Yukon Targeted Geoscience Initiative, Part 1: Results of accelerated bedrock mapping in Glenlyon (105L/1-7, 11-14) and northeast Carmacks (115I/9,16) areas, central Yukon

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ABSTRACT

The core of Glenlyon and northeastern Carmacks map areas is underlain by a northwest-trending belt of metasedimentary, metavolcanic and (meta)plutonic rocks of the Yukon-Tanana Terrane. It includes two successions of Carboniferous arc volcanic rocks, associated plutonic suites of Mississippian age, Devonian-Mississippian metaclastic rocks, and their basement complex. To the southwest, Yukon-Tanana Terrane is juxtaposed with the Semenof block — a belt of mafic metavolcanic rocks of uncertain terrane affinity — along the Needlerock and Big Salmon faults. To the northeast, the Tummel fault zone delineates the contact between Yukon-Tanana and Cassiar terranes. The narrow belt of chert, argillite and greenstone which occurs within the Tummel fault zone probably correlates with the Slide Mountain Terrane. The area is intruded by Early Jurassic and Cretaceous plutons and is dissected by a series of late faults, which results in approximately 56 km of dextral offset of the Yukon-Tanana Terrane.

RÉSUMÉ

Le coeur des région cartographiques de Glenlyon et de Carmacks nord-est est occupé par une ceinture de roches métasédimentaires, métavolcaniques, et (méta)plutoniques du terrane de Yukon-Tanana, d'orientation nord-ouest. Celle-ci inclue deux successions de roches volcaniques d'îles-en-arc datant du Carbonifère; les suites plutoniques mississippienne qui leur sont assoçiées; des roches métaclastiques du Dévonien-Mississippien; et leur socle rocheux. Au sud-ouest, le terrane de Yukon-Tanana est en contact avec le bloc de Semenof — une ceinture de roches métavolcaniques mafiques dont l'affinité tectonique est inconnue — le long des failles de Needlerock et de Big Salmon. Au nord-est, la zone de faille de Tummel définie le contact entre les terranes de Yukon-Tanana et de Cassiar. L'étroite ceinture de cherts, d'argillites et de roches vertes que l'on retrouve au sein de la zone de faille de Tummel appartient probablement au terrane de Slide Mountain. La région contient aussi des plutons d'âges jurassiques et crétacés. Elle est recoupée par une série de failles tardives qui résulte en un déplacement dextre du terrane de Yukon-Tanana d'environ 56 km.

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INTRODUCTION

Bedrock mapping in Glenlyon map area (105L) was initiated in 1998 to evaluate the possible correlation of Yukon-Tanana Terrane southwest of Tintina Fault with that of massive sulphide-hosting strata in the Finlayson Lake district, northeast of the fault, and to assess the potential of the area for volcanic-hosted massive sulphide deposits. The Glenlyon area lies along regional trend to the south of the Finlayson Lake district when ~425 km of dextral displacement is restored along Tintina Fault (Fig. 1).

Between 1998 and 2001, 1:50 000-scale mapping focused on areas of better exposure in northwest Glenlyon map area (105L/13; Colpron, 1998; 1999a) and near Little Salmon Lake, to the south (105L/1,2,7; Colpron, 2000; Colpron and Reinecke, 2000; Gladwin et al., 2002b). This detailed mapping has defined the stratigraphic framework of Yukon-Tanana Terrane in the area. In particular, it has identified successions of Carboniferous arc volcanic rocks, associated plutonic suites of Mississippian age, and their potential basement complex (Colpron, 2001). This work also uncovered indications that hydrothermal systems capable of producing volcanogenic massive sulphide deposits operated during volcanism, including a small massive sulphide occurrence (Yukon MINFILE 105L 062; Colpron, 1999b) and an occurrence of Mn chert exhalite in the Little Salmon formation.

This detailed work laid the foundation for regional, helicopter-supported bedrock mapping in poorly exposed areas of Glenlyon and northeastern Carmacks map areas during the 2002 summer. This program was conducted in conjunction with a till geochemistry survey of the area (Bond and Plouffe, this volume). The bedrock mapping and till sampling programs constitute the final contribution to the Yukon Targeted Geoscience Initiative, a program of the Geological Survey of Canada which supplemented ongoing mapping projects by the Yukon

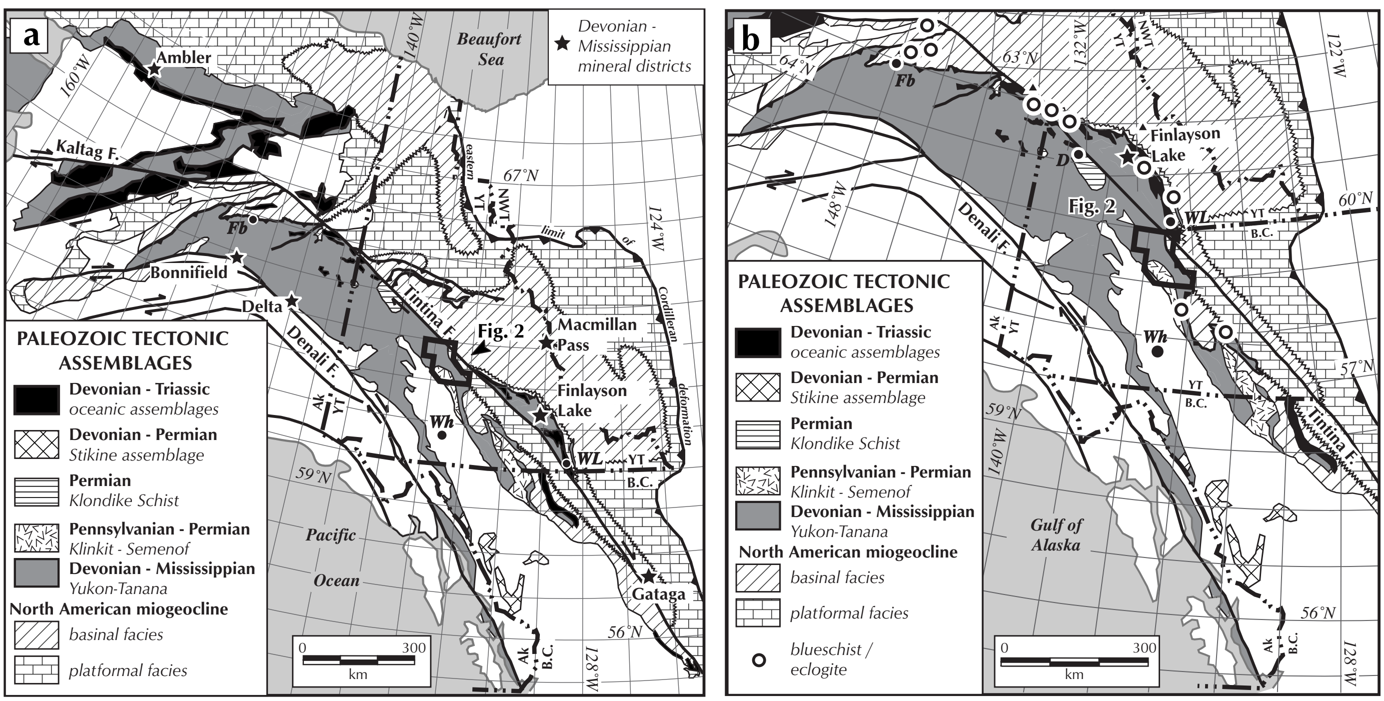


Figure 1. ***(a)*** *Location of the study area on a map of Paleozoic tectonic assemblages of the northern Cordillera (modified after Wheeler and McFeely, 1991; Silberling et al., 1992; and Foster et al., 1994).* ***(b)*** *Distribution of Paleozoic tectonic assemblages prior to displacement along Tintina Fault. Approximately 425 km of post-Late Cretaceous displacement has been restored along Tintina Fault. In this reconstruction, the study area lies along stike to the south of the Finlayson Lake district. Abbreviations: Ak – Alaska; B.C. – British Columbia; D – Dawson; Fb – Fairbanks; NWT – Northwest Territories; Wh – Whitehorse; WL – Watson Lake; YT – Yukon Territory. Blueschist and eclogite occurrences are from Dusel-Bacon (1994) and Erdmer et al. (1998).*

Geology Program and the Geological Survey of Canada undertaken under the auspices of the Ancient Pacific Margin National Mapping (NATMAP) project. This paper presents the results of the accelerated bedrock mapping component of the project. It is companion to the preliminary geological map of Glenlyon and northeast Carmacks areas (Colpron et al., 2002). The result of the till geochemistry survey are presented elsewhere in this volume (Bond and Plouffe, this volume).

The accelerated bedrock mapping program in Glenlyon and northeastern Carmacks areas aimed at determining (1) the regional extent of Carboniferous volcanic rocks of Yukon-Tanana Terrane and their local basement; (2) the nature of the contact between Yukon-Tanana and Cassiar terranes; and, (3) the composition of volcanic rocks at the northern end of the Semenof block (Tempelman-Kluit, 1984) and their relationship to Yukon-Tanana Terrane. In addition, this study provides new insights into the relationship between the Yukon-Tanana Terrane, the enigmatic Semenof block, and rocks of the Stikine Terrane. It also sheds new light on the history of post-accretionary faulting in central Yukon.

BEDROCK GEOLOGY OF GLENLYON AND NORTHEAST CARMACKS AREAS

The study area extends from displaced North American miogeoclinal strata of Cassiar Terrane in the northeast to the accreted arc volcanic and clastic rocks of Stikine Terrane in the southwest (Fig. 2; Colpron et al., 2002). The core of the area is underlain by a northwest-trending belt of metasedimentary, metavolcanic and (meta)plutonic rocks of the Yukon-Tanana Terrane. To the southwest, Yukon-Tanana Terrane is juxtaposed with the Semenof block — a belt of mafic metavolcanic rocks of uncertain terrane affinity (Tempelman-Kluit, 1984) — along the Needlerock and Big Salmon faults (Fig. 2). To the northeast, the Tummel fault zone delineates the contact between Yukon-Tanana and Cassiar terranes. The narrow belt of chert, argillite and greenstone which occurs within the Tummel fault zone probably correlates with the Slide Mountain Terrane. The area is intruded by Early Jurassic and Cretaceous plutons and is dissected by a series of late faults.

CASSIAR TERRANE

Mapping of Cassiar Terrane rocks in 2002 was limited to the west-half of 105L/11 (Colpron et al., 2002). In this area, Cassiar Terrane is underlain primarily by strata of the Silurian-Devonian Askin Group and Devonian-Mississippian Earn Group. The Askin Group is composed of dolostone and limestone, and lesser quartz sandstone. The Earn Group consists of black siliceous slate, quartz-chert greywacke, chert-granule grit and chert-pebble to -cobble conglomerate. North of Pelly River (105L/14), Earn Group strata host the Clear Lake deposit (Yukon MINFILE 105L 045).

Along Tummel River, a few outcrops of grey calcareous slate are attributed to the Cambrian-Ordovician Kechika Group (Colpron et al., 2002). Equivalents of the Kechika and Askin groups that are metamorphosed to amphibolite facies are also present in the southeast portion of the study area (105L/1) and are described in more detail in Gladwin et al. (this volume).

YUKON-TANANA TERRANE

Yukon-Tanana Terrane occupies a 19- to 46-km-wide, northwest-trending belt in the centre of the study area (Fig. 2; Colpron et al., 2002). It includes (Fig. 3): (1) Devonian and older polymetamorphic and polydeformed rocks of the Snowcap complex; (2) Devonian-Mississippian metaclastic rocks of the Drury and Pelmac formations; (3) Carboniferous metavolcanic rocks of the Little Kalzas and Little Salmon formations (and their subvolcanic intrusions); and (4) distal turbidites of the Bearfeed formation.

A number of new stratigraphic terms for Yukon-Tanana Terrane are introduced informally in this report and on the accompanying map (Colpron et al., 2002). These new stratigraphic units will be formally defined in a future bulletin.

SNOWCAP COMPLEX

The Snowcap metamorphic/plutonic complex constitutes the basement upon which Upper Devonian-Carboniferous strata of Yukon-Tanana Terrane were deposited (Fig. 3). It comprises predominantly psammitic schist, quartzite, dark grey carbonaceous schist and calc-silicate rocks which typically have amphibolite-grade metamorphic mineral assemblages (Fig. 4a). Coarse-grained garnet amphibolite and greenstone occur locally.

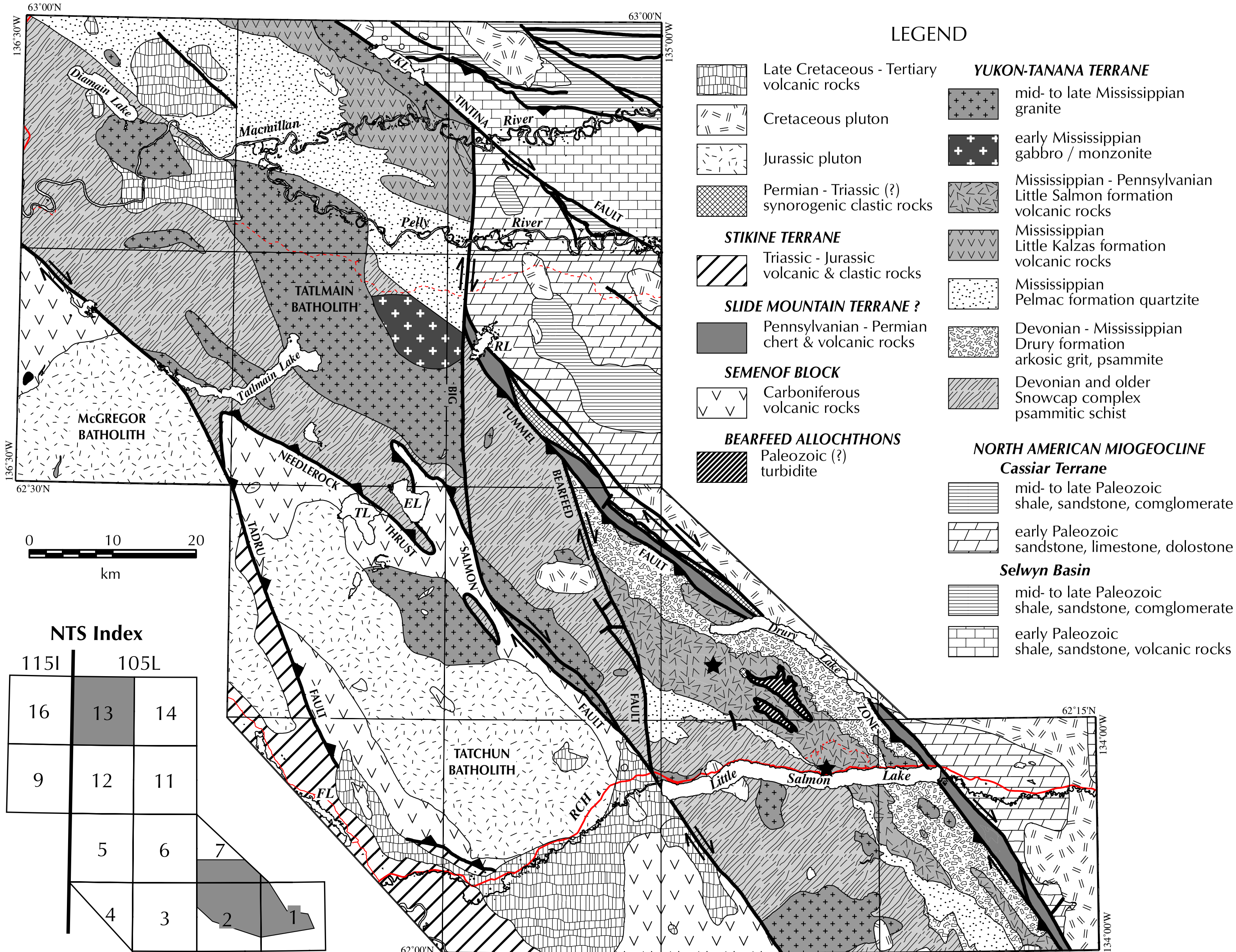


Figure 2. *Simplified geological map of Glenlyon and northwest Carmacks map area (modified after Colpron et al., 2002). Inset at lower left shows index to NTS 1:50 000-scale topographic maps. Grey-shaded areas were the focus of detailed (1:50 000-scale) mapping between 1998 and 2001 (Colpron, 1998; Colpron, 2000; Gladwin et al., 2002a). Star along the shore of Little Salmon Lake indicates the location of a small massive sulphide occurrence at the base of the Little Salmon formation (Yukon MINFILE, 2002, 105L 062). Star south of Drury Lake shows location of Mn chert near the top of the Little Salmon formation. Abbreviations: EL – Ess Lake; FL – Frenchman Lake; LKL – Little Kalzas Lake; RCH – Robert Campbell Highway; RL – Ragged Lake; TL – Tadru Lake.*

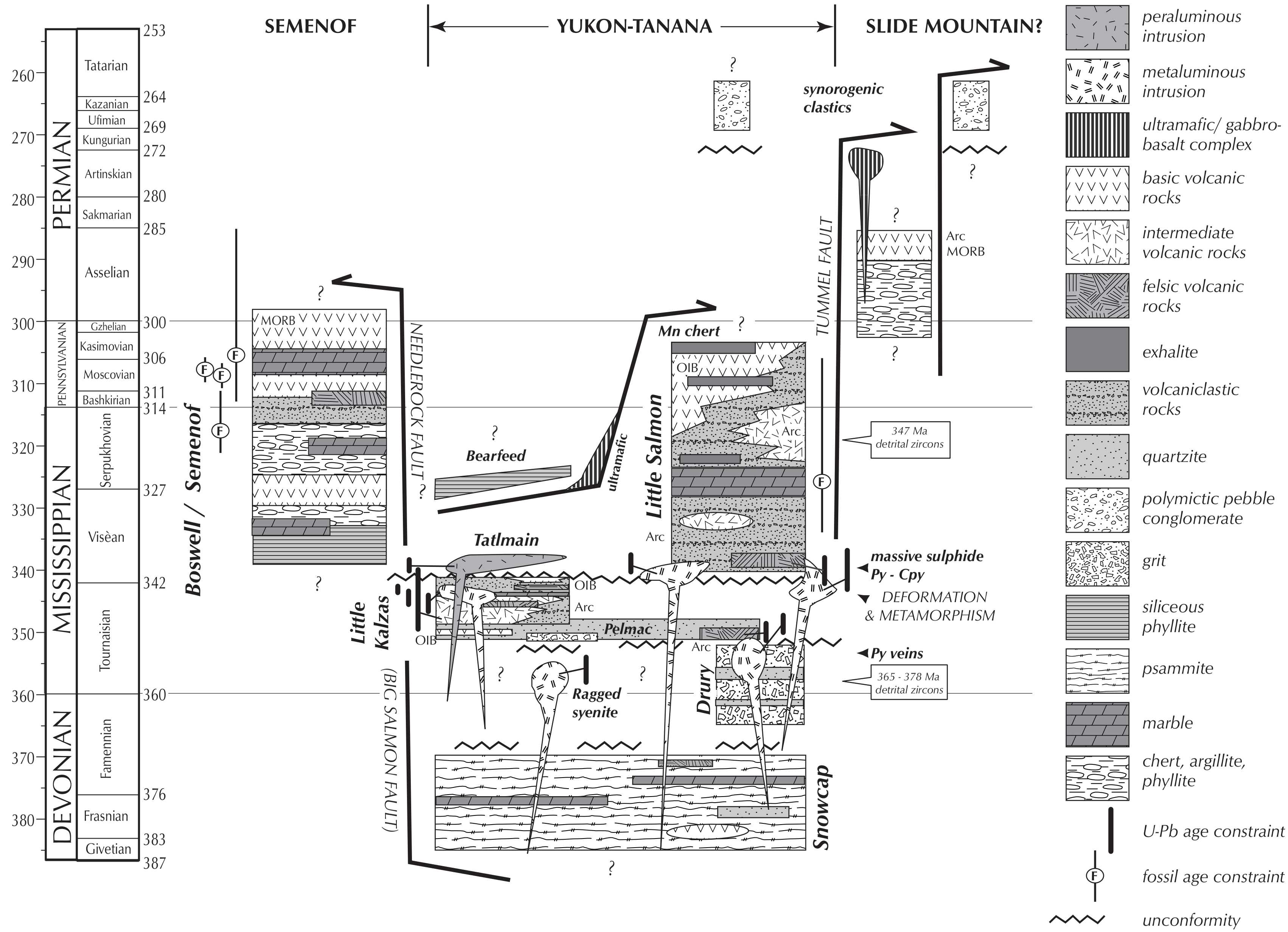
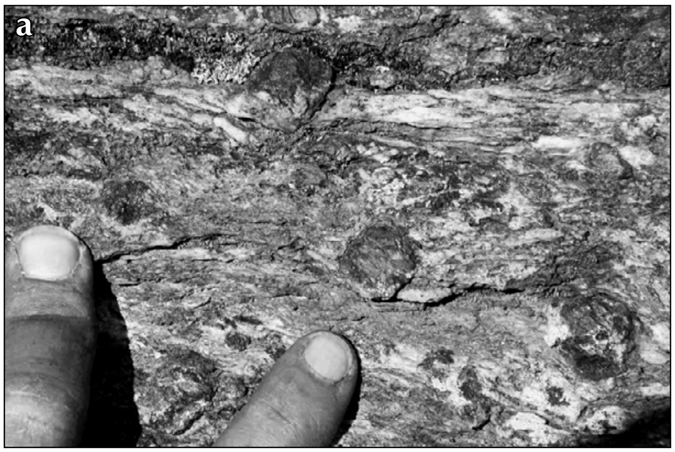


Figure 3. *Stratigraphic relations of Yukon-Tanana and affiliated terranes in Glenlyon and northeast Carmacks areas. Petrogenetic affinity of volcanic rocks: Arc = volcanic arc basalt/andesite ; MORB = mid-ocean ridge basalt; OIB = ocean-island basalt (alkalic). Time scale of Okulitch (2002). SMT? – Slide Mountain Terrane; Py – pyrite; Cpy – chalcopyrite.*

They are most common near Little Salmon Lake (105L/2; Colpron, 2000; Colpron et al., 2002) where they are locally intercalated with dolomitic marble. Amphibolite and greenstone have the geochemical characteristics of enriched mid-ocean ridge basalts (E-MORB) to transitional within-plate tholeiites (OIB; Colpron, unpublished data).

Marble locally defines good marker horizons that can be followed for tens of kilometres, such as near Little Salmon Lake (105L/2) and north of Tatlmain Lake (105L/12, 115I/9,16; Colpron et al., 2002). These occur with different lithologic associations and at different structural levels, suggesting that a number of carbonate intervals are present within the complex, rather than a single repeated



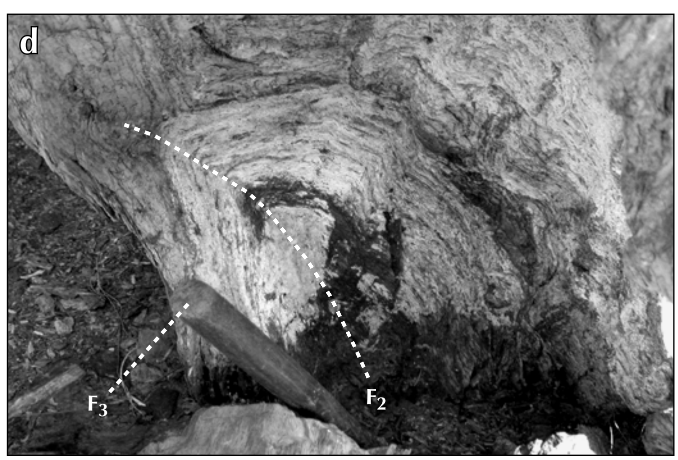


Figure 4. (a) *Garnet porphyroblasts in quartz-muscovite-actinolite schist, Snowcap complex south of Ragged Lake (105L/11). The garnets are late tectonic with respect to the foliation and partially retrograded to chlorite (dark rims).* ***(b)*** *Actinolite porphyroblasts in muscovite-quartz-feldspar schist (felsic metavolcanic ?) of the upper part of the Snowcap complex, south of Ragged Lake (105L/11).* ***(c)*** *Intrafolial isoclinal folds in metatonalite of the Snowcap complex, north of Tatlmain Lake (115I/9).* ***(d)*** *Polyphase deformation in psammitic schist of the Snowcap complex, south of Ragged Lake (105L/11). The dominant foliation is deformed by isoclinal folds (F_2, axial plane indicated by dashed line). Both dominant foliation and isoclinal folds are deformed by a younger set of open folds (F_3, axial plane indicated by dashed line).*

unit. At Little Salmon Lake, marble passes laterally into a polymictic pebble to boulder conglomerate (Colpron and Reinecke, 2000).

Distinctive muscovite-amphibole schist occurs locally near the top of the Snowcap complex. This rock is characterized by the presence of large green amphibole rosettes randomly oriented along the dominant foliation in cream-coloured muscovite schist (Fig. 4b). This unit may represent a metavolcanic horizon of intermediate to felsic composition. It is locally pyrite-banded and commonly associated with a light green muscovite-chlorite calcareous schist that contains abundant albite porphyroblasts.

Metasedimentary rocks of the Snowcap complex are intruded by numerous bodies of tonalite, granodiorite and granite, which are typically strongly foliated and lineated (Fig. 4c). These intrusive bodies are for the most part undated and may be coeval with Mississippian plutonic suites described below. South of Little Salmon Lake (105L/2; Fig. 2), plutons of the Little Salmon and Telegraph plutonic suites (338-340 Ma and 348-349 Ma, respectively; J.K. Mortensen, pers. comm., 2002) intrude the Snowcap complex. The Snowcap complex is unconformably overlain by Upper Devonian-Lower Mississippian strata of the Drury and Pelmac formations. It is therefore constrained as Late Devonian or older.

Rocks of the Snowcap complex have experienced a more complex deformational and metamorphic history than overlying Carboniferous strata. Psammitic and pelitic rocks of the Snowcap complex typically have garnet-grade metamorphic mineral assemblages and record multiple metamorphic events. Syn-tectonic garnet porphyroblasts are commonly partially to completely retrograded to chlorite. Rectangular aggregates of muscovite are likely pseudomorphs after an aluminosilicate phase (kyanite?; Colpron and Reinecke, 2000). Dominant, tight to isoclinal folds typically deform an earlier foliation (Fig. 4d).

RAGGED PLUTON

A body of coarse-grained augite gabbro and K-feldspar porphyritic syenite is inferred to intrude deformed rocks of the Snowcap complex west of Ragged Lake (105L/12; Colpron et al., 2002). The intrusive rock is unfoliated and intruded by granite of the adjacent Tatlmain Batholith. The Ragged pluton has yielded a preliminary Early Mississippian U/Pb zircon age (ca. 357 Ma; J.K. Mortensen, pers. comm., 2001). It is the oldest plutonic rock in the study area and predates all volcanic rocks in the area.

Figure 5. (a) *Coarse-grained arkosic grit of the Drury formation, along Robert Campbell Highway (105L/1). White grains are coarse, angular feldspar clasts. Hammer pick at top of photo for scale. Field of view is approximately 25 cm.* ***(b)*** *Well bedded quartzite of the Pelmac formation, north of Macmillan River (105L/13).*

DRURY FORMATION

The Drury formation consists predominantly of coarse-grained arkosic grit with up to 20% angular feldspar granules (Fig. 5a), grey and light green quartzite, psammitic schist, and green and grey phyllite. Recessive, dark grey, carbonaceous phyllite is likely an important constituent of the Drury formation. South of Little Salmon Lake, the Drury formation also includes calcareous phyllite and marble (Gladwin et al., this volume). Marble lenses are also locally present north of Little Salmon Lake. Detrital zircons from two samples of arkosic grit have yielded Late Devonian U/Pb ages exclusively (G. Gehrels, pers. comm., 2002). The Drury formation is intruded by granodiorite plutons of the 348-349 Ma Telegraph plutonic suite and is overlain by ca. 350 Ma metavolcanic rocks of the Lokken member of the Pelmac formation along the southeastern margin of the study area (105L/1). The Drury formation is therefore constrained as Upper Devonian to Early Mississippian.

PELMAC FORMATION

The Pelmac formation consists predominantly of massive to well bedded orthoquartzite (Fig. 5b). It is an extensive map unit in the northern part of the area, where more than 3 km of quartzite underlies volcanic rocks of the Little Kalzas formation (Fig. 2). To the south, the Pelmac quartzite has an average thickness of 400-600 m, but is only 10 m thick at Little Salmon Lake. It unconformably overlies the Snowcap complex and Drury formation, and is unconformably overlain by the Little Salmon formation. The quartzite commonly displays white to medium grey wispy banding. It is progressively more micaceous up-section, where it is locally intercalated with dark grey phyllite and dolomitic marble.

Near Pelly River, the quartzite is inferred to pass laterally into coarse-grained dolomitic grit and beige-weathering, medium to dark grey quartz-muscovite-dolomite schist (Colpron, 1998; Colpron et al., 2002). Dark grey dolomitic quartzite and minor light green quartz-muscovite-chlorite-dolomite (± biotite) schist are also intercalated with the grit and beige dolomitic schist that dominate this member of the Pelmac formation. The ubiquitous presence of dolomite distinguishes this unit from other parts of the Pelmac formation in the area. Along the banks of Pelly River, the dolomitic grit unit contains quartzite-pebble to -cobble conglomerate and minor carbonaceous phyllite.

Volcanic members

Bimodal metavolcanic and metavolcaniclastic rocks are locally associated with the Pelmac formation. In the southeastern part of the study area (105L/1), the Pelmac formation is underlain by quartz-feldspar porphyry, light green volcaniclastic rocks and minor mafic volcanic rocks (Lokken member; Gladwin et al., this volume). The quartz-feldspar porphyry yielded a preliminary U/Pb zircon age of ca. 350 Ma (J.K. Mortensen, pers. comm., 2002), which provides an upper age limit for the Pelmac formation. A sample of metabasalt has the geochemical characteristics of enriched mid-ocean ridge basalts (E-MORB; Colpron, unpublished data).

In the north (105L/13), volcanic rocks occur within the Pelmac quartzite. They consist predominantly of light green volcaniclastic sandstone and arkosic grit. Mafic volcanic (flow?) rocks are restricted to a few exposures within the volcaniclastic unit. They have trace element geochemical characteristics of within-plate alkali basalt (OIB; Colpron, 2001).

LITTLE KALZAS FORMATION

Metavolcanic and metavolcaniclastic rocks of the Little Kalzas formation form a northwest-trending belt in the northeast half of Little Kalzas Lake map area (105L/13; Fig. 2). The volcanic rocks are divided by a marble horizon into a lower and an upper unit (Colpron, 1998; 1999a). Below the marble, the volcanic succession consists predominantly of massive, plagioclase-phyric andesite and minor rhyolite. The andesite passes both upward and laterally to the southeast into a sequence of volcaniclastic rocks which is dominated by light green epiclastic sandstone and argillite. South of Macmillan River, epiclastic and tuffaceous rocks comprise the bulk of the lower unit. Outcrops of massive andesite occur sporadically within the volcaniclastic rocks.

Marble of the Little Kalzas formation forms a relatively continuous band of exposures in the northern part of Glenlyon map area (105L/13; Colpron et al., 2002). The marble varies in thickness from a few tens of metres to several hundred metres. South of Macmillan River, and at the northern edge of the map area, the marble forms large massifs which are likely the result of structural thickening. Marble also occupies a synclinal keel near Pelly River. There it passes laterally to the southeast into light green to grey chert. Marble of the Little Kalzas formation yielded Early(?) Carboniferous conodonts (M.J. Orchard, pers. comm., 1999).

Above the marble, the Little Kalzas formation consists of a mixture of metasedimentary and metavolcanic rocks (Colpron, 1999a). Carbonaceous phyllite and quartzite are dominant north of Macmillan River. Plagioclase-phyric andesite occurs only locally north of Macmillan River, and a rhyolitic tuff is exposed on the south-facing slope above the river. South of the river, light green epiclastic argillite, sandstone and grit make up the bulk of the upper unit. The sequence is capped by a dolomitic quartzite. Massive basalt outcrops are restricted to a small creek to the southwest of the dolomitic quartzite exposures.

Andesites of the Little Kalzas formation have calc-alkaline geochemistry typical of arc environments (Colpron, 2001). Basaltic rocks have the geochemical characteristics of alkali basalt of within-plate affinity (OIB, Colpron, 2001). Rhyolites have yielded preliminary U/Pb zircon ages of 345-346 Ma and show Proterozoic inheritance (J.K. Mortensen, pers. comm., 1999).

Little Kalzas and Telegraph plutonic suites

Granitoids of the Little Kalzas plutonic suite are broadly coeval with volcanic rocks of the Little Kalzas formation (343-346 Ma, Colpron et al., 2000) and are likely their subvolcanic equivalent. They occur as a large intrusive complex and small plutons southwest of Little Kalzas Lake (105L/13; Fig. 2). The dominant phase of the Little Kalzas suite consists of a fine- to medium-grained biotite (± hornblende) diorite, which is locally intruded by a granitic phase. Along Macmillan River, the Little Kalzas suite occurs as a sill complex of K-feldspar megacrystic granite. These rocks are strongly foliated and locally contain abundant xenoliths of country rocks.

South of Little Salmon Lake, foliated, hornblende-biotite quartz diorite to granodiorite plutons of the Telegraph suite intrude metasedimentary rocks of the Drury and Pelmac formations, as well as the Snowcap complex (NTS 105L/1,2; Colpron et al., 2002; Gladwin et al., this volume). These rocks yielded preliminary U/Pb zircon ages of 348-349 Ma (J.K. Mortensen, pers. comm., 2002).

LITTLE SALMON FORMATION

The Little Salmon formation is exposed in a 4- to 8-km-wide belt which extends northwesterly for approximately 50 km from south of Little Salmon Lake to northwest of Drury Lake, where it is truncated by the Bearfeed Fault (Fig. 2). It occupies a broad synclinorium and rests unconformably on arkosic grit and quartzite of the Drury formation, to the northeast, and on quartzite of the Pelmac formation to the southwest (Colpron, 2000). Near Little Salmon Lake, a quartzite-pebble to -boulder conglomerate locally marks the base of the Little Salmon formation (Gladwin et al., this volume).

The Little Salmon formation is dominated by volcaniclastic rocks (both epiclastic and tuffaceous; Colpron and Reinecke, 2000). A prominent marble unit of Late Mississippian-Early Pennsylvanian age (E.W. Bamber, *in:* Colpron and Reinecke, 2000) occurs in the lower part of the Little Salmon formation (Fig. 3). Dacite and quartz-feldspar porphyry mark the base of the sequence near Little Salmon Lake, along the western flank of the synclinorium. A small sulphide occurrence is present at the base of the felsic volcanic unit (Yukon MINFILE, 2002, 105L 062; Colpron, 1999b). Zircons from the quartz-feldspar porphyry yielded a U-Pb age of ca. 340 Ma and show Proterozoic inheritance (Colpron et al., 2000).

Volcanic rocks of intermediate composition (with subordinate mafic and felsic phases) form prominent exposures on the south-facing slopes overlooking Little Salmon Lake. These rocks are generally massive; pillow structures were observed at only one locality. Intermediate volcanic rocks grade laterally into tuffaceous rocks and epiclastic phyllite and sandstone. Along strike to the northwest, they occur as isolated lenses within the volcaniclastic rocks. These intermediate volcanic rocks have the geochemical character of calc-alkaline volcanic rocks of arc affinity.

South of Drury Lake (105L/7), the basal part of the Little Salmon formation locally contains a K-feldspar-crystal grit and granule conglomerate which yielded a concordant U/Pb zircon age of ca. 347 Ma (Mortensen, pers. comm., 2000). Similar rocks are also found south of Macmillan River (105L/14) where they occur near K-feldspar megacrystic granite of the Little Kalzas suite which is a likely source for the immature grits in the Little Salmon formation.

A distinctive plagioclase-phyric volcanic unit of intermediate composition is ubiquitous above the marble in the northwestern exposures of the Little Salmon formation. It contains up to 40-50% coarse (up to 3 cm), subhedral to euhedral plagioclase crystals in a fine-grained chloritic matrix. The abundance and large size of the plagioclase crystals suggest that these rocks may represent high-level subvolcanic intrusions. However, fine intercalations of dolostone and epiclastic sandstone with the crystal-rich volcanic rocks indicate that at least part of this unit has an extrusive origin.

Between Bearfeed Creek and Drury Lake, the Little Salmon formation contains a higher proportion of mafic flows and agglomerates than volcaniclastic rocks (Colpron, 2001; Colpron et al., 2002). Plagioclase- and hornblende-phyric basalts are dominant lithologies. The basalts commonly display well preserved pillow structures. Fragmental units, including pillow breccias and mass-flow deposits (poorly sorted, polymictic breccia with sericitic and/or hematitic matrix), are common adjacent to basaltic flow units. The basalts are intercalated with lapilli tuffs and reworked volcaniclastic rocks. Basaltic rocks of the

Little Salmon formation have subalkaline to alkaline affinities typical of rift environments (Colpron, 2001).

Two cherty horizons (1-10 m) occur in the upper part of the Little Salmon formation south of Drury Lake (Colpron et al., 2002). These siliceous rocks can be traced for up to 4 km along strike (Colpron, 2000). They were originally mapped as rhyolite on account of their very fine grain size and massive appearance (Colpron, 2000). However, their high silica (80-95% SiO_2), low potassium (<0.25% K_2O), and low zirconium (<50 ppm Zr) contents do not reflect a rhyolitic composition (Colpron, unpublished data). The lower horizon is light grey to light green and commonly contains brown-weathering dolomitic pods. Adjacent basalt exposures also contain dolomitic pods. The upper siliceous horizon is light grey, purple and pink, and is gradationally overlain by a 50-cm-thick red piemontite (Mn-rich epidote) chert horizon. This horizon is interpreted as an exhalative unit.

Tatlmain Batholith

The Tatlmain Batholith and Little Salmon plutonic suite comprise the sub-volcanic equivalent of the Little Salmon formation. The post-tectonic Tatlmain Batholith intrudes deformed Early Mississippian strata of Yukon-Tanana Terrane in northwest Glenlyon map area (Fig. 2). Tatlmain Batholith is an undeformed, homogeneous, coarse-grained biotite (± hornblende) quartz diorite to granite over its entire area. It intrudes the Snowcap complex and the Ragged pluton, and imposes a metamorphic aureole on quartzite and calc-silicate rocks of the Pelmac formation south of Pelly River. Near Diamain Lake, the coarse-grained granite contains xenoliths of foliated, fine-grained granodiorite similar to the main phase of the 343-346 Ma Little Kalzas plutonic suite. The Tatlmain Batholith is likely comagmatic with dacites of the Little Salmon formation (Colpron, 2001). A Late Triassic-Early Jurassic age was assigned to Tatlmain Batholith based on biotite K-Ar cooling dates in Carmacks map area (Stevens et al., 1982; Tempelman-Kluit, 1984). Preliminary U-Pb zircon age data indicate a mid-Mississippian age (ca. 340 Ma, Colpron et al., 2000).

Little Salmon plutonic suite

Near Little Salmon Lake, units underlying the Little Salmon formation (Drury and Pelmac formations and Snowcap complex) are intruded by plutons which have preliminary U/Pb ages similar to that of Tatlmain Batholith (J.K. Mortensen, pers. comm., 2000). These intrusions are included in the Little Salmon plutonic suite.

At the east end of Little Salmon Lake, a granodiorite pluton intrudes the Drury formation (Colpron, 2000). Zircons from this pluton yielded a discordant U-Pb age of 353 ± 1.4 Ma (Oliver and Mortensen, 1998). Preliminary results on another sample from this pluton suggest that its age may be younger (ca. 340 Ma; J.K. Mortensen, pers. comm., 2000). The Drury pluton consists of variably foliated, homogeneous, fine- to medium-grained, equigranular biotite ± hornblende granodiorite. Farther west, near the centre of Little Salmon Lake (Fig. 2), a large body of quartz diorite to granodiorite intrudes the Snowcap complex. The rock is moderately to strongly foliated, fine- to medium-grained, and contains hornblende and, locally, biotite. Muscovite is a common constituent of this rock; it probably formed as a result of low-grade metamorphism of original K-feldspar in the granodiorite. Small skarn occurrences are locally developed in calcareous rocks near the contact with plutons of the Little Salmon suite.

BEARFEED FORMATION

The Little Salmon formation is structurally overlain by an allochthonous sheet of distinct dark grey siliceous phyllite and light grey graded sandstone of the Bearfeed formation, which represents a distal turbidite sequence. It locally contains dark grey marble and carbonate-cobble conglomerate. Rocks of the Bearfeed formation may correlate with the basal part of the Boswell formation of Tempelman-Kluit (1984). The base of the Bearfeed allochthon is marked by sheared serpentinite and mylonitic fabric in the underlying Little Salmon formation south of Drury Lake (105L/7, Colpron, 2000).

SEMENOF BLOCK

Rocks of the Semenof block were first mapped by Tempelman-Kluit (1984) in Laberge map area (105E), south of the Glenlyon area. Tempelman-Kluit (1984; and *in:* Gordey et al., 1991) has informally subdivided rocks of the Semenof block into a lower sedimentary formation (Boswell formation) and an upper volcanic formation (Semenof formation; Fig. 3). Carbonates from both formations in Laberge map area have yielded conodonts and fusulinids of early to middle Pennsylvanian age (Tempelman-Kluit, 1984; Poulton et al., 1999). The terrane affinity of the Semenof block remains uncertain. Wheeler et al. (1991) and Tempelman-Kluit (*In:* Gabrielse, 1991) included rocks of the Semenof block in Slide Mountain Terrane. Gordey and Makepeace (1999) considered rocks of the Semenof block as part of the Klinkit subterrane — a probable northern equivalent of Harper Ranch subterrane, the Paleozoic basement of the Quesnel Terrane in British Columbia — because the absence of ultramafic bodies and abundance of siliciclastic rocks is atypical of the Slide Mountain Terrane. More recently, Colpron and Yukon-Tanana Working Group (2001) have raised the possibility that Semenof block may be part of Yukon-Tanana Terrane. An ongoing study of the Semenof block in Laberge map area will likely resolve this problem (see Simard and Devine, this volume).

In Glenlyon map area, the Semenof block consists primarily of mafic (meta)volcanic and subordinate carbonate rocks (Colpron et al., 2002), which are likely correlative with the Semenof formation of Tempelman-Kluit (1984). Rocks of the Semenof formation are variably deformed and metamorphosed in the area. Near Frenchman Lake, the Semenof formation consists of foliated basalt, greywacke and volcanic-lithic sandstone, minor recrystallized limestone and pink feldspar-phyric dacite and dacite breccia (Fig. 6a). This volcanic sequence is underlain by dark grey siltstone and siliceous argillite, chert-pebble to -boulder conglomerate and a thick, continuous limestone, which are likely equivalent to the Boswell formation of Tempelman-Kluit (1984). In this region the Semenof block is juxtaposed with rocks of the Whitehorse Trough (Stikine Terrane) along the Tadru Fault (Fig. 2; Colpron et al., 2002). In the south-central part of the area (105L/2-3; Fig. 2), the Semenof formation consists of undeformed basalt and plagioclase-phyric diorite metamorphosed to chlorite grade (greenschist facies). In one outcrop southwest of Little Salmon Lake, basaltic and dioritic phases show evidence of magma mingling (Fig. 6b).

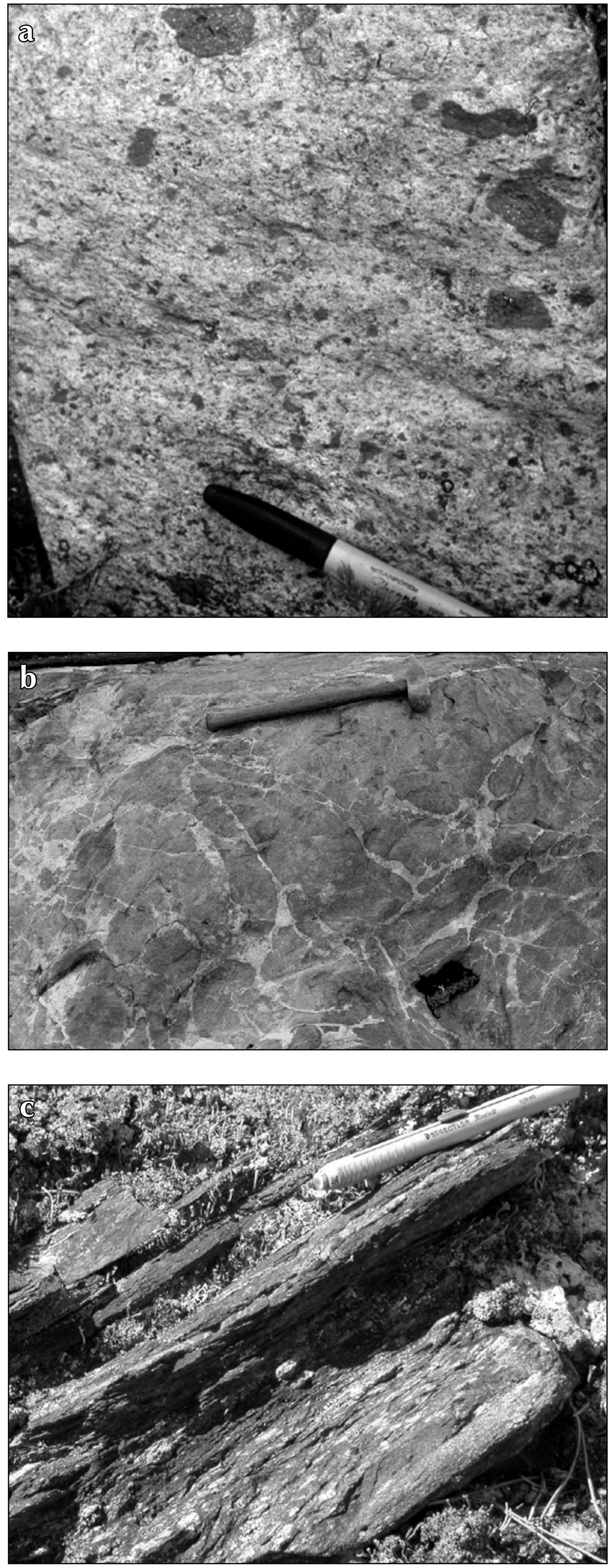


Figure 6. (a) *Dacite welded tuff with large maroon clasts, Semenof formation east of Frenchman Lake (105L/4).* ***(b)*** *Basalt (darker grey) intruded by fine- to medium-grained diorite, Semenof formation south of Robert Campbell Highway (105L/3). Contacts between the two phases are rounded and irregular. Relationships at this outcrop indicate that both basaltic and dioritic phases are coeval. Note that rocks are undeformed at this outcrop.* ***(c)*** *Feldspar-augen amphibolitic greenstone, Semenof formation east of Tatchun Batholith (105L/6). This rock is associated with fine-grained chlorite schist (metabasalt) which has the same composition as basalt in Figure 6b.*

Farther north, along the Bearfeed valley, between the Tatchun Batholith and the Big Salmon Fault (105L/6), the Semenof formation consists of strongly foliated, biotite-actinolite-grade, fine-grained to plagioclase-augen greenstone (Fig. 6c). Near Tadru Lake (105L/5,12), it is a strongly foliated and lineated, medium-grained (garnet) amphibolite intercalated with abundant white marble. Amphibolite, foliated diorite and ultramafic intrusions that are exposed west of Tatlmain Lake (north of McGregor Batholith; Fig. 2; Colpron et al., 2002) are likely part of Semenof block east of the Tadru Fault.

In a poorly exposed area south of Tadru Lake, the Semenof formation is apparently intruded by a strongly foliated hornblende tonalite to granodiorite which resembles plutonic rocks in the Snowcap complex to the east (Fig. 2; Colpron et al., 2002). This supports the notion that Semenof block and Yukon-Tanana Terrane may be genetically linked.

Rocks of the Snowcap complex are thrust onto the Semenof block along the Needlerock Fault, a folded thrust fault which marks the northern termination of the Semenof block between Tadru and Tatlmain lakes.

ROCKS OF THE TUMMEL FAULT ZONE

The Tummel fault zone is a 3- to 4-km-wide belt of imbricate fault slices extending from Ragged Lake to the southeast corner of the Glenlyon map area (Fig. 2; Colpron et al., 2002). It marks the contact between Yukon-Tanana and Cassiar terranes (see also Gladwin et al., this volume). Successive fault slices within the Tummel fault zone contain, from southwest to northeast, (1) chert, argillite and basalt correlated with Slide Mountain Terrane; (2) synorogenic polymictic conglomerate and wacke; and (3) miogeoclinal slate and carbonate of Cassiar Terrane (Fig. 2; Colpron et al., 2002).

CHERT-ARGILLITE-BASALT

The narrow belt of chert, argillite and basalt within the Tummel fault zone (Fig. 2) resemble rocks of the Pennsylvanian-Early Permian Campbell Range succession in the Finlayson Lake district, northeast of the Tintina Fault (Murphy et al., 2001; 2002). This belt comprises an association of chert, basalt, gabbro and serpentinite, which may represent a thin sliver of the Slide Mountain Terrane.

The chert is typically varicoloured (red, purple, pale green, and greenish-grey) and massive to thinly bedded, and weathers pale grey to tan. It is commonly interbedded with grey, red and black argillite. Chert and argillite make up the bulk of this belt north of Drury Lake (Colpron et al., 2002).

A unit of dark green, unfoliated basalt within the chert/argillite sequence shows flow breccia textures and altered glassy clast rims (Fig. 7a), typical of Sylvester Group basalts (Slide Mountain Terrane) in northern British Columbia (Nelson and Bradford, 1993).

Basalt is more extensive south of Little Salmon Lake where it is greenish-grey and variably foliated (see Gladwin et al., this volume). The basalt is locally intruded by medium- to coarse-grained hornblende leucogabbro. Serpentinite is also found locally within the basalt; it is commonly spatially associated with the leucogabbro (Gladwin et al., 2002a).

SYNOROGENIC CLASTIC ROCKS

North of Drury Lake (105L/6,7,11), fault slices northeast of the chert-argillite-basalt belt contain (1) polymictic pebble conglomerate; (2) light green, fine-grained arkosic sandstone; and (3) brown-weathering, black siliceous phyllite (Colpron et al., 2002). A similar polymictic pebble to cobble conglomerate and minor white and black quartzite also occur beneath the northeastern klippe of the Bearfeed allochthons (Colpron et al., 2002).

The conglomerate contains angular clasts of quartzite, black phyllite, greenstone, chert, and serpentinite supported by a light grey to light green fine-grained sandstone matrix (Fig. 7b). These clast compositions match closely with lithologies mapped in nearby exposures and, together with the angular shape of the clasts, suggest a proximal source for the conglomerate. In addition, a number of clasts are foliated, indicating that source rocks were deformed prior to deposition of the conglomerate. Black siliceous phyllite and arkosic sandstone are the dominant lithologies on a small hill southeast of Ragged Lake. The sandstone appears to contain detrital muscovite grains.

The polymictic conglomerate and arkosic sandstone are interpreted to be synorogenic clastic rocks that were deposited at the toe of advancing thrust sheets. The conglomerate resembles Permian-Triassic polymictic conglomerates that occur at the northeastern edge of Yukon-Tanana Terrane in Finlayson Lake and Watson Lake areas (Murphy et al., 2001; 2002; J.K. Mortensen, pers. comm., 2000). Occurrences of synorogenic polymictic conglomerate and sandstone both within the Tummel fault zone and beneath the Bearfeed allochthon suggest that thrust faulting was synchronous in both regions and, by correlation with the Finlayson Lake area, that deformation probably occurred during mid-Permian to Triassic time. Displacement indicators at the base of the Bearfeed allochthon show a top-to-the-east sense of transport (Colpron and Reinecke, 2000).

STIKINE TERRANE

Rocks of Stikine Terrane are exposed in the southwestern part of the map area (Fig. 2; Colpron et al., 2002). They comprise a lower unit of mafic volcanic rocks locally overlain by limestone (Lewes River Group), and an upper unit of immature clastic rocks of the Whitehorse Trough (Laberge Group). Stikine Terrane is juxtaposed with rocks of the Semenof block and Tatchun Batholith along Tadru Fault.

LEWES RIVER GROUP

The lowest unit observed in the area is a brown and green augite- (± olivine) phyric basalt. The rock is typically massive, although in the narrow belt between McGregor Batholith and Tadru Fault (105L/5) the basalt is commonly

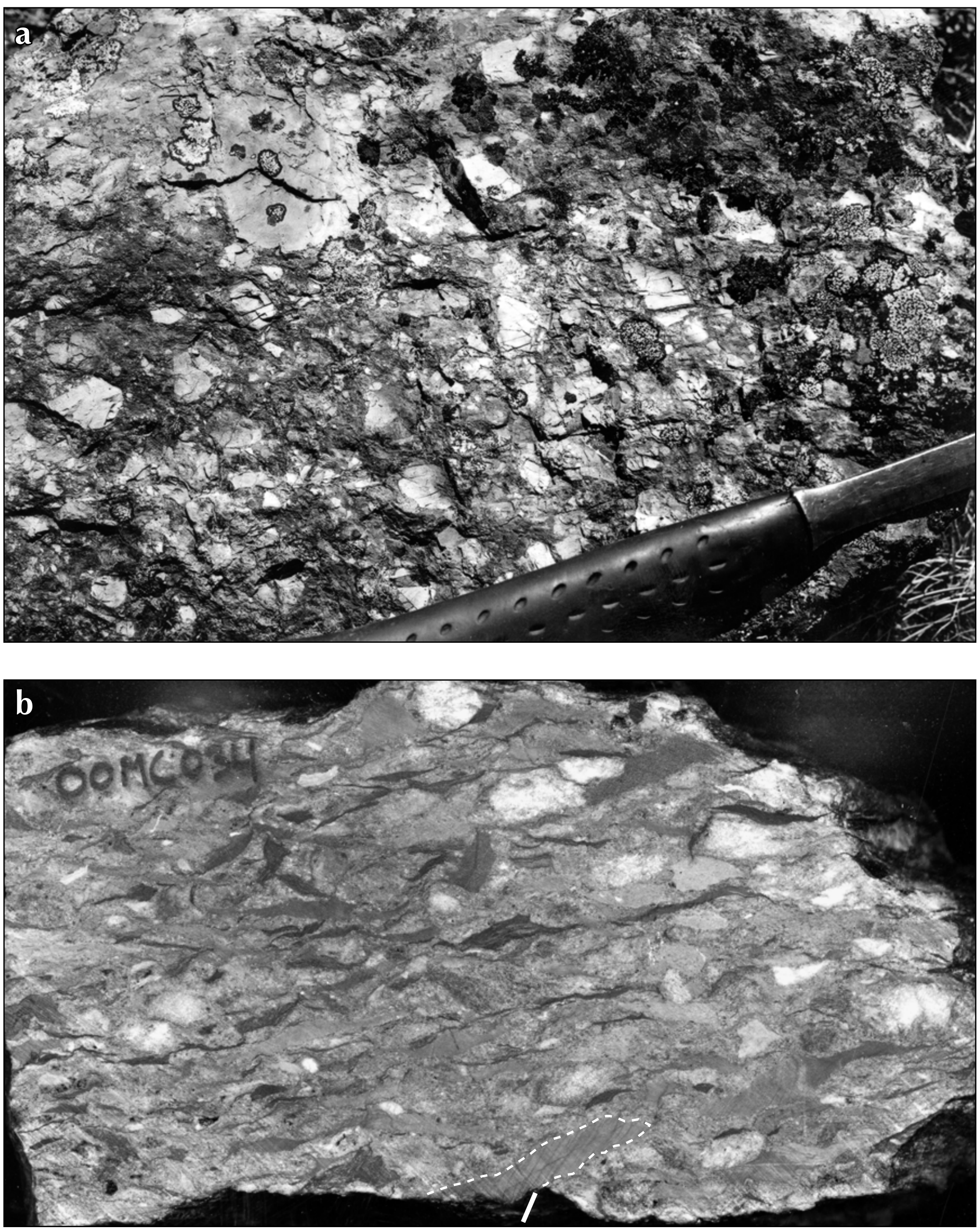


Figure 7. (a) *Flow breccia texture and altered glassy rims on clasts in basalt of the Tummel fault zone, north of Drury Lake (105L/7).* ***(b)*** *Slab sample of polymictic pebble conglomerate from the footwall of the northeastern klippe of the Bearfeed allochthons, south of Drury Lake (105L/7). Note foliated clast near bottom centre of the photo (dashed outline; solid line at bottom shows orientation of foliation in the clast). Sample is approximately 5 cm high.*

strongly foliated. In this area, a 2-m-thick horizon of foliated quartz-feldspar-phyric rhyolite occurs at one locality within the basalt. Near the southern edge of the map area (105L/3) the basalt locally shows pillow structures. Rare lapilli tuff is also present locally within this unit.

The mafic volcanic rocks are likely part of the Povoas Formation of the Lewes River Group, which is also characterized by abundant large augite phenocrysts (Tempelman-Kluit, 1984; Hart, 1997); however the presence of rhyolite and the local strong foliation in the basalt is more characteristic of the Late Mississippian Takhini assemblage of Hart (1997) and therefore these rocks could be of Paleozoic age.

Near Robert Campbell Highway, mafic volcanic rocks are locally overlain by fine-grained, massive limestone, which is probably equivalent to the Hancock member of the Aksala Formation (Lewes River Group; Tempelman-Kluit, 1984).

LABERGE GROUP

Rocks of the Lewes River Group are overlain by immature coarse-grained clastic rocks which are assigned to the Laberge Group. The predominant lithology is a red-weathering polymictic pebble to cobble conglomerate. Predominant clast types are plutonic and volcanic, and are supported by a matrix of graded sandstone. Red to dark brown siltstone occurs at one locality south of Robert Campbell Highway.

OVERLAP ASSEMBLAGE

TRIASSIC

Strata of probable Triassic age are exposed in two small outliers within Tummel fault zone (105L/6-7) and in the core of a syncline in Cassiar Terrane (105L/10; Colpron et al., 2002). They consist of finely laminated, soft, dark grey, buff-weathering shale and siltstone, fine-grained, grey sandstone and minor dark grey limestone. The siltstone and sandstone commonly contain detrital micas. These rocks resemble known Triassic strata elsewhere in Yukon.

TANTALUS FORMATION (?)

A single, isolated outcrop of light grey tuffaceous siltstone, lignite and tuff is exposed along Robert Campbell Highway (105L/3; Colpron et al., 2002). Tuff from this outcrop has yielded a U/Pb zircon age of 92 ± 1 Ma (L.E. Jackson, *in:* Breitsprecher et al., 2002). These rocks may be equivalent to the Tantalus Formation (Yorath, 1991), although the Late Cretaceous age from the tuff horizon is somewhat younger than the Late Jurassic-Early Cretaceous age (in part Albian; 99-111 Ma) typically assigned to the Tantalus Formation.

CARMACKS GROUP

Reddish brown-weathering basaltic rocks occur sporadically throughout the area (Fig. 2; Colpron et al., 2002). The largest extent of young basalt is in the southern part of the Glenlyon area (105L/3), where approximately 270 km^2 of dark green to black aphanitic basalt, amygdaloidal basalt and agglomerate are poorly exposed south of Robert Campbell Highway. Amygdules are commonly filled with agate. North of Robert Campbell Highway, a basalt outcrop yielded a K/Ar whole rock age of 73 Ma (Hunt and Roddick, 1992) indicating that these rocks correlate with the Carmacks Group (Grond et al., 1984). Exposures of Carmacks Group basalt south of Robert Campbell Highway were previously unrecognized. They were previously mapped as part of an extensive unit of volcanic rocks presumed to be Triassic or older (unit 16a of Campbell, 1967). Unit 16a is now shown to include volcanic rocks of the Carboniferous Semenof formation, Upper Triassic Lewes River Group and Upper Cretaceous Carmacks Group (Fig. 2).

A tongue of Carmacks basalt extends northwest to the vicinity of Frenchman Lake (105L/4; Fig. 2). East of Frenchman Lake, the basalt flows are beautifully exposed in a small canyon. Further north, the basalt abuts a small hill of limestone inferred to be part of the Boswell formation (Colpron et al., 2002). The Carmacks Group overlaps the Tadru Fault, which juxtaposes Semenof block and Stikine Terrane.

Carmacks Group volcanic rocks are also extensive in northeastern Carmacks area (115I/16; Fig. 2). Tempelman-Kluit (1984) considered these exposures of brown weathering, resistant, fresh andesitic basalt as part of the upper Carmacks Group. Up to 600 m of volcanic flows are exposed in benches northeast of Diamain Lake (115I/16). Near its contact with the underlying Tatlmain Batholith, the Carmacks Group locally contains volcanic breccia and sandstone. Exposures from Granite Canyon, on the Pelly River, and from hills northeast of Diamain Lake have yielded K/Ar whole rock dates of 64 Ma and 74 Ma, respectively (Wanless et al., 1979; Stevens et al., 1982; Tempelman-Kluit, 1984).

TERTIARY VOLCANIC ROCKS

Tertiary volcanic and high-level intrusive rocks also occur sporadically throughout the map area (Colpron et al., 2002). They consist of rhyolite flows and breccia, felsic to intermediate tuff, and quartz-feldspar porphyry. U/Pb zircon ages from two localities have yielded Late Paleocene ages (55-56 Ma; Breitsprecher et al., 2002). The rhyolite is locally flow-banded and/or spherulitic. Tertiary volcanic rocks are most common near exposures of Carmacks Group basalts.

JURASSIC PLUTONS

Intrusive rocks of Jurassic age are mostly found in the western part of the map area (Fig. 2). There, granitic rocks of probable Late Triassic - Early Jurassic age form two large plutons — the Tatchun and McGregor batholiths. These two intrusive bodies were previously mapped as a single continuous batholith (Campbell, 1967; Tempelman-Kluit, 1984) but our mapping shows that they are separated by the Tadru Fault and a narrow band of mafic metavolcanic rocks (Colpron et al., 2002).

The Tatchun and McGregor batholiths are both composed of three intrusive phases. The earliest phase is a variably foliated, coarse-grained equigranular hornblende-biotite granodiorite. It is locally hornblende porphyritic. Rare gabbro is also associated with this phase of the Early Jurassic plutons. Biotite gabbro appears to be the earliest phase at the north end of Tatchun Batholith (105L/5; Colpron et al., 2002). A small body of augite gabbro to pyroxenite also occurs in the northern McGregor Batholith (115I/9). The granodiorite phase is intruded by medium-grained K-feldspar megacrystic granodiorite. The megacrystic phase is locally weakly foliated. Both phases of granodiorite typically contain magmatic epidote indicating a minimum crystallization pressure of 6 kbar (Zen and Hammarstrom, 1984; Zen, 1989). The youngest phase is a beige-weathering, unfoliated, fine-grained leucogranite and aplite. Pegmatite dykes are locally associated with the aplite in the northern part of Tatchun Batholith. A sample of leucogranite from Tatchun Batholith yielded a preliminary U/Pb zircon age of ca. 197 Ma (J.K. Mortensen, pers. comm., 2001).

An altered gabbro to anorthosite pluton intrudes rocks of Cassiar Terrane in the northeastern part of the map area (105L/11; Colpron et al., 2002). This pluton is undated, but inferred to be Jurassic in age because its composition closely matches the gabbro described above.

Two small plutons of hornblende ± biotite quartz monzonite are exposed in the northern part of the area (105L/13; Colpron et al., 2002). The largest of these plutons (Cornolio pluton) has yielded an imprecise Permian U/Pb zircon age, but could well be of Early Jurassic age (J.K. Mortensen, pers. comm., 2000).

CRETACEOUS PLUTONS

Cretaceous granitic plutons intrude rocks of Yukon-Tanana and Cassiar terranes in the eastern part of the Glenlyon area (Fig. 2). The largest concentration of Cretaceous intrusive rocks is found in the Glenlyon Batholith, a large body of granodiorite, granite and rare pegmatite (see Black et al., this volume; and Gladwin et al., this volume, for more detailed descriptions). A single K/Ar whole rock date from hornfels near a satellite of the Glenlyon Batholith gives an age of 105 ± 4 Ma (Hunt and Roddick, 1990). This age is similar to a U/Pb monazite age of 109 ± 3 Ma obtained from the d'Abbadie pluton in Laberge map area (de Keizjer, 2000). D'Abbadie pluton is likely a southern extension of the Glenlyon Batholith (Gordey and Makepeace, 2000). A similar age (U/Pb zircon — 108.1 ± 0.2 Ma) was also obtained from a porphyry encountered in drill core at the Clear Lake deposit to the north (105L/14; Breitsprecher et al., 2002). Based on these age determinations, the Glenlyon Batholith can be indirectly dated as Early Cretaceous.

A series of smaller plutons intrude rocks of Yukon-Tanana Terrane between Tummel and Big Salmon faults (Fig. 2). These plutons are granitic, with medium-grained, equigranular biotite-bearing and K-feldspar megacrystic phases. Two plutons near Little Salmon Lake (105L/2; Colpron et al., 2002) yielded imprecise U/Pb zircon ages between 93-96 Ma (J.K. Mortensen, pers. comm., 2001).

STRUCTURE

Rocks of Yukon-Tanana Terrane in Glenlyon map area have experienced several episodes of deformation, which all resulted in foliation development and folding. The Snowcap complex records the most complex deformational history in the area, with some of its fabrics having clearly developed before deposition of overlying Carboniferous strata. The best constrained deformational event is the development of a foliation in rocks of the Pelmac formation in the northern part of the map area (105L/13) prior to intrusion of the undeformed Tatlmain Batholith at ca. 340 Ma. Elsewhere, the deformation is clearly younger than Mississippian (i.e. deforms rocks younger than 340 Ma) but is difficult to distinguish from the Mississippian fabrics. Development of the dominant regional folds and associated foliation is tentatively considered to be Permian to Jurassic in age. $^{40}Ar/^{39}Ar$ mica cooling ages from Yukon-Tanana Terrane in the area are consistently between 180-190 Ma, suggesting that the whole area cooled below ca. 300°C in Early Jurassic time. This would indicate that greenschist facies foliations developed before the Early Jurassic. More detailed descriptions of fabric relationships and mesoscopic scale structures will be presented in a bulletin in preparation.

One of the main contributions of the 2002 accelerated bedrock mapping program was to identify and delineate the major fault systems in Glenlyon and northeast Carmacks map areas (Fig. 2). These faults are described below.

TUMMEL FAULT ZONE AND BEARFEED ALLOCHTHONS

The Tummel fault zone marks the contact between Yukon-Tanana, to the southwest, and Cassiar terranes, to the northeast (Fig. 2). It comprises a series of imbricate fault slices of chert, basalt, polymictic conglomerate and metasedimentary rocks of Cassiar Terrane (see descriptions above and Gladwin et al., this volume). The Tummel fault zone contains both ductile fabrics and superimposed younger brittle fabrics, evidence of a complex structural evolution. Individual faults within this zone generally dip steeply to the southwest or are sub-vertical. Lithologic correlations suggest that rocks as young as Middle Permian and possibly Triassic are deformed in the Tummel fault zone. Occurrence of post-kinematic, low-pressure metamorphic assemblages (likely part of the contact aureole of the Glenlyon Batholith) across the fault zone suggest that minimal displacement has taken place after intrusion of the Early Cretaceous Glenlyon Batholith (Gladwin et al., this volume). Thus, deformation within the Tummel fault zone can be constrained to be between Late Permian and Early Cretaceous.

As discussed above, the polymictic conglomerates that occur in fault slices of the Tummel fault zone are interpreted as synorogenic clastic rocks that were deposited during emplacement of Yukon-Tanana Terrane onto the North American miogeocline (Cassiar Terrane). Thus the polymictic conglomerates may be genetically linked to the early stages of deformation within the Tummel fault zone.

A similar polymictic conglomerate also occurs at the base of the Bearfeed allochthons (Colpron et al., 2002). The basal contact of the eastern klippe of the Bearfeed allochthons is marked by sheared serpentinite and mylonitic fabric in the footwall of the fault. Rotated porphyroclasts in mylonitic metavolcanic rocks of the Little Salmon formation indicate northeasterly emplacement of the allochthons (Colpron and Reinecke, 2000). The Bearfeed allochthons and Tummel fault zone may have formed part of an easterly directed thrust stack of Middle Permian-Triassic age.

NEEDLEROCK THRUST

The Needlerock Thrust marks the northern termination of the Semenof block (Fig. 2). It juxtaposes psammitic schist and quartzite of the pre-Upper Devonian Snowcap complex, to the north, with greenstone, amphibolite and marble of the Carboniferous Semenof formation, to the south. A spectacular exposure of the thrust is present northeast of Ess Lake (105L/12; Fig. 8), where greenstone of the Semenof formation show progressive fabric development in the immediate footwall of the fault. Footwall fabrics from this locality suggest top-to-the-south thrusting. Elsewhere, the Needlerock Thrust is largely unexposed and was traced on the basis of the distribution of the contrasting Snowcap and Semenof lithologic assemblages. An isolated occurrence of serpentinite south of Tatlmain Lake may lie along the Needlerock Thrust (Colpron et al., 2002). The trace of the fault suggests that it is folded and therefore predates the map-scale folds in the area. Relationships that might show its temporal relationship to the Early Jurassic plutons were not seen. The Needlerock Thrust is cut off by the steeper Big Salmon (to the east) and Tadru faults (to the west). Timing of displacement along Needlerock Thrust is poorly constrained but may be Triassic-Jurassic.

TADRU FAULT

The Tadru Fault is the most westerly of the faults mapped in the Glenlyon-northeast Carmacks area (Fig. 2). In southwestern Glenlyon, it marks the contact between Semenof block on the east, and Stikine Terrane on the west. West of Tatlmain Lake (115I/9), it juxtaposes rocks of the Snowcap complex to the northeast with the Early Jurassic McGregor Batholith and amphibolite which is possibly correlative with the Semenof formation, to the southwest. The Tadru Fault has an apparently moderate northeast dip, east of Frenchman Lake. Farther north, the trace of the fault suggests that it dips more steeply to the east-northeast (Fig. 2). Shear bands in greenstone of the Lewes River Group in the footwall of the fault indicate top-to-the-southwest displacement. Similar structures in a mylonitic part of the early phase of Tatchun Batholith, east of the fault, indicate oblique top-to-the-northwest displacement. Ductile deformation of the Tatchun Batholith in the hanging wall of the fault also indicates that at least part of the displacement along Tadru Fault is Early Jurassic in age. Similar structures are also observed in the northern part of McGregor Batholith, in the footwall of Tadru Fault, west of Tatlmain Lake. The right-lateral offset of Tatchun and McGregor batholiths may indicate a history of strike-slip displacement along part of the Tadru Fault. Displacement along the Tadru Fault predates deposition of basalts of the Upper Cretaceous Carmacks Group, which overlap the fault near Frenchman Lake (105L/4; Fig. 2).

The Tadru Fault in Glenlyon map area occupies the same structural position as Teslin Fault farther south (Gordey and Makepeace, 2000).

BIG SALMON AND BEARFEED FAULTS

The Big Salmon and Bearfeed faults are relatively young, with well-defined topographic lineaments (Fig. 9). The Big Salmon Fault trends northwesterly between the southern edge of the map area and Ess Lake, where it juxtaposes Yukon-Tanana Terrane, on the east, with Semenof block, on the west (Fig. 2). East of Ess Lake, Big Salmon Fault becomes north-trending and juxtaposes rocks of Yukon-Tanana Terrane on both sides. From Ragged Lake to its termination against Tintina Fault, it marks the contact between Cassiar, on the east, and Yukon-Tanana terranes, on the west (Fig. 2). The fault itself is not exposed, but its map pattern suggests that it is subvertical. Structures in mylonitic marble along the Bearfeed valley indicate top-to-the-southwest kinematics, suggesting that at least part of the Big Salmon Fault has reverse displacement.

The Bearfeed Fault is a splay of the Big Salmon Fault (Fig. 2). It diverges from the Big Salmon Fault near the west end of Little Salmon Lake and trends north-northwesterly until it merges with the northern part of the Tummel fault zone, near Tummel River. Bearfeed Fault juxtaposes Carboniferous rocks of the Little Salmon formation, on the east, to pre-Upper Devonian (?)

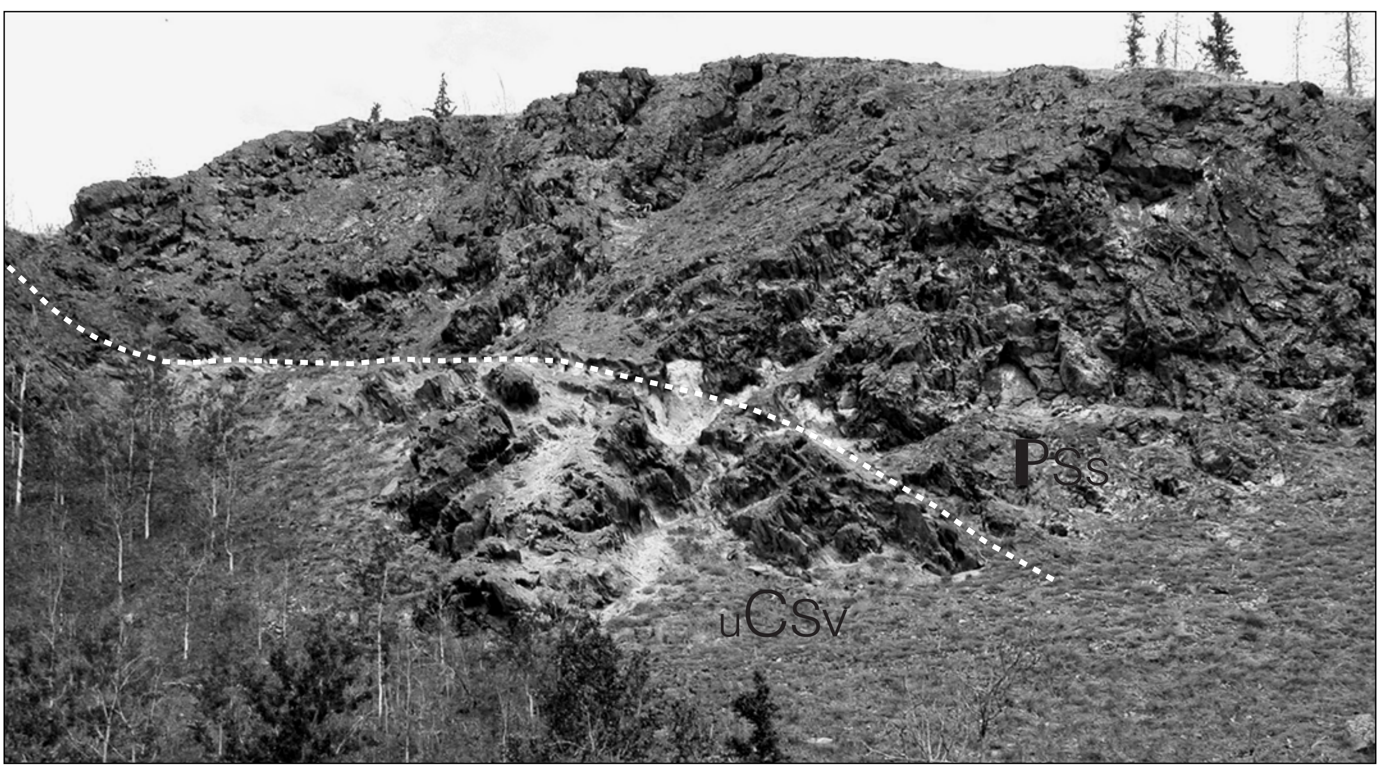


Figure 8. *Looking west at the only exposure of the Needlerock Thrust (dash line), north of Ess Lake (105L/12). Brown-weathering psammite of the Snowcap complex (PSs) overlies greenstone of the Semenof formation (uCSv) in the footwall of the fault.*

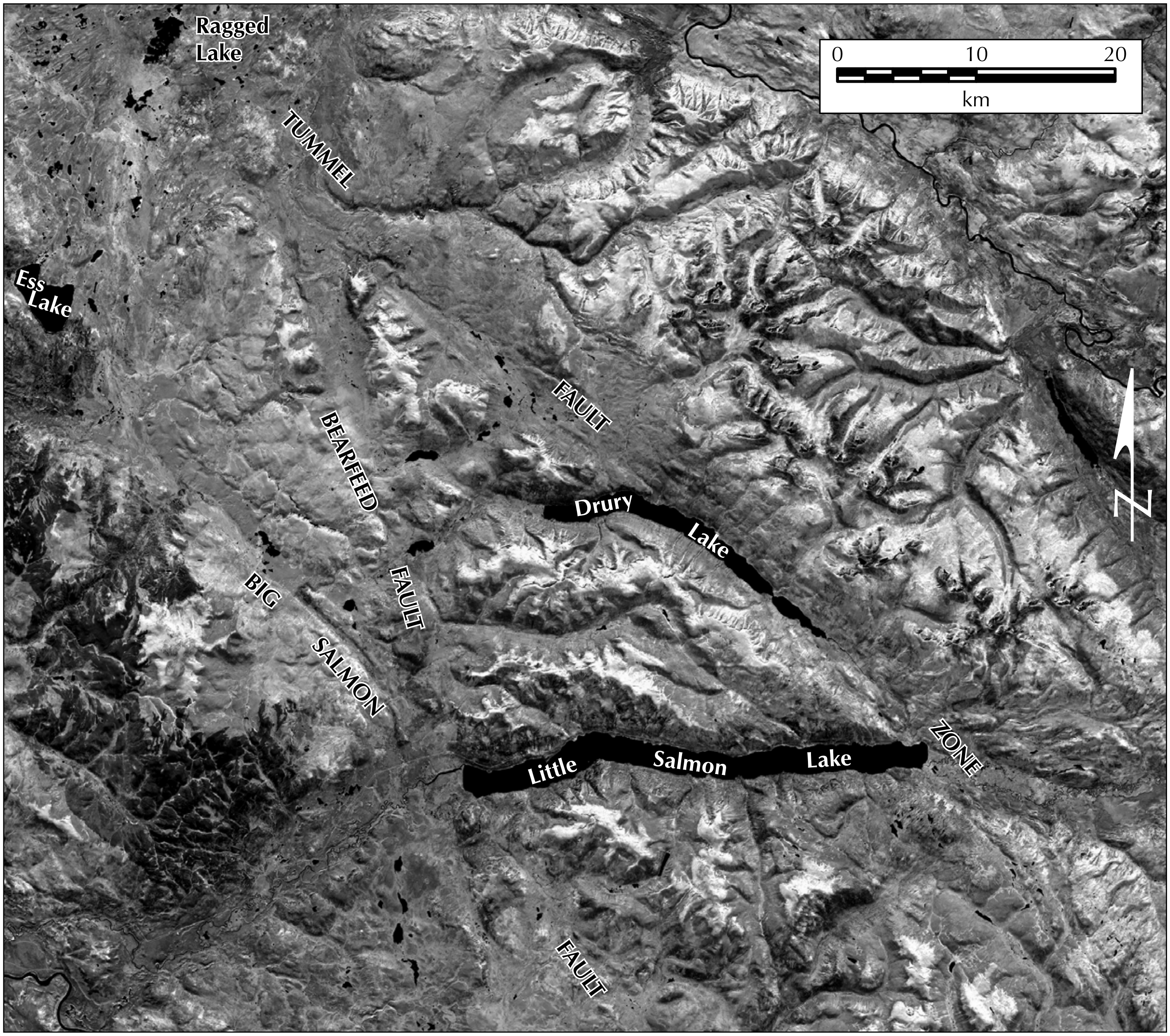


Figure 9. *Landsat 7 image of the southeast corner of the Glenlyon map area (image courtesy of Geomatics Yukon). Late faults in the area (labelled) are locally expressed by well defined topographic lineaments.*

basement rocks of the Snowcap complex, on the west, thus suggesting an apparent down-to-the-east normal displacement.

Right-lateral offset of the Pelmac formation (approximately 56 km) across the Glenlyon map area provides the best estimate for displacement along the Big Salmon-Bearfeed fault system (Fig. 2). The Big Salmon Fault truncates basalt of the Upper Cretaceous Carmacks Group at the west end of Little Salmon Lake and possibly offsets Tertiary rocks south of the lake. This suggests that at least part of the displacement along the Big Salmon-Bearfeed fault system must have occurred in Late Cretaceous-Early Tertiary time, possibly concurrently with displacement along Tintina Fault. On the other hand, this system is truncated by the Tintina Fault and must therefore predate the latest displacement along the Tintina Fault (Fig. 2).

MINERAL POTENTIAL

VOLCANIC-HOSTED MASSIVE SULPHIDES

The Carboniferous volcanic rocks of the Yukon-Tanana Terrane (Little Kalzas and Little Salmon formations) remain under-explored for volcanic-hosted massive sulphides. In particular, the Little Salmon formation is host to a small massive sulphide occurrence (Yukon MINFILE, 2002, 105L 062; Colpron, 1999b) and to Mn exhalites (Colpron and Reinecke, 2000). Geochemistry of till samples shows that the Little Salmon formation is anomalous in copper and gold (see Bond and Plouffe, this volume). Trace element geochemistry of the volcanic rocks suggests that the northwestern part of the Little Salmon formation may represent a rifted arc environment conducive to formation and preservation of massive sulphides (Colpron, 2001).

Rocks of the Semenof block have also seen little exploration activity. They mostly consist of mafic (meta)volcanic rocks and carbonate. However, the Semenof block locally contains felsic volcanic and tuffaceous rocks. Blocks of malachite-azurite in quartz were found near an occurrence of felsic volcanic rocks east of Frenchman Lake. Similar mineralized clasts were also found in a till sample and the geochemistry of the till yielded a copper anomaly in this area (Bond and Plouffe, this volume).

INTRUSION-RELATED MINERALIZATION

The map area contains numerous plutons of Mississippian, Jurassic and Cretaceous ages. Small skarn occurrences have been noted near some of the Mississippian plutons (Yukon MINFILE, 2002, 105L 008, 105L 011). Gossans are also locally present near Mississippian plutons. An extensive zone of gossan containing up to 2% pyrite can be traced for up to 5 km in the east-facing cliffs overlooking the southern part of Drury Lake (105L/7; Colpron, 2000). It lies along strike from granodiorite of the Drury pluton and just east of a small Mississippian gabbroic intrusion. Gossans are also present in psammitic schist at the southern margin of the Tatlmain Batholith (105L/12; at the contact and in a pendant within the pluton).

The Jurassic Tatchun and McGregor batholiths underlie a large portion of the western part of the map area. Both plutons have similar compositions. Samples of stream sediment and till from the McGregor Batholith yielded anomalous gold values (see Bond and Plouffe, this volume).

Cretaceous plutons in the eastern part of the area also have potential to host intrusion-related mineralization. A few skarn occurrences near the contact with the Glenlyon Batholith have seen some exploration activity (Yukon MINFILE, 2002, 105L 001, 105L 003) for lead-zinc-silver mineralization. Geochemistry of till samples from near Cretaceous plutons suggest that these plutons may also be suitable targets for intrusion-related gold deposits (see Bond and Plouffe, this volume). In particular, the small pluton of presumed Cretaceous age exposed to the south of Safety Pin Bend on the Pelly River (105L/11) yielded coincident Au, As and Sb anomalies (Bond and Plouffe, this volume).

FAULT-RELATED EPITHERMAL GOLD

Cretaceous-Early Tertiary faults of the Big Salmon-Bearfeed system should be considered for their potential to control distribution of epithermal gold mineralization in the area. Strong argillic alteration and quartz veining in gossaneous, brecciated rocks were noted in creek exposures along the Bearfeed Fault (105L/6). A sample of till collected along the Big Salmon Fault has returned anomalous values of Au, As, Sb and Pb (see Bond and Plouffe, this volume).

DISCUSSION

Bedrock mapping of Yukon-Tanana Terrane in Glenlyon map area has established the stratigraphic framework of the terrane southwest of Tintina Fault (Figs. 2,3). Yukon-Tanana consists of a basement complex of metasedimentary and metaplutonic rocks (Snowcap complex) overlain by a mainly Carboniferous volcano-sedimentary succession. This succession is subdivided into four formations — the Drury, Pelmac, Little Kalzas and Little Salmon formations — based on lithologic characteristics and preliminary age determinations. Regional mapping in 2002 shows that volcanic rocks of the Little Kalzas and Little Salmon formations, which are most prospective for VMS-style mineralization, are essentially restricted to areas previously mapped in detail (Fig. 2; Colpron, 1998; Colpron, 2000; Gladwin et al., 2002a). Both Little Kalzas and Little Salmon formations terminate abruptly against the Big Salmon-Bearfeed fault system — a series of Cretaceous-Early Tertiary dextral strike-slip faults which dissect Yukon-Tanana Terrane in the area.

The new mapping and ongoing geochronological studies have shown that plutonism and volcanism in Glenlyon map area are broadly contemporaneous with that of the Finlayson Lake area. The Little Kalzas formation, which consists predominantly of intermediate to mafic volcanic and sedimentary rocks of island arc affinity, is coeval with carbonaceous phyllite and felsic metavolcanic rocks of the Wolverine succession in Finlayson Lake map area, which have back-arc geochemical signatures (Piercey et al., 2000; Piercey et al., 2001; Piercey et al., 2002). As well, subvolcanic plutons of the Little Kalzas suite are coeval with the younger metaluminous plutons of the Simpson Range plutonic suite in the hanging wall of the Money Creek Thrust (Mortensen, 1992). Both the Little Kalzas and Simpson Range plutonic suites have calc-alkaline arc geochemical signatures (Grant et al., 1996; Piercey and Murphy, 2000; Colpron, 2001). Hence, the Little Kalzas formation, its subvolcanic plutons, and the Simpson Range plutonic suite probably define part of the arc system that laid in front of the Wolverine back-arc.

To the northeast, Yukon-Tanana Terrane is juxtaposed with Cassiar Terrane along the Tummel fault zone (Fig. 2). The Tummel fault zone comprises fault-bounded slices of (1) Pennsylvanian-Permian (?) chert-argillite-basalt of Slide Mountain Terrane; (2) Permian-Triassic (?) synorogenic clastic rocks; and (3) miogeoclinal rocks of Cassiar Terrane (Colpron et al., 2002). The Tummel fault zone is inferred to have originated as a southwest-dipping, easterly-directed thrust stack of Middle Permian to Triassic age. The thrusts were steepened and modified during subsequent Mesozoic (?) deformation. The structural stacking within the Tummel fault zone is similar to that at the leading edge of Yukon-Tanana Terrane in the Finlayson Lake area, northeast of Tintina Fault, where dark grey phyllite, chert and clastic rocks of the Finlayson succession are overlain by varicoloured chert and basalt of the Pennsylvanian-Permian Campbell Range succession (parautochthonous equivalent of Slide Mountain Terrane) and thrust onto rocks of Ancestral North America along the Inconnu Thrust (Murphy et al., 2001; 2002). Imbricates of Permian-Triassic, locally derived synorogenic clastic rocks locally occur along Inconnu Thrust. This zone is 10-15 km wide in Finlayson Lake area. Its equivalent in Glenlyon area is only 3-4 km wide.

This study also provides new data about the enigmatic Semenof block. Amphibolites north of Tatchun Batholith were previously considered a part of Yukon-Tanana Terrane (Campbell, 1967; Gordey and Makepeace, 2000). The new mapping now shows them to be the higher grade equivalents of basalt and diorite of the Semenof formation south of the batholith (Colpron et al., 2002). However, the presence of a foliated tonalite to granodiorite pluton (similar to those in the Snowcap complex) apparently intruding Semenof block south of Tadru Lake suggests that Semenof block and Yukon-Tanana Terrane may share a common history. North of Tadru and Ess lakes, the Needlerock Thrust juxtaposes rocks of the Snowcap complex in its hanging wall, with those of the Semenof formation in its footwall. The age of the Needlerock Thrust is unknown; it is apparently folded and therefore predates development of the regional scale, northwest-trending folds in the area.

Finally, this study sheds new light on the history of post-accretion faulting in the region. The Big Salmon and Bearfeed faults are part of a dextral strike-slip system which dissects the Yukon-Tanana Terrane in the area (Fig. 2). Dextral offset of the Pelmac formation suggests approximately 56 km of displacement along this fault system. The Big Salmon Fault is truncated to the north by the Tintina Fault. This implies that a matching counterpart of this fault must be present northeast of Tintina Fault approximately 425 km to the southeast, in the vicinity of Watson Lake. The regional significance of these post-accretionary structures has yet to be resolved.

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