

## DESCRIPTIVE NOTES

### INTRODUCTION

The Exeter Lake area (NTS 76D15) lies in the central part of the Slave Structural Province, 315 km NNE of Yellowknife. Dredge (1988) previously mapped the area as part of his 1:75 000 map of the Lac de Gras area. The geology of the area surrounding Exeter Lake has recently been mapped to the north by King et al. (1989), to the west by Thompson et al. (1984a, b) and to the south and east by Kjarvgaard et al. (1994a, b). Quaternary geology for the map area is described by Ward et al. (1990) and Dredge et al. (1997).

### ARCHEAN INTRUSIVE RELATIONSHIPS AND AGE CORRELATIONS

U-Pb geochronology is presently not available for Archean rocks in the Exeter Lake map sheet. Relative ages based on intrusive relationships and fabric development suggest that the Yellowknife Supergroup metasedimentary rocks (AYSS), containing S<sub>1</sub>, S<sub>2</sub> (and rarely S<sub>3</sub>) structures are the oldest map unit. Hornblende biotite tonalite (Ato-h.b) and biotite granodiorite (Agd-b) with variably developed S<sub>2</sub> structures intrude the metasedimentary rocks. Muscovite biotite granite (Agr-m.b) and associated pegmatite (Agr-peg), and the porphyritic biotite granite (Ato-b) intrude all the above mentioned map units and contain rare S<sub>3</sub> structures, hence they are thought to be the youngest Archean magmatic rocks. The relative age of the muscovite biotite (Ato-b) is somewhat problematic. Compared to tonalites associated with the younger granites (Ato-h.b), these rocks have a much lower colour index. The recrystallized nature and development of L<sub>1</sub> and S<sub>2</sub> fabrics (S<sub>2</sub> and S<sub>3</sub>) in the biotite tonalite rocks suggests this unit is older than the (Ato-h.b) and (Agd-b) suite granites.

Detailed zircon studies on a Yellowknife Supergroup metasediment sample from the Paul Lake sheet immediately southeast of the map area indicate a maximum deposition age of 2670 Ma (M.E. Villeneuve, pers. comm., 1994). In the Exeter Lake belt, Yellowknife Supergroup metasedimentary rocks sediments have possible affinities to the non-formation bearing Conroyville Formation while those in the northern part of the map area lack non-formation and so are more similar to the Itchen Formation, as defined by Botzok (1980).

The recrystallized biotite tonalite (Ato-h.b) along the north shore of Exeter Lake has many similarities to strongly deformed granitoids mapped as such in Exeter Lake. Continuing to the south, however, the metamorphic gradient steeply increases through sillimanite (from 0 to 10 cm scale sillimanite isograd) to migmatite grade metasedimentary rocks in this area of the Exeter Lake map sheet is thought to be related to the quartz diorite phase of the Koola batholith (in the adjacent Paul Lake and Koola map sheets to the south).

The hornblende biotite tonalite (Ato-h.b) and biotite granodiorite (Agd-b) suite rocks in the Exeter Lake map area contain mineral assemblages and structural fabrics similar to those described for the north in the Conroyville-Koola Lake sheet (King et al., 1992; Davis et al., 1994). The Concession suite rocks have U-Pb zircon intrusive ages of 2608 ± 54 Ma (Davis et al., 1994). However, the Exeter Lake tonalite-granodiorite suite rocks also have petrographic similarities to granitoids of the Debel suite in the Yellowknife area (Henderson, 1988). These latter granitoids are significantly older (2658 ± 3 Ma and 2624 ± 4 Ma) than the Concession suite granitoids (Davis and Bleeker, in press). Thus it is unclear if the Exeter Lake tonalite-granodiorite suite rocks are related to ca. 2608 Ma Concession suite plutonism, to ca. 2628 Ma Debel suite magmatism, or are temporally distinct.

The muscovite biotite granite (Agr-m.b) and porphyritic biotite granite (Ato-b) plutons in the map area are considered part of the 2580–2600 Ma pan-African period of granite plutons (van Breemen et al., 1990; Davis et al., 1994). These granites are similar to the post-deformation Proterozoic granite suite in the Yellowknife area (Henderson, 1988) and the late stage Yambak/Conroyville granite suite of Davis et al. (1994) to the north of Exeter Lake.

### METAMORPHISM

In the Yellowknife Supergroup metasediments, metamorphic grade is quite variable. Low grade biotite spotted metasediments dominate the southern belt, south and east of Exeter Lake. Cordierite + andalusite grade 'fretted' schist occur both to the north and south of the lower grade rocks east of Exeter Lake. Continuing to the south, however, the metamorphic gradient steeply increases through sillimanite (from 0 to 10 cm scale sillimanite isograd) to migmatite grade metasedimentary rocks in this area of the Exeter Lake map sheet is thought to be related to the quartz diorite phase of the Koola batholith (in the adjacent Paul Lake and Koola map sheets to the south).

Metamorphosed metasedimentary rocks also occur within the Exeter Lake map area in a northern belt. Here metamorphic grade increases northwards, from cordierite + andalusite 'fretted' schist through sillimanite grade 'fretted' schist to migmatite. The higher grade schist contain both sillimanite needles plus fibroclite plus plus part melt.

Small Yellowknife Supergroup metasedimentary enclaves associated with tonalite/granodiorite suite granitoids are invariably at migmatite grade. In contrast, metasediments in muscovite biotite granite exhibit metamorphic mineral assemblages similar to those observed in the nearby metasedimentary belts in the regional metamorphic grade. This is suggested to be due to the tonalite/granodiorite suite granitoids being emplaced at higher temperatures as compared to the muscovite biotite and biotite granites. The metamorphic assemblages observed in the metasediments are similar to those observed in other areas of the Slave Province (Thompson, 1978, 1989) and are consistent with low-P, high-T metamorphism.

### FAULTING

Direct evidence for faulting in the map area is limited to one area in the southwestern part of the map sheet. A wedge of migmatite grade metasedimentary rocks adjacent to biotite spotted mudstones and siltstones is interpreted as a fault-bounded pop-up. Strike trends on steeply dipping, often overturned joints coupled with rare slicken striae actually measurements indicate faulting may be associated with the following trends: ~015°, ~045°, ~080°, ~315°, ~345°.

### DIABASE DYKES

Four swarms of Proterozoic diabase dykes (< 1 to 50 m in width) occur in the map area. The individual dyke swarms are distinguished on the basis of their orientation, texture, mineralogy and magnetic characteristics (Kjarvgaard and Wylie, 1993, 1994; LeCheminant, 1994). All the dykes are weakly altered, suggested to be related to diagenetic processes. However, the Mackay dykes also appear to have been affected by a very weak prograde metamorphic event (A.N. LeCheminant, pers. comm.). The Mackenzie dykes, intruded at 1.27 Ga (LeCheminant and Heaman, 1989) are the youngest diabase dykes in the map area. The age of the 300° dykes is unknown, however, preliminary studies indicate a paleomagnetic pole position similar to previous determinations on dykes from the Mackenzie swarm (K. Buchan, written comm., 1984), hence they are suggested to be Mesoproterozoic in age. U-Pb baddeleyite studies in Lac de Gras and Mackay dyke samples yielded ages of 2.03 ± 0.20 Ga and 2.21 Ga, respectively (LeCheminant and van Breemen, 1995).

### KIMBERLITES

Limited geological information is available for kimberlites in the Exeter Lake map sheet. St. Pierre et al. (1996), on the basis of paleomagnetic studies suggest an approximate age of ca. 60 Ma for the Beaver pipe. The Beaver kimberlite thus could be distinctly older than the Panda (53 ± 3 ± 3; Carlson et al., 1986) and Leslie (53 ± 3 ± 3; Berg and Carlson, 1988) kimberlites, both of which lie within the BHP/DaMelt claim block immediately south of the map area. However, slightly older Cratonic age (74 ± 3.0 Myr) is also reported from the Lac de Gras area, suggesting the occurrence of multiple kimberlite emplacement episodes (e.g. Heaman et al., 1987; Davis and Kjarvgaard, 1997). Kimberlite-derived mudstone and shale casts containing Lower Cretaceous (Albian) to late Paleocene diroplagelate, pollen, spores and fossilized leaves, pollen lobes and fern parts provide the only evidence to date for deposition of Cretaceous and Tertiary strata in this region of the Slave Province (Nashchuk and Dyck, 1996).

### ECONOMIC GEOLOGY

More than 200 kimberlites have been discovered since the autumn of 1991 in the Lac de Gras area of the central Slave Province. A number of these kimberlites are diamond-bearing, and a subset of these economically viable. Production of gem quality diamonds from BHP Diamond/DaMelt (BHP/DaMelt) claim block is reported (BHP/DaMelt press release, 1994). The Slave kimberlite, located in the NCD13 map sheet, is one of the few kimberlites to be beneficiated during the life of the mine. Bulk sampling results for the Sabie and Falcon pipe are as follows (data from BHP/DaMelt press releases):

kimberlite	carats	gross weight (kg)	gross value (\$US)
Sabie	1070	1096	95
Falcon	120	426	28

\*Higher valuation includes a single 9 carat stone; lower valuation excludes this stone.

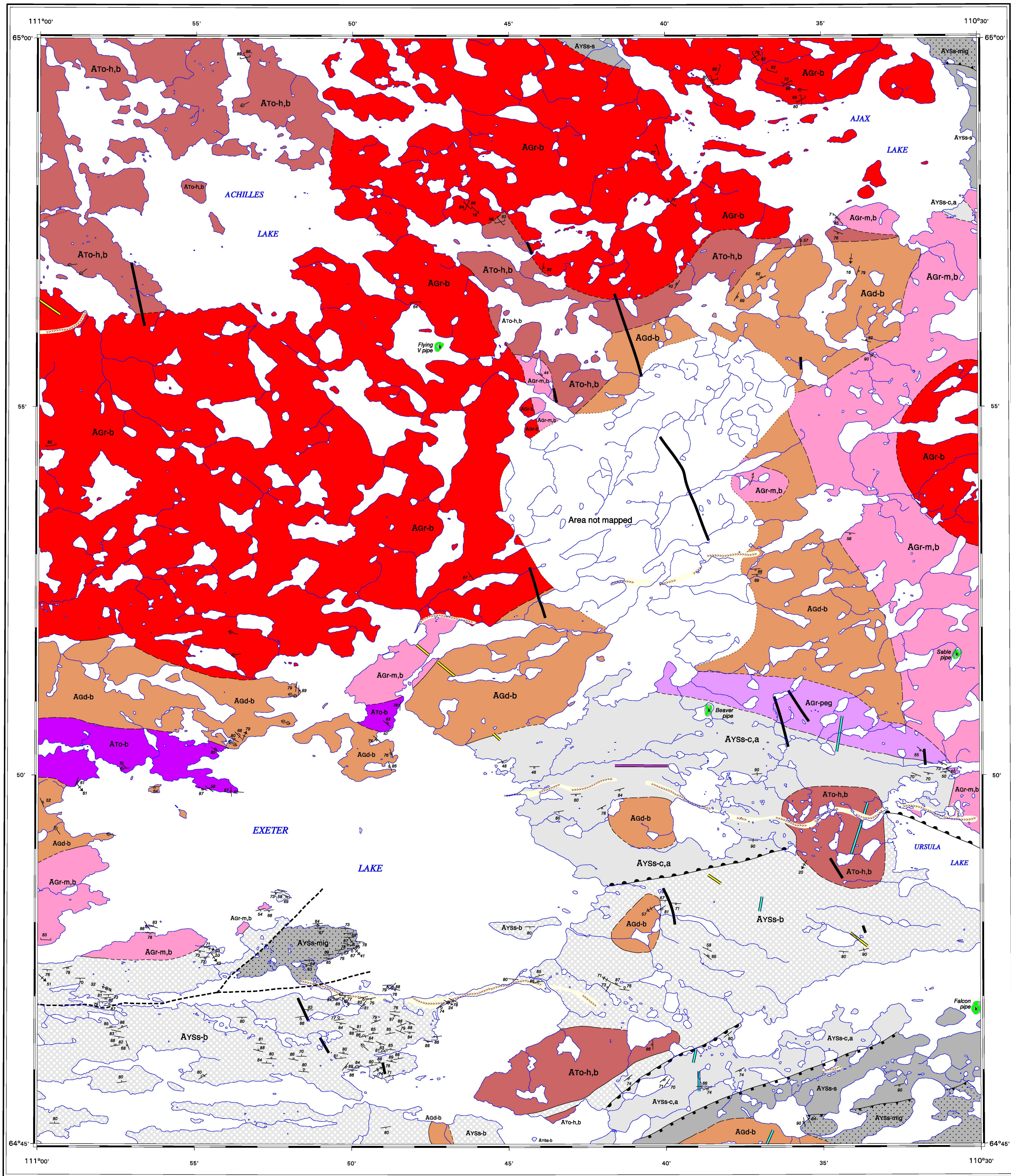
The diamond grade of a mini-bulk sample taken from the Beaver kimberlite was not reported, other than it was stated to be too low to warrant additional sampling. Follow-up mini-bulk sampling on the Tying V kimberlite has not been reported, suggesting that it may be economically significant (data from BHP/DaMelt press releases).

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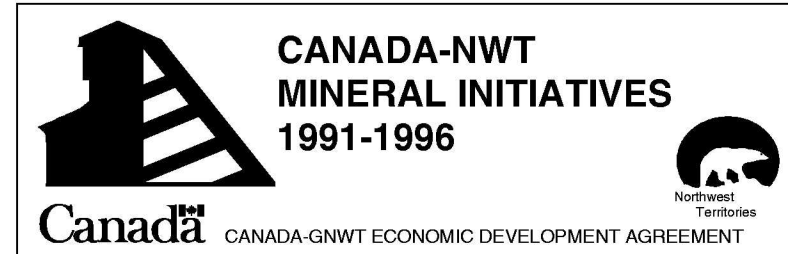
Geology by B.A. Kjarvgaard, Z.J. Jakop, R.S. Spark and R.J.S. Wylie  
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Magnetic declination 1999, 24°35' E, decreasing 20.6" annually

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OF 3702	OF 2967	
76 D11	76 D10	76 D9
OF 2966	OF 2759	

NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX TO YELLOWKNIFE GEOLOGICAL SURVEY OF CANADA MAPS



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