DESCRIPTIVE NOTES

INTRODUCTION

Mapping of the southwest McQuesten-northern Carmacks area was carried out in summer 2009, with supplemental field observations in summer 2010, under the Edges Project, part of National Resources Canada's Geomapping for Energy and Minerals (GEM) program. A more complete account of the mapping results is in Colpron and Ryan (2010). The area is heavily forested, and bedrock exposure is confined to alpine areas. It is glaciated by two lobes of the Selkirk Plateau ice cap, centred on Tintina Trench to the north, and by local glaciers and by glacial deposits of the Illinian West glaciation to the east (Bond and Lipovsky, 2010). A detailed aeromagnetic survey (see Figure 1) was acquired in advance of fieldwork to aid geological interpretation, and was published as a series of 1:50,000 scale maps (Kiss and Coyle, 2009); report results are available for download at (http://yukon.nrcan.gc.ca/aeromag/).

GEOLOGICAL FRAMEWORK

The central and northeast parts of the area are underlain by Yukon-Tanana terrane, which regionally comprises a metasedimentary basement complex (Snowcap assemblage) overlain by three unconformably-bounded, volcano-sedimentary sequences of predominantly arc affinity: the Finlayson (Upper Devonian-mid-Mississippian), Klinkit (Upper Mississippian-Lower Permian) and Klondike (Middle to Upper Permian) assemblages. Plutonic suites include the Grass Lakes (ca. 365-357 Ma), Simpson Range (ca. 355-345 Ma), and Tatlmain (ca. 342-336 Ma) suites, coeval with the Finlayson sequence, and the Sulphur Creek suite (ca. 264-252 Ma) related to the Klondike assemblage.

In the McQuesten-northern Carmacks area the terrane occurs in two northwest-trending belts separated by the Willow Lake fault. Southwest of the Willow Lake fault, a central domain of Permian to pre-Devonian, polydeformed, upper greenschist- to amphibolite-facies metasedimentary, metavolcanic, and metaplutonic rocks (pelitic, semipelitic, quartzofeldspathic, calcareous, and mafic to ultramafic compositions including siliciclastic, pelitic (commonly carbonaceous) and carbonate metasedimentary rocks, mafic, intermediate and felsic metavolcanic rocks, and a wide variety of metaplutonic rocks ranging from ultramafic to felsic composition. In contrast, rocks exposed northeast of the Willow Lake fault are relatively undeformed and unmetamorphosed. They comprise primarily intrusive rocks of intermediate to felsic composition and, near the eastern limit of the map area, intermediate to felsic volcanic and volcaniclastic rocks coeval with the main plutonic body, the Reid Lakes batholith.

The southern edge of the map area is underlain by rocks assigned to Quesnellia and Stikinia, two major mid-Paleozoic to early Mesozoic arc terranes that lie to the south and southwest of Yukon-Tanana terrane (Gordey and Makepeace, 1999). Stikinia is represented by Stuhini Group (Upper Triassic Semenof formations), and intruded by Early Jurassic plutons (Aishihik suite). The area is also underlain by postorogenic, post-accretion, mid-Cretaceous plutonic rocks (Whitehorse suite), volcanic rocks of the Upper Cretaceous Carmacks Group, and Quaternary basalt of the Selkirk Volcanic Group.

DETAILED GEOLOGY

The Snowcap assemblage (PDs1, PDs2, PDs3), constrained regionally to be Late Devonian and older by cross-cutting plutons and overlying metasedimentary rocks (Colpron et al., 2003; Gordey and Ryan, 2005), dominates the central part of the map. The most extensive unit PDs 1, comprises quartzite, micaceous quartzite and psammitic quartz-muscovite-biotite (±garnet) schist. The quartzite is generally fine-grained, banded to massive, grey to white in colour and most commonly intercalated (on cm-scale) with garnet-bearing pelitic schist. Locally, pebble meta-conglomerate horizons occur within the quartzite. Marble and calc-silicate schist (PDs 2) are minor constituents of the Snowcap assemblage, present in isolated lenses up to tens of metres in thickness. These rocks appear massive and light grey in colour, with little obvious compositional variation. Amphibolite (PDs 3) locally associated with metasedimentary rocks of the Snowcap assemblage, is most prominent near the White Mountains. It is typically fine- to medium-grained massive metabasite composed of hornblende-plagioclase±garnet. Hornblende commonly rims massive to patchy cores of clinopyroxene. Rocks with relict gabbroic textures are locally preserved. Amphibolite resembles chlorite-biotite schist but is typically characterized by heterogeneous layering and local preservation of volcanic and/or volcaniclastic textures.

In places, Snowcap assemblage is intercalated with quartzite and pelitic schist that are dark grey in colour, carbonaceous and locally graphitic. These are possibly equivalent to carbonaceous rocks of the Nasina quartzite in Stewart River area to the northeast (Gordey and Ryan, 2005), and are assigned to the Finlayson Assemblage (DMF 1). Less common metabasite in the central part of the area is characterized by a chlorite-actinolite greenstone assemblage (DMF2) typical of greenschist facies metamorphism. It is commonly medium- grain and fine-grained, locally preserving relict volcanic and volcaniclastic textures that are most evident when viewed perpendicular to the stretching lineation.

Chlorite and intermediate schist (Pk 1) and quartz-feldspar augen muscovite schist (Pk 2) exposed mainly in the northwestern part of the map area are assigned to the Lake Permian Klondike assemblage (Pk), which is typically spatially associated with quartz and K-feldspar augen granite of the Permian Sulphur Creek plutonic suite (PgSC, see below). Felsic to intermediate schist (Pk 2) of the Klondike assemblage is characterized by a sericite and quartz matrix with more altered and/or metamorphosed examples preserving decussate hornblende and locally coarse (> 1 cm) garnet porphyroblasts. Hornblende- porphyroblasts are in places pseudomorphed by chlorite and biotite. Felsic to intermediate schist is likely derived from volcanic or hypabyssal intrusive protolithe. Locally, the distinction between volcanic rocks of the Klondike assemblage and fine-grained, foliated phases of the Sulphur Creek suite is difficult. Chlorite schist (Pk 1) exposed northwest of Mount Adams represents intermediate to mafic metavolcanic rock of the Klondike assemblage. It commonly has a pitted weathering surface resulting from dissolution of pyrite crystals, and locally preserves relict volcanic textures.

The Simpson Range plutonic suite (MsIm) encompasses a compositional spectrum from monzogranite (MgrIm) to diorite (MdIm). The rocks are commonly greisenic with less deformed occurrences characterized by their fine- to medium-grained, equigranular, and weakly to strongly foliated appearance. Locally, monzogranite to granodiorite compositions are porphyritic with K-feldspar phenocrysts (or augen) up to 1 cm long (MsgIm), which may correlate to the Grass Lakes suite regionally. The porphyritic phase resembles the Permian augen granite of PgSC but is generally more leucocratic. Medium- to dark grey tonalite and diorite are also common constituents of unMdIm ; they are invariably fine-grained, equigranular, and biotite-bearing.

Mount Mye Suite (KMgr) is primarily exposed in the northwestern part of the map area, between Mount Adams and the White Mountains, and consists of variably deformed, fine- to medium-grained, biotite-bearing, quartz and K-feldspar porphyritic to augen-bearing monzogranite. A strong transposition foliation overprinted by up to two crenulations is typical. Augen monzogranite is spatially associated with felsic to intermediate schist of the Klondike assemblage.

Ultramafic rocks (DMum) are dominantly exposed in the White Mountains. They are commonly fine-grained, homogeneous, massive serpentinized peridotite. In places, the ultramafic bodies occur as medium-grained, serpentinized pyroxenite locally associated with coarse-grained gamet amphibolite (metagabbro). The degree of serpentinization is variable, with the margins of individual bodies marked by fish-scale serpentinite and by talc-carbonate alteration commonly associated with emplacement of ultramafic bodies observed in the enclosing metamafic rocks, indicating that the ultramafic bodies are structurally interbedded with Yukon-Tanana terrane rocks.

Northeast of the Willow Lake fault, rocks of Reid Lakes complex differ markedly from those southwest of the fault in their lack of deformation and metamorphism. Much of the Reid Lakes batholith (MgIn), comprises compositionally monotonous, coarse-grained, massive, quartz-phyric biotite monzogranite. Only in close proximity to the Willow Lake fault is there is a weakly developed fabric. Coarse-grained, hornblende-bearing, K-feldspar porphyritic granodiorite to quartz monzonite is common in the northeastern part of the batholith. On Tenasee Mountain, monzogranite intrudes an earlier phase of coarse-grained, locally megathetic, hornblende gabbro (MgIm). Bostock (1964) originally assigned the granitic rocks of the Reid Lakes batholith to the Coast Intrusions and inferred a Jurassic and/or Cretaceous age. However, recent U-Pb zircon data obtained for an equigranular phase and a K-feldspar porphyritic phase exposed along the North Klondike Highway yielded Permian crystallization ages (Mortensen, 2009; Mortensen, 2009; N. Joyce, pers. comm., 2009). It is highly probable that the Reid Lake batholith correlates with the Simpson Range plutonic suite.

Exposures of volcanic and volcaniclastic rocks (MvrL) dominate the ridges between Reid Lakes and Willow Lake in the eastern portion of the map area. Volcanic rocks include andesite, dacite, and rhyolite to rhyodacite porphyry. Volcaniclastic rocks include sandstone, conglomerate and/or breccia, and tuff. The volcanic rocks are commonly massive and lack internal structures. The volcaniclastic rocks locally preserve well-defined sedimentary structures such as parallel laminae, and bedding that is commonly inclined to moderately steep. Conglomerate and breccia are poorly sorted and composed of pebbles – cobbles of a variety of felsic to intermediate volcanic and hypabyssal rocks, similar to the adjacent volcanic rocks, in a sandy matrix. Rare beds of black argillite and chert pebble conglomerate. Includes quartz sandstone (MqrL), with blue-grey quartz grains that are similar in character to quartz phenocrysts in the Reid Lakes batholith.

The Reid Lakes volcanic succession was previously interpreted as Carboniferous(?) to Cretaceous in age (Bostock, 1964), as well as Triassic to mid-Cretaceous (Gordey and Makepeace, 1999). Our new mapping postulated a co-cogenetic relationship between the volcanic and plutonic rocks of the Reid Lakes batholith borne out by preliminary U-Pb zircon results that indicate an Early Mississippian age for the volcanic rocks (N. Joyce, pers. comm., 2009). It is highly probable that the Reid Lake volcanic succession correlates with the Finlayson assemblage regionally.

The southern part of the map area is mainly underlain by rocks of Quesnel and Stikine terranes. Rocks straddling Pelly River valley are Triassic to mid-Cretaceous (Gordey and Makepeace, 1999). Our new mapping postulated a co-cogenetic relationship between the volcanic and plutonic rocks of the Reid Lakes batholith borne out by preliminary U-Pb zircon results that indicate an Early Mississippian age for the volcanic rocks (N. Joyce, pers. comm., 2009). It is highly probable that the Reid Lake volcanic succession correlates with the Finlayson assemblage regionally.

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The southwest corner of the map area is primarily underlain by volcanic and plutonic rocks of Early Mesozoic age that could be part of either Stikinia or Quesnellia. Augite-phyric andesite-dacite volcanic flows and volcaniclastic rocks occur in a northwest-trending belt that roughly follows the northbank of the Yukon River. The rocks can readily be distinguished from adjacent Yukon–Tanana terrane by a weakly to moderately developed cleavage and metamorphism limited to subgreenschist to greenschist facies. These rocks resemble Upper Triassic volcanic rocks assigned to either the Povoas Formation of the Lewes River Group (Stikinia) or the Semenof Formation (Quesnellia). We tentatively assign the rocks to the Stuhini Group and to the Semenof Formation based on proximity to Stikinia.

The Semenof Formation is intruded and bounded to the southwest by Early Jurassic biotite ± hornblende-granodiorite to monzogranite of the Aishihik plutonic suite (EJgA). The rocks are generally medium- to coarse-grained, and equigranular, with monzogranite phases commonly K-feldspar porphyritic. The suite contains magmatic epidote, which is indicative of crystallization at mid-crustal depths. Alteration of individual plutons is locally exhibited as chloritization of the mafic minerals and epidote-filled fractures. The Aishihik suite is generally undeformed, but locally may have a well-developed tectonic foliation. This belt of plutonic rocks represents the northwest extension of the Minto pluton which hosts the high-grade Cu-Au Minto mine approximately 10 km to the southeast.

Rocks of the Upper Cretaceous Carmacks Group (uKC) is preserved as erosional remnants of a once-extensive volcanic cover a few metres to hundreds of metres in thickness. It generally forms positive topographic features and is well-defined by patchy high-velief anomalies intho new aeromagnetic data. Within the map bounds, the Carmacks Group largely comprises dacite and rhyodacite (uKC 1), and lesser brown-black basalt and basaltic andesite (uKC 2). The latter is more prevalent to the southeast in Carmacks and Glenlyon areas. The intermediate volcanic rocks are commonly hornblende and/or plagioclase phyric whereas the basalt is locally hornblende- and olivine-phyric. Local flow-banding and flow breccia indicate an extrusive origin. Two small occurrences of smokey quartz and K-feldspar phyric rhyolite are assigned to the Ross River Suite (Ers).

Subaerial to subglacial mafic volcanic flows of the Pliocene-Pleistocene Selkirk Volcanic Group (Qs) occur as valley fill near Fort Selkirk, at Volcano Mountain and along Rosebud Creek. The young basaltic lava flows and associated breccias are typically vesicular and exhibit fresh olivine phenocrysts. The flows are expressed in the new aeromagnetic data by very strong positive anomalies that follow valleys. The volcanics appear to have experienced little erosion, preserving the geomorphology that is spectacularly expressed at Volcano Mountain where a cinder cone, craters, lava domes(?) and flows are well preserved.

STRUCTURAL GEOLOGY

A variety of structural styles are observed across the area. The central belt of the Yukon-Tanana terrane is characterized by at least two phases of isoclinal folding and development of transposition foliations. The main foliation observed in these rocks developed at upper greenschist – amphibolite facies conditions and may represent a second generation fabric. Metaplutonic rocks of the Simpson Range and Sulphur Creek plutonic suites are commonly strongly foliated and transposition fabrics are well developed in the Simpson Range suite (Mortensen, 2007; Staikos et al., 2008). This dominant foliation is itself deformed locally by two younger sets of open folds that are defined by an axial planar crenulation cleavage that likely developed during episodes of less pervasive Triassic and/or Jurassic deformation and metamorphism.

In the northwestern part of the map area, the Reid Lakes complex has escaped the regional deformation recorded in the Yukon-Tanana terrane south of the Willow Lake fault. Rocks of the complex are only foliated in proximity to the fault and preserve evidence for metamorphism in the form of local chloritization of mafic minerals. The Willow Lake fault is well defined in the aeromagnetic data where it corresponds to a magnetic low, and truncation of anomalies. Although the sense of displacement along the Willow Lake fault is unknown, the juxtaposition of the Reid Lakes complex next to intensely deformed and metamorphosed rocks to the south suggests an important (down-to-the-north) vertical component of displacement.

The Klinkit and Klondike assemblage are affected by two phases of tight to isoclinal folding, producing local transposition foliation within an east-west trending structural grain. This contrasts with the northwest grain in Yukon-Tanana terrane rocks. The discontinuity is likely marked by a fault that is well delineated in the geophysical data. To the southeast, in Glenlyon map area, a similar structure (Needlebrook thrust) juxtaposes rocks of the Snowcap assemblage over amphibolite and marble of the Brewell assemblage (Colpron et al., 2003).

In the vicinity of Mount Walters, the Paleozoic Boswell assemblage has been juxtaposed with Triassic augite-phyric volcanic rocks along a fault. This structure is also well defined in the aeromagnetic data and can be traced northwestward to the Mount Adams area where it splays into a number of northwest-trending splays. Although the Tintina fault is not well expressed in the aeromagnetic anomalies suggestive of dextral displacement. These faults could potentially be part of the northern extension of the Tintina fault system.

The Tintina fault marks the northeast boundary of the map area. Although not exposed in the map area, it is well defined in the aeromagnetic data and marked by a prominent topographic lineament. Regionally, Tintina fault is well constrained to have dextral displacement of ~ 425 km since the Eocene (Gabrielse et al., 2006). Restoration of this displacement juxtaposes the Reid Lakes complex of the McQuesten area with part of the Finlayson Lake area of southeastern Yukon, where relatively unstrained Mississippian rocks have also been documented.

MINERAL POTENTIAL

The southwest McQuesten - north Carmacks area has few active mineral claims and only a handful of occurrences are reported in the Yukon MINFILE. The absence of activity is perhaps largely a factor of poor bedrock exposure, and until now, the lack of higher resolution geophysical data. The lack of activity belies a favourable mineral potential based on geological similarities to nearby prospective areas of the Dawson Range – Whitegold mineral district (e.g., Cretaceous intrusion related, structurally hosted gold); as well as the producing Jurassic Minto copper-gold mine to the south. See Colpron and Ryan (2010) for further thoughts on VMS prospectivity of Yukon Tanana terrane rocks, Mississippian porphyry potential of the Reid Lake complex, and gold potential of the Permian Klondike assemblage.

Abstract

The map area primarily hosts rocks of Yukon-Tanana Terrane, comprising two domains separated by the Willow Lake fault: a central domain of Permian to pre-Devonian, polydeformed, upper greenschist- to amphibolite-facies metasedimentary, metavolcanic, and metaplutonic rocks; and a northeastern domain of Early Mississippian, generally undeformed and unmetamorphosed volcano-plutonic rocks of the Reid Lakes complex. The southern part of the area hosts rocks of Quesnellia and Stikinia, including: Paleozoic retrogressed metamorphic rocks of the Boswell assemblage; Upper Triassic augite-phyric volcanic rocks; and Early Jurassic Aishihik plutonic suite. These rocks are dissected by a series of dextral strike-slip faults, probably related to the Teslin fault system. Postaccretion rocks include: mid-Cretaceous biotite monzogranite plutons; Upper Cretaceous Carmacks Group; and Quaternary basalt of the Selkirk volcanics. The area is underexplored, but shares many geological attributes with nearby, highly prospective mineral districts.

Résumé

La région cartographique renferme principalement des roches du terrane de Yukon-Tanana, qui appartiennent à deux domaines séparés par la faille de Willow Lake : un domaine central constitué de roches méta-sédimentaires, de roches métavolcaniques et de roches métaplutoniques polydéformées du faciès des schistes verts supérieur au faciès des amphibolites, s'échelonnant en âge du Permien au pré-Dévonien; et un domaine nord-est constitué de roches volcano-plutoniques généralement non déformées et non métamorphisées du complexe de Reid Lakes, datant du Mississippien précoce. La partie sud de la région renferme des roches de la Quesnellie et de la Stikinia, dont : des roches métamorphiques rétromorphosées de l'assemblage de Boswell du Paléozoique; des roches volcaniques à phénocristaux d'augite du Trias supérieur; et la suite plutonique d'Aishihik du Jurassique précoce. Ces roches sont recoupées par une série de décrochements dextres, probablement apparentées au système de failles de Teslin. Les roches postaccrétionnaires comprennent des plutons de monzogranite à biotite du Crétacé moyen, le Groupe de Carmacks du Crétacé supérieur, et des basaltes des volcanites de Selkirk du Quaternaire. Bien que sous-explorée, la région partage cependant plusieurs caractéristiques géologiques avec des districts minéralisés très prometteurs, situés à proximité.

National Topographic System reference

Cover illustration:
Looking southwest at Volcano Mountain, underlain by Quaternary basalt of the Selkirk Volcanics, northern Carmacks map area, Yukon. Photograph by Jim Ryan. No. 2010-185.

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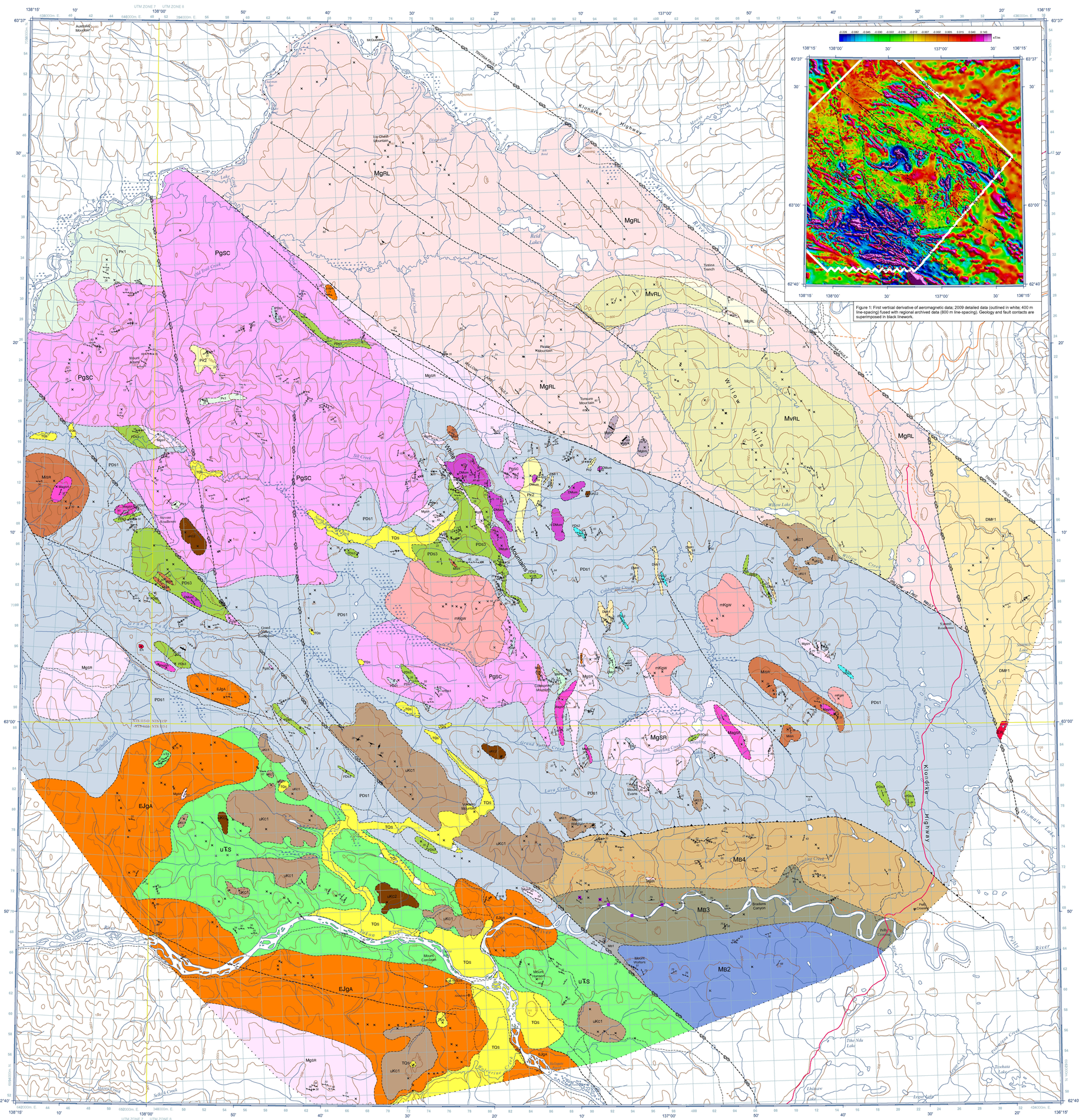
CANADIAN GEOSCIENCE MAP 7
(preliminary version)
GEOLOGY
SOUTHWESTERN McQUESTEN AND PARTS OF NORTHERN CARMACKS
Yukon
1:125 000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138°15'
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Klondike Highway
Tintina Trench
Reid Lakes
Willow Lake
Yukon River
Pelly River
Stewart River
MgRL
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PgSC
Pk1
Pk2
MgIR
MgRL
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