# Wildnest-Tabbernor Transect: Mirond-Pelican Lakes Area (Parts of NTS 63M-2 and -3)[1]

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Mapping along the Wildnest-Tabbernor Transect (Ashton and Leclair, 1991) was extended westward in 1994 to incorporate the Mirond-Pelican lakes area. The study covered a 240 km$^2$ area of the northwestern Hanson Lake Block centred 12 km south of Pelican Narrows and 75 km northwest of Flin Flon, Manitoba (Figure 1). The area is accessible from Highway 135 which links the villages of Pelican Narrows and Sandy Bay to the Hanson Lake Road (Highway 106).

Previous detailed mapping in the area (Macdonald, 1974; Macdonald and MacQuarrie, 1978; Sibbald, 1978) has been followed up by recent studies directed toward elucidating the tectonic history of the area (Lewry and Macdonald, 1988; Lewry *et al.*, 1989; Craig, 1989; Shi and Lewry, 1991, 1992; Sun *et al.*, 1991, 1992, 1993). Seismic reflection data has been collected along an east-west line 30 km to the south (Lucas *et al.*, 1993; Lewry *et al.*, 1994) and on a north-south line along Highway 135 (Lucas *et al.*, 1994) as part of the LITHOPROBE Trans-Hudson Orogen Transect.

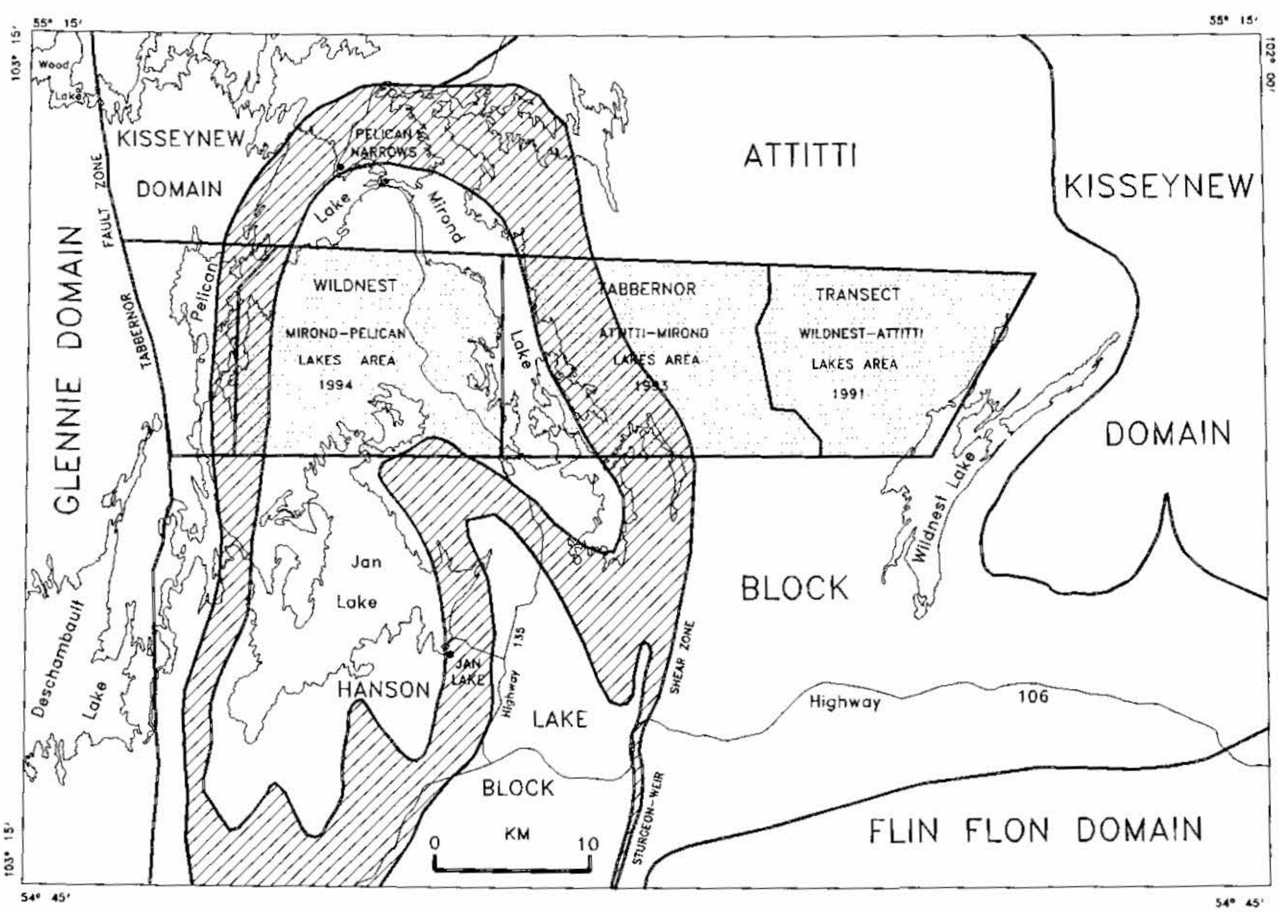


*Figure 1 - Location of the Wildnest-Tabbernor Transect (dots) showing completed work. Approximate outline of Pelican Slide and rooted Sturgeon-weir Shear Zone in diagonal stripes.*

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## 1. General Geology

The northern Hanson Lake Block is an upper amphibolite to granulite facies terrain consisting of the Archean (Bell and Macdonald, 1982; Van Schmus *et al.*, 1987; Sun *et al.*, 1993) Sahli Granite (Macdonald, 1974, 1976), a paragneiss-leucogranodiorite suite of unknown age, and a Proterozoic volcano-plutonic suite representing a northwestern extension of the Flin Flon Domain and Attitti Block. The Proterozoic volcano-plutonic rocks are thought to have been thrust southwestwards over the Sahli Granite along a wide mylonite zone (Lewry *et al.*, 1989, 1990; Ashton *et al.*, 1993) termed the Pelican Slide (Lewry *et al.*, 1991). Two phases of late folding produced an overall domal geometry in the northern Hanson Lake Block, exposing both the Pelican Slide and its footwall (Lewry *et al.*, 1989).

The Pelican Slide was studied along the eastern side of the dome in 1993 (Ashton *et al.*, 1993). This summer, mapping of the central and western side of the dome has allowed better delineation of the Pelican Slide and its footwall. The most intense deformation is recorded within the Proterozoic volcano-plutonic suite and in rocks extending about 1 km into the footwall. Rocks of the hanging wall include mylonitic to ultramylonitic amphibolites, graphitic hornblende paragneisses, and granodioritic to tonalitic orthogneisses, and are collectively termed the **external suite** (Figure 2).

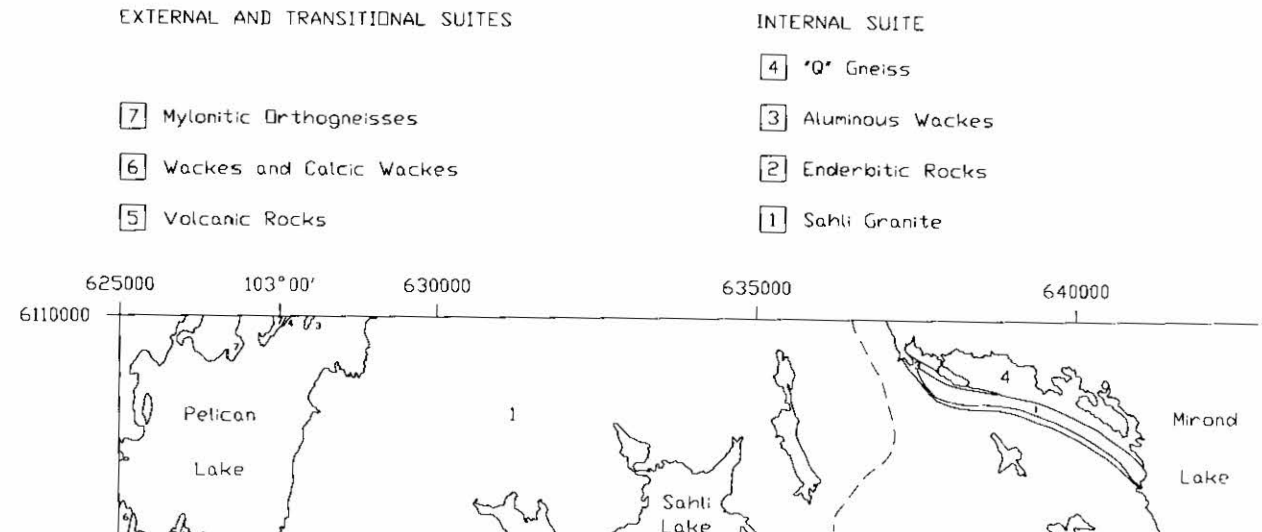


*Figure 2 - Simplified geological map of the Mirond-Pelican lakes area.*

The protomylonitic to mylonitic footwall rocks making up the **internal suite** include the Archean Sahli Granite and the migmatitic aluminous wackes and leucogranodiorite-tonalite orthogneisses of unknown age. The Sahli Granite is a coarse-grained homogeneous body of variably retrogressed charnockite. It is generally mantled by a thin veneer of aluminous wackes which locally contain minor calc-silicate rocks. Leucogranodioritic to tonalitic rocks are tectonically intercalated with the migmatitic wackes on a scale of metres to kilometres and are locally in direct contact with the Sahli Granite. The contact between the Sahli Granite and other rocks of the internal suite is invariably sheared suggesting that it may represent a second fundamental structural discontinuity.

The contact between the internal and external suites is a 1 to 2 km wide mylonite zone of mixed rocks termed the **transitional suite**.

Medium-grained to pegmatitic granitic dykes and various dioritic to gabbroic intrusions were emplaced in both internal and external suites prior to mylonitization. An extensive suite of late dominantly granitic intrusions, termed the Jan Lake Granite (Macdonald and MacQuarrie, 1978), postdates most of the deformation.

Peak metamorphic conditions reached upper amphibolite to granulite facies, although late retrogression is widespread.

Early deformation in the area was largely overprinted by the effects of the Pelican Slide, which include widespread grain size reduction and the development of porphyroclastic gneisses formed by the dismemberment of medium- to coarse-grained leucosomal material. Late recrystallization has largely annealed the shear-induced fabrics and produced widespread hornblende blastesis in rocks of appropriate composition.

The first of the two phases of late regional folding has a steeply northeast-dipping axial plane and was probably coeval with the Pelican Slide. The later phase is responsible for the overall domal geometry and resulted in abundant minor folds with steeply east-dipping axial planes.

## 2. Unit Descriptions

### a) Internal Suite

#### Sahli Granite (Ch)

The Sahli Granite (Macdonald 1974, 1976; Craig, 1989) is a deeply weathered, homogeneous, charnockite underlying most of the northern half of the area. It was originally coarse grained with feldspars in the 2 to 4 cm range, but now consists of a fine-grained recrystallized aggregate.

Rocks from the least deformed and retrogressed core weather white, but are waxy green on fresh surfaces. Typical rocks contain 10 to 20 percent combined orthopyroxene, clinopyroxene, hornblende, and minor garnet. Medium- to coarse-grained K-feldspar cores have locally survived recrystallization. Hornblende-bearing sweats appear to have formed during late folding, after the peak of metamorphism.

In the retrogressed margins, rocks are typically augen foliates and weather pink (Figure 3). Peak metamorphic pyroxenes are largely replaced by aggregates of hornblende, biotite, garnet, and magnetite.

Attempts to date the Sahli Granite using various techniques have yielded poorly constrained ages of about 2500 Ma (Bell and Macdonald, 1982; Van Schmus *et al.*, 1987; Sun *et al.*, 1993).

#### Enderbitic Rocks (En)

The enderbitic rocks previously reported from southeastern Mirond Lake (Ashton *et al.*, 1993) extend to the northwest and were also found on the northern shore of Harrison Lake. They are brown, rubbly granulite facies rocks, made up of a fine-grained recrystallized aggregate which has been derived from a coarse-grained protolith. Rock types range from granite to gabbro but most are intermediate in composition. Peak assemblages contain orthopyroxene, clinopyroxene, garnet, and perthitic to antiperthitic feldspars; however, retrogression has produced late hornblende, cummingtonite, garnet, and various greenschist facies minerals. The enderbitic rocks are tentatively interpreted as part of the Archean suite.

#### Migmatitic Aluminous Wackes (Wa)

Layered aluminous wackes are most abundant in the south, but occur throughout the area. They are variably mylonitized and migmatitic to rarely diatexitic, containing 30 to 80 percent white leucosomal layers up to about 10 cm thick (Figure 4). The paleosome consists of 20 to 25 percent biotite, 10 to 15 percent garnet, minor sillimanite, and trace graphite. A well-developed millimetre-scale sillimanite-garnet-biotite-rich melanosome is generally associated with the leucosome, although both are variably boudinaged. Sillimanite occurs as prisms up to 1 cm and is locally present in the leu-

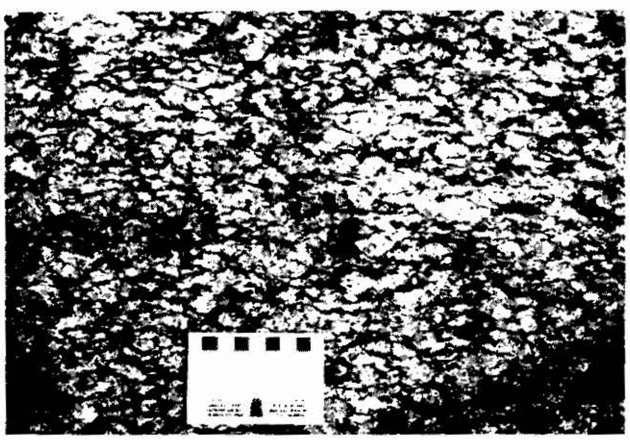

*Figure 3 - Foliated Sahli Granite (Ch) from retrogressed margin on Mirond Lake.*

cosome. A brown amphibole thought to be anthophyllite was noted at several localities.

The arenaceous component of the layered wackes locally grades into fine-grained feldspathic quartzite which occurs as variably boudinaged centimetre-scale layers containing about 30 percent feldspar and 70 percent quartz.

Unlike similar aluminous wackes in the Attitti Block, the aluminous wackes are generally not associated with volcanic and more heterogeneous sedimentary rocks. Their widespread homogeneity suggests a more likely correlation with the Burntwood Group of the Kisseynew Domain. Detrital zircon studies on Burntwood-type wackes suggest that they were deposited after 1850 to 1857 Ma (David *et al.*, 1993).

**Calc-silicate Rocks (Cs)**

Calc-silicate rocks and impure marbles containing forsterite, phlogopite, spinel, graphite, and carbonate occur as metre-scale layers in several isolated exposures of the aluminous wackes. Contacts are gradational through a thin unit of diopside-bearing calcic wacke and local diopsidic arenite. Rare pyrrhotite-bearing mafic rocks are locally associated with the calc-silicates.

**"Q" Gneiss Suite**

Leucocratic granitoid rocks, designated as "Q" gneisses (Macdonald, 1974; Macdonald and MacQuarrie, 1978), underlie much of the southern part of the Mirond-Pelican lakes area. They differ from similar leucogranodiorite-tonalites observed east of the Pelican Slide by having a lower colour index of less than 10. Outcrops are complex, with a 20 to 50 percent partial melt fraction and abundant late mafic and granitoid dykes. In highly strained areas, dismemberment of the leucosome has produced centimetre-scale feldspar porphyroclasts. Some occurrences adjacent to the migmatitic aluminous wackes are garnetiferous although this is not thought to necessarily imply intrusive relationships. Five varieties of the "Q" gneiss have been distinguished.

*Leucogranodiorite-tonalite (Gqt)*

Homogeneous grey to white leucogranodiorite-tonalite is most common in the southwest. It is fine grained, but includes 20 to 30 percent centimetre-scale layers of medium-grained, white to pink leucosome. Typical samples contain 4 to 7 percent biotite with trace zircon, apatite, and opaque minerals.

*Leucogranite-granodiorite (Gqg)*

Southern occurrences of the "Q" gneiss suite are more granitic in composition. The most common phase is a pink-grey to white leucocratic granite-granodiorite which underlies much of the northern Jan Lake area. It consists of a fine- to medium-grained paleosome containing 3 to 5 percent biotite and 20 to 50 percent medium-grained leucosome.

*Hornblende-magnetite Leucogranite-granodiorite (Gqh)*

A distinctive pink, fine- to medium-grained hornblende-magnetite phase of the leucogranite-granodiorite contains 35 to 50 percent pink, medium-grained hornblende-K-feldspar leucosome bounded by a thin hornblende± biotite selvedge (Figure 5). Samples contain about 4 percent hornblende, 4 percent biotite, and minor magnetite.

*Biotite-magnetite Leucogranite-granodiorite (Gqm)*

The hornblende-magnetite leucogranite-granodiorite locally grades into a biotite-magnetite variety consisting of a pink grey to rust, fine-grained paleosome and 35 to 45 percent pink, medium-grained leucosome. It contains about 1 to 5 percent biotite and 1 to 5 percent magnetite.

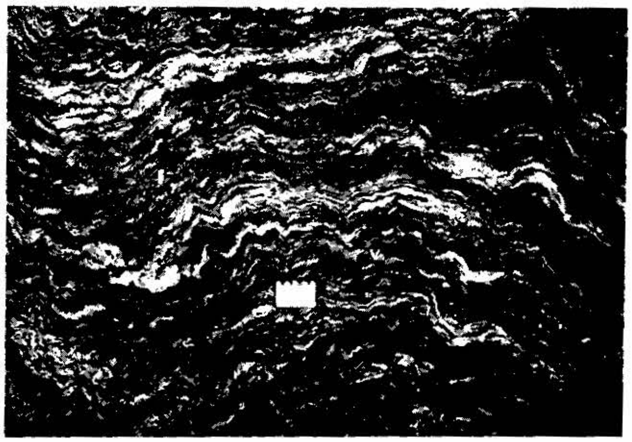

*Figure 4 - Migmatitic aluminous wacke (Wa) from northern Jan Lake showing intact leucosome-melanosome relationship.*

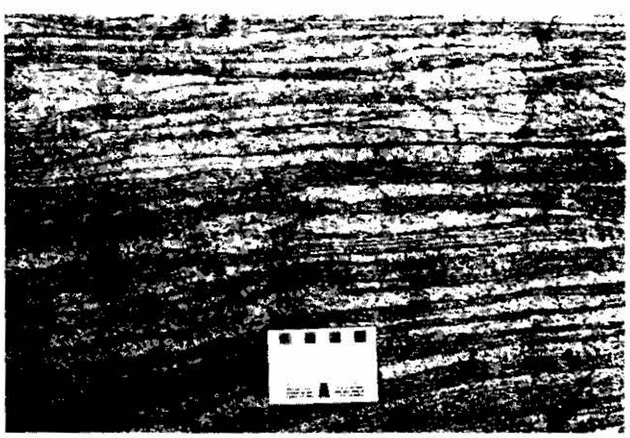

*Figure 5 - Hornblende-magnetite leucogranite-granodiorite (Gqh) from northern Pelican Lake showing thin selvedge of hornblende and biotite adjacent to leucosome and a late cross-cutting quartz foliation.*

*Heterogeneous Leucogranite-tonalite (Gqd)*

A well-layered, more heterogeneous variety of the "Q" gneiss occurs at major boundaries with other rock types and as units up to several hundred metres thick. Most outcrops are dominated by one of the leucogranitic-granodioritic phases but also include abundant centimetre-scale mafic layers, inclusions, and/or schlieren as well as intermediate hornblende-rich hybrid phases. These rocks tend to be tightly folded and generally appear more highly deformed than other "Q" gneisses. They are tentatively interpreted as marking high-strain zones in which attenuation due to shearing has converted intrusive, metre-scale mafic dykes to thin mafic layers. The hybrid phases are thought to have resulted from interaction between the mafic dykes and syn-tectonic melt phases during deformation.

## b) External Suite

Previous work has demonstrated that Proterozoic supracrustal rocks of the Flin Flon Domain, together with 1865 to 1840 Ma (Ansdell and Kyser, 1991; Heaman *et al.*, 1992) plutons, extend continuously northwestwards into the Attitti and northern Hanson Lake blocks (Ashton and Leclair, 1991; Ashton *et al.*, 1993). Recognition of the same association of high-grade mylonitized gneisses in the western and southern parts of the Mirond-Pelican lakes area (Macdonald, 1974, 1981, this volume) indicates that these rocks continue westward, mantling the internal suite.

### Mafic to Intermediate Volcanic, Volcaniclastic and Intrusive Rocks (Am)

Mafic to intermediate supracrustal rocks are restricted to the far west and south where they form units up to several hundred metres in outcrop width. They consist of fine-grained, black, hornblende-plagioclase±clinopyroxene±garnet gneisses, with local centimetre-scale intercalations of green clinopyroxene-plagioclase± pyrrhotite layers thought to be the high-grade equivalents of epidote alteration (Figure 6). Minor calc-silicate lenses, locally associated with the mafic rocks, are thought to result from pre-metamorphic carbonatization.

### Intermediate Volcanic, Volcaniclastic, and Intrusive Rocks (Ai)

Intermediate rocks occur intercalated with their mafic counterparts and as distinct units up to hundreds of metres in apparent thickness. They are typically fine-grained, grey and contain 20 to 40 percent hornblende, minor biotite, and local garnet and clinopyroxene. Homogeneous varieties are tentatively interpreted as volcanic and/or intrusive rocks, whereas well layered equivalents are probably volcaniclastic.

### Felsic to Intermediate Volcanic and Volcaniclastic Rocks (Af)

Interlayered felsic and intermediate volcanic and/or volcaniclastic rocks are associated with more mafic counterparts along the shore of Pelican Lake. They include both decimetre-scale white rhyolitic to rhyodacitic units containing minor biotite, hornblende, clinopyroxene and pyrrhotite, and grey dacitic biotite-garnet rocks in which the leucosome has been largely dismembered.

### Calcic Wackes (Wc)

Mylonitized gneissic to migmatitic calcic wackes are interlayered with volcanic rocks as units up to hundreds of metres in outcrop width. The paleosome consists of about 20 to 25 percent biotite, up to 10 percent hornblende, minor graphite, and local garnet. The leucosome is generally dismembered into distinctive centimetre-scale feldspar±quartz±hornblende lenses (Figure 7).

The calcic wackes are interpreted as sedimentary because they are biotite-rich and commonly contain graphite of inferred biogenic origin. Their calcic composition and close spatial association suggests that they were derived from the volcanic suite.

*Figure 6 - Laminated mafic mylonite from 0.9 km west of Lloyd Lake showing back-rotated clinopyroxene-plagioclase and injected leucosome boudins indicating a sinistral component of shear.*

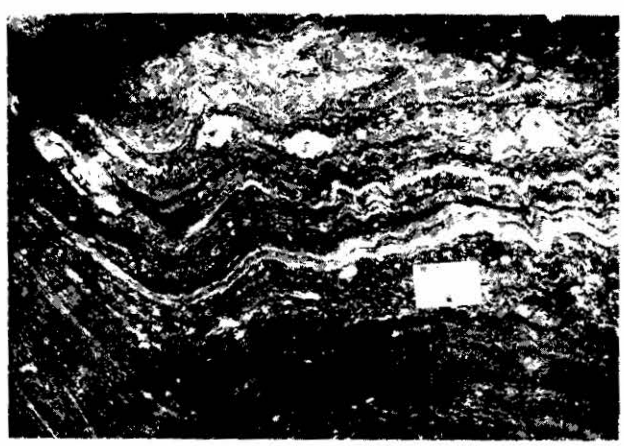

*Figure 7 - Doubly folded mylonitic calcic wacke (Wc) from the eastern shore of Pelican Lake showing dismemberment of leucosome and attenuation of refolded mafic dyke.*

### Migmatitic Hornblende Granodiorite-tonalite (Mgg)

Migmatitic hornblende granodioritic-tonalitic rocks of the Attitti Block (Ashton and Leclair, 1991; Ashton *et al.*, 1993) are continuous through the Pelican Narrows area and extend into the recrystallized mylonitic to ultramylonitic package along Pelican Lake (Figure 8). Typical rocks have a colour index of 15 to 30 and include a grey, fine-grained biotite-quartz-feldspar paleosome and a white, medium-grained hornblende-K-feldspar-quartz leucosome. Most outcrops also exhibit metre-scale mafic blocks and schlieren, more than one melt fraction, and various granitoid dykes. Late, fine- to medium-grained hornblende occurs throughout the rock and locally grades into centimetre-scale pods of hornblendite. The presence of feldspar porphyroclasts up to 2 cm imply significant dismemberment of early melt.

## c) Transitional Suite

The boundary between the internal and external suites is a 1 to 2 km wide high-strain zone dominated by mylonitized wackes and orthogneisses. Most of these rocks are thought to be deformed equivalents of the internal suite wackes and "Q" gneisses but structural repetition in the zone has involved at least some external suite rocks.

### Migmatitic Wackes (W)

Most migmatitic wackes in the western transitional suite are fine-grained, grey- to rust-weathering rocks containing 20 to 30 percent biotite. Garnet and sillimanite or hornblende are only locally recognizable, probably due to mylonitization. The leucosome is typically dismembered, occurring as centimetre-scale lenses of fine-grained recrystallized feldspar-quartz aggregates and feldspar porphyroclasts (Figure 9).

### Mylonitic Leucogranite-tonalite (Mgl)

The "Q" gneiss becomes mylonitized approaching the external suite, and consists of grey to pink, fine-grained paleosome and pink to white, fine- to medium-grained leucosome, with centimetre-scale feldspar porphyroclasts derived by dismemberment of the leucosome. Late, 1 to 3 mm hornblende porphyroblasts characterize the mylonites, which also contain centimetre-scale hornblendite lenses and up to 30 percent centimetre- to metre-scale mafic blocks, inclusions, and schlieren.

Rarely, the transition from hornblende-magnetite (Gqh) or heterogeneous leucogranite-tonalite (Gqd) to mylonitic leucogranite-tonalite (Mgl) is recognizable at the outcrop scale, but elsewhere the precursors are difficult to determine and may have been leucocratic phases of the hornblende granodiorite-tonalite.

## d) Pre- to Syn-$D_3$ Intrusive Rocks

### Early Medium-grained to Pegmatitic Granite

Many outcrops, including some in the Sahli Granite, contain a small component of early, medium-grained to pegmatitic granitoid material. Typical rocks vary from white to pink and generally contain a minor amount of biotite. Their orientation and internal foliation is parallel to the main regional shear foliation. Vague fine-grained felsic layers and/or feldspar porphyroclasts may be all that is left of these rocks in the mylonitic zones.

### Dioritic to Gabbroic Rocks (Gb)

Several varieties of variably boudinaged layer-parallel dioritic to gabbroic units, up to 30 m wide, intrude all of the rock types described above and total as much as 10 percent of the area. They commonly occur together and are locally transitional, suggesting a common age.

1) The most common phase is a black, **fine-grained gabbro (Gbd)** containing various proportions of hornblende, clinopyroxene, orthopyroxene, and relict garnet. Thick dykes are zoned and exhibit a green-brown core dominated by clinopyroxene. Medium-

*Figure 8 - Tectonic inclusion of migmatitic granodiorite-tonalite from the east side of Pelican Lake showing strain gradient at bottom into mylonitic equivalent characterized by feldspar porphyroclasts and hornblende blastesis.*

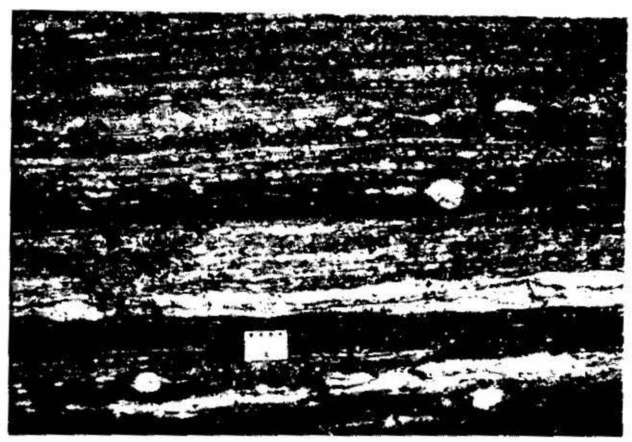

*Figure 9 - Mylonitic wacke (W) from eastern shore of Pelican Lake showing general dismemberment of leucosome to form beaded texture. Note δ-porphyroclast at bottom left indicating sinistral component of displacement.*

to coarse-grained sweats contain clinopyroxene and locally orthopyroxene porphyroblasts up to 1 cm.

2) **Medium- to coarse-grained gabbro (Gbm)** occurs in several localities with fine-grained equivalents. In general, the coarser gabbroic rocks appear to represent separate phases of a mafic complex rather than the cores of single intrusions.

3) **Plagioclase-phyric gabbro (Gbp)** dykes contain relict millimetre- to centimetre-scale phenocrysts consisting of a grey core surrounded by fine-grained garnet and a white recrystallized rim. In one such intrusion, on northern Mirond Lake, recrystallized plagioclase phenocrysts up to 3 cm in size are concentrated around the margins, suggesting a primary cumulate texture.

4) **Net-veined dioritic to gabbroic rocks (Gbn)** contain up to 30 percent injected medium-grained to pegmatitic granitoid material. Many outcrops exhibit a thin hornblende-rich selvedge between the host and granitic layers, suggesting that some of the granitic material may be *in situ* partial melt.

5) A **magnetite-rich tonalitic to dioritic gneiss (Dm)**, which exhibits a similar style of occurrence to that of the gabbroic dykes, occurs in "Q" gneisses and aluminous wackes of the Mirond Lake area. Typical rocks weather grey-brown and were medium-grained prior to being recrystallized to a fine-grained aggregate. They include an irregular 20 percent melt fraction and are mineralogically heterogeneous, containing various proportions of orthopyroxene, clinopyroxene, hornblende, and garnet.

### e) Post-$D_3$ Intrusive Rocks (Jan Lake Suite)

**Late, medium-grained to pegmatitic granites (JL)** in the region have been historically grouped under the term "Jan Lake Granite" (Macdonald and MacQuarrie, 1978). They have generally been considered post-deformational, but occurrences in this area include a diverse suite of rocks which ranges from massive to well foliated, folded, and/or boudinaged. Many outcrops exhibit good cross-cutting relationships between early deformed dykes and late massive phases. Both deformed and undeformed varieties were intruded as similarly oriented, pink to less commonly white dykes and layer-parallel sheets up to about 30 m wide.

The medium-grained to pegmatitic granitoid rocks are chiefly composed of biotite, quartz, and feldspar, however, some of the early deformed phases are affected by the bulk composition of the host rocks. Where they intrude "Q" gneisses, the dykes contain biotite books up to 2 cm in size, whereas dykes intruding the more calcic Sahli Granite contain coarse hornblende porphyroblasts. The aluminous wackes impart an aluminous to peraluminous character to the dykes, generally resulting in biotite, garnet, and coarse mauve cordierite in the Jan Lake area. Stellate masses of sillimanite with minor intergrown kyanite occur in the most aluminous dyke on the eastern shore of Jan Lake.

In addition to granitic dykes and sheets, the Jan Lake Suite includes a variety of small irregular pink, white or grey, medium-grained **granitic, granodioritic, and intermediate intrusions (JLg)**, as well as rare mafic dykes. Several of these small granitic intrusions contain comagmatic phases exhibiting evidence of magma mingling.

Granitic members of the Jan Lake Suite have yielded U-Pb dates of 1773 ±9 Ma (zircon; Bickford *et al.*, 1987) and 1767 ±1 (monazite; Ashton *et al.*, 1992). Similar rocks of that age are also known from the Glennie Domain (Chiarenzelli, 1989).

## 3. Metamorphism

Granulite facies conditions are recorded in most rock types, although amphibolite facies retrogression is widespread. Fresh charnockites in the core of the Sahli Granite contain the assemblage orthopyroxene-clinopyroxene-garnet-quartz-plagioclase-perthite. The enderbitic rocks and many of the mafic dykes also contain orthopyroxene.

Calc-silicate rocks within the migmatitic aluminous wackes contain the assemblage forsterite-phlogopite-calcite-graphite±spinel which Turner (1981) classifies as granulite facies.

The migmatitic aluminous wackes exhibit good melanosome-leucosome relationships indicating *in situ* partial melting and contain the upper amphibolite to granulite facies assemblage sillimanite-garnet-biotite-graphite-quartz-plagioclase-K-feldspar. The local presence of perthite and antiperthite suggests that granulite facies conditions were at least locally attained (Turner, 1981). Cordierite occurs as rims around garnet and some sillimanite, suggesting late growth during decompression (Figure 10).

An unmelted equivalent of the migmatitic aluminous wackes, together with minor feldspathic quartzite and

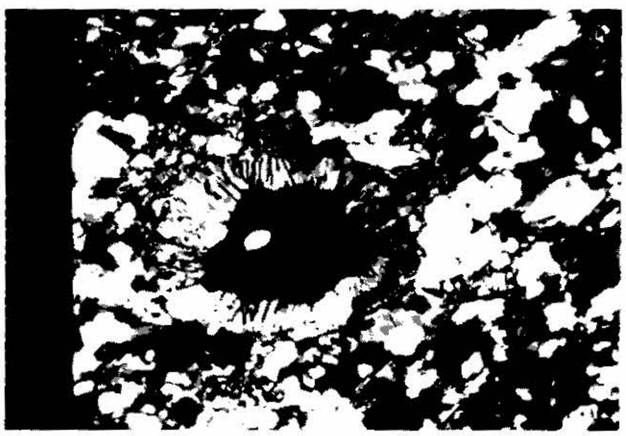

*Figure 10 - Photomicrograph of migmatitic aluminous wacke (Wa) from east shore of Mirond Lake showing rim of cordierite around corroded garnet (crossed polars, field of view is about 2 mm across).*

calc-silicate rocks, is enclosed by the Sahli Granite on the southern shore of Sahli Lake. The wackes contain the same metamorphic assemblage as the migmatitic rocks, although the garnet appears stable and the K-feldspar is not perthitic. The absence of a significant melt phase is tentatively attributed to an absence of water due to the isolation of these rocks within the Sahli Granite.

Granitoid rocks generally exhibit structures and assemblages indicative of upper amphibolite facies. These include the widespread occurrence of migmatites resulting from the *in situ* development of several types of partial melt. The pink to white hornblende-K-feldspar melt noted in granodioritic to tonalitic migmatites of the Attitti-Mirond lakes area (Ashton *et al.*, 1993) was also noted in hornblende-bearing granitoid rocks (Gqh, Mgg) and calcic wackes (Wc) of the Mirond-Pelican lakes area. The melt-forming reaction is thought to take the form:

biotite+plagioclase+quartz=K-feldspar-rich melt+ hornblende± magnetite±sphene (Winkler, 1974).

Centimetre-scale hornblendite pods probably result from this melting process in situations where the melt is continuously squeezed away from the reaction site leaving concentrations of solid phase hornblende.

The retrogression affecting the aluminous wackes is also evident in many mafic dykes where garnet, in the presence of hornblende, is partially replaced by cummingtonite and plagioclase. Such retrogression is widespread (Ashton and Digel, 1992; Ashton *et al.*, 1993; Shi, in prep.) and precludes conventional use of common thermobarometers to determine peak metamorphic conditions.

In spite of the difficulties in quantifying peak metamorphic conditions, the presence of granulite facies assemblages confirms that the Mirond-Pelican lakes area represents a metamorphic culmination.

## 4. Structure

### a) $D_1$ and $D_2$ Deformation

The earliest two phases of deformation produced the main regional foliation ($S_1$) and subsequent isoclinal folds ($F_2$). These early folds are not easily recognized due to the effects of later deformation, but are thought to have produced the structural interlayering of "Q" gneiss and migmatitic aluminous wackes in the south, and volcanic rocks and calcic wackes in the west.

### b) $D_3$ Deformation

The $D_3$ event was long-lived and involved intense shearing and associated tight to isoclinal folding related to the Pelican Slide. The main structural discontinuity forms an approximately 5 km wide straight zone at the contact between the internal and external suites. The zone includes about 1 km of mylonitized internal suite rocks (transitional suite) and all of the external suite.

$D_3$ deformation was more heterogeneously distributed in the inferred footwall. In the Sahli Granite, most was taken up in the margins, producing lineated augen foliates. Elsewhere, the most intense deformation is exhibited along lithological contacts and in wide shear zones hosted by the heterogeneous leucogranite-tonalite (Gqd). The highly attenuated nature of the mafic dykes, together with the apparent hybridization of mafic dyke and "Q" gneiss material, suggests that this unit represents an intermediate step in the mylonitization process between less deformed "Q" gneiss and the mylonitic leucogranite-tonalite (Mgl) of the transitional suite. Deformation in the inferred hanging wall is homogeneously distributed through the mylonitic to ultramylonitic external suite.

A well-developed, moderately northeast-plunging stretching lineation, similar in style and orientation to that in the Attitti-Mirond lakes area (Ashton *et al.*, 1993) is common in the north and east where the main regional foliation is east dipping. Elsewhere lineations are less well developed and more variably oriented, making it difficult to distinguish lineations related to tectonic transport from those related to later folding.

Kinematic indicators in the east-dipping mylonitic to ultramylonitic rocks between Parenteau and Mirond lakes to the east conclusively point to southwest-directed tectonic transport (Ashton *et al.*, 1993). In the Mirond Lake area, kinematic indicators are rare, but the same southwest vergence is suggested by the consistent northeasterly plunge of the stretching lineation. In the mylonitic to ultramylonitic rocks adjacent to Pelican Lake, kinematic indicators are rare and equivocal due to recrystallization, late folding, and the absence of a distinct stretching lineation. However, most of those recognized suggest a sinistral component of shear (Figure 9), which is consistent with southwest vergence prior to the late folding.

$F_3$ folding was coeval with the shearing, but outlasted it. In the south, where the effects of later folding are minimal, $F_3$ folds have moderately northeast-dipping axial planes and plunge to the southeast. In the highly strained straight zone to the west, folding appears to have been continuous during the $D_3$ event producing type 3 interference patterns (Figures 7 and 11).

### c) $D_4$ Deformation

The $D_4$ event produced a multitude of minor folds and the overall domal geometry of the region. Typically, tight $F_4$ folds have moderately east-dipping to upright axial planes, which are marked by a quartz flattening foliation best developed in the Sahli Granite and in the leucosome of the "Q" gneiss (Figure 5). $F_4$ folds plunge to the north in the northern part of the area. In the south, they are superposed on irregular $F_3$ surfaces and plunge mainly to the southeast.

The Jan Lake Suite spans the duration of $D_4$ deformation, ranging from dykes that are folded and/or carry the $S_4$ axial planar foliation to those which cut $F_4$ folds. Many of these dykes are approximately coplanar with $F_4$ axial planes, and some were the focus of ductile

*Figure 11 - Doubly folded mylonitic leucogranodiorite-tonalite (Mgl) from the eastern shore of Pelican Lake showing type 3 interference.*

shearing related either to late readjustments or to the folding itself.

## 5. Economic Potential

The volcanic rocks and calcic wackes along the western and southern boundaries of the area have potential for volcanogenic massive sulphide mineralization by virtue of their broad stratigraphic equivalence with rocks of the Flin Flon Domain. A gossan containing disseminated pyrrhotite extends for at least 150 m on the eastern side of Pelican Lake (UTM 626040 E, 6106740 N). It occurs at a contact between mafic and felsic to intermediate volcanic rocks and is interpreted as a sulphide facies iron formation. Another small pyrrhotite-bearing gossan occurs at a contact between mafic volcanic rocks and migmatitic wackes on an island in eastern Lloyd Lake (UTM 627220 E, 6098290 N).

Minor rusty mafic rocks containing pyrrhotite and graphite are associated with calc-silicates in the aluminous wackes along the southern shore of Sahli Lake. The precursors may have been lean silicate-sulphide facies iron formation.

## 6. Timing of Deformation and Tectonic Implications

Peak metamorphic indicator minerals such as orthopyroxene are deformed by the main shear fabric and partial melts have been generally dismembered, supporting the suggestion that the main deformation associated with the Pelican Slide took place at or slightly after the peak of metamorphism (Lewry *et al.*, 1989). Pervasive hornblende blastesis associated with recrystallization, and the presence of melt material in the hinges of some $F_4$ minor folds, indicate that upper amphibolite facies conditions persisted for some time after the main shearing event.

Age relationships within the internal suite remain unclear. The aluminous wackes on southern Sahli Lake appear to have been enveloped by the Sahli Granite prior to the peak of metamorphism. A high concentration of garnet in Sahli rocks at the contact confirms that the wackes were in contact during metamorphism, and a granulite facies assemblage in the calc-silicate rocks associated with the wackes confirms that these rocks were subjected to the same high-grade conditions. Therefore, anatexis must have been inhibited by a shortage of water which would be expected if the wackes represent an isolated inclusion within the Sahli Granite. This scenario would suggest that the aluminous wackes are either Burntwood-type rocks tectonically emplaced from the Kisseynew Domain prior to, or during the early stages of, the Pelican Slide or they are older, possibly Archean.

The presence of pre- to syn-$D_3$ mafic dykes in both the internal and external suites suggests that $D_3$ was long lived. Assuming the dykes are coeval, their age would represent a minimum for juxtaposition of the two suites and a maximum for at least some of the mylonitization related to the Pelican Slide. Mafic dykes of similar composition and relative age are known from the Attitti Block and from the Kisseynew Domain, where they intrude the Missi Group. If all of these dykes are coeval, then a major extensional event must have affected the entire region between the time of Missi deposition and the time of peak metamorphism and the Pelican Slide. Norman and Williams (1993) have proposed such an extensional event based on independent evidence in Manitoba.

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