Bedrock geology at the boundary between Yukon-Tanana and Cassiar terranes, Truitt Creek map area (NTS 105L/1), south-central Yukon

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ABSTRACT

The Tummel fault zone, a northwest-trending belt of rocks of uncertain age and/or tectonic affinity, separates Paleozoic miogeoclinal strata of Cassiar Terrane from Yukon-Tanana Terrane metavolcanic and metasedimentary rocks. Northeast of the fault, Cassiar Terrane comprises pelitic and semipelitic rocks with rare amphibolite, which are correlated with the Kechika Group. These are overlain by carbonate correlated with the Askin Group. Southwest of the fault, in Yukon-Tanana Terrane, Devono-Mississippian siliciclastic rocks are overlain by Mississippian arc volcanic rocks. Granodiorite and diorite of the Telegraph Plutonic Suite (348-350 Ma) intrude the siliciclastic rocks. Foliated greenstone, leucogabbro intrusions, serpentinite and chert occur in the Tummel fault zone.

The Early Cretaceous Glenlyon Batholith intrudes strata of Cassiar Terrane. Contact metamorphism recognized across the Tummel fault zone is interpreted to have been imposed by the Glenlyon Batholith. If correct, this interpretation requires that post-mid-Cretaceous displacement across the Tummel fault zone has been minimal (~5 km).

RÉSUMÉ

La zone de failles de Tummel, une zone de roches à direction nord-ouest d'âge incertain et d'affinité tectonique imprécise, sépare les couches de plate-forme paléozoïques du terrane de Cassiar des roches métasédimentaires et métavolcaniques du terrane de Yukon-Tanana. Au nord-est de la faille, le terrane de Cassiar comprend les roches pélitiques et semi-pélitiques du Groupe de Kechika (?) avec de l'amphibolite rare, que recouvrent des roches carbonatées du Groupe d'Askin (?). Au sud-ouest de la faille, dans le terrane de Yukon-Tanana, des roches silicoclastiques dévono-mississippiennes sont sous-jacentes à des roches d'arc volcanique du Mississippien. La granodiorite et la diorite de la suite plutonique de Telegraph (348-350 Ma) recoupent les roches silicoclastiques. La zone de failles de Tummel comprend des roches vertes foliées, des intrusions de leucogabbro, de la serpentinite et du chert.

Le batholite de Glenlyon du Crétacé moyen recoupe les strates du terrane de Cassiar. Le métamorphisme de contact que l'on observe à travers de la zone de faille de Tummel est vraisemblablement associé au batholite de Glenlyon. Cette interprétation requiert donc que le déplacement le long de la zone de faille de Tummel soit minimal (~5 km) suite à l'intrusion du batholite au Crétacé moyen.

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INTRODUCTION

A northwest-trending fault system regionally separates lower Paleozoic platformal and basinal metasedimentary rocks of Cassiar Terrane to the east from mid-Paleozoic metasedimentary and metavolcanic rocks of Yukon-Tanana Terrane to the west (Fig. 1). The nature of this contact in Glenlyon and Laberge map areas is controversial. In eastern Laberge map area (NTS 105E; Fig. 2), the southern part of this fault system is the d'Abbadie Fault of Tempelman-Kluit (1984), who interpreted it as a pre-Cretaceous east-verging thrust fault that emplaced Yukon-Tanana Terrane over Cassiar Terrane. Hansen (1989)

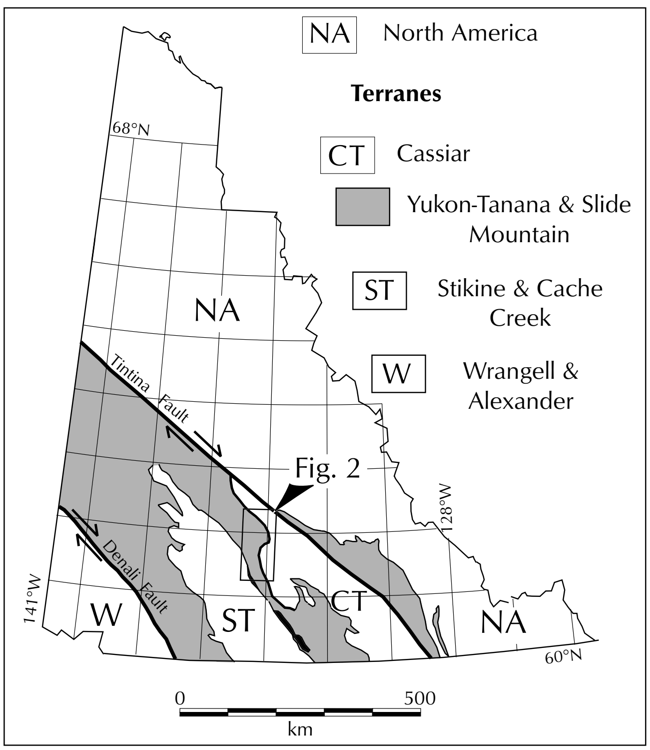


Figure 1. *Location of the study area in the southeast corner of Glenlyon map area (NTS 105L). Simplified tectonic boundaries are modified after Wheeler and McFeely (1991).*

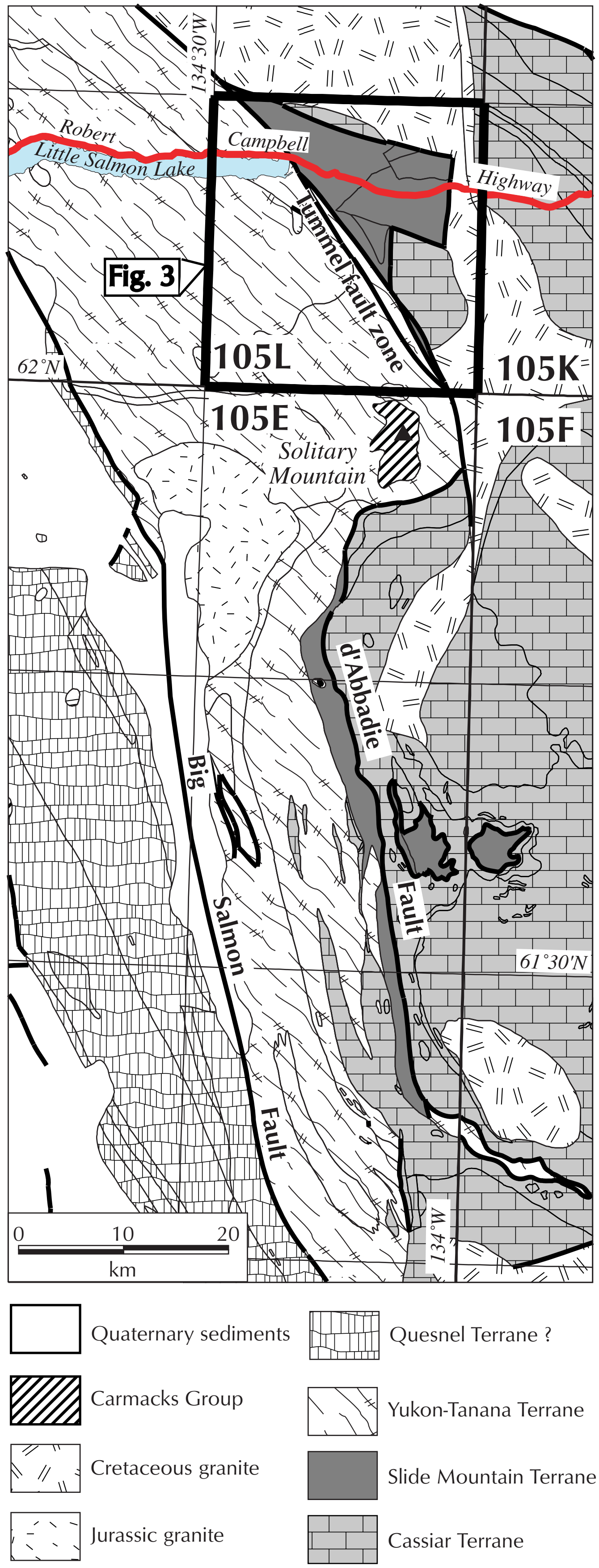


Figure 2. *Regional geological map along the boundary of Yukon-Tanana and Cassiar terranes, and region surrounding the study area (from Gordey and Makepeace, 1999). In this compilation, rocks east of the Tummel fault zone along Robert Campbell highway are interpreted as part of Slide Mountain Terrane. Gladwin et al. (2002a) have reinterpreted these rocks as part of Cassiar Terrane. TFZ – Tummel fault zone.*

reinterpreted it as a Jurassic strike-slip fault that formed the eastern boundary of a transpressional shear zone. Right-lateral strike-slip displacement of 4 km was estimated on this fault by Harvey et al. (1997) from offset of similar stratigraphy. Harvey et al. (1997) also demonstrated that d'Abbadie Fault is intruded by the synkinematic Last Peak granite, dated by Brown et al. (1998) at 98 Ma. De Keijzer et al. (1999) interpreted the d'Abbadie Fault as a brittle normal fault that cuts an earlier thrust fault that emplaced Yukon-Tanana Terrane onto Cassiar Terrane. Tempelman-Kluit (1984) reported an ~83 Ma K-Ar age from the Quiet Lake Batholith, which apparently truncates the d'Abbadie Fault.

When traced northward, d'Abbadie Fault takes a sharp northeast-trending bend in the northeast corner of Laberge map area (south of Solitary Mountain; 105E; Fig. 2), where it merges into the northwest-trending fault system, which extends into southeastern Glenlyon map area (105L, Fig. 3; Campbell, 1967). This fault system — the Tummel fault zone (Colpron et al., 2002) — is the focus of this study.

Recent paleomagnetic studies from Late Cretaceous volcanic rocks that sit disconformably on the Yukon-Tanana Terrane at Solitary Mountain, in northern Laberge map area, have focused attention on the Tummel fault zone. The basalt flows that underlie Solitary Mountain, immediately west of the Tummel fault zone, are the easternmost occurrence of the Carmacks Group (Gordey and Makepeace, 2000). Calculated paleolatitudes require large-scale (~2000 km) dextral displacement since Late Cretaceous time, consistent with paleomagnetic results from coeval volcanic rocks across central Yukon (Johnston, 2001; Johnston et al., 2001; Wynne et al., 1998). Currently recognized geological structures east of Solitary Mountain can accommodate a maximum of 450 km of dextral displacement (Gabrielse, 1985; Roddick, 1967). If the calculated paleolatitude is correct, northward translation of Yukon-Tanana Terrane requires a major Late Cretaceous-Early Tertiary structure northeast of Solitary Mountain.

This paper presents the results of bedrock geological mapping of the Truitt Creek area (105L/1; Gladwin et al., 2002b) and discusses the implications of these results for the interpretation of the Tummel fault zone. Detailed mapping of the Truitt Creek area was conducted during the summers 2001 and 2002. It is a contribution to the Yukon Targeted Geoscience Initiative — a joint program of accelerated bedrock mapping and till geochemistry conducted in Glenlyon and northeastern Carmacks areas in 2002 by the Yukon Geology Program and the Geological Survey of Canada (Colpron et al., 2003, this volume; Bond et al., 2003, this volume).

TRUITT CREEK MAP AREA

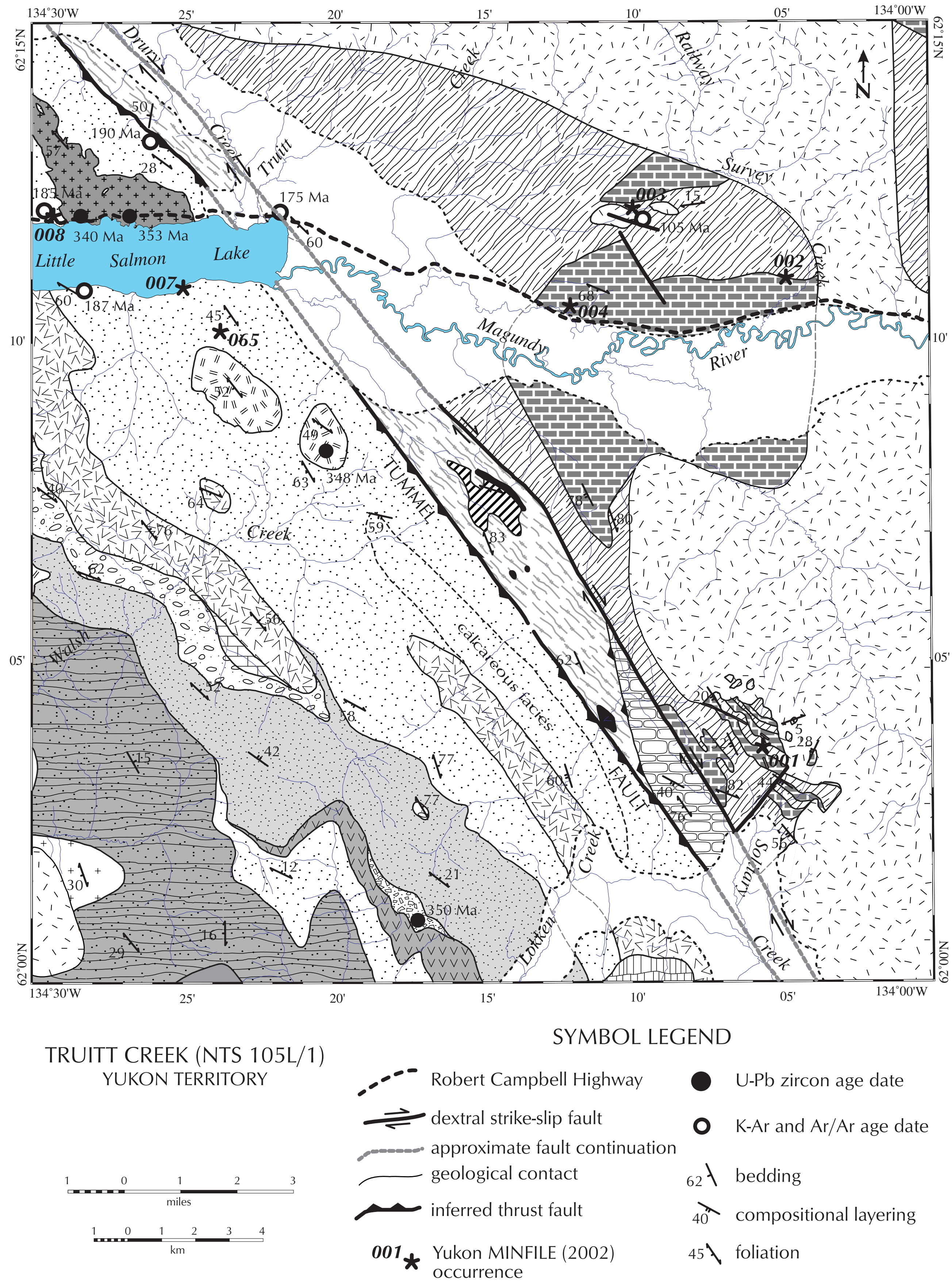
The Truitt Creek map area (105L/1) includes the eastern end of Little Salmon Lake, in the southeast corner of Glenlyon map area (105L) in south-central Yukon (Fig. 1-3). Reconnaissance mapping of the area was first conducted by Campbell (1967) at a scale of 1:250 000. More recent mapping by Colpron (2000) has established the stratigraphic framework of Yukon-Tanana Terrane in the area.

In the Truitt Creek area, lower Paleozoic metasedimentary rocks of Cassiar Terrane, in the northeast part of the map area, are separated from mid-Paleozoic metasedimentary and metavolcanic rocks of Yukon-Tanana Terrane to the southwest, by the northwest-trending Tummel fault zone (Fig. 3; Colpron et al., 2002). The Tummel fault zone has a complex deformational history, including lateral and thrust displacements under ductile and brittle conditions. Although it intersects the d'Abbadie Fault in eastern Laberge map area, the Tummel fault has been distinguished from the d'Abbadie because the extent of shared history is unknown.

CASSIAR TERRANE

Cassiar Terrane is a crustal fragment of platformal rocks that has been interpreted either as displaced North American miogeocline that is not far-travelled (Fritz et al., 1991), or as a far-travelled exotic terrane (Johnston, 2001; Pope and Sears, 1997). In Truitt Creek map area, Cassiar Terrane comprises two units: a lower phyllite-dominated unit and an overlying marble unit.

Along Robert Campbell Highway, grey to black, locally calcareous phyllite with rare sandy layers is exposed in several road cuts and borrow pits. Outcrops commonly exhibit iron-oxide staining. Adjacent to the batholith, correlative rocks are contact metamorphosed, up to amphibolite grade. Quartz-muscovite ± biotite ± garnet schist is the most abundant lithology, with minor pale green to white quartzite, marble, calc-silicate rocks and amphibolite. Centimetre-scale intercalations of siliceous and calcareous sedimentary rocks are common in the southeast. Schistosity dips shallowly to the west, and parallels compositional layering. Metamorphic grade decreases away from the batholith to the southwest. Skarn mineralization is developed in several places, and


134°30'W
25'
20'
15'
10'
05'
134°00'W
62°15'N
10'
05'
62°00'N
N
Drury Creek
Truitt Creek
Railway
Survey Creek
Little Salmon Lake
Magundy River
Creek
Walsh
TUMMEL FAULT
calcareous facies
Lokken Creek
Solitary Creek
190 Ma
185 Ma
175 Ma
340 Ma
353 Ma
187 Ma
105 Ma
348 Ma
350 Ma
008
007
065
003
002
004
001
TRUITT CREEK (NTS 105L/1)
YUKON TERRITORY
miles
km
SYMBOL LEGEND
Robert Campbell Highway
dextral strike-slip fault
approximate fault continuation
geological contact
inferred thrust fault
001 Yukon MINFILE (2002) occurrence
U-Pb zircon age date
K-Ar and Ar/Ar age date
62 bedding
40 compositional layering
45 foliation

some exploration work has been done in the area (Lokken occurrence: MINFILE 2002, 105L 001).

Fine- to coarse-grained, light grey to black, locally graphitic marble occurs structurally above the phyllite. At the highway, the marble is massive, fine-grained, dark grey to black, and heavily veined with calcite. At the Moule occurrence (Yukon MINFILE 2002, 105L 004), malachite-bearing calcite veins are present within the marble unit. In the central and southeastern parts of the map area, this unit is medium- to coarse-grained, and medium grey to white.

Samples from two narrow (1-5 m) laterally continuous amphibolite bodies within the schist were analysed for major and trace elements (Appendix I). Amphibolite

LEGEND

Quaternary
unconsolidated alluvium, colluvium and glacial deposits

OVERLAP ASSEMBLAGE

INTRUSIVE ROCKS

Early Cretaceous
biotite granite, biotite-muscovite granite

Early Jurassic (?)
hornblende-biotite gabbro

LAYERED ROCKS

Upper Cretaceous
Carmacks Group - basalt flows, agglomerate

SLIDE MOUNTAIN TERRANE (?)

Permian (?)
medium- to coarse-grained hornblende leucogabbro

Permian (?)
coarse-grained serpentinized harzburgite

Pennsylvanian to Lower Permian (?)
white, green, & black chert, quartzite, black slate

Pennsylvanian to Lower Permian (?)
basalt, basaltic andesite, greenstone

YUKON-TANANA TERRANE

INTRUSIVE ROCKS

Middle Mississippian
Little Salmon Plutonic Suite - hornblende quartz diorite, granodiorite

Early Mississippian
Telegraph Plutonic Suite - hornblende-biotite granodiorite, quartz diorite

Devonian - Mississippian
hornblende-biotite tonalite, hornblende diorite to granodiorite

YUKON-TANANA TERRANE

LAYERED ROCKS

Upper Mississippian - Middle Pennsylvanian
Little Salmon - dark grey biotite marble

Middle Mississippian - Pennsylvanian (?)
Little Salmon - green banded volcaniclastic rocks

Middle Mississippian
Little Salmon - quartzite-clast conglomerate, quartz-chlorite schist

Lower Mississippian
Pelmac formation - quartzite, quartz-mica schist

Lower Mississippian
Lokken member - quartz-feldspar porphyry, volcaniclastic rocks

Lower Mississippian
Intermediate volcaniclastic rocks, minor marble and psammite

Devono - Mississippian
Drury formation - arkosic grit, quartzite, psammite, marble

Devonian and older (?)
Snowcap complex - quartzite, psammitic and pelitic schist

CASSIAR TERRANE

LAYERED ROCKS

Silurian - Devonian
Askin Group (?) - marble, calc-silicate rocks, quartz-mica schist

Cambrian - Ordovician
phyllite, quartz-mica schist, quartzite, marble, amphiboliite

Figure 3. *(preceding page and legend above) Geological map of Truitt Creek area (NTS 105L/1), based on mapping completed in 2001 and 2002. Location shown in Figure 2.*

layers are both parallel and crosscutting with respect to compositional layering in surrounding schist. They are interpreted as mafic dykes that were metamorphosed along with the host rock by the intrusion of Glenlyon Batholith. These amphibolite dykes have trace element geochemical characteristics of alkali basalts (Fig. 4a), consistent with a within-plate tectonic setting such as a continental rift. On primitive mantle-normalized plots, amphibolite of the Cassiar Terrane has trace element patterns similar to volcanic rocks of the Cambrian-Silurian Menzies Creek Formation from the Faro region (Fig. 4b).

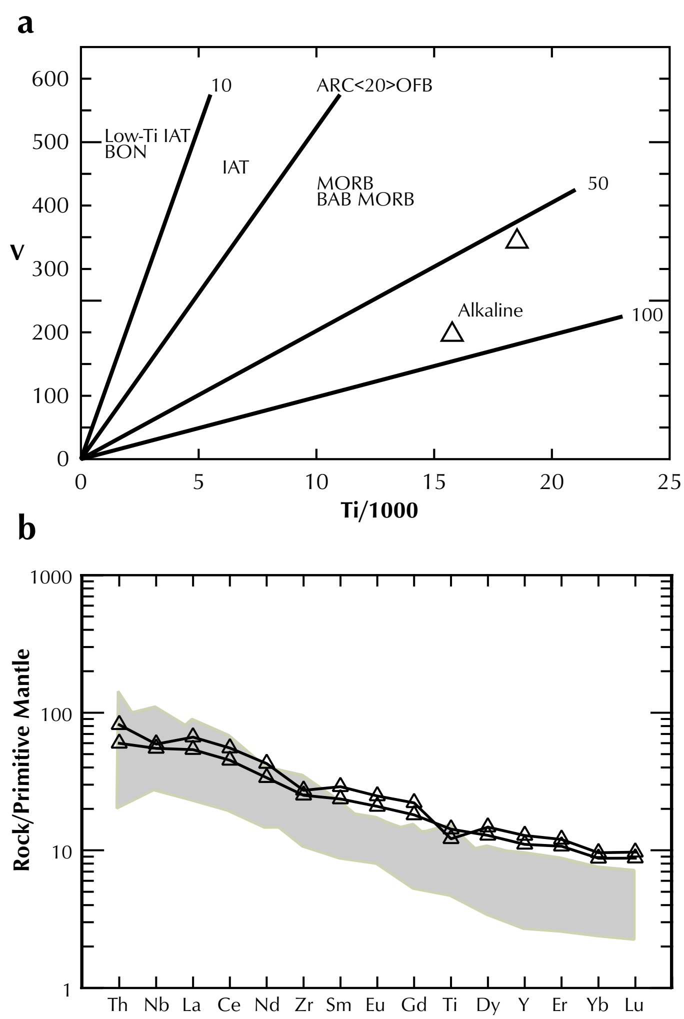


***Figure 4. (a)** V vs Ti/1000 diagram showing amphibolite dykes (triangles) in Kechika Group rocks in the southeastern part of the map area (diagram after Shervais, 1982). **(b)** Trace element pattern of amphibolite dyke samples normalized to primitive mantle values of Sun and McDonough, 1989. Samples from Truitt Creek area are superimposed on range of analyses from volcanic rocks of Menzies Creek Formation from the Faro region (shaded region; data from L.C. Pigage, pers. comm, 2002).*

The phyllite/schist and marble units of Cassiar Terrane in Truitt Creek area are tentatively correlated with the Cambrian-Ordovician Kechika Group and the Silurian-Devonian Askin Group, respectively.

YUKON-TANANA TERRANE

Yukon-Tanana Terrane southwest of the Tummel fault zone includes (1) pre-Late Devonian metasedimentary and metaplutonic rocks of the Snowcap complex; (2) Devonian-Mississippian metasedimentary and minor metavolcanic rocks of the Drury and Pelmac formations; (3) intermediate intrusive rocks of the Telegraph Plutonic Suite; and (4) Carboniferous metasedimentary and metavolcanic rocks of the Little Salmon formation. A number of new stratigraphic units in Yukon-Tanana Terrane, some of which are described below, were informally introduced by Colpron et al. (2002). These units will be formally defined in a bulletin in preparation.

The oldest rocks in Yukon-Tanana Terrane are psammitic schist and quartzite of the Snowcap complex exposed in the southwestern corner of the map area (Fig. 3). The Snowcap complex is the most extensive unit of Yukon-Tanana Terrane in Glenlyon map area (Colpron et al., 2002; Colpron et al., 2003, this volume). In Truitt Creek area, the Snowcap complex consists of light grey garnet-quartz-muscovite schist, dark grey quartzite, minor dark grey muscovite schist and foliated grey hornblende tonalite. The rocks are typically strongly foliated and coarsely recrystallized.

The Drury formation overlies the Snowcap complex. It extends northwest of the study area to the east shore of Drury Lake (Colpron et al., 2003, this volume). The Drury formation includes coarse-grained arkosic grit, light to dark grey quartzite, micaceous quartzite and psammitic schist. The Drury formation locally comprises a unit of dark grey to black phyllite and light calcareous sandy layers intercalated with 5- to 20-cm thick layers of light grey marble.

The age of the Drury grit is bracketed as lower Mississippian from the ages of detrital zircons and a crosscutting pluton. Two samples of grit from the Drury formation (Fig. 3) yielded Upper Devonian detrital zircons (G. Gehrels in Colpron et al., 2003, this volume).

Fine- to medium-grained, foliated hornblende quartz diorite to granodiorite of the Drury pluton intrudes coarse-grained arkosic grit and psammite of the Drury formation at the eastern end of Little Salmon Lake, along Robert Campbell Highway. Zircons from this pluton yielded a discordant U/Pb age of 353.0 ± 1.4 Ma (Oliver and Mortensen, 1998). Results from another sample of the same pluton yield a somewhat younger age, correlative with the 338-340 Ma Little Salmon Plutonic Suite — the plutonic root to the volcanic rocks of the Little Salmon formation (Colpron, 2001). In either case, a lower Mississippian age is indicated for the Drury grit.

LOKKEN MEMBER AND PELMAC FORMATION

Near the southern edge of the map area, the Pelmac formation overlies the Drury formation. The lower part of the Pelmac formation, the Lokken member, consists of mint- to yellow-green intermediate volcanic and volcaniclastic rocks, overlain by thinly layered, green to maroon, tuffaceous volcaniclastic rocks, and an upper white, fine- to medium-grained, foliated quartz-feldspar porphyry. In some exposures, up to 50% of the porphyry is made up of feldspar and quartz phenocrysts. The porphyry is interpreted as a volcanic rock, although a high-level intrusive protolith is possible. It has yielded a preliminary U-Pb zircon date of ca. 350 Ma (J.K. Mortensen, pers. comm., 2002).

The remainder of the Pelmac formation above the porphyry consists of a distinct and laterally extensive quartzite unit that can be traced across the Glenlyon map area to the northwest (Colpron et al., 2003, this volume). In the western part of Truitt Creek map area, the quartzite is white or pale green and massive. Southwest of Walsh Creek, 2-cm-thick horizons of quartz-chlorite schist are intercalated with 3- to 10-cm-thick quartzite beds (Fig. 5).

TELEGRAPH PLUTONIC SUITE

Rocks of the Snowcap complex, Drury formation, and Pelmac formation are intruded by plutons of the Telegraph Suite in the central and western part of the map area (Fig. 3). The Telegraph Plutonic Suite includes medium- to coarse-grained hornblende ± biotite granodiorite and hornblende quartz diorite. A moderate to strong foliation, defined by alignment of hornblende, parallels foliation in surrounding country rock. Preliminary U-Pb zircon analyses indicate crystallization ages of 348-349 Ma (J.K. Mortensen, pers. comm., 2002).

Figure 5. *Quartzite with thin bands of intercalated quartz-chlorite schist in the Pelmac formation. Rock hammer and magnet for scale.*

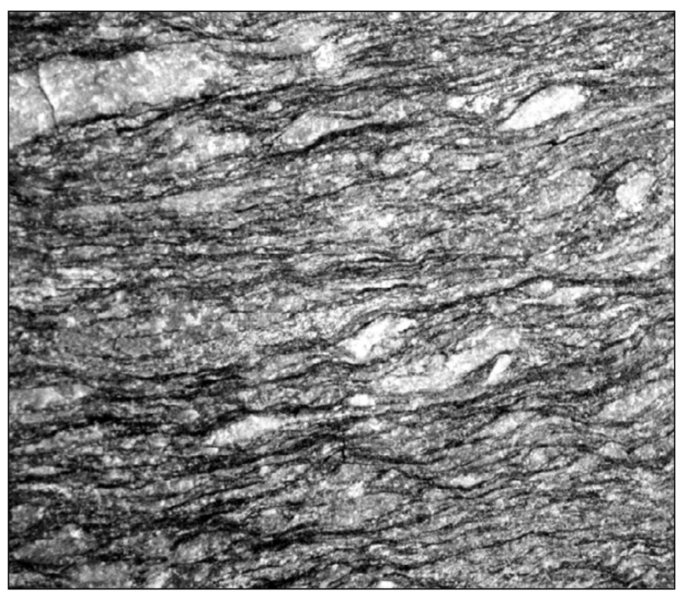


Figure 6. *Basal conglomerate of the Little Salmon formation: quartzite pebbles and cobbles in a chloritic matrix. Field of view is approximately 40 cm across.*

LITTLE SALMON FORMATION

Conglomerate, marble, and intermediate volcaniclastic rocks occur in a narrow northwest-trending belt in the western central part of the map area. The base of the succession is marked by a quartzite-pebble to -boulder conglomerate which has subangular to subrounded clasts of grey quartzite supported by a green-grey chloritic sandstone matrix (Fig. 6). Tightly folded fabric observed within some of the boulders indicates derivation from a deformed and metamorphosed source terrane.

A biotite marble occurs between the lower conglomerate member and upper volcaniclastic member of the Little Salmon formation on one ridge in the western central part of the study region. This unit was not found elsewhere in the map area, but may correlate with marble that occurs near the base of the Little Salmon formation along strike to the northwest (Colpron, 2000). The biotile marble is interpreted to stratigraphically overlie the conglomerate unit.

Chlorite-epidote ± biotite ± magnetite schist is the uppermost member of the Little Salmon formation. The schist sits conformably above the marble unit, and forms synformal keels in the gentle folds of regional foliation. North of Little Salmon Lake, a dacite at the base of the Little Salmon formation has yielded a preliminary U/Pb zircon age of ca. 340 Ma (J.K. Mortensen, pers. comm., 1999).

ROCKS OF THE TUMMEL FAULT ZONE

The central and northwestern sections of the Tummel fault zone are made up of metamorphosed basalt and mafic volcaniclastic rocks. These are fine-grained and foliated, moderately to highly altered, light to dark green rocks, with relict plagioclase and rare clinopyroxene (Fig. 7). Highly altered samples contain significant amounts of epidote chlorite, calcite and serpentine.

At the southeastern end of the Tummel fault zone, and along Robert Campbell Highway, chert is the dominant lithology, with lesser quartzite, micaceous quartzite, and locally graphitic black slate. At the highway, the chert is pale green and massive, with large (7-8 mm) pyrite porphyroblasts in some places; in the southeast, the chert is massive and black or white. On the south side of the Lokken Creek valley, an east-verging thrust fault places greenstone over chert. To the north, Colpron et al. (2003, this volume) have observed the chert and basalt in stratigraphic contact.

The greenstone is intruded by medium- to coarse-grained hornblende leucogabbro in the central part of the map area. Xenoliths of greenstone are found within the intrusion. The leucogabbro is spatially associated with coarse-grained, serpentinized harzburgite, especially in a northwest-trending belt along the eastern side of the large pluton in the centre of the map area. The harzburgite locally has thin (<1 cm) quartz-carbonate or antigorite

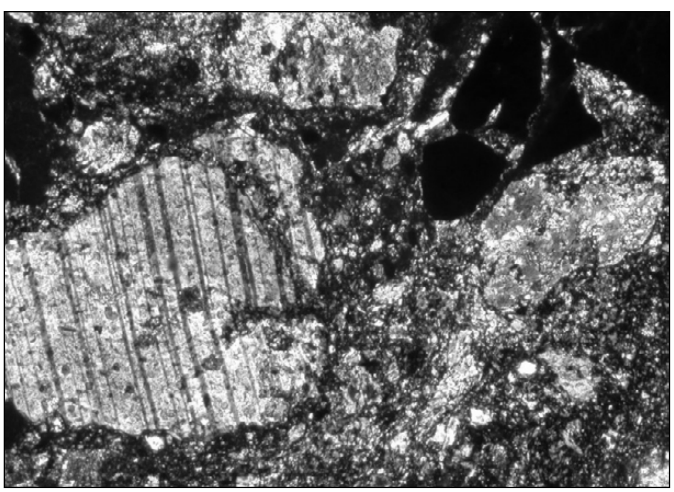


Figure 7. Photomicrograph of relict plagioclase and clinopyroxene in greenstone from the Tummel fault zone. Field of view is 3 mm across.

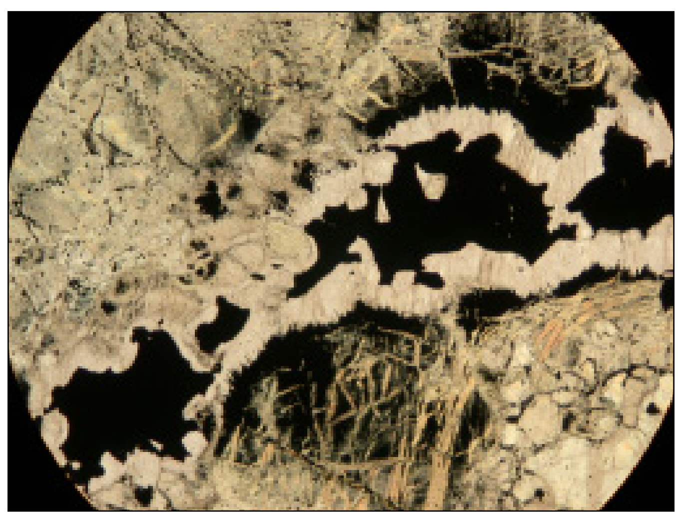


Figure 8. Photomicrograph of magnetite porphyroblast in harzburgite with 'holly-leaf texture' indicative of high-temperature (>1200°C) deformation. Chlorite has replaced plagioclase in the surrounding corona. Field of view is 5 mm across.

veins. In places, white crystals of carbonate, 1-3 mm in diameter with a radiating habit, give the rock a distinct speckled appearance. Large (4-6 mm) pseudomorphs of orthopyroxene characterize the peridotite, and are locally strung out over distances of >30 cm. Magnetite and chlorite have replaced spinel and associated plagioclase coronae, respectively (Fig. 8).

Contacts between harzburgite and adjacent units, while not observed, can be spatially constrained. Greenstone occurs east and west of the elongate band of ultramafic rocks in the central part of the Tummel fault zone (Fig. 3). Gabbro was only observed west of the ultramafic rocks. However, a black and white, medium-grained, altered and mylonitized hornblende-chlorite-saussurite rock, probably derived from a leucogabbro protolith, occurs 100 m northeast of the ultramafic exposure. The fabric in this outcrop dips steeply (84°) to the south-southwest and the altered leucogabbro projects beneath the harzburgite.

The 'holly-leaf' shape of magnetite (originally spinel) crystals observed in thin sections of the harzburgite (Fig. 8), and the coarse grain size of the harzburgite porphyroclasts require recrystallization at mantle temperatures (~1250°C; Nicolas, 1995). In an intrusive body, spinel crystals that crystallized at lower temperatures have a coherent cubic shape. In addition, deformation at lower temperatures (<1000°C and less) would produce a significantly finer grained rock (Nicolas, 1995). The strung-out orthopyroxene porphyroclast texture is also commonly produced as a result of solid-state deformation in the mantle (D. Canil, pers. comm., 2002). Petrographic observations, together with fabric relationships in the ultramafic harzburgite and adjacent rocks, suggest that harzburgite of the Tummel fault zone originated as mantle tectonite. However, the spatial association of harzburgite with gabbroic intrusions and the distribution of ultramafic rocks throughout basalts of the Tummel fault zone are also consistent with an intrusive origin for the ultramafic rocks.

The association of basalt, chert, leucogabbro and ultramafic rocks in the Tummel fault zone in the Truitt Creek map area resembles the Campbell Range succession of the Finlayson Lake area (Murphy et al., 2001; Colpron et al., 2003, this volume). Similar to ultramafic rocks in the Tummel fault zone, ultramafic rocks in the Campbell Range have a spatial association with bodies of leucogabbro. The presence of coarse-grained cumulate textures, geometric relationships, and occurrences of calc-silicate hornfels near ultramafic bodies all suggest that ultramafic rocks of the Campbell Range are intrusions (Murphy, 2001).

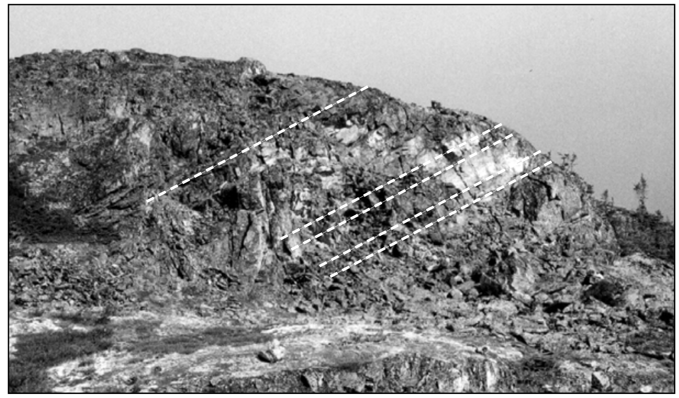


Figure 9. *Thick (2-5 m) southwest-dipping sills of biotite granite intrude quartz-mica schist. Dashed lines separate thin layers of schist from thicker granite sills. Tree at right is ~4 m tall and very old.*

GLENLYON BATHOLITH

The Glenlyon Batholith intrudes the sedimentary rocks of Cassiar Terrane along the eastern side of the map area, and is well exposed along Robert Campbell Highway and in alpine areas to the south. Three intrusive phases were recognized in the batholith. The earliest, a medium-grained biotite-hornblende granodiorite, is intruded by voluminous medium- to coarse-grained biotite ± muscovite granite, locally with phenocrysts of plagioclase or potassium feldspar. A late muscovite-quartz-plagioclase pegmatite phase is locally present. Five andesite dykes, 1-5 m wide, cut the batholith.

The batholith margins are characterized by lit-par-lit gneisses (Fig. 9). This may reflect the gross geometry of the batholith, as a sheet-like body or series of bodies that dip gently to moderately (~30°) to the southwest. Pendants of quartz-muscovite-biotite ± garnet schist are common within the intrusion, especially at topographic high points and near the batholith margin, ranging from tens to hundreds of metres across. This is interpreted as evidence that the present level of exposure is near the roof(s) of the magma chamber(s).

Whole-rock K-Ar analysis of hornfels adjacent to the batholith on the north side of the highway has yielded a metamorphic cooling age of 105 ± 4 Ma (Hunt and Roddick, 1990).

DEFORMATION AND METAMORPHISM IN TRUITT CREEK MAP AREA

The style and history of deformation and metamorphism vary across the Truitt Creek map area. Southwest of the Tummel fault zone, rocks of Yukon-Tanana Terrane have experienced a polyphase deformational history. The Snowcap complex has undergone at least one deformational event not recognized in overlying Mississippian units (Colpron et al., 2003, this volume). Contact metamorphism associated with plutons of the Telegraph and Little Salmon suites is locally preserved, although generally overprinted by subsequent regional metamorphism of all Yukon-Tanana elements. A regional dynamothermal event is recognized in, and thus post-dates emplacement of, Little Salmon volcanic and plutonic rocks. Mineral paragenesis in rocks of Yukon-Tanana Terrane indicates middle to upper greenschist facies metamorphism (chlorite- to garnet-grade). This metamorphism probably occurred prior to Early Jurassic time, as indicated by $^{40}Ar/^{39}Ar$ white mica cooling ages from samples collected along Robert Campbell Highway (Oliver, 1996).

Greenstone within the Tummel fault zone has a dominant northwest-trending S_2 schistosity that is axial planar to isoclinal folds of an earlier S_1 schistosity. A moderately to steeply east-dipping spaced crenulation cleavage is also developed in these rocks. In many places, rocks of the greenstone and chert units have a cataclastic texture (intensely fractured). Foliation in leucogabbro intrusions, defined by alignment of hornblende, is broadly parallel to S_2 schistosity. An epidote-actinolite-chlorite-plagioclase mineral assemblage indicates that these rocks have reached middle greenschist facies.

In Cassiar Terrane strata, a southwest-dipping phyllitic foliation along Robert Campbell Highway gives way to a well developed, southwest-dipping schistosity near the Glenlyon Batholith in the southeast part of the map area. Compositional layering is commonly parallel to foliation, and a moderately southwest-plunging crenulation lineation is locally developed. East of Little Salmon Lake and adjacent to the Tummel fault zone in the southeast part of the map area, pelitic and overlying carbonate strata are folded into kilometre-scale, north-northwest-trending open synclines. Also in the southeast, a northeast-trending subvertical strike-slip fault has a 1-km dextral offset.

Phyllite of the Cassiar Terrane along Robert Campbell Highway is regionally metamorphosed to chlorite grade (greenschist facies), whereas the biotite-garnet schist to the southeast, adjacent to the Glenlyon Batholith, is metamorphosed to lower amphibolite facies. The Early Cretaceous Glenlyon Batholith imposes a contact metamorphic aureole on rocks of the Cassiar Terrane.

A weak foliation of aligned phenocrysts, interpreted as a magmatic feature, is locally present in the Glenlyon Batholith. Subvertical northwest- or north-trending joints, spaced metres to tens of metres apart, are developed throughout the intrusion. Locally, joint faces are chloritized, with subhorizontal or shallowly plunging slickensides.

A NEW SULPHIDE OCCURRENCE

A new sulphide occurrence (Glad showing; Yukon MINFILE 2002, 105L 065) was uncovered during mapping of the Truitt Creek area. It consists of a vein-hosted pyrite occurrence within the Drury formation, south of the eastern end of Little Salmon Lake (Fig. 3; UTM zone 8, NAD83, 531554E, 6893223N). Assay results from two grab samples returned anomalies in Cu (1451 ppm; 425 ppm), Au (184 ppb; 177 ppb), Ag (2.8 ppm; 2.1 ppm), Co (624 ppm; 708 ppm) and Ni (844 ppm; 953 ppm). The samples were taken from a rockfall at the base of a steep cliff of highly deformed quartzite and psammitic schist. Two thin (1-2 cm) veins of pyrite were found in outcrop above the fall. Iron-oxide staining was noted on much of the talus beneath the cliff. The Glad occurrence is similar in style and in commodity to the Highway showing (Yukon MINFILE 2002, 105L 063; Colpron, 1999), in which pyrite veins less than 1 cm-thick are hosted in a black quartzite assigned to the Pelmac formation. The Glad showing is 2 km southeast along strike from the Red Knoll showing (Yukon MINFILE 2002, 105L 007) on the southeastern shore of Little Salmon Lake. The Red Knoll showing is an occurrence of disseminated pyrite hosted by the Drury formation. These sulphide occurrences occupy the footwall of the Little Salmon formation, which hosts a small massive sulphide occurrence at its base (Yukon MINFILE 2002, 105L 062; Colpron, 1999).

DISCUSSION OF NATURE, AMOUNT AND AGE OF DISPLACEMENT ACROSS THE TUMMEL FAULT ZONE

A paucity of marker units across the Tummel fault zone precludes an estimate of the nature and amount of displacement accommodated by the zone. A cataclastic texture, common in chert and greenstone, provides evidence of some brittle deformation within the Tummel fault zone. Primary mineralogies and textures are locally preserved in basalt, leucogabbro, and harzburgite, indicating a lack of penetrative strain due to faulting.

The metamorphic aureole around the Glenlyon Batholith extends across the Tummel fault zone, constraining the age of any significant displacement to pre-mid-Cretaceous. Cordierite, andalusite and garnet porphyroblasts overgrow dominant foliation (Fig. 10) and therefore cannot have been caused by earlier intrusions (such as those of the Telegraph Plutonic Suite) that share this foliation. In the southern part of the map area, no intrusions other than Glenlyon Batholith are recognized near the porphyroblastic rocks.

If this late metamorphic feature is the contact aureole of the Glenlyon Batholith, Yukon-Tanana and Cassiar terranes were juxtaposed before ~105 Ma, and little displacement on the Tummel zone can have occurred since that time. This interpretation is inconsistent with the recently proposed Saybia model (Johnston, 2001), which requires large-scale dextral displacement since late Cretaceous time.

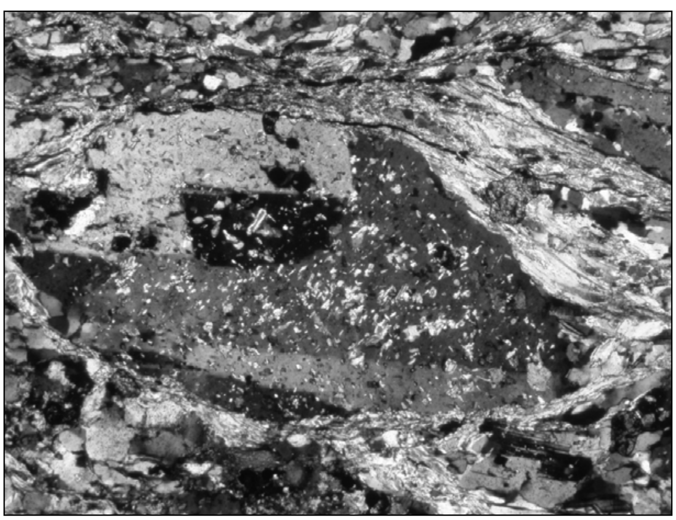


Figure 10. *Photomicrograph of cordierite porphyroblast in foliated arkosic grit of the Drury formation. Sample is from the centre of the map area, immediately west of the Tummel zone. Porphyroblast is 1.5 mm long.*

Most recent workers agree that d'Abbadie Fault in Solitary Mountain map area is a late structure that has not accommodated significant displacement (Harvey et al., 1997; de Keijzer et al., 1999). Motion on the d'Abbadie is temporally constrained by the synkinematic Last Peak pluton (98 Ma, U-Pb monazite: Harvey et al., 1997) and by ~97 Ma $^{40}Ar/^{39}Ar$ cooling dates from muscovite and biotite of the Mendocina orthogneiss, which is adjacent to the Last Peak pluton (Hansen et al. 1991; Hansen, 1992). Displacements on the order of those documented for d'Abbadie Fault (~4 km; Harvey et al., 1997) could have been accommodated by the Tummel fault zone.

SUMMARY

In Truitt Creek map area, miogeoclinal rocks of Cassiar Terrane, tentatively correlated with the Paleozoic Kechika and Askin groups, are separated from mid-late Paleozoic metavolcanic and metasedimentary rocks of Yukon-Tanana Terrane by the Tummel fault zone. The Tummel fault zone is a northwest-trending belt of metamorphosed chert, mafic and ultramafic rocks that may be correlative with the Campbell Range succession of the Finlayson Lake district.

Contact metamorphism attributed to the mid-Cretaceous Glenlyon Batholith extends across the Tummel fault zone, suggesting minimal (<5 km?) displacement since mid-Cretaceous time. Post-Late-Cretaceous large-scale translation required by recent paleomagnetic interpretations cannot have been accommodated by the Tummel fault zone.

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APPENDIX 1. GEOCHEMISTRY OF CASSIAR TERRANE AMPHIBOLITES

Analytical method: Major elements were analysed by fused disc x-ray fluorescence (XRF), and some trace elements (Ni, Co, Cr, V, Cu, Pb, Zn, As, Zr, Ga, Sr, Rb, Ba) were analysed by pressed-pellet XRF, both at the University of Western Ontario. The other trace elements were dissolved in a closed beaker, all-in-one digest using a mixed acid digestion (HF-HNO_3-perchloric) with subsequent analysis for certain trace elements (S, Sc, Mo, W, Cd, Li) by inductively coupled plasma emission spectrometry (ICP-ES), and remaining trace elements (Nb, Ta, Hf, Cs, Th, U) and rare earth elements (REE) by inductively coupled plasma mass spectrometry (ICP-MS) at the Ontario Geoscience Laboratories in Sudbury.

Sample	KG01-154	KG01-153	Method
Easting	546587	546587	
Northing	6881712	6881532	
Zone, Datum	8V, NAD83	8V, NAD83	
SiO_2	48.87	48.60	XRF
TiO_2	2.63	3.09	XRF
Al_2O_3	12.30	13.90	XRF
Fe_2O_3	14.04	15.11	XRF
MnO	0.29	0.22	XRF
MgO	4.10	4.35	XRF
CaO	9.57	8.27	XRF
K_2O	1.38	1.11	XRF
Na_2O	2.58	2.72	XRF
P_2O_5	1.22	0.71	XRF
Cr_2O_3	0.01	0.01	XRF
LOI	1.99	0.95	XRF
Total	98.99	99.04	
Nb	39.9	35	XRF
Zr	305.7	281.2	XRF
Y	58.3	50.3	XRF
Sr	133.5	308.3	XRF
Rb	52.6	48	XRF
Ba	304.5	359.3	XRF
Ga	19.1	24.9	XRF
Mn	2267.5	1616.6	XRF
Pb	5	(3)	XRF
As	(1)	(1)	XRF
Zn	166	137	XRF
Cu	23	45	XRF
Ni	215	58	XRF
Co	27	33	XRF
Cr	32	32	XRF
V	196	343	XRF

Sample	KG01-154	KG01-153	Method
Al	55980	62673	ICP-ES
Ba	338	359	ICP-ES
Be	4	N.D.	ICP-ES
Ca	67026	58692	ICP-ES
Cd	16	17	ICP-ES
Co	51	63	ICP-ES
Cr	47	43	ICP-ES
Cu	N.D.	6	ICP-ES
Fe	93789	98806	ICP-ES
K	9457	7998	ICP-ES
Li	19	45	ICP-ES
Mg	24232	25668	ICP-ES
Mn	2223	1594	ICP-ES
Mo	N.D.	N.D.	ICP-ES
Na	22605	24057	ICP-ES
Ni	48	33	ICP-ES
P	4983	2921	ICP-ES
S	491	567	ICP-ES
Sc	26	29	ICP-ES
Sr	136	291	ICP-ES
Ti	16293	20100	ICP-ES
V	178	312	ICP-ES
W	N.D.	N.D.	ICP-ES
Y	46	41	ICP-ES
Zn	220	158	ICP-ES
Ce	98.27	80.06	ICP-MS
Cs	1.65	>5.00	ICP-MS
Dy	10.86	9.46	ICP-MS
Er	5.76	5.14	ICP-MS
Eu	4.17	3.5	ICP-MS
Gd	13.19	10.78	ICP-MS
Hf	6.86	4.44	ICP-MS
Ho	2.14	1.91	ICP-MS
La	45.65	37.04	ICP-MS
Lu	0.717	0.649	ICP-MS
Nb	42.18	39.25	ICP-MS
Nd	57.82	45.64	ICP-MS
Pr	13.39	10.88	ICP-MS
Rb	56.18	52.88	ICP-MS
Sm	12.86	10.48	ICP-MS
Sr	165.03	355.5	ICP-MS
Ta	2.35	2.15	ICP-MS
Tb	1.92	1.64	ICP-MS
Th	6.95	5.09	ICP-MS
Tm	0.82	0.73	ICP-MS
U	1.68	1.33	ICP-MS
Y	57.62	51.97	ICP-MS
Yb	4.73	4.31	ICP-MS
Zr	281.54	182.67	ICP-MS