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DESCRIPTIVE NOTES

The northeast trending Great Slave Lake Shear Zone is located between the Slave and Churchill provinces (Fig. 1) in parts of the Fort Resolution (85 H), Taltson Lake (75 E), Snowdrift (75 L) and Fort Reliance (75 K) map areas in the Northwest Territories. Field work was completed by the Geological Survey of Canada during the summers of 1984, 1985, and 1987 (Hanmer and Lucas, 1985; Hanmer and Connelly, 1986; Hanmer and Needham, 1988). Previous mapping in the areas was by Wright (1968a,b) and Reinhardt (1966, 1969). The map area is accessible by float-plane out of Yellowknife. Bedrock exposure is excellent in the La Loche segment, very good in the Schist-Daisy segment, but very poor in the Snowdrift segment (Fig. 2).

The Great Slave Lake Shear Zone is an upright, predominantly strike-slip, crustal-scale mylonite zone, up to 25 km wide, which separates Slave Province from northwest Churchill (Rae) Province (Fig. 1). The mylonites (units **Pm-Pumc**) are mostly derived form biotite-hornblende megacrystic granitoid (unit **Pmgb**) protolith (La Loche batholith, Hanmer and Connelly, 1986) with inclusions and screens of paragneiss (units **Pip** and **Pcs**), plus clinopyroxene meta-tonalite (unit **Pt**). The paragneisses comprise an assemblage of rhythmically layered pelitic to silicious metasediments, banded amphibolite, calc-silicate and rare calcite marble. This assemblage occurs throughout the Great Slave Lake Shear Zone; in the high grade areas it is strongly migmatitic (sillimanite-garnet-cordierite metatexite to diatexite) and associated with abundant garnetiferous leucosome. To the northwest, wall rock is mildly deformed two-mica granite (unit **Pga**) intruded into folded metasediments (units **Pep** and **Pcs**), all cut by generally northeast-trending, upright mafic (Hearne) dykes (not shown on compilation map). The rhythmically layered pelitic and silicious metasediments are sillimanite-garnet-chiastolite-staurolite bearing and are migmatic towards the northwest. They are deformed by upright, vertical small-scale folds, axial planar cleavage, and an axis-parallel extension lineation. To the southeast, wall rock comprises moderately foliated peraluminous leucogranite with locally abundant paragneiss inclusions and rafts (unit **Pgg**). Four discrete biotite-hornblende-granitic intrusions have strongly influenced the map pattern; unit **Pmga** and units **Pgd** and **Pgdi** intrude belt 2 mylonites, unit **Pgb** intrudes Schist Lakes Belt mylonites, and unit **Pgc** intrudes Daisy Lakes Belt mylonites.

The Great Slave Lake Shear Zone shows a simple geometry and an overall dextral transcurrent displacement. La Loche and Schist-Daisy segments have been divided into belts (Fig. 2) on the basis of relative age of mylonitization and grade of metamorphism (Hanmer and Lucas, 1985; Hanmer and Connelly, 1986; Hanmer and Needham, 1988). Foliation is upright and northeast trending except for belt 1, where it is highly variable in orientation, extension lineations are sub-horizontal except for the Daisy Lakes Belt where they are dip-parallel. In the La Loche segment, however, a corridor of mixed steep and shallow lineations occurs along the northwestern side of belt 3. La Loche segment was the locus of strike-slip movement, while the Schist-Daisy segment was initially strike-slip in its northwestern part, followed by later dip-slip displacements in its southeastern part. Strike-lineated strike-slip mylonites in all segments carry a widespread assemblage of mechanically independent shear sense indicators (Fig. 3). Shear sense is consistently dextral, with the exception of the necking of belt 3 south-southwest of La Loche Lakes. Shear sense indicators in the dip-lineated Daisy Lakes Belt are contradictory.

From cross-cutting, transposition and reworking field relations, the relative age and metamorphic grade of preserved mylonites in the La Loche segment decrease in the sequence: belt 1 (granulite, unit **Pm**), belt 2 (upper amphibolite), belt 3 (lower amphibolite), followed by Hornby Channel and La Loche River ultramylonite belts (greenschist). With time, metamorphic pressure and the width of the active shear zone also decrease (Hanmer, 1988). In the Schist-Daisy segment, metamorphic grade ranges from granulite facies in the Daisy Lakes Belt via upper amphibolite Schist Lakes Belt to greenschist facies mylonites on the northwest side of the segment. Microstructure, metamorphism, and confinet suggest that chlorite-bearing mylonites on the northwest side of the La Loche and Schist-Daisy segments are parts of the Hornby Channel ultramylonite belt. Similarly, Schist Lakes Belt and belt 2 are indistinguishable. The southeastern sides of both segments represent different kinematic frameworks (strike-parallel vs. dip-parallel extension) and the granulite mylonites of each segment are only similar in metamorphic grade. The decrease in shear zone width and crustal depth with time continued through the brittle-ductile transition. The Hornby Channel and La Loche River ultramylonite belts were extensively reworked by non-dilational penetrative brecciation (Hanmer, 1989), discrete, east-west, metre to kilometre spaced dextral faults, dilational pseudotachylite and quartz veining (stockworks), in that order. The La Loche segment thus represents a series of preserved depth sections through a crustal-scale fault zone profile in accord with the model of Sibson (1977). In the Schist-Daisy segment, granite (unit **Pgb**) cuts the Schist Lakes Belt but is deformed with the mylonites of the Daisy Lakes Belt, demonstrating that the latter tectonites are younger than the former. Both of these belts are truncated to the northwest by the younger Hornby Channel ultramylonite belt.

Three important discrete transcurrent faults were recognized in the map area. Austin fault and McKee fault zone delimit the segment boundaries of Great Slave Lake Shear Zone (Fig. 2). McDonald fault truncates the shear zone in several places. McKee fault zone has a complex structure and history, comprising a number of discrete strands lined by biotite-bearing mylonite, up to several hundred metres thick, cut by well developed penetrative chlorite-bearing cataclasite, cut by dilational quartz veins. A similarly well developed zone of cataclasis east of McDonald Lake represents the northwestward continuation of Hornby Channel ultramylonite belt in the La Loche segment. Both zones of cataclasis are truncated by McDonald fault and may represent the structural link between the two sections of Hornby Channel ultramylonite belt.

Mylonites of the Schist Lakes Belt are unconformably overlain by an upward coarsening, 250 m thick succession of arenites and polymictic conglomerates (unit **Ps**). These sediments strongly resemble and are probably an outlier of the Sosan Group (lower Great Slave Supergroup; Hoffman et al., 1977). The outlier is gently folded into a horizontal, upright, doubly plunging syncline with very mild axial-planar cleavage. The cleavage is locally cut by a dilatant breccia zone filled with leucocratic intrusive material resembling the diatremes cutting the Sosan Group in Great Slave Lake (Reinhardt, 1972)

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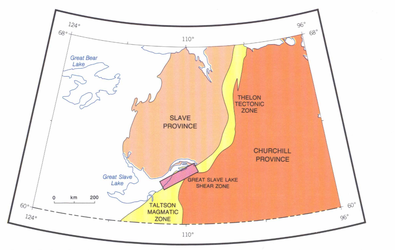

Figure 1: The Slave-Churchill province boundary. The boundary zone comprises the Thelon Tectonic Zone to the north and the Taltson Magmatic Zone to the south, linked by the northeast-trending Great Slave Lake Shear Zone

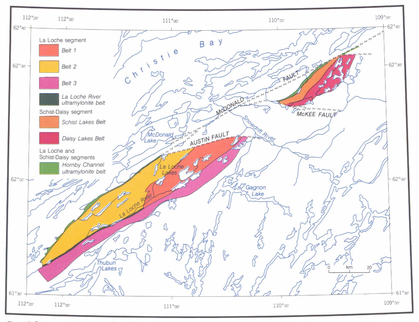

Figure 2: Segments and belts of the Great Slave Lake Shear Zone. La Loche segment includes belts 1, 2, 3. La Loche River ultramylonite belt and Hornby Channel ultramylonite belt. Schist-Daisy segment comprises the Schist Lakes Belt, Daisy Lakes Belt and Hornby Channel ultramylonite belt. Snowdrift segment is confined between Austin and McKee faults

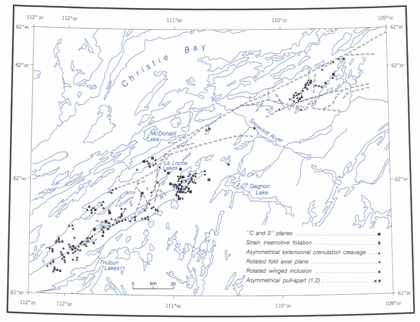

Figure 3: Distribution of unequivocal observations of shear sense indicators in Great Slave Lake Shear Zone

LEGEND

Note that the order of map units in the legend is only generally arranged in stratigraphic sequence

PROTEROZOIC

- **Ps** — SOSAN GROUP ?: *trough crossbedded quartz arenites, feldspathic quartz arenites and polymictic channel conglomerates*
- **Pumc** — *Ultramylonite and mylonite; chlorite-bearing*
- **Pms** — *Mesh structure[3]; 10-50 m lenses of disrupted mylonite wrapped around by anastomosing greenschist facies mylonite zones*
- **Pum** — *Ultramylonite, mainly derived from biotite-hornblende megacrystic granite protolith*
- **Phom** — *Homoclastic[2] mylonite, mainly derived from biotite-hornblende megacrystic granite protolith*
- **Phem** — *Heteroclastic[2] mylonite, mainly derived from biotite-hornblende megacrystic granite protolith*
- **Phop** — *Homoclastic[2] protomylonite, mainly derived from biotite-hornblende megacrystic granite protolith*
- **Pm** — *Undifferentiated, orthopyroxene-garnet-biotite-hornblende annealed mylonites after megacrystic granitic (circa 1.98 Ga?) and paragneiss protoliths; strongly disrupted by later deformation in La Loche segment*
- **Pgdi** — *Injection zone; veins of unit* **Pgd** *intimately intruded into mylonite wall rocks*
- **Pgd** — *Biotite-hornblende equigranular granitoid; isotropic; circa 1.925 Ga[1]*
- **Pgc** — *Biotite-hornblende equigranular granitoid; isotropic to mildly foliated; folded and locally mylonitized*
- **Pgb** — *Biotite-hornblende equigranular granitoid; isotropic to mildly foliated; mylonitized on the southeastern margin*
- **Pmgb** — *Biotite-hornblende megacrystic granitoid; strongly foliated; circa 1.925 Ga[1] in belt 3*
- **Pmga** — *Biotite-hornblende megacrystic granitoid; isotropic to mildly foliated; very locally mylonitized; circa 1.92 Ga[1]*
- **Pgg** — *Garnet leucogranite; moderately foliated to mylonitized; circa 1.96 Ga[1]*
- **Pt** — *Clinopyroxene meta-tonalite, mylonitized to mildly foliated*
- **Pga** — *Undifferentiated, two-mica leucogranite; mildly foliated to isotropic; circa 2.55 Ga[1]*
- **Pa** — *Amphibolite*
- **Pcs** — *Calc-silicate*
- **Pip** — *Internal paragneiss; rhythmically layered pelitic and silicious metasediments; banded amphibolite and calc-silicate*
- **Pep** — *External paragneiss; rhythmically layered pelitic and silicious metasediments; amphibolite schists and calc-silicate*

[1] *S.A. Bowring (personnal communication, 1987)*
[2] *S. Hanmer (1987)*
[3] *R.H. Sibson (1979)*

? *Blank areas with a question mark southwest of La Loche Lakes represent a complex association of the immediately surrounding map units, cut and displaced by a number of discrete faults. Given the location of this area at the southwestern end of belt 1 and the complexity of the local geology, the question mark implies "undifferentiated gneisses"*

Lithological contact (defined, approximate)
Bedding (inclined facing known)
Foliation (vertical, inclined)
Extension lineation
Oblique extension lineation on vertical foliation
Extension lineation on inclined foliation
subhorizontal
oblique
dip-parallel
Sense of shear (sinistral, dextral) on foliation (vertical, inclined)
Oblique extension lineation on foliation (vertical, inclined) with sense of shear (dextral case shown)
Fault (undifferentiated)

Geology by G.M. Wright 1950, E.W. Reinhardt 1965, 1966, S. Hanmer 1984, 1985, 1987, S.B. Lucas 1984, J.N. Connelly 1985, T.W. Needham 1987

Compilation by S. Hanmer 1984-1988

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Elevations in feet above mean sea level

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MAP 1740A

GEOLOGY

GREAT SLAVE LAKE SHEAR ZONE

DISTRICT OF MACKENZIE

NORTHWEST TERRITORIES

Scale 1:150 000 - Échelle 1/150 000

Kilometres 2 0 2 4 6 8 10 Kilomètres

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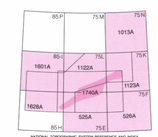

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