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New geological mapping in Yukon–Tanana terrane near Thistle Creek, Stewart River map area, Yukon Territory[1]

[1] Contribution to the Ancient Pacific Margin NATMAP Project

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Abstract

The Thistle Creek map area (NTS 115-O/3), in the Stewart River area, Yukon Territory, is underlain by poly-deformed and metamorphosed Paleozoic rocks of the Yukon–Tanana terrane, and younger plutonic rocks. Two fault-bounded tectonostratigraphic associations dominate the map: 1) polyphase grey orthogneiss in garnet-amphibolite schist-gneiss, interpreted herein as a metavolcano-plutonic complex; 2) interstratified garnet-amphibolite schist-gneiss and metasedimentary schist and paragneiss derived from psammite, semipelite and quartz-arenite, collectively interpreted as a metavolcano-sedimentary succession. Grey and white banded quartzite beds are generally in fault contact with the gneiss and schist units, and their stratigraphic relationships are equivocal. Recognition of this area as an extensive metavolcanic terrane has significant implications for the economic potential of this area. Primary stratigraphy is obscured by an intense transposition deformation, and later, open folds and faults. Regional correlations of plutonic suites indicate that the transposition event was post-Carboniferous and pre-Jurassic.

Résumé

La région cartographique de Thistle Creek (SNRC 115-O/3), dans la région de la rivière Stewart (Territoire du Yukon), comporte des roches paléozoïques polydéformées et métamorphisées du terrane de Yukon-Tanana et des roches plutoniques plus récentes. Deux associations tectonostratigraphiques limitées par des failles prédominent sur la carte : 1) un orthogneiss gris polyphasé présent dans du schiste-gneiss amphibolitique à grenat, interprété comme étant un complexe métavolcano-plutonique; 2) du schiste-gneiss amphibolitique à grenat interstratifié, et du schiste et du paragneiss métasédimentaires dérivés de psammite, de semipélite et de quartzarénite, collectivement interprétés comme étant une séquence métavolcano-sédimentaire. Les lits de quartzite rubané gris et blanc sont généralement en contact de faille avec les unités de gneiss et de schiste et leurs relations stratigraphiques sont équivoques. L'identification de cette région comme étant un vaste terrane métavolcanique a des implications significatives en ce qui a trait à son potentiel économique. La stratigraphie primaire est masquée par une déformation transpositionnelle intense et, ultérieurement, par des failles et des plis ouverts. Des corrélations régionales établies entre des cortèges de roches plutoniques indiquent que la transposition a été postérieure au Carbonifère et antérieure au Jurassique.

INTRODUCTION

This work is a component of the Ancient Pacific Margin NATMAP project (**Fig. 1**), initiated by the Geological Survey of Canada, Yukon Geology Program, and British Columbia Geological Survey.

The project's goal is to understand the composition, relationships, and metallogeny of poorly understood terranes sandwiched between the ancestral North American margin and those known with more certainty to be tectonically accreted (Thompson et al., 2000). The Stewart River component focuses on the Yukon–Tanana terrane, comprising complexly deformed meta-igneous and metasedimentary rocks of mostly (?)Paleozoic age.

The earliest geological mapping in the area was by H.S. Bostock from 1934–1936 (Bostock, 1942) who produced a 1:253 440-scale coloured map for the eastern two-thirds of the Stewart River map area. The remaining western third was completed by Tempelman-Kluit (1974) at 1:250 000 scale. The northern quarter of the area (NTS 115 N/15,16; NTS 115-O/1–4) was mapped and recompiled by Mortensen (1996) at 1:50 000 scale. Within the Thistle Creek area (NTS 115-O/3), Cairnes (1917) provided a brief description of the bedrock geology; however, his report concentrated on the hitherto undocumented placer occurrences discovered during the Klondike gold rush of 1898.

The objective of the Stewart River project is to investigate the stratigraphic, structural, and tectonic history and the economic framework of the Yukon–Tanana terrane, by mapping parts of the eastern two-thirds of the area over a four year period. New and old data will be compiled into a new geological map of the Stewart River area.

AREA AND GENERAL GEOLOGY

Access to the Thistle Creek area (**Fig. 2**) is afforded by boat along the Yukon and Stewart rivers, and by air to a gravel strip along Thistle Creek. Helicopter access is restricted by extensive tree cover. Placer mining roads vary in condition from well maintained, to disused bulldozer trails, and provide good access within the area by all-terrane vehicle (ATV). This year's work consisted almost entirely of foot traverses from ATV and boat, with two short helicopter camps on and around Mount Stewart.

As noted by Bostock (1942), most of the Stewart River area is unglaciated (Jackson and Huscroft, 2000; Jackson et al., 2001). Bedrock is obscured by a thick (~1 m) soil veneer, thick gravel, and loess deposits in valley bottoms (Jackson and Huscroft, 2000), and by thick cover of forest, moss, and lichen. The best natural bedrock exposures are on the highest ridge crests (particularly south-facing slopes).

Excellent manmade exposures lie along placer mining benches and their access roads. The use of float is critical in locating bedrock contacts, particularly for the younger granite bodies that are more deeply eroded than the schist and gneiss.

The older rocks in the area are generally schistose or gneissic, and exhibit a shallowly inclined, high-strain regional foliation (S_T), formed through transposition of bedding (S_0), unit contacts, an earlier foliation (?S_1), and minor veins. Most geological boundaries on the map (Fig. 2) are portrayed as relatively straight and simplistic, due chiefly to the poor quality of bedrock exposure. It is difficult to accurately locate the trace and ascertain the dip of most contacts; however, if superordinate structures mimic those at the outcrop scale, it is more likely that unit boundaries, in detail, outline complex high-amplitude, low-wavelength isoclinal folds.

GEOLOGICAL UNITS

Bostock (1942) grouped most of the bedrock in the Thistle Creek area into what he termed the "Precambrian and Later" Yukon Group, and delineated several young plutons that he interpreted as Jurassic to Eocene. He divided the Yukon Group into "unit E: gneiss, quartzite, schist, slate" and "unit D: limestone". Similar rocks to the west and south were termed by Tempelman-Kluit (1974) as the "schist gneiss unit", comprising "brown-weathering muscovite-biotite quartzite and quartz mica schist, including amphibolite, augen gneiss and minor marble". He was able to discriminate several suites of younger plutonic rocks. Our mapping allowed division of these rocks into 15 units mappable at 1:50 000 scale (**Fig. 2**). Apart from some of the relatively young intrusive rocks, the stratigraphic succession is uncertain, and awaits ongoing geochronological study. Abundant dykes and veins of a variety of granitic rocks crosscut the gneiss units, and it is not possible separate them by age.

Metasedimentary rocks (units 1–5)

Unit 1 comprises a thick sequence of grey to white, banded quartzite. It is generally strongly recrystallized, and has metamorphic grain size in excess of 1 mm. Varieties range from black to rusty brown. Bostock (1942) and Tempelman-Kluit (1974) attributed the black to grey colour of the quartzite to fine-grained graphite. The quartzite commonly exhibits intrafolial isoclinal folds (**Fig. 3**); however, it does not appear as highly strained as most of the schist and gneiss across the area because bedding is well preserved. Although the thick quartzite is largely fault bounded (Fig. 2), local stratigraphic transition from quartzite to quartz-mica schist does occur (*see* 'Discussion'). Rhythmic layering in some quartzite (**Fig. 4**) is reminiscent of that observed in ribbon chert, and a chert origin for some of this quartzite cannot be excluded (*see* below).

Unit 2 comprises metaconglomerate, observed at one locality along the Yukon River (**Fig. 2**). It is strongly deformed, as evidenced by isoclinal folds of granite veins that cut it, but clasts are clearly recognizable in a matrix of quartzofeldpathic schist (**Fig. 5**). The conglomerate is matrix supported, and clasts are well rounded. Clasts are generally less that 10 cm in diameter, and composed chiefly of white quartzite (probably derived from eroded bull quartz veins). Less common clasts of tonalite are as large as 20 cm in diameter. The conglomerate grades locally to impure quartz arenite, and is adjacent to an occurrence of grey quartzite (Fig. 2). The contact with the quartzite may be stratigraphic, but could not be observed directly because it lies in the upper part of a cliff face. Due to transposition of this succession, the stratigraphic "younging" is unknown. The environment of formation of a tonalite-quartzite clast conglomerate is not consistent with the low sedimentation rates generally associated with thick chert accumulation, therefore a chert parentage for the quartzite at this locality is unlikely.

Unit 3 includes undivided mica-quartz schist and paragneiss derived from psammite, semipelite, and rare pelite. Although transposed, they generally preserve primary compositional layering. The mineral assemblage garnet-biotite-muscovite-quartz±plagioclase is common; pseudomorphs of sericite after staurolite were noted at three localities. Aluminosilicate minerals were not identified in the field. The relatively common assemblage of garnet and hornblende in mafic rocks (units 6 and 12) suggests metamorphic conditions of at least middle amphibolite facies. Aluminosilicate minerals should be expected in pelitic rocks under those conditions, and could be present in microscopic grain sizes. Kyanite has been observed in float on Grizzly Dome, 20 km east of the limit of mapping.

Unit 4 consists of quartz-mica (muscovite and biotite) schist, and differs from the mica-quartz schist and paragneiss of unit 3 by a much higher quartz content. It is interstratified with, and commonly grades into unit 3, and for simplicity, units 3 and 4 are combined on Figure 2. The quartz-mica schist, which was probably derived from siliceous siltstone, is also interstratified with amphibolite, and includes finely interlayered horizons of garnet-metapelite. Some beds grade to white- or beige-weathering micaceous quartz arenite. More locally, this variety of the quartz-mica schist is associated with white to grey banded quartzite. The association of quartz-mica schist with both quartzite and amphibolite is important for deciphering the setting of deposition of these rocks (*see* 'Discussion').

Metacarbonate of unit 5 forms a very minor component of the Thistle Creek area, although it is more widespread in the region north of Stewart River (Bostock, 1942). The unit is dominated by coarse-grained (~5 mm) marble, with lesser calc-silicate schist (**Fig. 6**). These are interpreted as being derived from relatively pure limestone, and impure limestone to calcareous pelite, respectively.

Metavolcanic and volcaniclastic rocks (units 6–8)

Unit 6 comprises amphibolite schist and gneiss (metabasite) of highly variable composition and state of strain. Amphibolite generally contains the mineral assemblages hornblende-plagioclase or garnet-hornblende-plagioclase(±quartz and epidote), with local chlorite-biotite. They occur as two main associations: 1) with the metasedimetary rocks described above, and 2) with an orthogneissic complex (units 9 and 10). The amphibolite units were intensely tectonized, and underwent extreme grain-size coarsening during regional metamorphism, making it difficult to discern the protolith. A common feature of the amphibolite is heterogeneous compositional layering, suggesting primary heterogeneity. Locally, vestiges of primary textures such as breccia clasts or pillow selvages (**Fig. 7**) are convincingly preserved, and we interpret the amphibolite as having been derived from mafic volcanic to volcaniclastic rocks.

More intermediate varieties of amphibolite contain large hornblende porphyroblasts that commonly exhibit spectacular decussate texture, or occur as spaced rosettes (**Fig. 8**) that are as large as 15 cm. Complete gradation is seen between the mafic and intermediate compositions, and we interpret this to represent primary variation of the volcanic rocks. Some amphibolite grades locally to mafic psammitic schist, probably derived from greywacke. The psammitic schist grades to mica-quartz schist and quartz-mica schist, suggesting original stratigraphic interfingering.

Some of the amphibolite has strongly tectonized layers, particularly evident where marked by quartz-mylonite bands (**Fig. 9**). It is difficult to tell if the quartz mylonites are derived from deformed veins, or from quartz-rich beds. A vein source is favoured, because a variety of strain states are seen in quartz veins. Some quartz-rich layers were possibly derived from severely transposed interpillow chert.

Some amphibolite horizons are interpreted as mafic sills (or dykes), because of their massive nature and, and rare discordances with their wall rocks. The sills are generally boudinaged, probably due to their higher competency relative to enclosing metavolcanic or metasedimentary rocks.

Amphibolite units in the northeastern part of the map host an orthogneiss complex (units 9 and 10), wherein metasedimentary rocks are lacking. Some of the mafic amphibolite units there are coarser grained than their equivalents to the west, and are more gneissic than schistose. The gneissic variety may reflect more extreme metamorphic conditions, or they may be derived from gabbroic or dioritic intrusions.

Unit 7 comprises quartz-sericite schist or metafelsite, possibly derived from felsic volcanic rocks or hypabyssal intrusions. Phenocrysts have been obliterated by strain and metamorphism. At one locality east of Thistle Mountain, a metafelsite horizon has layers that carry abnormally large and abundant garnet porphyroblasts (**Fig. 10**). This horizon is readily traceable for 3 km (**Fig. 2**). The interfingered metafelsite and amphibolite units are consistent with bimodal volcanism, possibly in an arc setting.

The conspicuous mafic schist of unit 8 is composed of biotite-hornblende±plagioclase-quartz, with blocky books of biotite. The rock is charcoal-grey weathering, and has a distinct pitted appearance where biotite has weathered out. The rock is laced with quartz veins, giving it a gneissic appearance. Unit 8 is bounded above and below by more typical amphibolite. The unit has only been observed around Thistle Mountain.

Orthogneissic rocks (units 9–11)

Unit 9 comprises an intrusive complex of intermediate to mafic orthogneiss. It is composed chiefly of grey-weathering tonalite to diorite sheets (commonly 5–50 cm thick) and veinlets, giving the rock an intensely layered and banded appearance (**Fig. 11**). Although the intrusive sheets are now subparallel due to high strain, they may have originally been more randomly oriented. The sheets are usually interlayered with the amphibolite schist-gneiss country rock. Hornblende and biotite are common mafic phases in these gneiss units, and rare garnet porphyroblasts were noted. How much younger the intrusive complex is than the host metavolcanic rocks is unknown. It is possible that they represent subvolcanic intrusions to the volcanic pile(s), essentially forming a volcano-plutonic complex. Due to particularly poor exposure in the northeast part of the map (**Fig. 2**), units 6 and 9 are there undivided.

Felsic to intermediate orthogneiss of unit 10 is composed of pink- to orange-weathering granite to granodiorite sheets and veinlets. In detail, these crosscut the diorite and tonalite sheets, with which they were transposed. Gneissic granitic sheets observed outside of the intrusive complex are presently grouped in unit 10, although a similar age is not yet proven.

Potassic feldspar augen granitic orthogneiss comprises unit 11. This unit is pink to grey weathering, and forms one of the more distinct units across the area. For the most part, these rocks are highly strained. Quartz is strung out into ribbons, and feldspar forms augen and porphyroclasts where the rocks are protomylonitic. The internal portion of the large body northwest of Kirkman Creek (Fig. 2) preserves low-strain vestiges of porphyritic monzogranite, containing mica schist xenoliths in a groundmass of red and white feldspar, grey quartz, and biotite (**Fig. 12**). At high strain, the augen granite can be confused with metasedimentary schist, if not for the feldspar porphyroclasts. The augen gneiss may correlate with a suite of Devono-Mississippian augen granite bodies dated regionally at ca. 360 Ma (Mortensen, 1992).

Younger plutonic rocks (units 12–15)

Unit 12 comprises rare metagabbro bodies. Some gabbros contain garnet porphyroblasts, indicating that they have undergone the regional metamorphism. Less-metamorphosed examples crosscut the regional foliation.

Unit 13 includes a variety of monzogranite, granodiorite, and quartz monzonite intrusions. These crosscut the regional gneissosity, but are themselves moderately to strongly foliated. Their lesser state of strain relative to the orthogneiss units (units 9, 10, and 11) suggests a younger age.

Young, crosscutting granitic plutons and/or dykes of unit 14 are commonly aplitic. They are leucocratic and include pink to grey, felsic to intermediate varieties. Some carry a weak foliation in their margins, and others exhibit weak boudinage. Absolute ages of these bodies will shed light on the age of youngest deformation in the area. A pluton and several smaller satellite bodies and dykes in the central part of the map area consist of syenogranite with large potassic feldspar phenocrysts. They are completely undeformed, and are likely Cretaceous or younger.

Rare, young, quartz-potassic feldspar porphyritic rhyolite to rhyodacite stocks of unit 15 are probably Eocene or Tertiary. One of these stocks was mapped at the drainage divide between Thistle Creek and Barker Creek to the east, and may be the source of pebbles of porphyry noted in those creeks by Jackson and Huscroft (2000).

DEFORMATIONAL STRUCTURES

Regional foliation

The regional foliation (S_T) in the area is characterized by high-strain transposition of layering in gneiss and schist, with abundant intrafolial isoclinal folds (**Fig. 13, 14**) that are commonly rootless. Primary compositional layering (S_0) in metasedimentary rocks, unit contacts (e.g. dyke margins), and a pre-existing foliation (S_1) can be recognized around closures of the transposition folds, indicating that they are at least F_2 structures. The F_2 folds are generally recumbent to shallowly inclined, close to isoclinal, long-wavelength structures. Associated with the folds is an intensely developed regional extension lineation (L_2) that is parallel to the F_2 axes. Surprisingly, even at these high strains, there is little development of an axial planar fabric; rather, S_T is characterized by the complete reorientation of, and strain intensification of, S_0 and S_1. Although S_T is largely defined by pre-existing layering, its present geometrical surface is considered a second generation feature. A good summary of transposed foliation is given in Hobbs et al. (1976).

The intensity of strain within the regional foliation locally grades to mylonite; however, the amount of displacement along the mylonitic bands is unknown. Spacing between mafic boudins in the gneiss indicates extension on the order of 1000%. Some F_2 folds are doubly closing, which may indicate a sheath-like geometry, further attesting to the high strain in these rocks.

Despite the high strain associated with the F_2 event, vergence (direction of rotation of the short limb) is systematic. In the north-trending units on the western side of the map (**Fig. 2**), the vergence of F_2 folds is generally to the west, and their axes and L_2 plunge shallowly north and south. In the east-trending units to the south and east (Fig. 2), F_2 folds verge to the north, and plunge west-southwest or east-northeast parallel to L_2. We interpret that the S_T and L_2 had a consistent orientation across the area prior to faulting and

F_3 folding. Parallelism between the regional extension lineation and the transposition folds, at a striking obliquity to direction of rotation of the fold limbs, precludes the use of F_2 fold vergence as a means of determining transport direction in these rocks. This structural style is most consistent with having developed in a triclinic noncoaxial flow regime (e.g. Jiang and Williams, 1999), where the transport direction was probably parallel to the extension lineation.

F_3 folds

F_3 folds are open, moderately inclined (with shallow to steep varieties), shallowly plunging structures (**Fig. 15**). They have weak axial-planar fabric where developed in schistose layers, and have no associated extension lineation. Tighter examples of F_3 folds can be difficult to distinguish from more open F_2 folds. Some localities show the moderately inclined to upright, spaced S_3 cleavage (spaced 1–3 cm), overprinting F_2 isoclines (**Fig. 16**) where minor F_3 folds are absent. F_3 structures appear to post-date regional metamorphism.

Faults

The Thistle Creek area, as well as the greater Stewart River area, is transected by abundant prominent physiographic and aeromagnetic lineaments, some of which correspond to faults in the underlying bedrock (**Fig. 2**). Locating faults is hampered by poor exposure, particularly in valleys. Faults are more readily apparent where there is striking lithological or structural changes.

An east-trending fault that runs through the upper part of Blueberry and Lulu creeks not only forms a prominent topographic and aeromagnetic lineament, but also clearly separates rocks of the volcano-plutonic complex from the volcano-sedimentary succession. A granite that is truncated by the fault shows brecciation, with small east-trending, vertically dipping cataclastic shear bands, and intense chlorite alteration, adjacent to the fault. The age of the granite is unknown, and thus the age of the fault is not constrained. The low-grade mineral assemblage associated with the structure indicates that it formed at a relatively shallow crustal level, possibly quite late in the tectonic history.

METAMORPHISM

The relative timing between metamorphism and fabric development based on field observations is complex. Locally, garnet (of the peak metamorphic assemblage) is wrapped by S_T (the transposed foliation) (**Fig. 10**), whereas in other places S_T appears overgrown by garnet. Amphibolite west of Thistle Mountain may show two populations of hornblende. An older set appears to define the lineation, whereas the second population, made up of rosettes, radiate within, and locally across, the foliation plane. At a locality north of Thistle Creek, large hornblende crystals that radiate in the S_T foliation plane appear to overprint S_T, and yet are deformed (**Fig. 17**). This complexity is brought about largely as a function of S_T being defined mainly by reoriented S_1 and S_0. Porphyroblasts have overgrown S_1, but whether they were wrapped by S_T was dependant upon how strongly the S_1 foliation was reactivated during the F_2 transposition episode. If a layer rotated passively without accommodating internal strain, porphyroblasts that overgrew S_1 could survive F_2 deformation with little to no F_2 strain. It is also possible that the rocks have undergone polymetamorphism, or that fabric development was diachronous. Petrography will help clarify the relative timing of porphyroblast growth and fabric development across the area.

Some rocks exhibit localized retrograde metamorphism. For the most part, peak assemblage minerals like garnet and hornblende are stable and well preserved, but locally, hornblende is altered to chlorite and biotite, and garnet to chlorite-quartz or plagioclase. Plagioclase retrogression is generally manifest as rims around garnet, but complete replacement was also noted. The breakdown of garnet to plagioclase may be evidence for an isothermal decompression reaction.

DISCUSSION

Paleotectonic setting

The abundance of metavolcanic rocks (amphibolite; units 6, 8) in association with widespread mafic to intermediate metaplutonic rocks (units 9, 10, 11) is consistent with a setting in a volcano-plutonic complex, of possible island-arc affinity. Conversely, the abundant quartz-rich mica schist and quartzite (units 1, 3, 4, 5) are suggestive of deposition within a continental margin setting, i.e. a location in which quartz-rich detritus can be derived and accumulate. Given the structural complexity, small size of the area mapped, and uncertainty in stratigraphic facing, the relationship between units indicative of the two settings is unclear. In the Finlayson Lake area (**Fig. 1**), quartz-rich metasedimentary rocks occur lower in the stratigraphy relative to metavolcanic-metaplutonic components Murphy (1998).

High-strain foliation

The correlation of augen-orthogneiss (unit 6) with similar gneiss units regionally (e.g. Mortensen, 1992) suggests that the widespread, high-strain, amphibolite-facies transposition foliation is of post-Earliest Carboniferous (360 Ma). A younger limit on the age is provided by a regional suite of crosscutting, largely undeformed intrusions of early Jurassic (196–186 Ma) age (e.g. Mortensen, 1992). Detailed geochronological work being performed as a part of this project (U-Pb, Ar-Ar) is expected to improve this control significantly as well as provide constraints as to timing of metamorphism relative to structural fabrics. Evidence for Upper Paleozoic orogenic event(s) are being recognized through ongoing work elsewhere in the Yukon–Tanana terrane (Fig. 1) (e.g. Murphy, 1998). Our future mapping should help clarify whether the transposition foliation is part of a regional-scale shear zone, or merely characterizes the type of flow active in the middle crust during and after orogenesis.

Economic framework

One of the more significant findings is that the Thistle Creek area is dominated by a possible volcano-plutonic arc complex with implied potential for volcanogenic massive-sulphide-type mineralization. In the Finlayson Lake area (Fig. 1) massive-sulphide mineralization is associated with both felsic (e.g. Kudz Ze Kayah and Wolverine Lake deposits; Murphy (1998, and references therein)) and mafic (Fyre Lake deposit; Foreman (1997)) metavolcanic sequences. In line with the suggestion that felsic volcanic rocks may be the most prospective for syngenetic mineralization, the few occurrences noted (unit 7) in the Thistle Creek area may be worthy of further inspection. It should be noted that primary geochemical (e.g. alteration), structural, and lithological signatures may be strongly modified by the high metamorphic grade and state of strain.

In Yukon Territory and Alaska, mid-Cretaceous (105–90 Ma) and Late Cretaceous (70–65 Ma) plutons and their country rock are prospective targets for intrusion-related gold deposits (e.g. Hart et al., 2000). The undeformed granite-syenite stock, and its satellites, near Mount Stewart are possibly Cretaceous or Tertiary, and could be prospective. The remaining plutonic rocks in the Thistle Creek area show evidence of significant strain, and are all likely pre-Early Jurassic (Paleozoic). The source of gold in the significant placer deposits in Thistle Creek remains enigmatic; middle to late Cretaceous and younger plutonic rocks are very rare within the confines of the Thistle Creek drainage. The only significant mineral occurrence within this drainage is the “Black Fox”, described as a 0.9 m thick quartz vein hosting pockets of galena, chalcopyrite and pyrite, and exhibiting significant gold values (Yukon Minfile, #115O014, Indian and Northern Affairs Canada, 1999).

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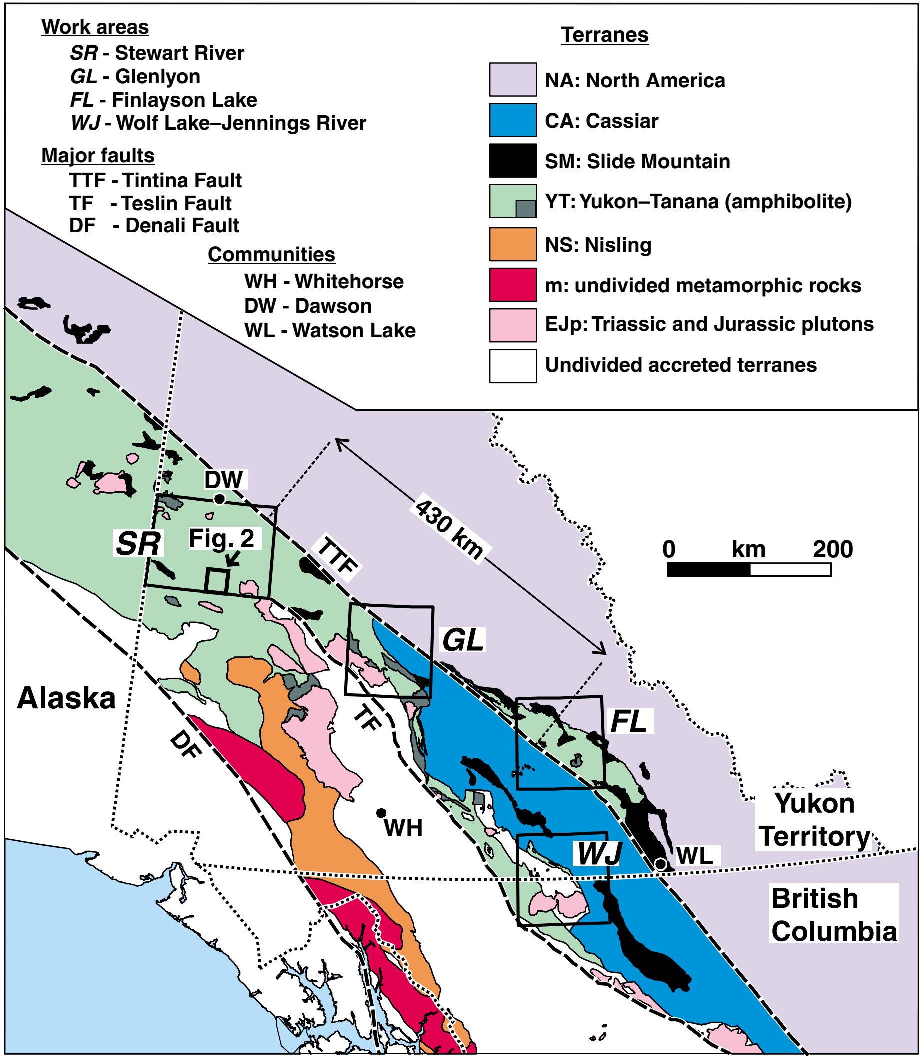


Figure 1. Location of the NATMAP project areas in Yukon Territory and northern British Columbia. Restoration of Cretaceous–Tertiary dextral offset of about 430 km (Dover, 1994) along Tintina Fault would place the Stewart River area in close proximity to the Finlayson Lake area. A project in southern British Columbia (not included on this figure) comprises the southern component of the NATMAP project (*see* Thompson et al., 2000 and references therein).

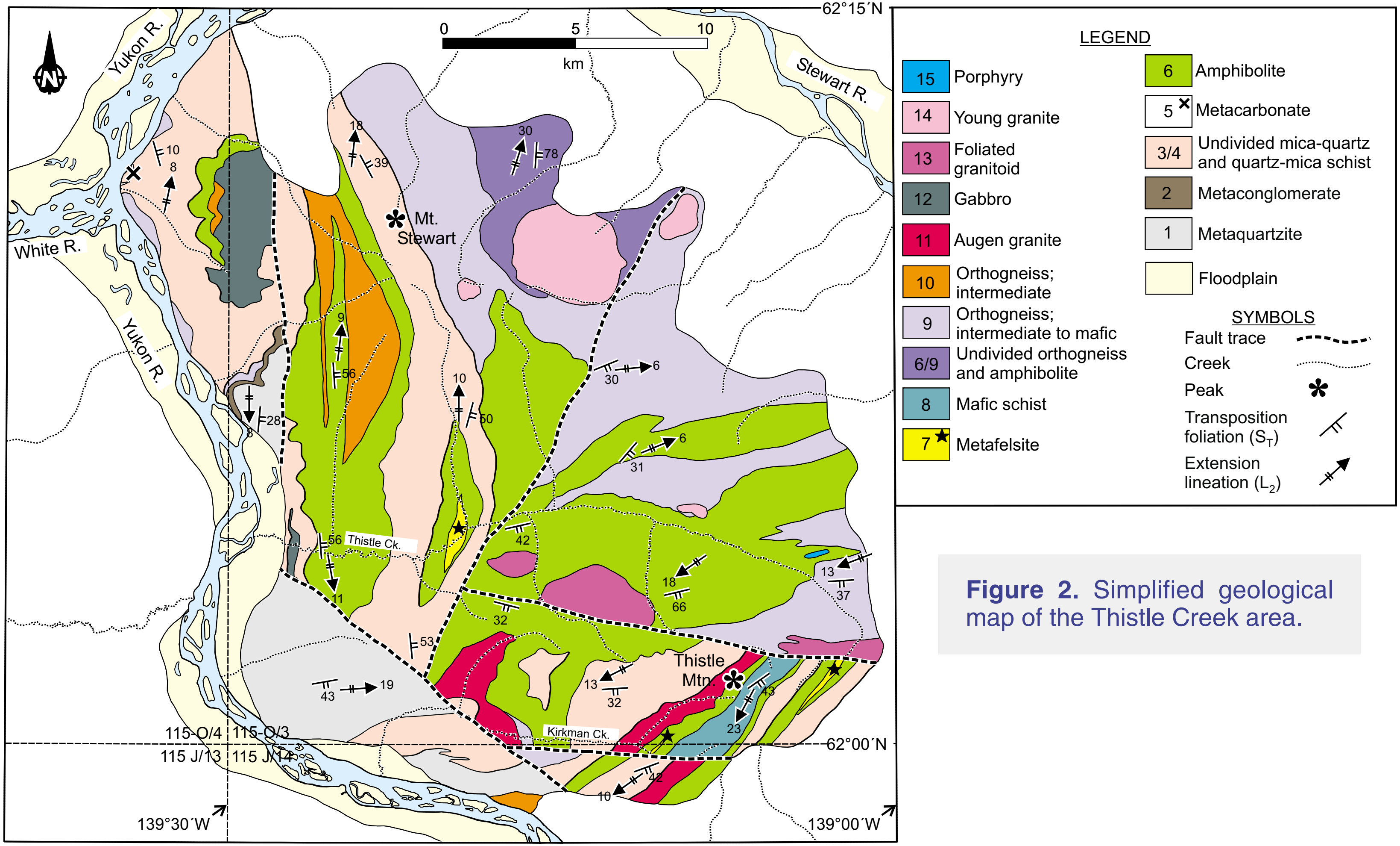


Figure 2. Simplified geological map of the Thistle Creek area.

Figure 3.

Banded grey and white quartzite (unit 1), exhibiting intrafolial isoclinal F_2 folds (axes parallel to pencil) of S_0/S_1.

Figure 4.

Rhythmically layered quartzite (unit 1), with thin laminations of semipelite. May represent recrystallized chert. Pencil for scale.

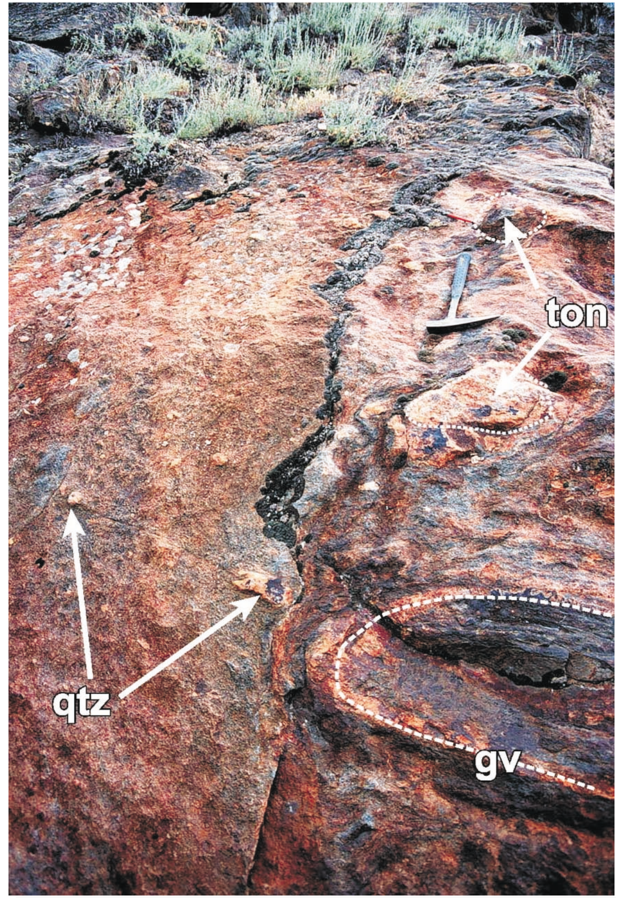


Figure 5. Deformed conglomerate (unit 2), dominated by quartz (qtz) pebbles, with rare tonalite (ton) boulders. Note folded granite vein (gv).

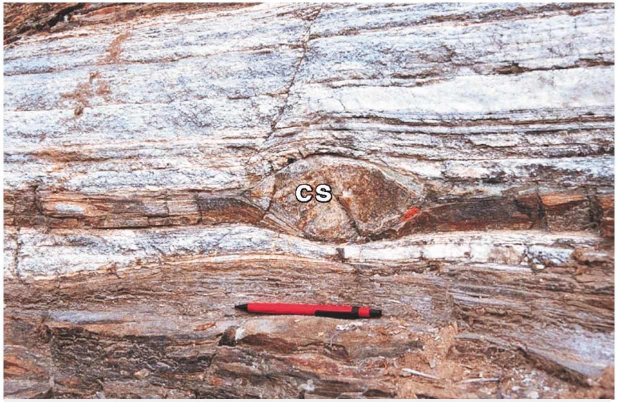


Figure 6. Calc-silicate (cs) pod within layered white marble and schist (unit 5). Pencil for scale.

Figure 7.

Layer of possible strongly flattened pillow selvages in a banded amphibolite (unit 6). Hornblende reaction halos are symmetrical about these features. Pencil for scale (arrow).

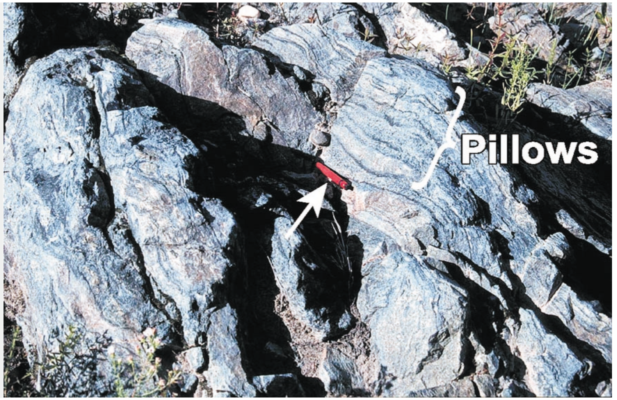


Figure 8.

Large rosettes of hornblende radiating on the foliation surface of an intermediate amphibolite (unit 6). Pencil for scale.

Figure 9. Finely laminated, statically recrystallized quartz-mylonite (q-m) layers in amphibolite schist (unit 6). Pencil for scale.

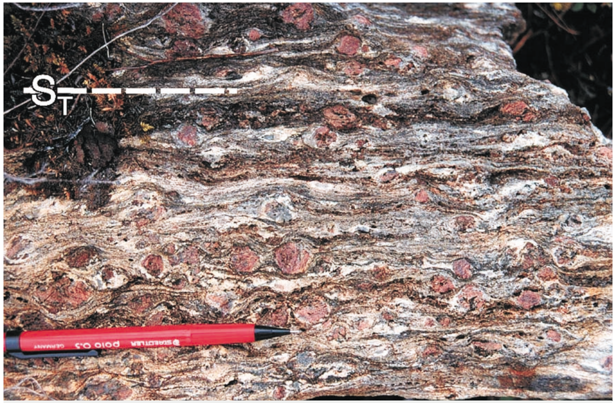


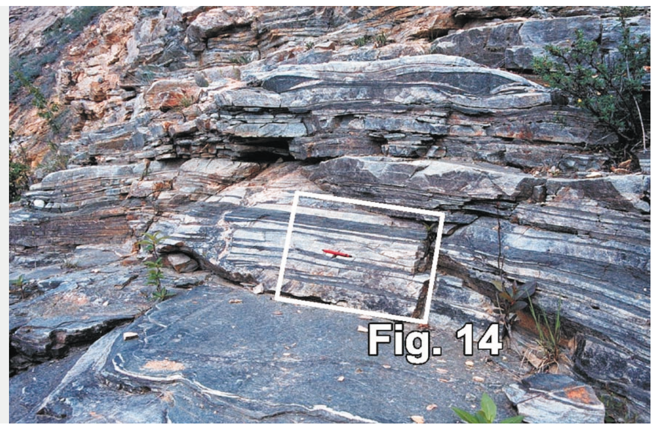
Figure 10. Large garnet porphyroblasts, wrapped by S_T foliation, in quartz-sericite schist (metafelsite; unit 7). Pencil for scale.

Figure 11. Typical banded appearance of heterogeneous, compositionally layered gneiss (unit 9) composed of diorite, tonalite and granodiorite. Pencil for scale.

Figure 12. Metasedimentary xenoliths in coarse augen granite (unit 11). Pencil for scale.

Figure 13.

Planar, high-strain (protomylonitic) mixture of tonalite sheets in amphibolite. Pencil for scale (*see* Fig. 14).



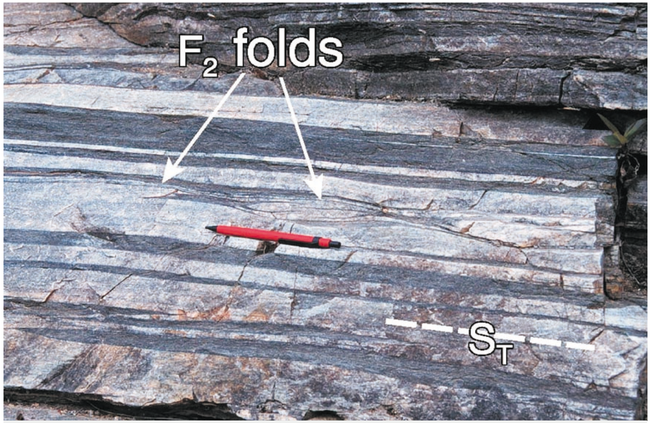


Figure 14. Closer view of the local high-strain nature of the transposition foliation in the orthogneiss. Note that the oppositely verging, isoclinal F_2 folds of the contact between the tonalite and amphibolite are parallel to the extension lineation, forming sheath-like folds. Pencil for scale.

Figure 15.

West-verging F_3 folds, plunging shallowly north (parallel to pencil), with steeply dipping axial planar crenulations in mica-quartz schist.

Figure 16.

Steeply east-dipping, S_3 spaced crenulation cleavage (shear band geometry) overprints S_T, and decapitates isoclinal F_2 closures outlined in quartz veins in mica-quartz schist. Notebook is 20 cm long.

Figure 17. Decussate texture in hornblende porphyroblasts that grow across the S_T foliation (parallel to pencil) in unit 6. The hornblende porphyroblasts were deformed either in the later stages of F_2, or during F_3 folding.