Quartz monzodiorite: hornblende-biote bearing, grey; from outcrop located 2.8 km east-southeast of the northwesterly boundary corner of Blackwell Township.

6. Quartz diorite: biotite bearing, grey; from outcrop located 2.7 km southwest of the northeastern boundary corner of Blackwell Township.

Sundbar-BAtwing Batholith

7. Granodiorite: hornblende bearing, pink; from outcrop located 1.1 km east-northeast of the southwestern boundary corner of Laurie Township.

8. Quartz mozodiorite: biotite-hornblende bearing, ping; from outcrop located 1.3 km west of the intersection of the Matawin River and the southern boundary of Laurie Township.

Notes:

1. x denotes that less than one percent to trace of the mineral is present
2. Classification according to Streckeisen (1976)

Table 11: Chemical analysis and specific gravity of porphyries of the Felsic Intrusive Rocks, Blackwell and Laurie Townships

Major Components (weight percent):

Column No.	1	2
Specimen No.	86MWC-0007	86MWC-0040
Field No.	4C13-4	4F28-11
SiO_2	58.70	63.10
TiO_2	0.42	0.46
Al_2O_3	17.00	18.00
Fe_2O_3	6.45	2.44
FeO	0.0	0.0
MnO	0.12	0.05
MgO	2.82	0.68
CaO	4.87	5.95
Na_2O	4.44	7.13
K_2O	0.81	0.31
P_2O_5	0.24	0.21
CO_2	1.20	1.46
S	0.01	0.01
H_2O+	0.0	0.0
H_2O-	0.0	0.0
Total	97.08	99.80
LOI	3.10	1.80
Sp.Gr.	2.79	2.75
Trace Elements (ppm)		
Sn	80	-
Nb	-5	-5
Sr	557	694
La	29	-
Ce	-35	-

Notes:
1. Negative value denotes detection limit.
2. Dash alone (-) means not analyzed for.

Name and location of specimen:

1. Hornblende-feldspar porphyry: brown, calc-alkalic; from outcrop located 400 m north-northeast of Annex on Highway 11, in west-central Blackwell Township.

2. Feldspar porphyry: very light grey, calc-alkalic; from outcrop located 5 km southeast of the northwestern boundary corner of Laurie Township, in north-central Laurie Township.

Table 12: Molecular nor, normative colour index and normative plagioclase composition of porphyries of the Felsic Intrusive Rocks, Blackwell and Laurie Townships.

Column No.	1	2
Specimen No.	86MWC-0007	86MWC-0040
Field No.	4C13-4	4F28-11
Apatite	0.6	0.5
Ilmenite	0.6	0.6
Orthoclase	5.0	1.8
Albite	41.7	63.8
Anorthite	23.6	16.1
Corundum	0.6	0.0
Magnetite	2.1	0.1
Hematite	0.0	1.3
Wollastonite	0.0	2.9
Enstatite	8.1	0.0
Ferrosilite	4.8	0.0
Diopside	0.0	3.7
Quartz	12.9	9.1
Total	100.0	99.9
Colour Index	15.6	8.6
Plagioclase Composition (%An)	36.1	20.2

Name and location of speciment:

1. Hornblende-feldspar porphyry: brown, calc-alkalic; from outcrop located 400 m north-northeast of Annex on Highway 11, in west-central Blackwell Township.

2. Feldspar porphyry: very light grey, calc-alkalic; from outcrop located 5 km southeast of the northwestern boundary corner of Laurie Township, in north-central Laurie Township.

Table 13: Chemical analysis and specific gravity of Timiskaming-type shoshonitic metavolcanic rocks, Blackwell and Laurie Townships

Major Components (weight percent):

Column No.	1	2
Specimen No.	86MWC-0033	86MWC-0008
Field No.	4D22-2	4D25-15
SiO_2	50.40	57.80
TiO_2	0.94	0.41
Al_2O_3	15.30	16.80
Fe_2O_3	8.66	5.36
FeO	0.0	0.0
MnO	0.13	0.10
MgO	3.91	3.71
CaO	5.99	4.08
Na_2O	4.15	5.34
K_2O	2.78	2.37
P_2O_5	0.58	0.23
CO_2	4.38	0.76
S	0.01	0.01
H_2O+	0.0	0.0
H_2O-	0.0	0.0
Total	97.23	96.97
LOI	6.40	2.60
Sp.Gr.	2.74	2.72
Trace Elements (ppm)		
Sn	193	133
Nb	-5	-5
Sr	717	1086
La	89	52
Ce	73	47

Notes:
1. Negative value denotes detection limit.
2. Dash alone (-) means not analyzed for.
3. Classification according to Mackenzie and Chappell (1972).

Name and location of specimen:
1. Shoshonite: dark purple, foliated; from outcrop located on the south shore of the Shebandowan River, 0.6 km southeast of Annex on Highway 11 near the central part of the west boundary of Blackwell Township.
2. Latite: hornblende-feldspar phyric, red lapilli tuff; from outcrop located 400 m north of Mabella Station, in southwestern Blackwell Township.

Table 14: Molecular norm, normative colour index and normative plagioclase composition of Timiskaming-type shoshonitic metavolcanic rocks, Blackwell and Laurie Townships

Column No.	1	2
Specimen No.	86MWC-0033	86MWC-0008
Field No.	4D22-2	4D25-15
Apatite	1.5	0.6
Ilmenite	1.4	0.6
Orthoclase	17.7	14.3
Albite	40.2	49.1
Anorthite	16.1	15.2
Magnetite	2.8	2.0
Enstatite	2.9	9.3
Ferrosilite	1.6	2.8
Diopside	6.2	2.4
Quartz	0.0	3.1
Forsterite	4.2	0.0
Fayalite	2.3	0.0
Hedenbergite	3.3	0.7
Total	100.2	100.1
Colour Index	24.7	17.8
Plagioclase Composition (%An)	28.6	23.6

Name and location of specimen:

1. Shoshonite: dark purple, foliated; from outcrop located on the south shore of the Shebandowan River, 0.6 km southeast of Annex on Highway 11 near the central part of the west boundary of Blackwell Township.

2. Latite: hornblende-feldspar phyric clast in red lapilli tuff; from outcrop located 400 m north of Mabella Station, in southwestern Blackwell Township.

APPENDIX

MAP LEGENDS

LEGEND

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Sand, clay, gravel and swamp deposits

UNCONFORMITY

PRECAMBRIAN

LATE ARCHEAN TO PROTEROZOIC

MAFIC INTRUSIVE ROCKS

15a Diabase, aphyric, medium-grained

15c Diabase, porphyritic, feldspar phenocrysts

15g Hornblende lamprophyre

15j Lamprophyre

15k Biotite lamprophyre with pink carbonate

LATE ARCHEAN

INTRUSIVE CONTACT

METAVOLCANICS AND METASEDIMENTS (TIMISKAMING-TYPE)[a]

METASEDIMENTS

CLASTIC METASEDIMENTS

14a Chlorite schist (matrix of conglomerate)

14b Chlorite-sericite schist (matrix of conglomerate)

14c Conglomerate

14e Arkose, grey

14f Mudstone, green (chloritic)

14g Arkose, green (chloritic)

14h Mudstone

14j Siltstone

14k Ankeritized sediment

14m Arkose, red and brown

14n Siltstone, graphitic, black

14p Breccia

14q Wacke

14r Arenite

14s Siltstone, argillaceous

14t Arkose, mauve with pink calcite

14u Arkose, with pink feldspars and hornblende

14v Arkose, green with pink feldspars

CHEMICAL METASEDIMENTS

13a Magnetite-jasper ironstone

13b Magnetite-arkose-slate ironstone

13c Magnetite-siltstone ironstone

13d Magnetite-green arkose ironstone

13e Magnetite ironstone

13f Magnetite-red arkose ironstone

13g Magnetite-mudstone ironstone

METAVOLCANICS

SHOSHONITIC METAVOLCANICS

MAFIC TO FELSIC METAVOLCANICS

12a Intermediate to felsic flows and pyroclastics

12b Mafic to intermediate flows and pyroclastics

12c Tuff

12d Debris flow

12f Porphyritic flow (hornblende phenocrysts), red

12g Lapilli-tuff

CALC-ALKALIC METAVOLCANICS

INTERMEDIATE METAVOLCANIC

11a Tuff

11b Porphyritic flow (feldspar phenocrysts)

INDETERMINATE CONTACT

FELSIC INTRUSIVE ROCKS

10a Biotitic felsite

10c Biotite-hornblende granodiorite with feldspar phenocrysts

10d Biotite quartz diorite

10e Biotite granodiorite, pink

10f Biotite syenite

10g Hornblende granodiorite

10h Biotite-muscovite granite

10k Hornblende-biotite quartz monzodiorite

10n Biotite quartz monzonite

10p Granophyre

10q Feldspar porphyry

10r Hornblende-feldspar porphyry

INDETERMINATE CONTACT

METAMORPHOSED MAFIC INTRUSIVE ROCKS

9a Gabbro, medium-grained

9b Gabbro, coarse-grained

9c Gabbro, fine-grained

INTRUSIVE CONTACT

METASEDIMENTS (QUETICO-TYPE)

CLASTIC METASEDIMENTS

8a Wacke

8b Mudstone

8c Wacke, garnetiferous

8d Siltstone

8e Siltstone, argillaceous

8f Wacke with pegmatite leucosome and biotitic melanosome

8g Wacke with granitic and dioritic veins and pods

8h Wacke with dioritic veins

8j Wacke cut by pegmatitic veins

8k Gneiss, medium-grained

8m Wacke with tonalitic leucosome

8n Gneiss, coarse-grained

METAVOLCANICS AND METASEDIMENTS (KEEWATIN-TYPE)[a]

METASEDIMENTS

CHEMICAL METASEDIMENTS

7b Magnetite-jasper ironstone

7c Chert (black or grey)

CLASTIC METASEDIMENTS

6a Siltstone

6b Mudstone

6c Siltstone, graphitic

6d Laharic breccia with pyrite nodules

6f Wacke

6h Siltstone, argillaceous and pyritized

METAVOLCANICS

ALKALIC (SHOSHONITIC) METAVOLCANICS

MAFIC TO FELSIC METAVOLCANICS

5a Intermediate to felsic flows and pyroclastics

5b Mafic to intermediate flows and pyroclastics

5c Sericite schist

5d Tuff

5e Hornblende porphyry with mafic clots, red

5f Quartz-feldspar porphyry

5g Hornblende-feldspar porphyry, brown

5j Feldspar porphyry

5k Lapilli-tuff

5m Hornblende phenocrysts

5n Aphanitic flow

5p Carbonatized flow

5q Amygdaloidal flow

5r Debris flow

5s Glomeroporphyritic flow

5t Quartz latite (quartz phenocrysts)

CALC-ALKALIC AND HIGH-K CALC-ALKALIC METAVOLCANICS

FELSIC METAVOLCANICS

4a Feldspar porphyry

4b Debris flow, fine-grained

4c Tuff

4d Aphanitic flow

4e Quartz-feldspar porphyry

MAFIC TO INTERMEDIATE METAVOLCANICS

3a Basaltic flows and pyroclastics

3b Andesitic and dacitic flows and pyroclastics

3c Aphanitic flows

3d Fine-grained flows

3e Porphyritic flow (feldspar phenocrysts)

3g Debris flow, coarse-grained

3h Tuff

3j Debris flow, fine-grained

3k Carbonatized volcanic

3m Lapilli-tuff

3n Autoclastic (flow-top) breccia

3p Hornblende phenocrysts

3q Amygdaloidal flow

3r Silicified flow or pyroclastic

3s Quartz and feldspar phenocrysts

3t Glomeroporphyritic flow

THOLEIITIC METAVOLCANICS

BASALTIC AND ANDESITIC METAVOLCANICS

2a Aphanitic flow

2b Fine-grained flow

2c Medium-grained flow

2d Amygdaloidal flow

2e Pillowed flow

2f Carbonatized flow

2g Andesitic tuff

2h Silicified flow

2j Tuff

2k Coarse-grained flow

2n Blastoporphyritic flow (amphibole pseudomorphs)

2q Mafic flow with granitic bands

2r Amphibolite with large feldspar porphyroblasts

2s Banded flow

2v Breccia, autoclastic (flow-top breccia)

KOMATIITIC METAVOLCANICS

ULTRAMAFIC AND MAFIC METAVOLCANICS

1a Ultramafic flow

1b Basaltic flow, grey

1c Spinifex-textured flow

1d Polyhedrally-jointed flow

1e Carbonatized flow

1f Basaltic flows, dark grey

1g Variolitic flows

1h Breccia, autoclastic (flow-top breccia)

1k Pillowed flow

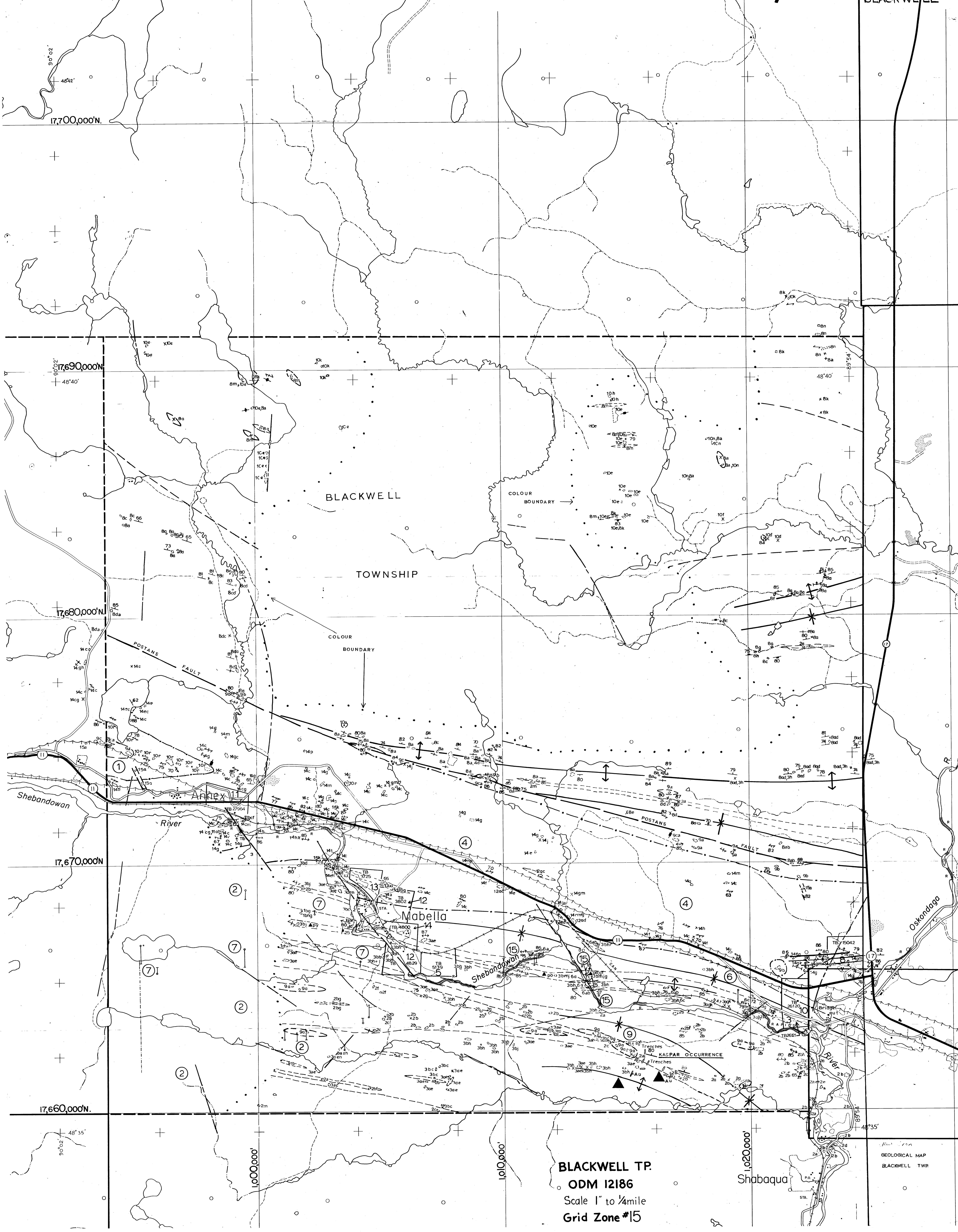
1m String-beef-textured flow

1n Perioditic flow

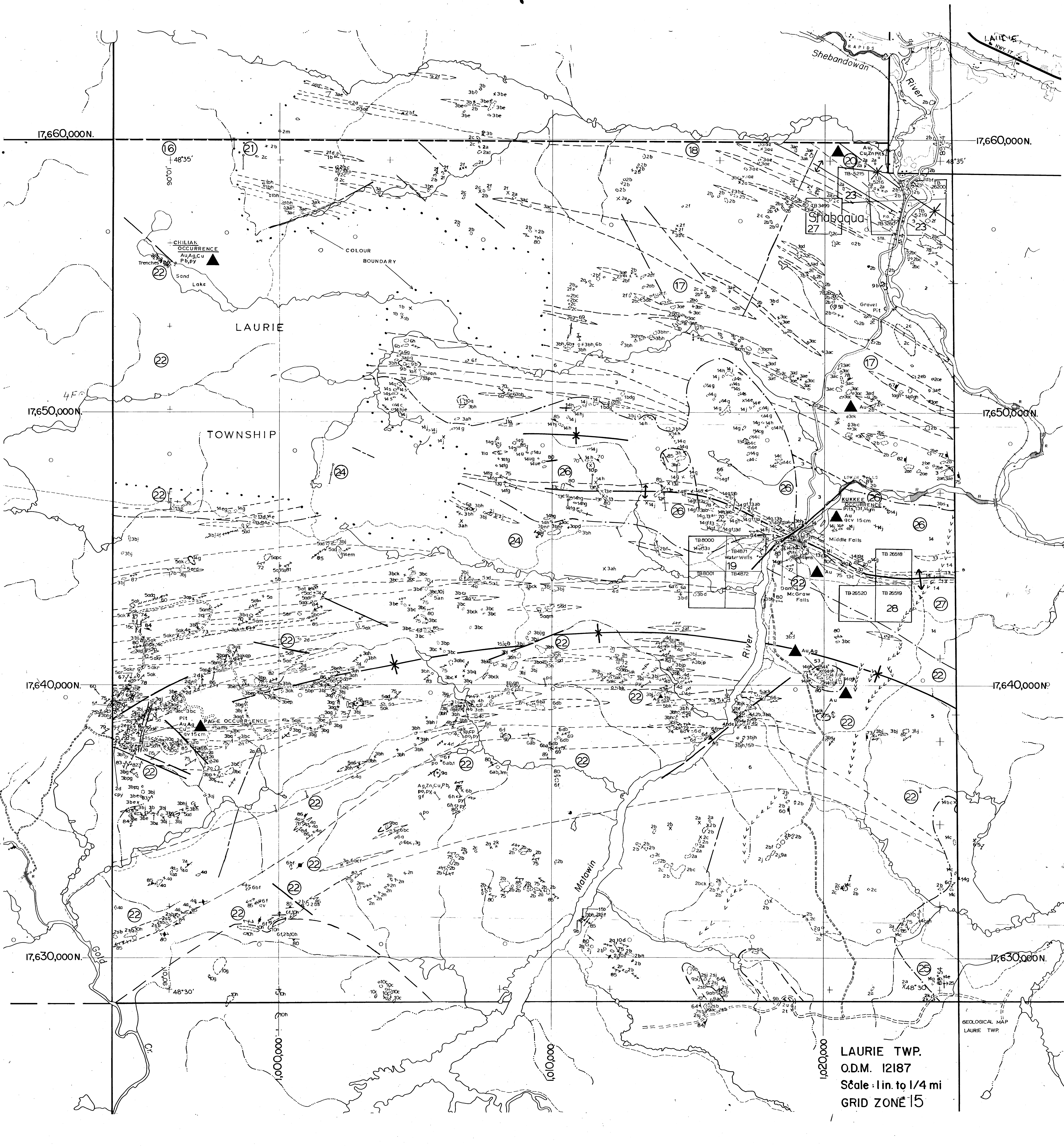
Notes:

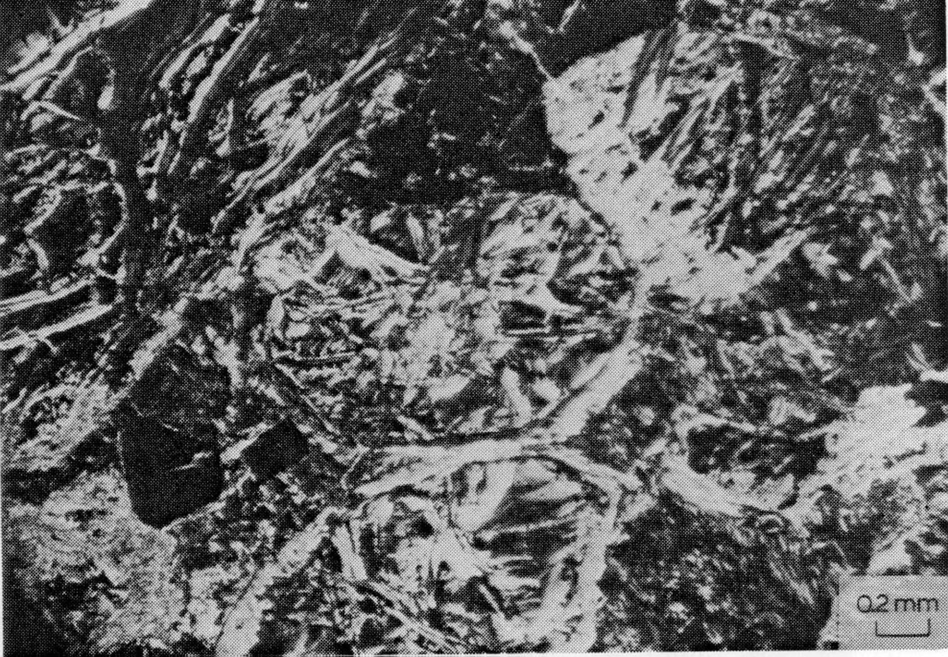
a) No age relationships are inferred between or within these groups.

MAP 1 - OFR 5727



MAP 2 - OFR 5727

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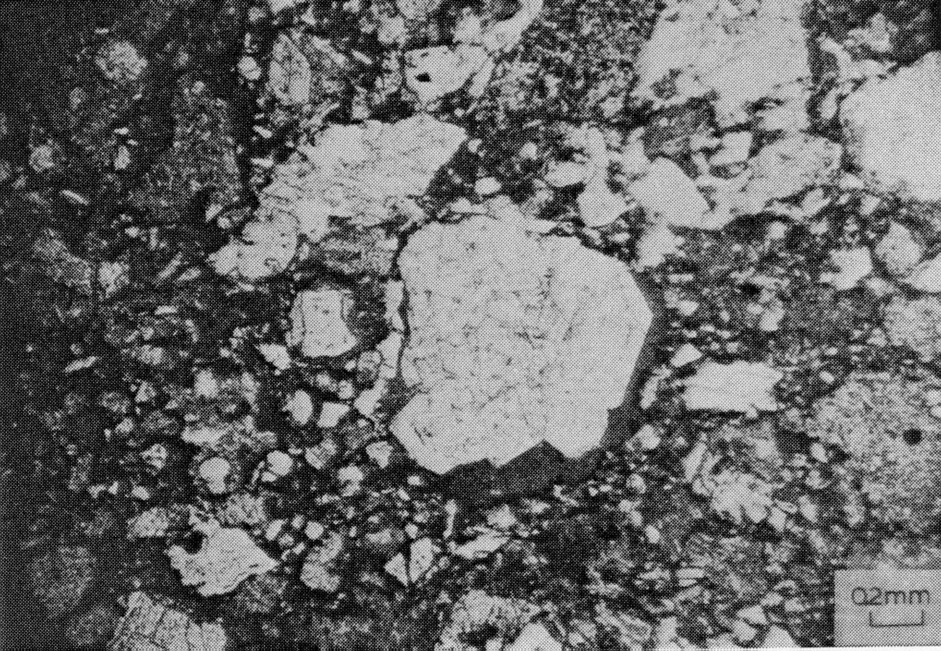
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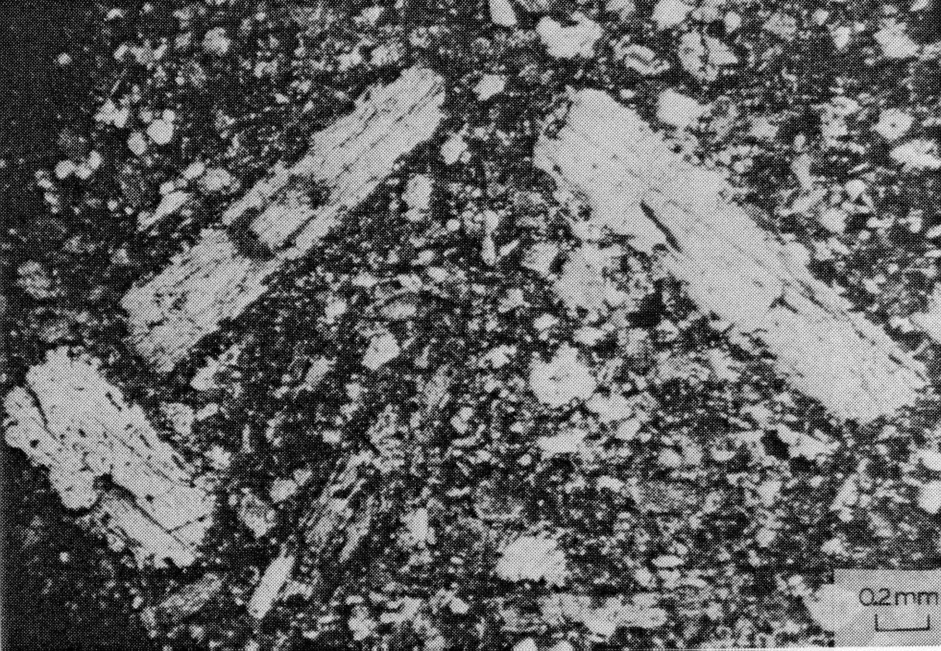
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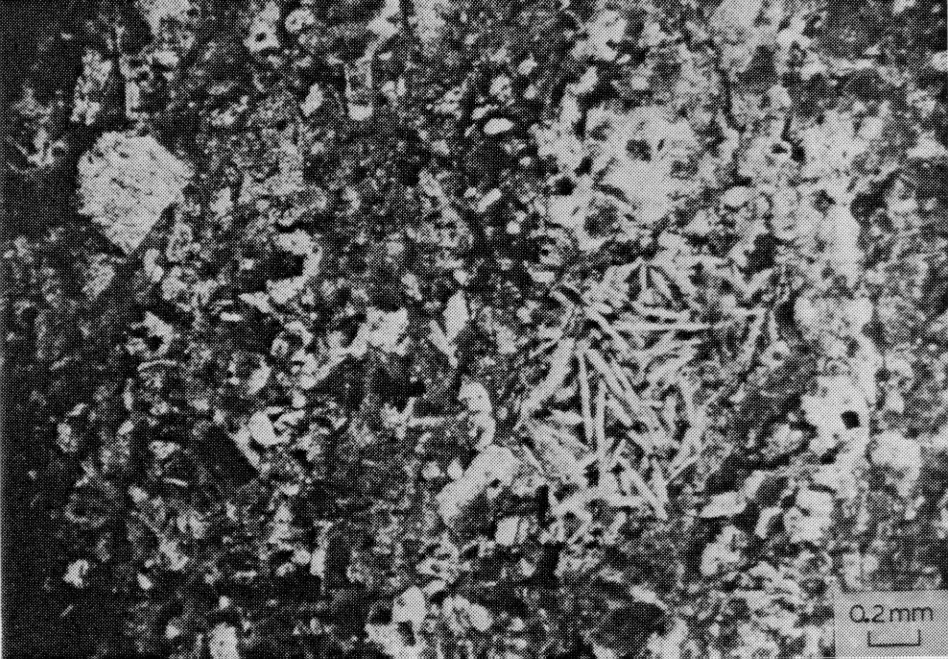
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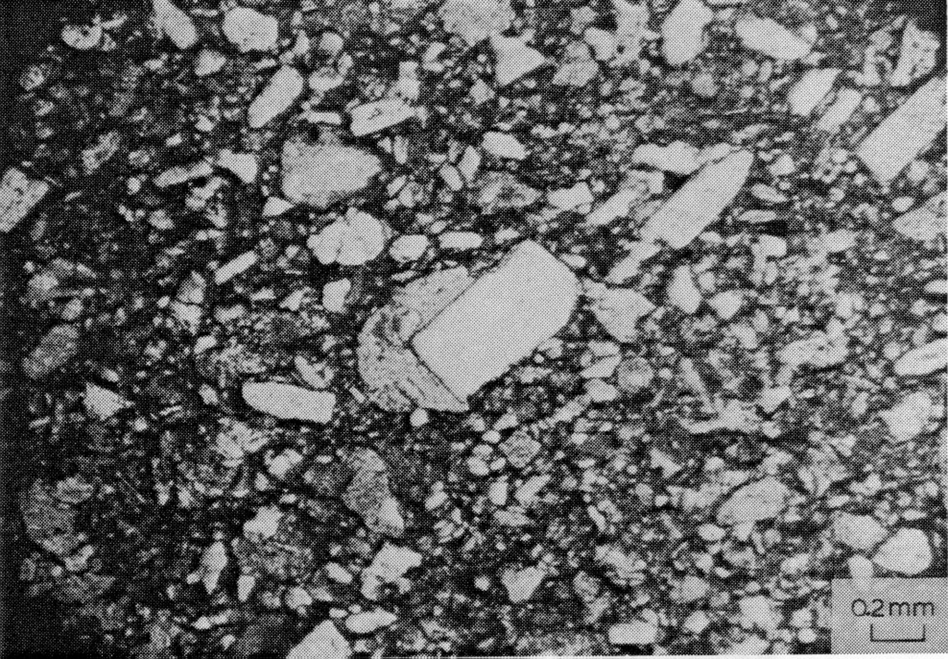
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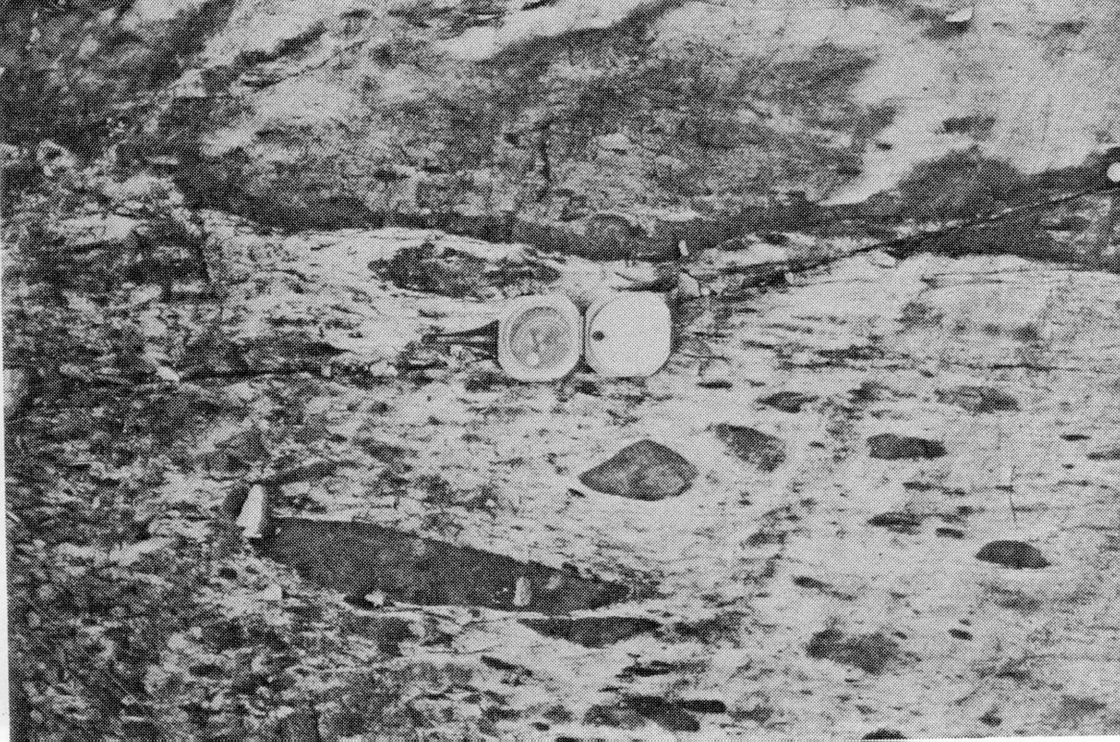


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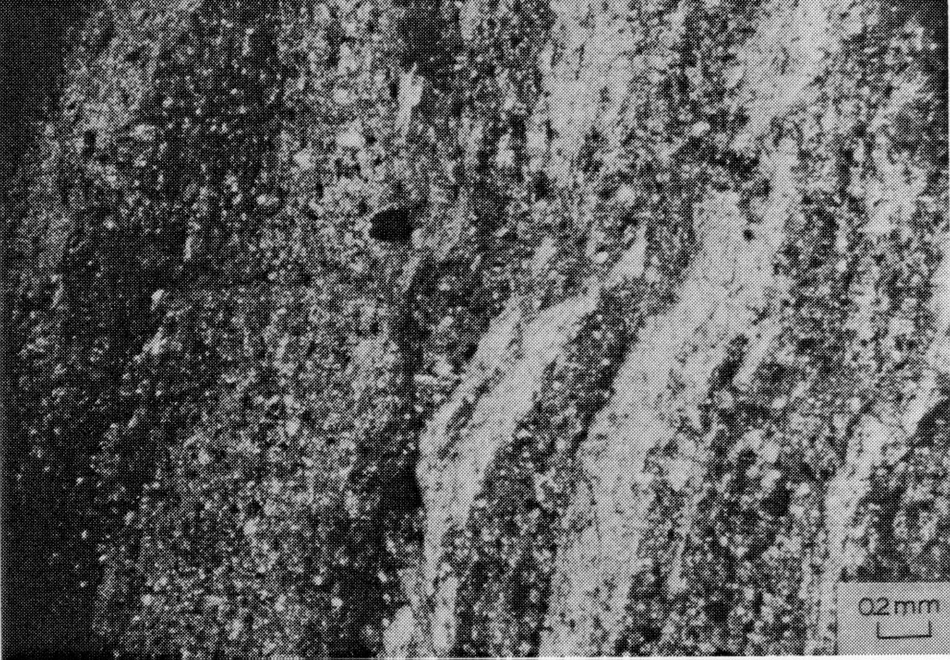
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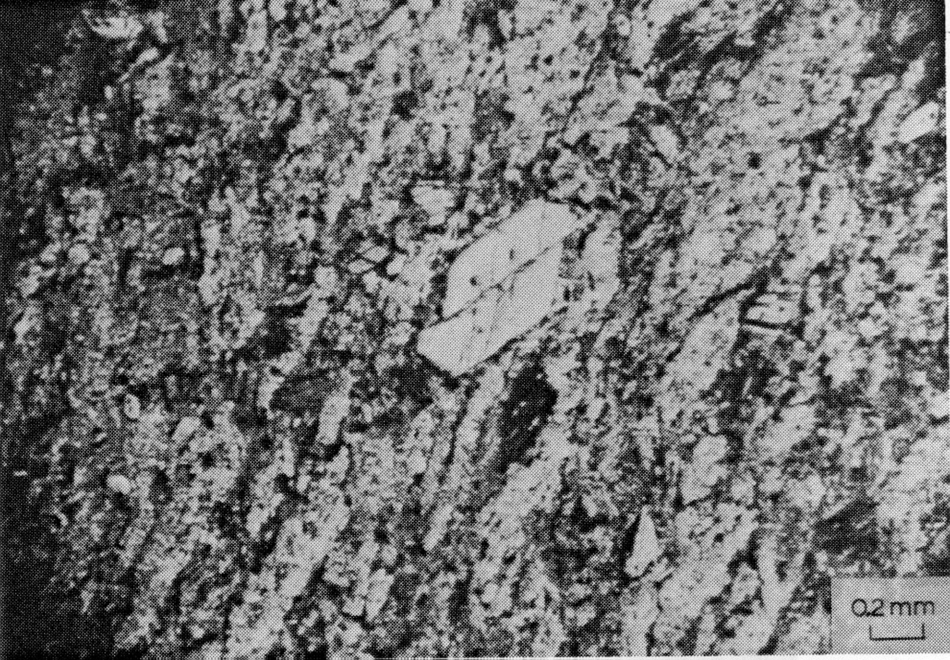
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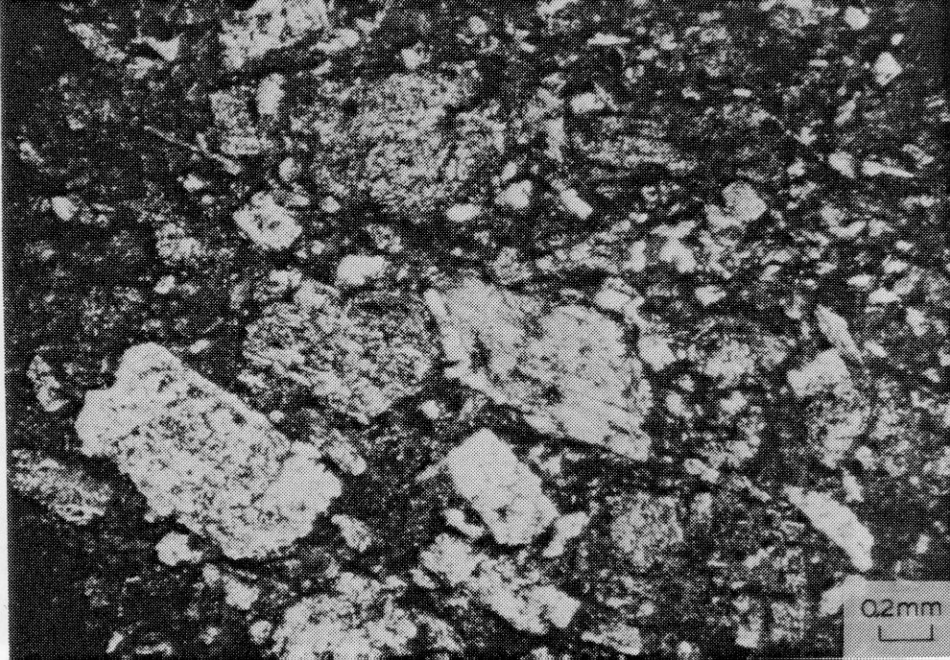
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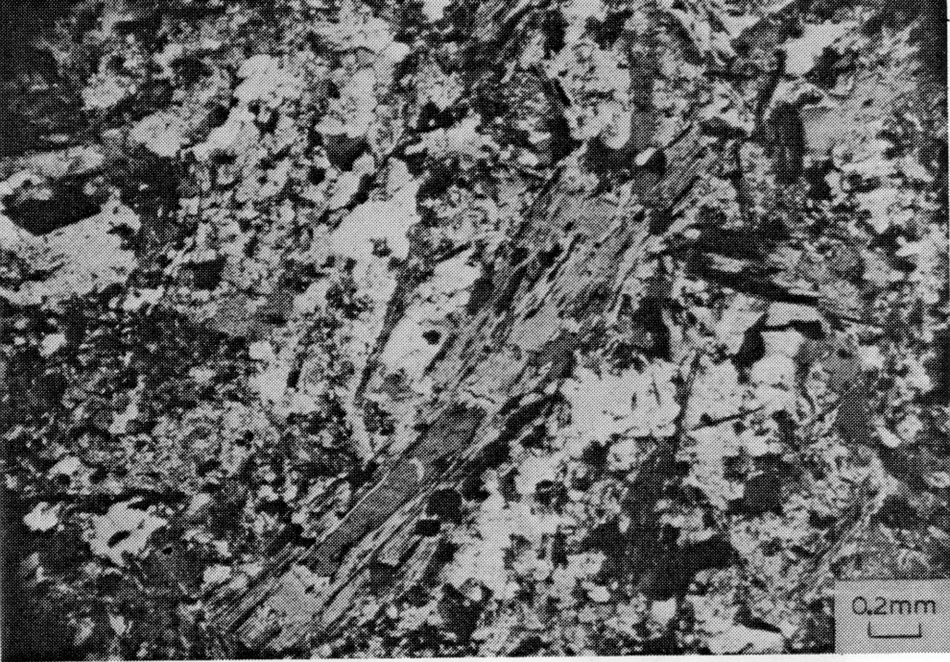
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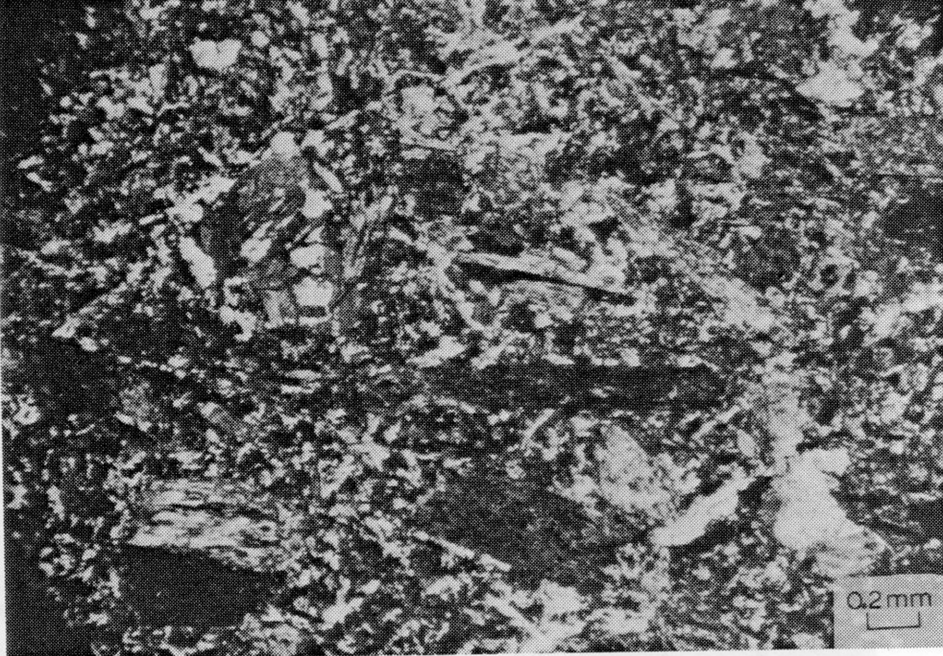
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