Natural Resources Canada / Ressources naturelles Canada

DESCRIPTIVE NOTES

The Thistle Creek map area is underlain by polydeformed and metamorphosed Paleozoic rocks of the Yukon-Tanana terrane, and younger plutonic rocks. Recognition of this area as an extensive metavolcanic terrane rather than a siliciclastic continental margin succession as previously interpreted (Wheeler and McFeeley,1991) implies a new and favourable potential for volcanic-hosted massive sulphide (Cu-Zn-Pb) deposits as seen elsewhere in the terrane (e.g. Murphy, 1998). The source of historically and currently produced placer gold along Thistle, Kirkman and Frisco creeks remains enigmatic.

The only previous geological mapping 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. D.D. Cairns (1917) provided descriptive notes related to the setting of placer gold deposits along Scroggie, Barker, Thistle and Kirkman Creek, the latter two within the area of this map. As noted by Bostock, 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 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 granites which tend to be more deeply eroded than the schists and gneisses.

GEOLOGICAL UNITS

Metasedimentary rocks (units 1-5)

Unit 1 comprises a thick sequence of grey to white, banded quartzite. It is strongly recrystallized, with a metamorphic grain size in excess of 1 mm. Varieties range in colour from black to rusty brown. Bostock (1942) and Tempelman-Kluit (1974) attributed the black to grey colour of the quartzites to fine-grained graphite. The quartzites commonly exhibit intrafolial isoclinal folds; however, they do not appear as highly strained as most of the schists and gneisses across the area because bedding is well preserved. Rhythmic layering in some quartzite is reminiscent of that observed in ribbon chert, and a chert origin for some of this quartzite cannot be excluded.

Unit 2 comprises metaconglomerate, observed at one locality along the Yukon River. 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. The conglomerate is matrix supported, and clasts are well rounded. Clasts are generally less that 10 cm in diameter, and composed chiefly of bull white quartzite (probably derived from eroded 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. Due to structural transposition, the direction of stratigraphic "younging" is unknown.

Unit 3 includes undivided mica-quartz schist and paragneiss derived from psammite, semipelite and rare pelite. Although transposed, primary compositional layering is generally preserved. The mineral assemblage garnet-biotite-muscovite-quartz ± plagioclase is common; pseudomorphs of sericite after staurolite were noted at three localities.

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 undifferentiated. 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.

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. These are likely derived from relatively pure limestone, and impure limestone to calcareous pelite respectively.

Metavolcanic and volcaniclastic rocks (units 6-8)

Unit 6 comprises amphibolite schist/gneiss (metabasite) of highly variable composition and state of strain. Amphibolites generally contain 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 amphibolites were intensely tectonized, and underwent extreme grain size coarsening during regional metamorphism, making it difficult to discern their protolith. A common feature of the amphibolites is heterogeneous compositional layering, suggesting primary heterogeneity. Locally, vestiges of primary textures such as breccia clasts or pillow selvages are convincingly preserved. The amphibolites are probably derived from mafic volcanic and volcaniclastic rocks.

Amphibolite of intermediate composition contains large hornblende porphyroblasts that commonly exhibit spectacular decussate texture, or that occur as spaced rosettes as large as 15 cm in diameter. Complete gradation is seen between these intermediate amphibolites and those of more mafic composition, likely reflecting primary compositional variation of the volcanic rocks. Some amphibolites grade locally to mafic psammitic schist, probably derived from greywacke. The psammitic schists grade to mica-quartz schist and quartz-mica schist, suggesting original stratigraphic interfingering.

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

Amphibolites in the northeastern part of the map host an orthogneiss complex (units 9 and 10), wherein metasedimentary rocks are lacking. Some of the mafic amphibolites there are coarser grained than their counterparts to the west, and are more gneissic than schistose. The gneissic variety may reflect more extreme metamorphic conditions, or a protolith as 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 readily tracable for 3 km carries abnormally large and abundant garnet porphyroblasts. The interfingered metafelsites and amphibolites 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 to 50 cm thick) and veinlets, giving the rock an intensely layered and banded appearance. The parallel alignment of the sheets may partly be the effect of high strain acting on a more random initial orientation. The sheets are usually interlayered with the amphibolite schist/gneiss country rock. Hornblende and biotite are common mafic phases in these gneisses, and rare garnet porphyroblasts were noted. The difference in age between the intrusive complex and the host metavolcanic rocks is unknown. They two are interpreted as coeval, and to represent subvolcanic intrusions to an overlying volcanic pile(s) respectively, essentially forming a volcano-plutonic complex. Due to particularly poor exposure in the northeast part of the map, 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 proven.

Potassic feldspar augen granitic orthogneiss comprises unit 11. This unit is pink to grey weathering, and forms one of the more distinct units within 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 preserves low-strain vestiges of porphyritic monzogranite, containing mica schist xenoliths in a groundmass of red and white feldspar, grey quartz, and biotite. At high strain, the augen granite can be confused with metasedimentary schist, if not for the feldspar porphyroclasts.

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.

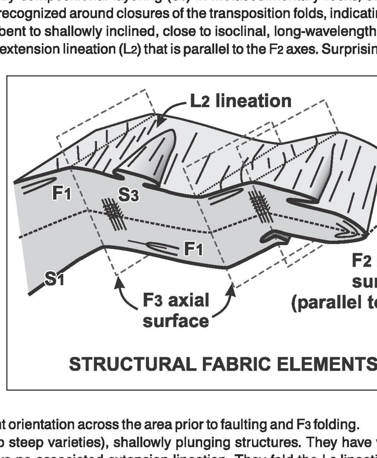
Young, crosscutting granitic plutons and/or dykes of unit 14 are commonly aplitic. They are leucocratic and include pink to grey, felsic to intermediate varieties. Some carry a weak foliation in their margins, and others exhibit weak boudinage. Absolute ages of these bodies will shed light on the age 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 of Eocene or Tertiary age. 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).

STRUCTURE

Foliation

The regional foliation (S_T) in the area is characterized by high-strain transposition of layering in gneisses and schists, with abundant intrafolial isoclinal folds 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 to F_2; 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.



STRUCTURAL FABRIC ELEMENTS

The intensity of strain within the regional foliation locally grades to mylonite; however, the amount of displacement along these mylonitic bands is unknown. Spacing between mafic boudins in the gneisses 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, 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, 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.

F_3 folds are open, moderately inclined (with shallow to steep varieties), shallowly plunging structures. They have weak axial-planar fabric where developed in schistose layers, and have no associated extension lineation. They fold the L_2 lineation. Tighter examples of F_3 folds can be difficult to distinguish from more open F_2 folds. Some localities show a moderately inclined, to upright spaced S_3 cleavage (spaced 1-3 cm), overprinting F_2 isoclines without the apparent development of outcrop scale or smaller F_3 folds. F_3 structures appear to postdate regional metamorphism.

Faults

The Thistle Creek and greater Stewart River map areas, are transected by abundant prominent physiographic and aeromagnetic lineaments, some of which correspond to faults in the underlying bedrock.

An east-trending fault that runs through the upper part of Blueberry and Lulu creeks forms a prominent topographic and aeromagnetic lineament, and 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-west-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 and the subject of further investigation. Locally, garnet (of the peak metamorphic assemblage) is wrapped by S_T (the transposed foliation), whereas in other places S_T appears overgrown by garnet. Amphibolites 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 hornblendes that radiate in the S_T foliation plane appear to overprint S_T, and yet are deformed. 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.

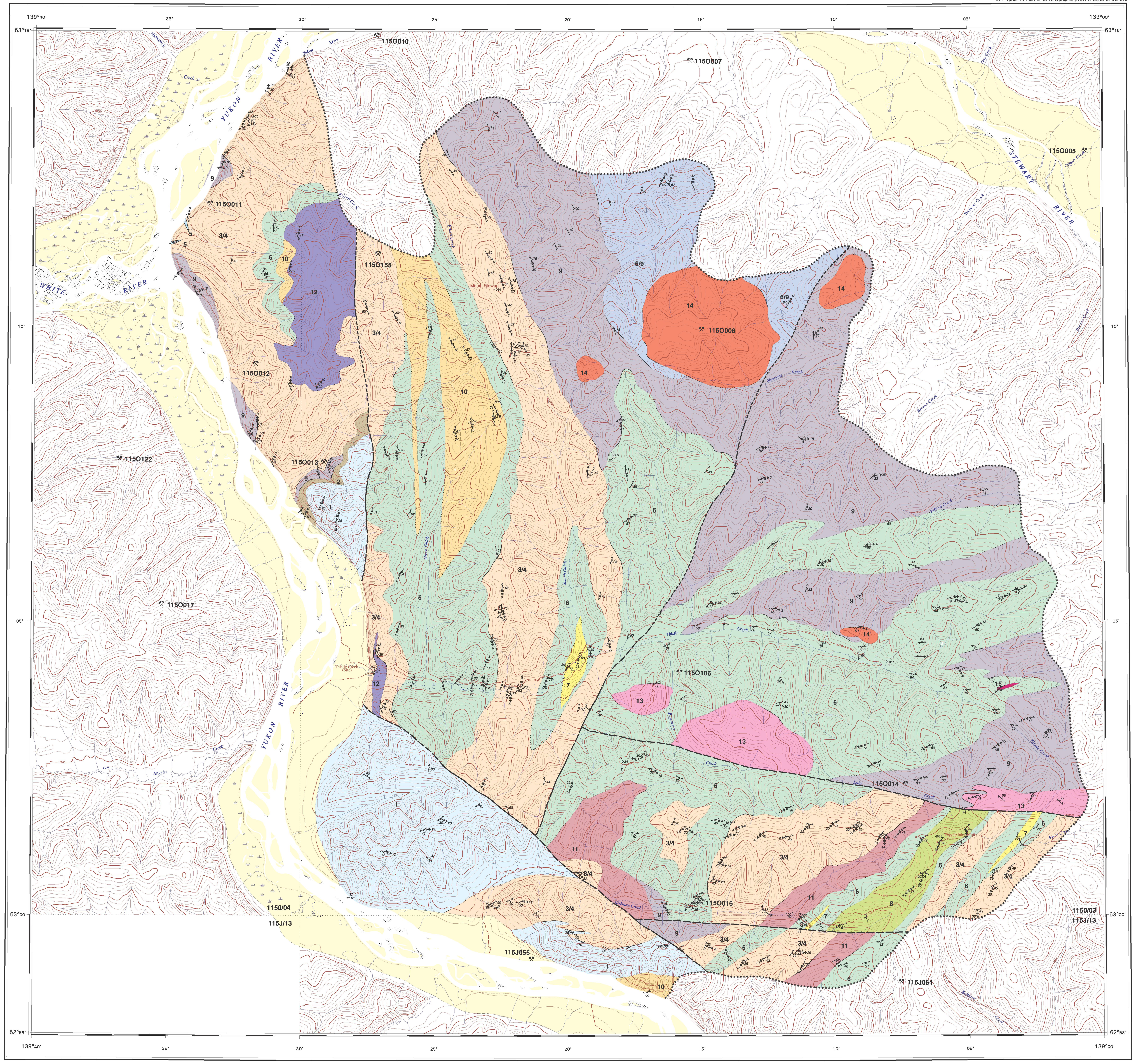
The relatively common assemblage of garnet and hornblende in mafic rocks (units 6 and 12) suggests metamorphic conditions of at least middle amphibolite facies. Aluminosilicate minerals, not yet identified, should be expected in pelitic rocks under those conditions, and could be present in microscopic grain sizes. For the most part, peak assemblage minerals like garnet and hornblende are stable and well preserved. Locally, hornblende is retrograded to biotite and chlorite 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. The state of strain and metamorphic grade are suggestive of deformation and metamorphism at mid-crustal levels. Regional considerations suggest a Permo-Triassic age.

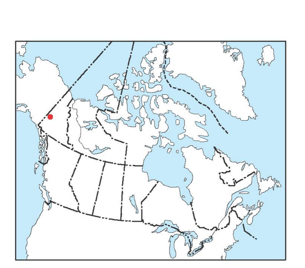
Ancient Pacific Margin NATMAP CARTNAT Ancienne marge du Pacifique

Canada

GEOLOGICAL SURVEY OF CANADA — COMMISSION GÉOLOGIQUE DU CANADA

NATMAP CARTNAT
Canada's National Geoscience Mapping Program
Le Programme national de cartographie géoscientifique du Canada





OPEN FILE 3690

GEOLOGY

THISTLE CREEK AREA YUKON TERRITORY

YUKON TERRITORY

Scale 1:50 000/Échelle 1/50 000

kilometres 1 0 1 2 3 4 kilomètres

Universal Transverse Mercator Projection
North American Datum 1983

Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1983

Geology by J.J. Ryan and S.P. Gordey (2000)

Geological Survey of Canada

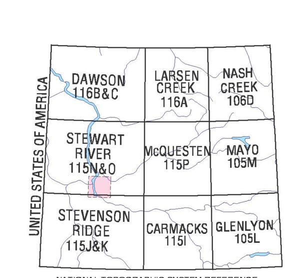
Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada

Digital base map from data compiled by Geomatics Canada modified by ESS Info

Mean magnetic declination 2001, 25°56'E, decreasing 17.8' annually

Elevations in feet above mean sea level

Contour interval 100 feet



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE

LEGEND

QUATERNARY

Unit	Description
	Fluvial silt, sand and gravel deposits along valleys of the Yukon, White and Stewart rivers

LATE CRETACEOUS TO EOCENE?

Unit	Description
15	*PORPHYRY: young, cross-cutting quartz-K-feldspar porphyritic rhyolite to rhyodacite stock; possibly related to Carmacks volcanics*

JURASSIC OR CRETACEOUS

Unit	Description
14	*GRANITE: cross-cutting plutons, and/or dykes; includes felsic to intermediate varieties, leucocratic, pink to grey*

PALEOZOIC AND/OR MESOZOIC

Unit	Description
13	*FOLIATED GRANITE: deformed (foliated to gneissic), felsic to intermediate monzogranite, granodiorite, quartz monzonite*
12	*GABBRO: metagabbro (locally garnet bearing); diabase, metabasite*

MID(?)- TO LATE PALEOZOIC

Orthogneissic Rocks

Unit	Description
11	*AUGEN GNEISS: potassic feldspar augen granite; exhibits various states of strain including porphyroclastic straight gneiss*
10	*FELSIC GNEISS: pink to orange felsic orthogneiss; banded to layered; veined and/or segregated; derived from felsic granitoid sheets*
6/9	*AMPHIBOLITE AND MAFIC GNEISS UNITS UNDIVIDED*
9	*GREY GNEISS: intermediate to mafic orthogneiss; generally grey; banded to layered; commonly veined; derived from intermediate granitoid (tonalite to diorite) sheets; usually interlayered with amphibolite schist and gneiss*

Metavolcanic(?) and Volcaniclastic Rocks

Unit	Description
8	*MAFIC SCHIST: metabasite? biotite-hornblende +/-plagioclase +/-quartz; generally associated with amphibolite; main locality on Thistle Mountain*
7	*QUARTZ-SERICITE SCHIST: quartz-sericite schist or metafelsite, possibly derived from felsic volcanic or hypabyssal intrusive rocks, e.g. rhyolite or quartz-feldspar porphyry*
6	*AMPHIBOLITE: amphibolite schist and gneiss; metabasite; usually containing garnet-hornblende-plagioclase or hornblende-plagioclase with local chlorite and biotite; locally associated with psammite or interlayered with orthogneiss; probably derived from mafic volcanic to volcaniclastic rocks; locally seen as trains of boudins, which may represent disrupted mafic sills; intermediate varieties locally contain rosettes of large hornblende crystals in decussate texture*

Metasedimentary Rocks

Unit	Description
5	*MARBLE: marble (metacarbonate) derived from pure to impure limestone; associated calc-silicate schist derived from calcareous metapelite*
3/4	*QUARTZ-MICA SCHIST AND MICA-QUARTZ SCHIST/PARAGNEISS UNITS UNDIVIDED*
4	*QUARTZ-MICA SCHIST: quartz-muscovite-biotite schist possibly derived from siliceous siltstone; commonly finely interlayered with garnet metapelite; commonly contains beds of micaceous quartz arenite*
3	*MICA-QUARTZ SCHIST/PARAGNEISS: undivided metasedimentary rocks dominated by metapsammite, semipelite and metapelite; commonly garnet-biotite-muscovite +/-plagioclase schist; generally heterogeneously layered; grades locally to paragneiss; varies to quartz-mica schist*
2	*CONGLOMERATE: pebble- to boulder-sized rounded clasts; mainly massive white bull quartz, but including some granitoid clasts (tonalite?); has an arkosic matrix; grades into quartzite; matrix supported*
1	*QUARTZITE: banded to massive, grey to white quartzite; unclear if clastic in origin, or possibly derived from metachert; possibly correlated with Nasina Quartzite*

SYMBOLS

Geological contact (defined, approximate, assumed)

Fault, sense of movement uncertain (defined, approximate, assumed)

Limit of mapping

Transposition foliation 10

Foliation (S2,S3) 12 12

Mineral (elongation) lineation 23

Minor fold axis (F1, u-fold) 19

Minor fold axis (F2, u-fold, z-fold, s-fold) 28 28 28

Minor fold axis (F3, u-fold, s-fold) 18 18

Minor fold axial plane (F2, F3) 44 44

Mineral Prospect

MINERAL PROSPECTS

MINFILE #	NAME	STATUS	DEPOSIT CLASS	COMMODITIES Major; Minor	MINERALS Significant; Associated	UTM (Zone 7) Easting; Northing
115J055	KIRKMAN/FANNIN REEF	unknown	unknown			583417; 6985126
115J061	BALLARAT/HAZEL	unknown	unknown			595086; 6984744
115O005	COOPER	unknown	unknown			600167; 7011058
115O006	SCOTCH	unknown	unknown			588240; 7005116
115O007	THREE SISTERS	unknown	unknown			587661; 7013566
115O010	TREVA	unknown	unknown			577786; 7014105
115O011	SHAMROCK	unknown	unknown			572665; 7008686
115O012	NORTHERN LIGHTS	unknown	unknown			574243; 7003679
115O013	DONAHUE	unknown	unknown	antimony/gold/silver	unknown; quartz	576475; 7000636
115O014	BLACK FOX	showing	disseminated/vein	gold/silver; lead	galena/chalcopyrite; pyrite/quartz	595049; 6990962
115O016	NONPAREIL	unknown	unknown			588671; 6986994
115O017	JACK	anomaly	unknown			571474; 6996026
115O106	HAKONSON	unknown	unknown	lead/silver/gold		587826; 6994286
115O122	VANESSA	unknown	unknown			570017; 7000580
115O155	FRISCO	unknown	unknown			578005; 7007223

Note: List includes claims staked about which little is known. Mineralization has not been recorded and/or the reason for staking is unclear.
Source: Indian and Northern Affairs Canada 1999: Yukon Minfile, a database of mineral occurrences in Yukon in Yukon digital geology, S.P. Gordey and A.J. Makepeace (comp.); Geological Survey of Canada Open File D3826 and Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, Open File 1999-1(D) (incorporates data compiled to September 15, 1997)

REFERENCES

Bostock, H.S.
1942: Ogilvie, Yukon Territory; Geological Survey of Canada, "A" Series Map, 711A, 1:250 000 scale.
Cairnes, D.D.
1917: Scroggie, Barker, Thistle, and Kirkman Creeks, Yukon Territory; Geological Survey of Canada, Memoir 97, 47 p.
Jackson, L.E. and Huscroft, C.A.
2000: Late Cenozoic geology, Ancient Pacific Margin NATMAP Project, report 2: survey of placer-gravel lithology and exploration of glacial limits along the Yukon and Stewart rivers, Yukon Territory; Geological Survey of Canada, Current Research 2000-A3, 7 p.
Jackson, L.E., Shimamura, K., and Huscroft, C.A.
2001: Late Cenozoic geology, Ancient Pacific Margin NATMAP Project, report 3: a reevaluation of glacial limits in the Stewart Basin of Stewart River map area, Yukon Territory; Geological Survey of Canada, Current Research 2001-A3, 17 p.
Murphy, D.C.
1998: Stratigraphic framework for syngenetic mineral occurrences, Yukon-Tanana terrane south of Finlayson Lake: A progress report; *in* Yukon Exploration and Geology, 1997; Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 51-58.
Tempelman-Kluit, D.J.
1974: Reconnaissance geology of Aishihik Lake, Snag and part of Stewart River map-areas, west-central Yukon; Geological Survey of Canada, Paper 73-41, 97 p. (including maps).
Wheeler, J.O. and McFeely, P.
1991: Tectonic Assemblage Map of the Canadian Cordillera and Adjacent Parts of the United States of America; Geological Survey of Canada, "A" Series Map , 1712A; *in* Geology of the Cordilleran Orogen in Canada, Gabrielse, H. and Yorath, C J. (Ed.) Geological Survey of Canada, Geology of Canada Series , no. 4, 1991; 844 pages

ACKNOWLEDGMENTS

Ken Glover and Scott Merwin provided excellent assistance in the field. We are indebted to Stewart Schmidt, Dave Procee and Rick Riemer for generously providing accommodation at Thistle Creek. They, and all the placer miners along Thistle Creek, as well as Eric Stretch, showed us great kindness. Heinz Sauer, Rick Charlebois, Brian MacDonald and Karl Scholz are thanked for transportation services, and Charlie Roots for help with field preparations. Discussions with Mike Villeneuve, Lionel Jackson and Jim Mortenson have contributed to the project. Carmel Lowe, Carol Wagner and Kaz Shimamura are thanked for digital visualization data, and Carol Wagner for base map preparation. Andrew Okulitch is thanked for a constructive review of the map.

OPEN FILE
DOSSIER PUBLIC
3690
GEOLOGICAL SURVEY OF CANADA
COMMISSION G ÉOLOGIQUE DU CANADA
OTTAWA
05/2001

Recommended citation:
Ryan, J.J. and Gordey, S.P.
2001: Geology, Thistle Creek area, Yukon Territory (115O/3); Geological Survey of Canada, Open File 3690, scale 1:50 000.