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MARGINAL NOTES

INTRODUCTION

The western and eastern Pickle Lake map areas were mapped as part of a multiyear program to upgrade the Precambrian geology of the central Uchi Subprovince.

Approximately 2000 km^2 were mapped at a scale of 1:50 000 in the Pickle Lake area, including major granitoid intrusions within, and adjacent to, the metavolcanic belt. Bedrock exposure is highly variable. Large parts of the belt display little or no outcrop. The best exposure is seen along a broad northeast-trending area through the old Pickle Crow gold camp. The limited exposure across the belt has been a major impediment to gold exploration and to the ability to trace the regional stratigraphy.

The results provide a modest revision of previous mapping in the metavolcanic belt. In addition, these maps present a subdivision of the adjacent granitoid complexes into several intrusive units. A summary is given of the tectonic sequence of events encompassing the Pickle Lake Belt and adjacent *granitoid rocks*.

LOCATION AND ACCESS

The Pickle Lake area centres on a metavolcanic belt (Pickle Lake Belt) bordered by large granitoid batholithic complexes. The belt is the northeasterly extension of a large metavolcanic terrain that includes the Meen–Dempster Lakes Belt (Stott and LaRocque 1984a, 1983b; Stott and Wilson 1986) and the Lake St. Joseph Belt (Stott *et al.* 1987a, 1987b). There is limited access from Highway 599, which traverses the length of the Pickle Lake Belt. Other parts of the belt can be reached by float- or ski-equipped aircraft from Pickle Lake.

PREVIOUS WORK

Parts of the Pickle Lake Belt, notably in the vicinity of the Pickle Crow–Central Patricia gold camp, were previously mapped by Hurst (1931), Thomson (1939), Evans (1941), Ferguson (1966), and Pye (1976). In 1972, a helicopter-supported reconnaissance survey covered the Cat Lake–Pickle Lake region (Sage and Breaks 1982).

MINERAL EXPLORATION

Since 1928, the Pickle Lake area has experienced fluctuating periods of activity in gold exploration, base-metal exploration, and, more recently, there has been a renewed effort to find new gold deposits. The outcome of almost 60 years of activity has been the development of two gold mines, both long since closed, namely the Pickle Crow Mine (Thomson 1939; Corking 1948) and the Central Patricia Mine (Barrett and Johnston 1948); the development of a low grade copper-nickel deposit at the Thierry Mine, which is also closed (Verbeek *et al.* 1972; Patterson 1980); and the recent discovery of the Dona Lake gold deposit southeast of the town of Pickle Lake (Cohoon 1986). There is also renewed interest in the vein systems at the Pickle Crow Mine held by Noramco Mining Corporation.

Figure 1 illustrates that much of the belt has been staked in recent years, reflecting the intensity of interest that has been generated about the potential for more gold deposits across much of the central Uchi Subprovince.

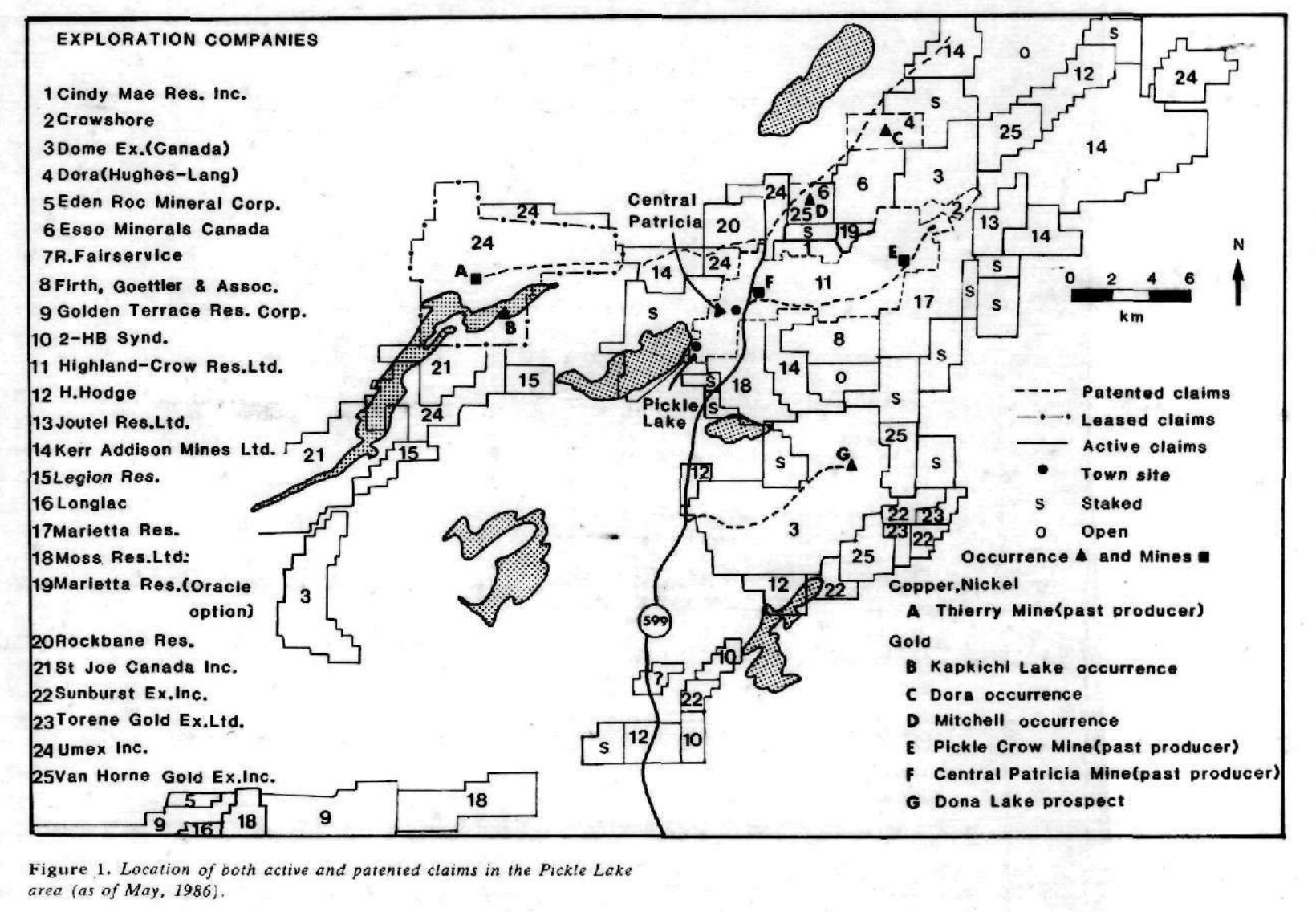

Figure 1. *Location of both active and patented claims in the Pickle Lake area (as of May, 1986).*

GENERAL GEOLOGY

Owing to the scarcity of outcrop in many parts of the Pickle Lake Belt, and the widespread lack of reliable stratigraphic younging indicators, it has not been possible to provide a satisfactory stratigraphic-structural framework for the entire belt, nor as yet to complete the correlation of stratigraphic units with the volcanic cycles defined in the Meen–Dempster Lakes Belt to the southwest (Stott and Wilson 1986). This correlation problem is presently being analyzed using the airborne geophysical survey results contracted by the Ontario Ministry of Northern Development and Mines (OGS 1986). In addition, a U-Pb zircon dating program is presently being conducted across the central Uchi Subprovince to establish a time framework for the regional stratigraphy and the tectonic history.

The general geology of the Pickle Lake Belt is summarized in Figure 2.

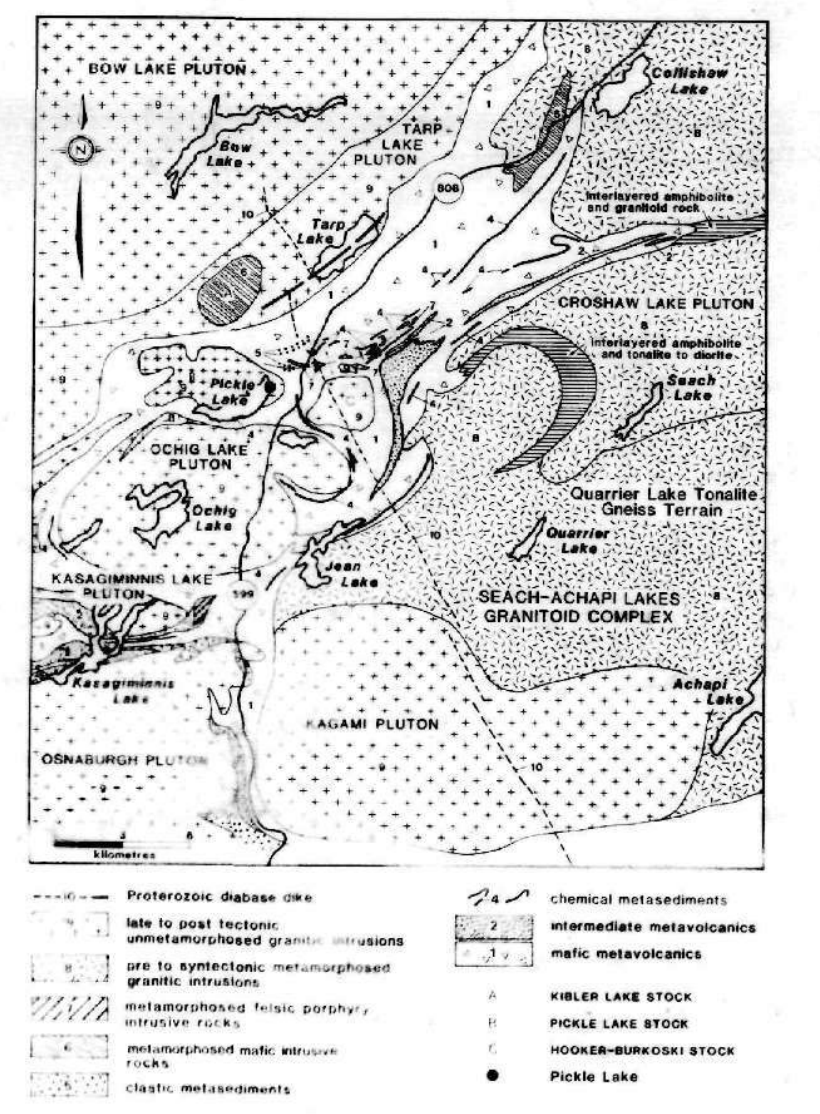

Figure 2. *General geology of the Pickle Lake area.*

SUPRACRUSTAL ROCKS

This metavolcanic belt is dominated by massive to pillowed basaltic flows (Unit 1). The rocks are typically fine grained, but coarse-grained flows are locally prominent, notably east of the Ochig Lake Pluton on the Dona Lake gold property, which is held by Placer–Dome Incorporated. Dacitic to andesitic tuff and flow rocks (Unit 2) are observed south of Pickle Crow, along the southeastern side of the belt, and in the Kasagiminnis Lake area. Lapilli and bomb size clasts are only locally observed south of Pickle Crow and on Kasagiminnis Lake. Felsic pyroclastic rocks (Unit 3) are scarce and occur associated with the major units of intermediate metavolcanics.

Long, continuous marker units of magnetite-chert ironstone, interbedded with greenish mudstone (Unit 4), occur most typically within the mafic metavolcanics. Ironstone also occurs locally within intermediate tuff (Unit 2) near the eastern margin of the belt.

The interbeds of greenish mudstone and local graphitic schist associated with the ironstone units are extensively ferroan dolomitized in the vicinity of the village of Central Patricia and the former settlement of Pickle Crow. This alteration is spatially associated with pervasive carbonatization of the volcanic rocks. *Such extensive alteration of rocks occurs in two* zones shown schematically in Figure 3.

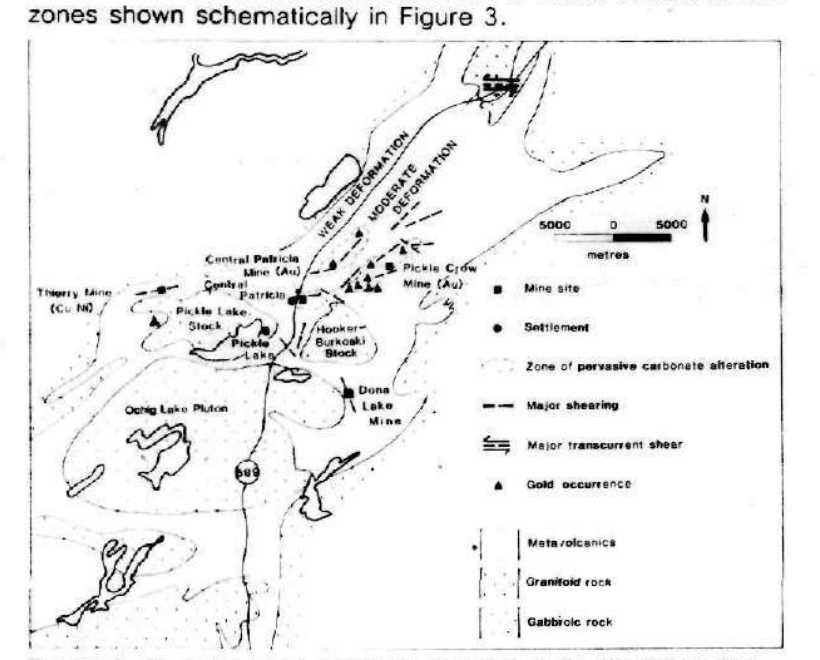

Figure 3. *Shear zones and carbonate alteration in the Pickle Lake Belt.*

Very few clastic metasediments (Unit 5) are observed in this belt apart from units in the southern part of the map area, east of Kasagiminnis Lake and on Highway 599 (Figure 2).

Within the metavolcanic assemblage, gabbroic sills (Unit 6) are not easily distinguished from coarse basaltic flows. A large gabbroic intrusion lies adjacent to the northern end of the belt, southwest of Collishaw Lake. Gabbroic and ultramafic intrusive sheets occur north of the Pickle Lake Stock and host the copper-nickel deposit at the Thierry Mine. Very little is known about the circular Kibler Lake Stock that intruded into the Tarp Lake Pluton. Sage and Breaks (1982, p.193-194) report that the outer part of this apparently multiphase or layered intrusion with a donut shaped aeromagnetic signature (ODM-GSC 1960) is at least locally composed of magnetite-rich melanocratic diorite.

Lenticular quartz porphyry intrusions (Unit 7) occupy a significant volume of the stratigraphy in the Central Patricia–Pickle Crow area. These bodies are all somewhat similar, with quartz eyes in a variably deformed and sericitized fine-grained matrix. The rocks are locally sheared and in places contain inclusions of mafic metavolcanics and ironstone.

A schistose quartz- to quartz-feldspar porphyry intrusion lies east of the Kasagiminnis Lake Pluton and flanks a major unit of intermediate pyroclastic rocks. These pyroclastic rocks strike westward and may correlate with the intermediate metavolcanics of the Dempster Lake cycle observed at the northern end of Caley Lake, west of the present map area (*see* Stott and Wallace 1984; Stott and Wilson 1986).

GRANITIC ROCKS

The western half of the Seach–Achapi Lakes Granitoid Complex has been subdivided into several major components (Figure 2). The names of this complex and the intrusive subdivisions within it are given here for the first time. The central core of this complex is composed of the oldest granitoid rocks—the Quarrier Lake tonalite gneiss terrain. These fine-grained foliated to gneissic tonalites (Unit 8), which contain local zones of amphibolite inclusions, may comprise more than one intrusion. The tonalite is metamorphosed and recrystallized. It is more strongly deformed near the contact with the younger, slightly metamorphosed Croshaw Lake Pluton. This younger quartz-phyric tonalite pluton forms an arcuate, crescent-shaped body 16 km wide, which borders and intrudes both the metavolcanic belt to the north and the tonalitic gneisses to the south and west (Figure 2). Both the gneissic terrain and the Croshaw Lake Pluton are crosscut by younger granite pegmatite dikes.

The youngest intrusion in the granitoid complex is the Kagami Pluton (Unit 9). This slightly arcuate, "boot-shaped" pluton appears to have invaded along a pre-existing arcuate boundary between the metavolcanic belt and the older Quarrier Lake tonalite. The pluton is unmetamorphosed and comprises a dominant quartz-phyric granodiorite phase and a narrow marginal phase of fine-grained, equigranular granodiorite. The internal pattern of foliation and shallowly-plunging mineral lineations is consistent with that of a primary magmatic fabric *formed during emplacement of a synformal crescent-shaped* sheet intrusion (Schwerdtner *et al.* 1983).

Northwest of the Pickle Lake Belt is a large granitoid terrain which straddles both the Uchi and Sachigo subprovinces. This terrain is dominated by an immense, apparently single phase intrusion, referred to here as the Bow Lake Batholith, which spans up to 55 km in width. This body is composed of medium- to coarse-grained potassium-feldspar megacrystic monzogranite to granodiorite (Unit 9). There is an abundance of visible magnetite crystals throughout the batholith, which produces the high magnetic intensity (typically >61 000 nT (gammas)) that characterizes this intrusion.

Immediately adjacent to the Pickle Lake Belt is the unmetamorphosed late to posttectonic Tarp Lake Pluton. This body has imposed only a very narrow contact strain aureole upon the adjacent metavolcanic belt.

Within the metavolcanic belt are several late to posttectonic felsic intrusions that appear to possess primary magmatic foliations and stretching lineations formed during the emplacement of these bodies. The Ochig Lake Pluton, and Hooker–Burkoski Stock are quartz-phyric trondhjemite intrusions and may be related as domical exposures of a common granitoid mass. The Pickle Lake Stock is similarly quartz-phyric but also contains potassic-feldspar megacrysts. Each of the three intrusions has imposed a strain fabric and a metamorphic aureole upon the surrounding supracrustal rocks. The Ochig Lake Pluton, for example, has produced a contact strain aureole up to 3 km wide on its eastern margin. The strain aureole surrounding the Pickle Lake Stock encompasses the Thierry Mine copper-nickel deposit, and an examination of that deposit suggests that the remobilization and concentration of sulphide mineralization is related to the deformation imposed by the emplacement of the Pickle Lake Stock.

The Kasagiminnis Lake Pluton is a late, unmetamorphosed granodiorite intrusion that contains both quartz phenocrysts and potassium-feldspar megacrysts and is texturally similar to the Osnaburgh Pluton.

STRUCTURAL GEOLOGY

Reliable top indicators are not widespread in the northwestern half of the belt. However, stratigraphic younging evidence in the southeastern half of the belt, outside of the tightly folded rocks in the Pickle Crow area, suggests that the regional younging direction in this part of the belt is southeastward toward the Seach–Achapi Lakes Granitoid Complex.

Mapping by Pye (1975) and earlier workers has defined large folds of the stratigraphy in the Pickle Crow area, and local younging evidence from pillowed basalts, confirm the earlier defined anticlines and synclines there (Pye 1975). However, in other parts of the belt, the continuity of electromagnetic conductors and stratigraphic units, such as ironstone and intermediate tuff, suggests a simple stratigraphy on the regional scale with megascopic folding concentrated locally, for example, south of the Ochig Lake Pluton.

A single planar alignment of minerals, a schistosity which lies at a small angle to or parallel to the bedding, was observed in most areas of the belt. There are regional variations in the intensity of development of this schistosity. A weak flattening fabric is typical of the northwesternmost part of the belt along Highway 808. A moderate deformation appears to be most typical of other parts of the belt with notable exceptions. These exceptions include

1. discrete deformation zones of strong to intense schistosity in the Pickle Crow area
2. a triangular area of the belt, south of Ochig Lake Pluton, squeezed between several late plutons and bearing a highly constrictive strain where rocks in many places are almost purely lineated
3. strong flattening fabrics in the supracrustal rocks enveloping the late to posttectonic plutons within the belt

This latter example is well illustrated by the strongly flattened and banded amphibolite on the Thierry Mine Road along the northern margin of the Pickle Lake Stock.

Other zones of shear have been observed locally (Figure 3) but in each case the full extent of these zones has not been established. One example is an east-trending zone of right-handed transcurrent shear, several tens of metres wide, within *quartz diorite at July Falls on Highway 808 at the northernmost* end of the belt. The narrow ductile deformation zones within the supracrustal wedge between the Ochig Lake Pluton and the Hooker–Burkoski Stock are another example.

Apart from a late transcurrent shear zone seen at July Falls, where the stretching lineation is subhorizontal, most zones of strong to intense deformation show moderate to steeply plunging lineations which are parallel to the stretching lineations in the surrounding moderately deformed rocks. In spite of the generally poor bedrock exposure which characterizes large parts of the Pickle Lake Belt, there are regional patterns of total strain in the rocks which allow for the subdivision of the belt into structural domains (Figure 4). These domains are defined mainly by orientations of stretching lineations and fold axes (all lineations referred to below are stretching lineations).

In general, the oldest observed strain element in the belt appears to be an easterly to north-northeasterly plunging stretching lineation which characterizes most of the northern and eastern parts of the belt (Figure 4). This region, termed Domain 1, is mainly flanked to the southeast by the tonalite terrain of the Seach–Achapi Lakes Granitoid Complex. Domain 1 includes the Pickle Crow area and mineralized deformation zones. The gold-quartz veins in these deformation zones are folded and typically possess steep northeasterly plunging lineations. This gold mineralization is localized along discrete shear zones, some of which are folded. These shear zones formed at a low angle to the flattening schistosity, concomitant with the deformation that characterizes this domain.

East of Domain 1 is Domain 2, characterized by westerly plunging lineations that parallel lineations in the adjacent quartz-phyric Croshaw Lake Pluton (Figure 4). It is suggested here that Domain 2 may represent a wide contact strain aureole related to the emplacement of the Croshaw Lake Pluton and postdating the strain event recorded in Domain 1.

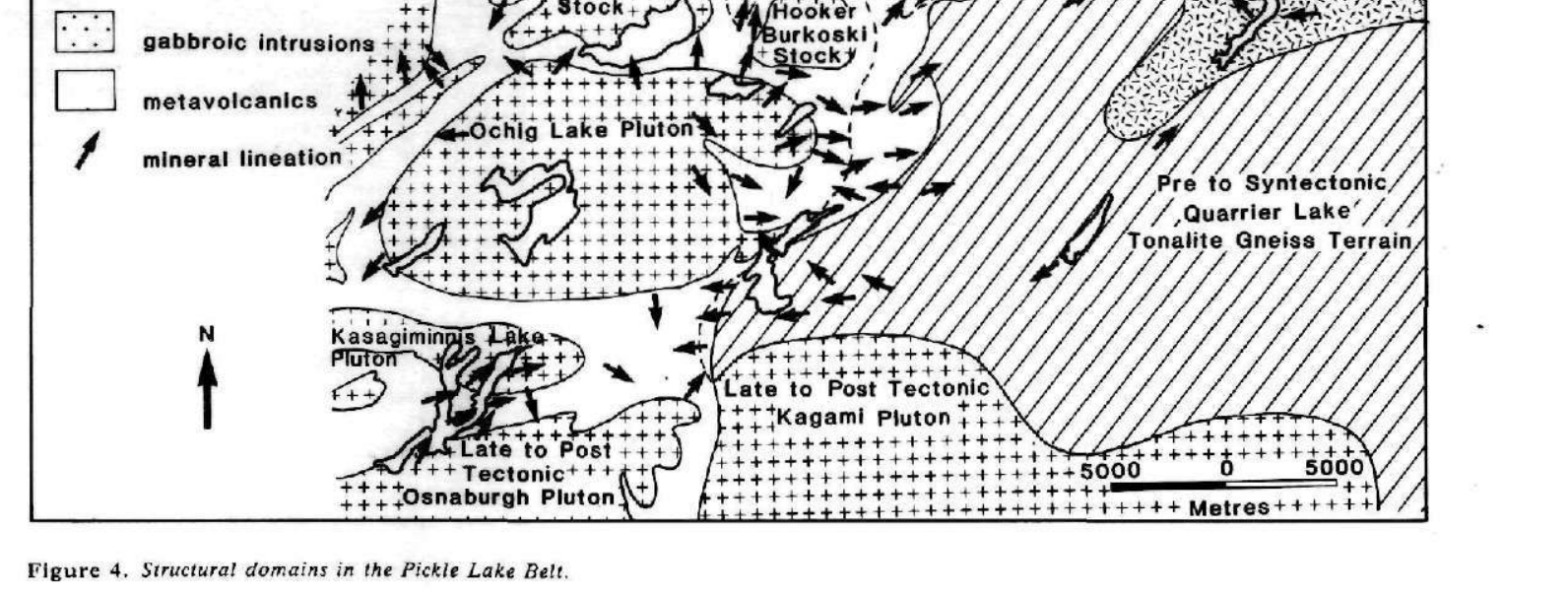

Figure 4. *Structural domains in the Pickle Lake Belt.*

Other recognizable domains (grouped as Domain 3 in Figure 4) are spatially restricted contact strain aureoles surrounding, or adjacent to, late felsic plutons such as the Pickle Lake Stock and the Ochig Lake Pluton.

The earliest stages of the tectonic history remain a mystery, but some features of the overall history are suggested from this reconnaissance study. The first two points are largely speculative at present.

1. If there was a regional tilting of strata toward the southeast, it probably predated the emplacement of tonalite in the Seach–Achapi Lakes Granitoid Complex. Such a southeastward tilting may correspond to the southward-facing homoclinal tilt of stratigraphy that forms the Meen–Dempster Lakes Belt, west of Kasagiminnis Lake (Stott and Wilson 1986). This megascopic tilting of the supracrustal rocks may extend beyond the length of any individual batholith and, as such, may be attributable to an early orogenic force of a much broader scale.
2. A record of the deformation in structural Domain 1 can be seen in the steep northeast-plunging lineations and fold axes in bedding and quartz veins at the former settlement of Pickle Crow, related possibly to the emplacement of tonalite in the Seach–Achapi Lakes Granitoid Complex. Domain 1 may have covered a broader region prior to the emplacement of the Croshaw Lake Pluton and the younger posttectonic intrusions. Local sets of shear zones and fractures developed at a low angle to the flattening schistosity. This is most evident in the Pickle Crow area where these narrow shear zones host gold-bearing quartz veins.
3. The development of structural Domain 2 was concomitant with the emplacement of the Croshaw Lake Pluton. Within the belt, Domain 2 outlines an area with a westerly plunging mineral lineation which corresponds to the magmatic stretching lineation observed in the Croshaw Lake Pluton. Field relationships show that this pluton postdates the tonalitic terrain along its southern flank.
4. The emplacement of late to posttectonic felsic plutons has imposed contact strain aureoles (Domain 3) and metamorphic aureoles upon the adjacent supracrustal rocks. In some cases, narrow shear zones have developed within these aureoles. Examples occur between the Ochig Lake Pluton and the Hooker–Burkoski Stock and on the northern side of the Pickle Lake Stock, at the Thierry Mine. Other possible examples are shear zones, which are not exposed on surface, occurring at the Dona Lake gold deposit (Cohoon 1986).
5. Late transcurrent shear zones may predate or postdate the late felsic intrusions. The transcurrent shear zones, such as the east-trending right-handed shear zone at July Falls, are interpreted to be related to the same late stage of crustal shortening that produced the Lake St. Joseph Fault at the Uchi–English River subprovinces boundary (Stott 1985) and the shear zone along the northeastern boundary of the Meen–Dempster Lakes Belt (Stott and Wilson 1986).

ECONOMIC GEOLOGY: DISCUSSION

GOLD

Exploration for gold in the Pickle Lake Belt has focused for many years on ironstone units. This arose from the fact that gold-bearing stockworks of quartz- and sulphide-filled fractures occur in ironstones at both the Central Patricia Mine (Barrett and Johnston 1948) and in parts of the Pickle Crow Mine (Thomson 1939). In addition, sulphidized zones occur where shear zone-hosted quartz veins intersect ironstone beds (for example, No. 5 vein at the Pickle Crow Mine). Ironstone beds served as effective structural traps for hydrothermal fluids and, of equal importance, as chemical traps wherein replacement sulphide mineralization was produced and accompanying gold in solution was preferentially precipitated (Macdonald 1984). The importance of searching for sulphidized parts of ironstones is underlined by the discovery in 1984 of the Dona Lake gold deposit (Property G, Figure 1) by Dome Exploration (Canada) Limited.

There are important regional structural relationships that should be considered (apart from the identification of fold hinges) in planning an exploration program for gold. It is important to identify those areas in which there is a greater likelihood of finding zones of intense deformation that could have served as permeable conduits for the flow of hydrothermal fluids.

Figure 4 illustrates that the Pickle Lake Belt can be subdivided into several structural domains. Major parts of the belt are dominated by contact strain aureoles imposed by the emplacement of late tectonic intrusions. Experience in other greenstone belts (Stott and Wilson 1986) suggests that, although there is a general decrease in the intensity of deformation outwards from these plutons, considerable variations in strain intensity can occur within these aureoles, and that localized shear zones, as well as tight folds and fracture systems, commonly form as part of such deformation. Zones of intensely developed schistosity can occur adjacent to, or within, comparatively more competent lithologies, such as porphyry intrusions and banded ironstones, and comparatively less competent lithologies, such as intermediate tuff units. It is not generally possible to predict whether and where such zones will develop within contact strain aureoles. Their association, however, with the rise of granitoid intrusions means that the recognition of the relative timing of the intrusions and the breadth of their surrounding contact strain aureoles is economically important.

The author recognizes three types of shear zones within the strain aureoles of felsic intrusions:

1. A single shear zone, at the outboard margin of a broad contact strain aureole, was produced by a large batholith. An example in the Meen–Dempster Lakes Belt (Stott and Wilson 1986) is the shear zone that lies at the southern *margin of the strain domain adjacent to the Dobie Lake* Batholith, west of the Pickle Lake Belt. This zone is interpreted to be a zone of differential displacement between the subsiding and flattened domain of contact strain and the unaffected supracrustals that lie south of this domain and away from the batholith. Gold-bearing quartz-tourmaline veins in this zone form over-rotated infillings of tension gashes developed during the shearing.
2. Stratigraphically-controlled shear zones developed within or along the margins of certain lithologies, notably banded ironstone. One example is the narrow shear zone at the Dona Lake gold deposit, which extends for over 1 km along the footwall margin of the ore-bearing ironstone (Cohoon 1986). This zone lies within the 3 km wide contact strain aureole imposed upon the supracrustal rocks by the Ochig Lake Pluton. The easterly extent of the strain aureole is shown schematically in Figure 4.
3. Shear zones formed along conjugate fractures at a low angle (typically 15°) to the principal flattening schistosity. Very locally, both members of a conjugate set may form as *narrow shears, but in general, only one member of the set* appears to develop into a significant shear zone in any one locality. This appears to be the case at the Pickle Crow Mine. Many of the major shear zones that host auriferous quartz, tourmaline, and sulphide mineralization veins are slightly oblique to the main northeast-striking flattening schistosity in this structural domain (Domain 1, Figure 4). In many cases, these zones are folded, and in all cases they contain asymmetrically folded quartz veins. The asymmetry of folds in these cases is consistent with conjugate fracturing, shearing, and concomitant rotation toward the flattening plane during the major shortening event that produced the Domain 1 schistosity and stretching lineations.

Similar observations have been made by Wilson *et al.* (1985) across the Red Lake Belt. They recognize conjugate fractures and shear zones as structural elements formed during subhorizontal flattening of the supracrustal rocks by adjacent plutons. The principal shear zones and vein systems at the Pickle Crow Mine, including the Howell vein, the Riopelle, and No. 5 veins and the "D" zone (Pye 1976, p.171), conform to a model of conjugate fracturing during northwestward-directed shortening of the supracrustal rocks. This may have occurred during expansion of the tonalitic mass to the southeast of the belt in the Seach–Achapi Lakes Granitoid Complex. It may eventually be shown with further study that these auriferous conjugate shear zones, so well developed in the Pickle Crow area, are related to the pervasive iron carbonatization in this area at the time of deformation (Figure 3). For similar observations in the Red Lake Belt *see* Andrews (1984).

In addition to these three types of shear zones that are associated with plutonic emplacement, we also distinguish major transcurrent shear zones that tend to form along northwest-trending granite-greenstone boundaries as well as along subprovince boundaries. These transcurrent shear zones are related to a major late stage, northwest-directed, oblique compression of the crust. One example is the transcurrent shear zone along the northeastern margin of the Meen–Dempster Lakes Metavolcanic Belt (Stott and Wilson 1986). There appears to be several splays off this zone, including one which is localized within and along the margins of a narrow felsic tuff unit at the St. Joe Canada Incorporated (now Bond Gold Canada Incorporated) gold discovery north of Muskegsagagen Lake, 65 km southwest of the town of Pickle Lake. An auriferous cherty quartz sheet, several thousand metres long, occurs along the margin of this unit (The Northern Miner 1986).

With an understanding of the structural significance of both late tectonic felsic plutons and late stage subhorizontal oblique compression of the crust, the different structural settings of gold deposits can be assessed and these deposits can be placed in the relative sequence of regional tectonic events. For example, there are differences in the regional structural settings between the Dona Lake Deposit (Figure 3) and deposits at the Pickle Crow Mine. The authors' work has indicated that the contact strain aureole and amphibolite facies metamorphism imposed by the Ochig Lake Pluton (Figure 4) encompasses the ironstone units on its eastern margin. The major penetrative fabric imposed by the pluton is superimposed by later structures, in particular steeply plunging flexures or "cross folds" (Cohoon 1986) of the schistosity and bedding. Field evidence suggests that the open flexure folding of the bedding is restricted to the supracrustal rocks at the eastern margin of the pluton. Since the emplacement of the Ochig Lake Pluton is the last deforming event in the vicinity of the gold deposit, it is reasonable to suggest that a progressive history of diapirism, ballooning, and second-order doming of the intrusion is responsible for the sequence of structures observed along the length of the supracrustal "tail" extending into the eastern part of the pluton and leading eastward to the gold deposit. The Dona Lake Deposit is therefore interpreted to accompany the emplacement of the Ochig Lake Pluton.

In contrast, the vein systems in the variably iron carbonatized rocks of the Pickle Crow area are related to an earlier deformational event that formed the structures of Domain 1 (Figure 4). Discrete shear zones carry gold in quartz veins that transect a range of host lithologies. The significance of the orientation of these shear zones was discussed earlier. They appear to be synkinematic with the development of the main penetrative schistosity in Domain 1. This schistosity was deflected and locally buckled by the emplacement of the trondhjemitic Hooker–Burkoski Stock which appears to be magmatically related to the Ochig Lake Pluton.

The implication, therefore, is that the mineralization in the area of Pickle Crow and Central Patricia was emplaced during a *deformational event (possibly related to emplacement of* tonalitic rocks southeast of the belt) which preceded the emplacement of the Hooker–Burkoski and Ochig Lake intrusions and accordingly, preceded the emplacement of the Dona Lake gold deposit.

THE THIERRY MINE COPPER–NICKEL DEPOSIT

The Thierry Mine is located just north of the Pickle Lake Stock (Figure 3) and lies within a contact strain aureole imposed by the stock (Figure 4).

The mine has a history of almost 10 years as a producer of low grade copper and nickel before closing down in 1982. The mine consists of underground workings and two open pits within sheared gabbroic rocks and ultramafic schists. The ore principally contains chalcopyrite, pyrrhotite, pyrite, and pentlandite, and forms several structural types including breccia ore, chlorite-biotite schist ore, and ores of disseminated sulphide mineralization (Patterson 1980).

The author examined this deposit underground at the 850-foot level and on the surface in the East Pit. There is a consistent northward dip of schistosity in the amphibolites and a downdip to moderately northwest-plunging mineral lineation. Associated with this penetrative ductile fabric are discrete normal faults and fractures, subparallel to schistosity, plus narrow shears along fault planes with identical mineral lineation orientation. The sense of movement on these fault surfaces, and on the penetrative foliation surfaces, is best observed on the southern wall of the East Pit. Numerous penetrative step fractures, local penetrative rotation of flattening schistosity into shear cleavages, and slickensides on fault planes, indicate that a south-side-up sense of movement (i.e., Pickle Lake Stock-side-up) is pervasive. This sense of movement is consistent across the breadth of the Thierry Mine property.

The northward dip of schistosity away from the Pickle Lake Stock, the sense of movement on the penetrative schistosity and fault planes, the intense colour banding, and higher metamorphic grade (amphibolite facies traced around the pluton), plus the width of the contact strain aureole, strongly suggest that the sulphide mineral emplacement as massive fracture fillings (*some containing brecciated amphibolite*) *and disseminations* to form ore occurred during the emplacement of the Pickle Lake Stock. The author suggests, therefore, that the structural framework of the deposit may be intimately related to the emplacement of the Pickle Lake Stock. The deposit is thus composed of tectonically concentrated ore as noted by Patterson (1980).

The author also noted, on the southern wall of the East Pit, the presence of sulphide mineral-bearing cherty quartz veins that cut the above mentioned fabrics. These veins appear to be spatially related to a late set of steep listric reverse faults that show a south-side-up sense of movement. The faults are well exposed on the southern and western walls of the East Pit. They may reflect more brittle responses to the same pluton-induced stress system.

PROSPECTING RECOMMENDATIONS

The following recommendations are both specific to the Pickle Lake Belt and generally applicable elsewhere in the Uchi Subprovince.

1. It is recommended that prospectors focus on discrete zones of strong to intense deformation within broad contact strain aureoles around late felsic plutons, especially where structural and chemical traps are present. The recognition of these strain aureoles is therefore the first step. Not all late intrusions have imposed broad strain domains, but there is an abundance of these late intrusions in the Superior Province and many appear to cluster in age (Colvine *et al.* 1985).
2. It is recommended that consideration be given to tracing late transcurrent faults and shear zones. Most have probably formed along greenstone-granite boundaries and subprovince boundaries but some east-trending faults may also transect significant portions of a greenstone belt. They formed by northwest directed oblique compression of the crust and postdate other tectonic events. One possible example is the east-trending transcurrent shear zone at the northeastern end of the Pickle Lake Metavolcanic Belt (Figure 3). This zone may be accompanied by others not yet identified within the belt.

   Splays off faults or shear zones along metavolcanic-granite boundaries may locally project into a greenstone belt and trace along bedding surfaces for some distance. Such shear systems in greenstone belts are similar to wrench faults (Wilcox *et al.* 1973) but modified and controlled by prominent planar anisotropies in the supracrustal rocks. The transcurrent shear zone along the northeastern margin of the Meen–Dempster Lakes Belt (Stott and Wilson 1986) is an example. It is broadest in the vicinity of the stratigraphically-controlled St. Joe Canada Incorporated (Bond Gold Canda Incorporated) gold discovery north of Muskegsagagen Lake. Similar deformation zones can be predicted and sought along similar northwest and northeast-trending greenstone-granite boundaries; for example, the Keezhik Lake Belt north of Miminiska Lake in the eastern Uchi Subprovince bears a marked similarity in form and orientation to the Meen–Dempster Lake Belt. In addition, "horsetail" splays off of major subprovince boundary faults have not all been identified and some of these may have produced important structural traps within greenstone belts.
3. Finally, in view of current interest in gabbroid-related platinum group mineralization, it is recommended that some investigation be made of the Kibler Lake Stock (Figure 2) since it may be a zoned mafic intrusion (Sage and Breaks 1982, p.193). Little is known about this body which is not exposed on the surface.

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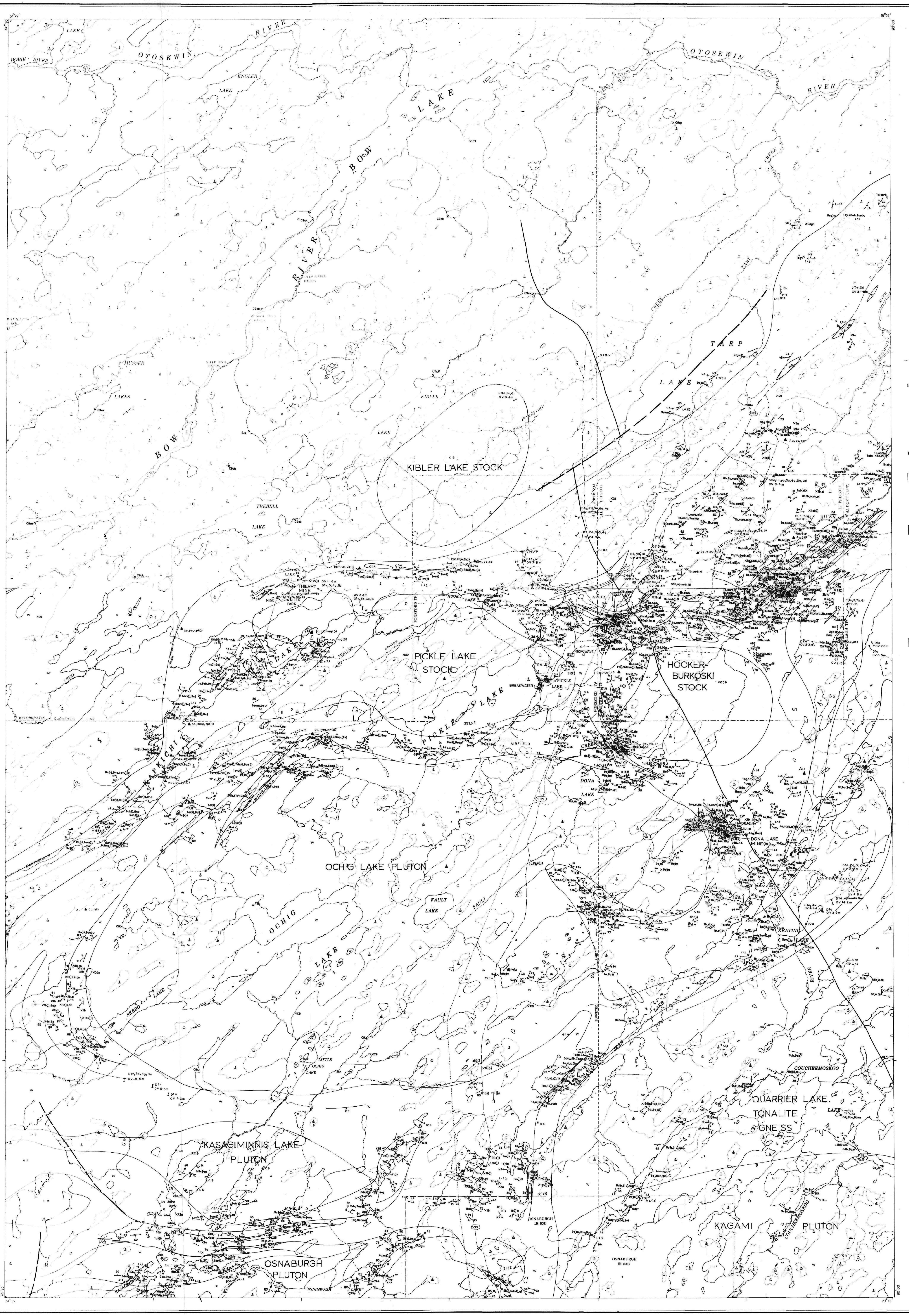

Ministry of
Northern Development
and Mines
Ontario

Mines and
Minerals
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Ontario Geological Survey

MAP P.3056

Geological Series—Preliminary Map

PRECAMBRIAN GEOLOGY

PICKLE LAKE AREA

WESTERN PART

Scale 1:50 000

Mile 1 0 1 Mile
Metres 1000 0 1 Kilometre

NTS References: 52 O/8,9
ODM–GSC Aeromagnetic Maps: 923G, 924G
ODM Geological Compilation Map: 2218

Printed in Ontario, Canada

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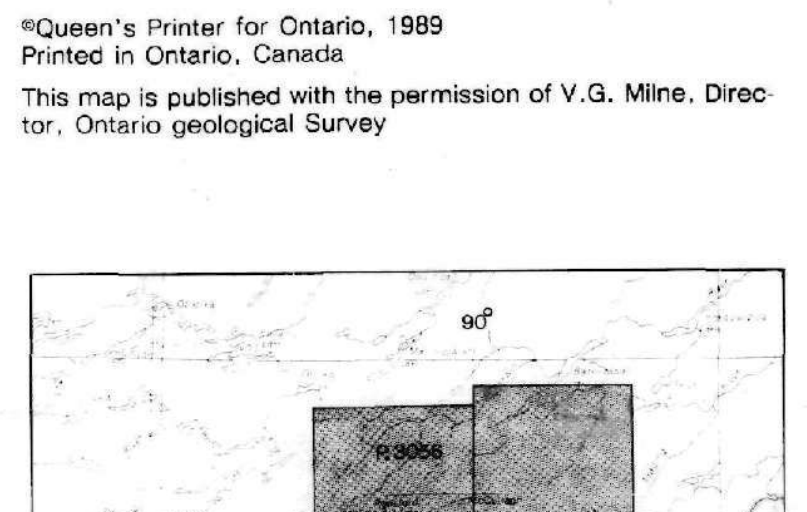

LOCATION MAP

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

LEGEND[a,b]

PHANEROZOIC
CENOZOIC
QUATERNARY
RECENT

Stream, lake, and organic bog deposits

PLEISTOCENE

Eskers, drumlinoids, glacial till

UNCONFORMITY

PRECAMBRIAN[c,d]
PROTEROZOIC
MAFIC DIKES

10
- 10a Gabbroic (diabase) dike
- 10b Mafic phenocryst-bearing dike

INTRUSIVE CONTACT

ARCHEAN
FELSIC INTRUSIVE ROCKS[d]
UNMETAMORPHOSED LATE TO POSTTECTONIC GRANITIC ROCKS

9
- 9 Unsubdivided
- 9a Syenogranite
- 9b Monzogranite
- 9c Granodiorite
- 9d Tonalite, trondhjemite
- 9e Quartz diorite
- 9f Syenite
- 9g Granitic rock with amphibole>biotite
- 9h Granitic rock with biotite>amphibole
- 9j Granitic rock with biotite
- 9k Potassic feldspar-megacrystic granitic rock
- 9l Plagioclase feldspar-phyric granitic rock
- 9m Quartz-phyric granitic rock
- 9n Granite pegmatite
- 9o Sill, dike
- 9p Xenolith-bearing[d]

INTRUSIVE CONTACT

METAMORPHOSED PRE- TO SYNTECTONIC GRANITIC ROCKS

8
- 8a Syenogranite
- 8b Monzogranite
- 8c Granodiorite
- 8d Tonalite, trondhjemite
- 8e Quartz diorite
- 8f Granitic rock with amphibole
- 8g Granitic rock with amphibole>biotite
- 8h Granitic rock with biotite>amphibole
- 8j Granitic rock with biotite
- 8k Potassic feldspar-megacrystic granitic rock
- 8l Plagioclase feldspar-phyric granitic rock
- 8m Biotite-phyric granitic rock
- 8n Hornblende-phyric granitic rock
- 8o Quartz-phyric granitic rock
- 8p Granite pegmatite
- 8r Sill, dike
- 8s Xenolith-bearing[d]

INTRUSIVE CONTACT

METAMORPHOSED FELSIC PORPHYRY INTRUSIVE ROCKS[e]

7
- 7a Quartz porphyry
- 7b Feldspar porphyry
- 7c Quartz-feldspar porphry
- 7d Felsite, fine grained
- 7e Porphyry sill, dike
- 7f Xenolith-bearing[d]

INTRUSIVE CONTACT

MAFIC TO ULTRAMAFIC INTRUSIVE ROCKS[c]
METAMORPHOSED MAFIC INTRUSIVE ROCKS

6
- 6a Diorite
- 6b Gabbro
- 6c Anorthosite
- 6d Leucocratic gabbro (Colour Index >10 and <35)
- 6e Melanocratic gabbro (Colour Index >65 and <90); and ultramafic intrusive rock
- 6f Plagioclase feldspar-phyric mafic intrusive rock
- 6g Quartz-bearing mafic intrusive rock
- 6h Pegmatite
- 6j Fine-grained sill, dike
- 6k Xenolith-bearing[d]

INTRUSIVE CONTACT

METAVOLCANICS AND METASEDIMENTS
METASEDIMENTS
Clastic Metasediments

5
- 5 Undifferentiated
- 5a Quartzose wacke
- 5b Feldspathic wacke
- 5c Lithic wacke
- 5d Mudstone (slate/argillite)

Chemical Metasediments

4
- 4 Undifferentiated
- 4a Ironstone
- 4b Ferruginous chert
- 4c Chert
- 4d Siderite/ankerite
- 4e Sulphide ironstone
- 4f Amphibole-rich ironstone
- 4g Graphitic schist

METAVOLCANICS
Felsic Metavolcanics

3
- 3a Massive flow (may include fine-grained ash flow)
- 3b Quartz-feldspar porphyry[f]
- 3c Flow-layered rock
- 3d Quartz-phyric rock
- 3e Tuff
- 3f Lapilli tuff
- 3g Lapillistone

Intermediate Metavolcanics

2
- 2a Massive flow (may include fine-grained ash flow)
- 2b Pillowed flow
- 2c Quartz-feldspar porphyry[f]
- 2d Tuff
- 2e Crystal tuff
- 2f Lithic tuff
- 2g Lapilli tuff
- 2h Lapillistone
- 2j Tuff breccia
- 2k Pyroclastic breccia
- 2l Monolithic pyroclastic rock
- 2m Heterolithic pyroclastic rock
- 2n Pyroclastic rock with fragments more felsic than matrix

Mafic Metavolcanics

1
- 1 Undifferentiated
- 1a Massive flow
- 1b Pillowed flow
- 1c Pillow breccia
- 1d Amygdaloidal flow
- 1e Variolitic flow
- 1f Flow top breccia, flow breccia
- 1g Coarse-grained flow
- 1h Mafic phenocryst-bearing rock
- 1j Plagioclase feldspar-phyric rock
- 1k Tuff
- 1l Crystal tuff
- 1m Lapilli tuff
- 1n Lapillistone
- 1o Tuff breccia
- 1p Pyroclastic breccia
- 1r Volcaniclastic metasediments (map include tuff and resedimented tuff)
- 1s Monolithic pyroclastic rock
- 1t Heterolithic pyroclastic rock
- 1u Very silicified (cherty) rock
- 1v Amphibolitized rock
- 1w Gneissec rock
- 1x Epidote-rich layers and lenses in flows or pyroclastic rock
- 1y Pyroclastic rock with fragments that are more felsic than the matrix

carb Carbonatized

si Silicified

NOTES

a) This is basically a field legend and may be changed as a result of subsequent laboratory investigations.

b) The age relationship of rocks coded 1 to 7 are varied.

c) The plutonic rock classification follows the IUGS Subcommission on the Systematics of Igneous Rocks (Streckeisen 1976).

d) Types of xenoliths which are shown in ( ) are listed in order of decreasing abundance where noted.

e) May be extrusive in part.

f) May be intrusive in part.

The letter "C" preceding a code refers to selected data compiled from previous maps of the Ontario Geological Survey in areas of poor outcrop exposure or areas not visited by the present mapping project.

The letter "G" preceding a code indicates that the interpretation is based on geophysical data.

The letter "D" preceding a code refers to data compiled from diamond drill logs filed for assessment work credit with the Ontario Geological Survey, Toronto, and the Resident Geologist's Files, Ontario Ministry of Northern Development and Mines, Sioux Lookout.

Parentheses),)), and))), following a code, refer to field estimates of intensity of rock deformation. A semi-quantitative scale of weak, moderate, strong, and intense deformation is used. Most metavolcanic belt outcrops show a "moderate" degree of deformation and are not labelled as such.

"Weakly-deformed" rocks are indicated by ")"

"Strongly-deformed" rocks are indicated by "))"

Intensely-deformed rocks (typically shear zones which include mylonitic rocks) are indicated by ")))"

L>S, L=S, and L<S refer to visual estimates of the relative prominence to the stretching lineation (L) in comparison with the schistosity (S).

The Marginal Notes, Abbreviations, Symbols, Legend, and Figures refer to both the western (P.3056) and eastern (P.3057) parts of the Pickle Lake area.

SYMBOLS

- Esker
- Small bedrock outcrop
- Area of bedrock outcrop
- Bedding, top unknown; (inclined, vertical)
- Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned)
- Lava flow; top (arrow) from pillows shape and packing
- Lava flow; top in direction of arrow
- Pillow elongation; (inclined, vertical)
- Gneissosity; (horizontal, inclined, vertical)
- Foliation; (horizontal, inclined, vertical)
- Second foliation; (horizontal, inclined, vertical)
- Shear zone
- Mineral lineation
- Anticline, syncline (showing strike of axial plane)
- Anticline, with plunge
- S-fold, W-fold, Z-fold (showing plunge of fold axis)
- Geological boundary, position interpreted
- Fault or lineament
- Diamond-drillhole; (vertical, inclined; with depth of overburden)
- Ironstone horizon
- △ Mineral occurrence
- ○ Past producer
- ● Producer
- Marsh; swamp (wooded)

ABBREVIATIONS

Ag	silver	Ni	nickel
asp	arsenopyrite	Pd	palladium
Au	gold	pent	pentlandite
cn	cubanite	po	pyrrhotite
cp	chalcopyrite	Pt	platinum
Cu	copper	py	pyrite
gf	graphite	sill	sillimanite
gt	garnet	sp	sphalerite
il	ilmenite	W	tungsten
mag	magnetite		

SOURCES OF INFORMATION

Base map derived from Maps 52 O/8 (Pickle Lake) and 52 O/9 (Tarp Lake) of the National Topographic System.

Geology not tied to surveyed lines.

Magnetic declination approximately 0°32'W in 1986.

Contour interval 10 m.

Metric conversion factor: 1 foot = 0.3048 m.

CREDITS

Geology by G.M. Stott, G.H. Brown, V.J. Coleman, G.M. Green, B.A. Reilly, and assistants, 1986.

Every possible effort has been made to ensure the accuracy of the information presented on this map; however, the Ontario Ministry of Northern Development and Mines does not assume any liability for errors that may occur. Users may wish to verify critical information; sources include both the references listed here, and information on file at the Resident Geologist's Office and the Mining Recorder's Office nearest the map area.

Issued 1989

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