Preliminary results on the Middle Triassic-Middle Jurassic stratigraphy and structure of the Teslin Mountain area, southern Yukon

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ABSTRACT

Stratigraphic and structural relationships within Stikinia, and overlap assemblages of the Whitehorse trough, are investigated in the Teslin Mountain area, southern Yukon. The Middle Triassic Joe Mountain Formation is dominated by a thick sequence of aphyric basalt produced by subaqueous volcanism. The Upper Triassic Lewes River Group displays complex lateral and vertical lithological and facies changes. It illustrates synvolcanic terrane exhumation, with erosion of the volcanic upland leading to deposition of thick volcaniclastic sequences, in parallel with ongoing clastic and carbonate sedimentation in marginal basins. Unravelling the Lewes River Group stratigraphy is critical in understanding the latest stages of Stikinia arc volcanism and the onset of Whitehorse trough marine sedimentation in the Early-Middle Jurassic. Further mapping and analytical work will focus at characterizing the Joe Mountain Formation and Lewes River Group, to determine how Stikinia evolved prior to final amalgamation of the Intermontane terranes with North America.

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INTRODUCTION

The Teslin Mountain area, northeast of Whitehorse (NTS 105E/2; Fig. 1) is underlain by volcano-sedimentary rocks that are considered to be part of Stikinia, the largest of the Intermontane terranes in the Canadian Cordillera. In particular, the Middle Triassic Joe Mountain Formation (JMF; Hart, 1997) and the Upper Triassic Lewes River Group (LRG; Bostock and Lees, 1938; Lees, 1934; Tempelman-Kluit, 1984, 2009; Tozer, 1958; Wheeler, 1961) are the focus of this paper. These units are overlain by up to 3000 m of sedimentary strata of the Lower to Middle Jurassic Laberge Group, which defines the Whitehorse trough (Fig. 1; White *et al.*, 2012).

Triassic volcanic rocks are rare in the Cordillera. JMF rocks constitute a unique and geographically restricted occurrence in Yukon (Hart, 1997). The base of the JMF is not exposed, its terrane affiliation is unclear, and the transition from the JMF to LRG and their overall relationship are uncertain (Hart, 1997). Both the JMF and LRG comprise an assemblage of subaqueous basalt, volcaniclastic and sedimentary rocks. However, the basaltic portion of both units displays distinctive field, petrographic and geochemical characteristics (detailed below). In British Columbia (BC), arc volcanism within Stikinia is represented by the Upper Triassic Stuhini Group (*e.g.*, Souther, 1971) and Takla Group (*e.g.*, Monger, 1977), and the Lower to Middle Jurassic Hazelton Group (*e.g.*, Tipper and Richards, 1976). Overall, arc volcanism within the Intermontane terranes is younger in BC than in Yukon.

Bedrock mapping (1:50 000 scale) in the Teslin Mountain area was initiated during the summer of 2015 as part of a multi-year project that will investigate: (1) the relationship between the JMF and LRG, and their uncertain link with Stikinia; (2) the diachronous timing of arc volcanism in Stikinia between southern Yukon and BC; (3) the setting and nature of Triassic volcanism with respect to the development of the Whitehorse trough in Early-Middle Jurassic; and (4) the age and nature of deformation affecting strata that underlie or fill the Whitehorse trough. This study builds upon existing maps, geological datasets and previously recognized stratigraphic relationships. Early reconnaissance geological mapping (1:2 500 000 scale) was conducted by the Geological Survey of Canada around Whitehorse (NTS 105D; *e.g.*, Wheeler, 1961), and east of Lake Laberge (Fig. 1; NTS 105E; Bostock and Lees, 1938; Lees, 1934; Tempelman-Kluit, 1984, 2009; Tozer, 1958). Mapping at 1:50 000 scale (105D/2,3,6,11: Hart and Radloff, 1990; 105D/13-16: Hart and Hunt, 1994, 1995) was integrated with isotopic and biostratigraphic dates, and supports the currently used stratigraphic framework and nomenclature for Stikinia and overlap assemblages present in this region (Hart, 1997; *see* below).

This paper reports on the most recent field observations from the Teslin Mountain area, and proposes preliminary interpretations of the stratigraphic and structural relationships within the Middle to Upper Triassic volcanic sequence. A brief review of the tectonic setting and geology of southern Yukon is followed by detailed lithologies for the JMF, LRG and Laberge Group, as well as Middle and Late Cretaceous plutonic and volcanic rocks. A sedimentary sequence was identified that may constitute the base of the JMF mafic volcanic and volcaniclastic rocks at Teslin Mountain. The internal stratigraphy within the LRG is complex, and characterized by lateral and vertical facies variations. In the central part of the map area, a sedimentary sequence that underlies a mafic volcaniclastic package is inferred to represent the base of the LRG. Thick limestone beds, scattered across the map area and regionally across the Whitehorse trough may represent distinct episodes of carbonate sedimentation during the Late Triassic (e.g., Lees, 1934; Tozer, 1958). Projected detailed mapping of these prominent strata will help refine stratigraphic relationships within the LRG, as well as constrain deformation of pre, syn and post-Whitehorse trough deformation.

TECTONIC SETTING

The Intermontane terranes underlie most of southern Yukon and BC southwest of the Tintina fault (Fig. 1). They represent the largest amalgamation of crustal fragments that accreted to the North American margin during the Mesozoic (Coney *et al.*, 1980). In Yukon, the outer margin of the Intermontane terranes is defined by Middle Paleozoic metasedimentary and metavolcanic rocks of the Yukon-Tanana terrane (Fig. 1; Mortensen and Jilson, 1985; Mortensen, 1992). The core and bulk of the Intermontane terranes comprise Mesozoic volcanic arc rocks of Stikinia and Quesnellia (Fig. 1; Colpron and Nelson, 2011; Wheeler *et al.*, 1991), which are juxtaposed along the Teslin fault north of Whitehorse (Fig. 1). Upper Paleozoic accretionary complex rocks of the Cache Creek terrane (*e.g.*, Monger *et al.*, 1991; Struik *et al.*, 2001) are surrounded by Stikinia and Quesnellia (Fig. 1) and extend south of Whitehorse to northern British Columbia. So far, Cache Creek rocks have not been recognized north of Whitehorse (Bickerton *et al.*, 2013), and the Teslin Mountain area is inferred to be underlain by Stikinia.

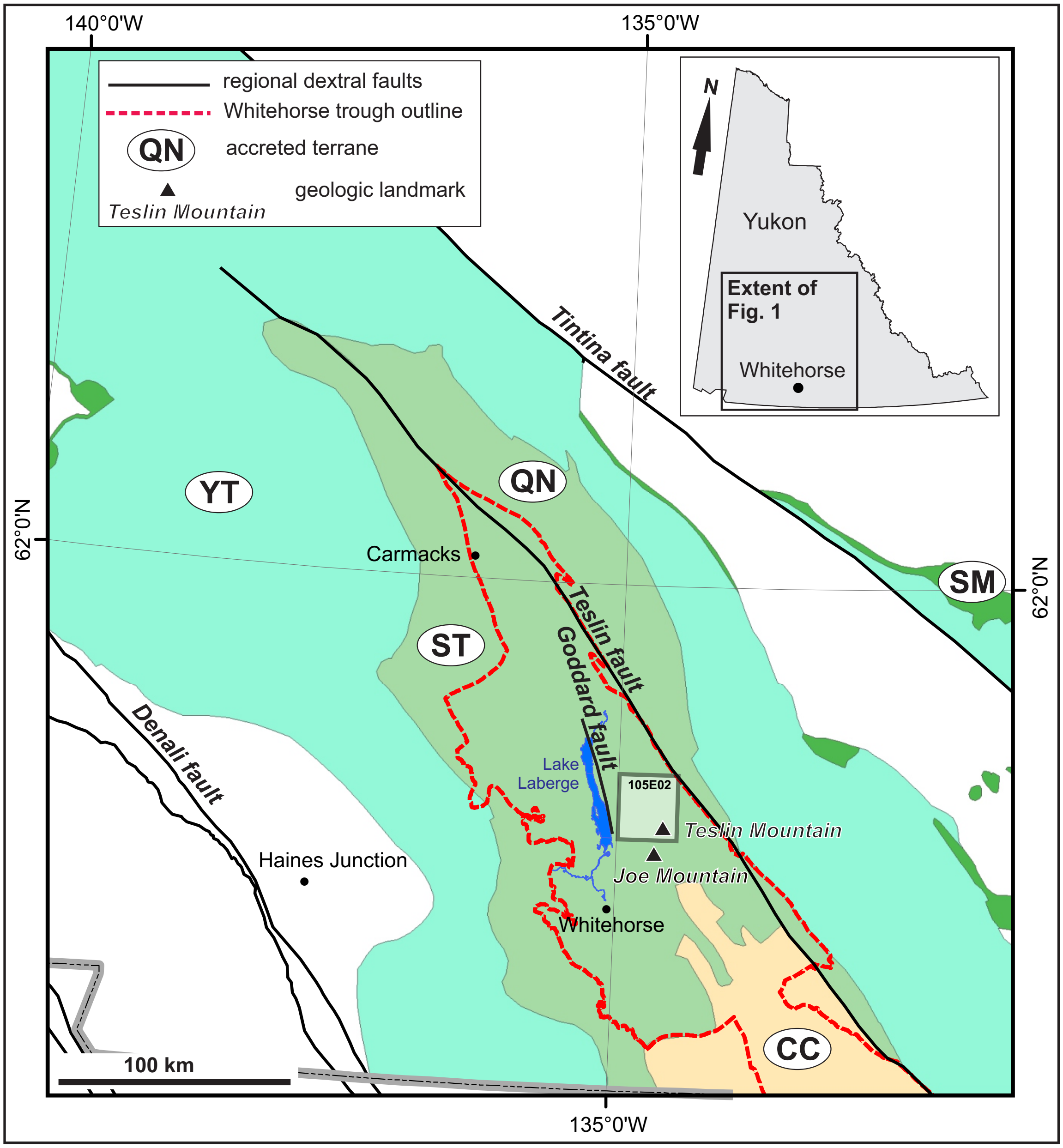


Figure 1. *Tectonic assemblage map of south-central Yukon. Intermontane terranes are ST: Stikinia, QN: Quesnellia; CC: Cache Creek, YT: Yukon-Tanana; and SM: Slide Mountain. Yukon inset map shows figure extent in square. Grey outline on figure is Teslin Mountain area (105E02). Terrane boundaries after Colpron and Nelson (2011). Whitehorse trough outline after Hutchison (pers. comm.).*

The Middle Triassic JMF and Upper Triassic LRG record arc volcanism and arc-related basin sedimentation along the North American margin in the Mesozoic (Hart, 1997). JMF sub-alkalic basalt and basaltic andesite display an iron-enriched tholeiitic signature, typical of island arc tholeiite and mid-ocean ridge basalt (Hart, 1997). The LRG mafic sequence comprises pyroxene-phyric, calc-alkaline, high-K basalt typical of island arc settings (Hart, 1997). The extensive volcaniclastic component part of the LRG (Hart, 1997; Tempelman-Kluit, 1984, 2009) suggests high rates of erosion of the arc related to exhumation and uplift of the Intermontane terranes following accretion.

Deposition of up to 3000 m of sediments of the Laberge Group (e.g., Wheeler, 1961; White *et al.*, 2012) took place in the Whitehorse trough (Fig. 1) from the Early to Middle Jurassic. The Whitehorse trough extends about 650 km from Dease Lake in BC to north of Carmacks in central Yukon (Colpron *et al.*, 2015; White *et al.*, 2012).

The basin records deposition in a forearc setting, as a result of subduction of the Cache Creek ocean beneath Stikinia (Lewes River Arc) and Quesnellia in the Mesozoic (Colpron *et al.*, 2015; White *et al.*, 2012). The Whitehorse trough evolved as a northwest trending, synorogenic, intermontane piggy-back transpressional basin by Middle Jurassic (White *et al.*, 2012).

REGIONAL STRATIGRAPHY

The Teslin Mountain area is underlain by three major rock assemblages: the Middle Triassic JMF and Upper Triassic LRG are inferred to be part of Stikinia (Fig. 2), and are overlain by the Lower to Middle Jurassic Laberge Group. Other overlap assemblages include Early-Middle Cretaceous Open Creek volcanic rocks, and intrusive bodies related to the Teslin and Whitehorse plutonic suites (Fig. 2).

The JMF includes a sequence of Middle Triassic (Ladinian) pillow basalt, clastic and calcareous sedimentary rocks, microdiorite, diabase and gabbro, originally defined by Hart (1997) at Joe Mountain (type section) and Mount Byng (NTS 105D/15,16). The JMF may unconformably overlie the Upper Paleozoic Takhini assemblage (Fig. 2), a package of deformed and metamorphosed mafic volcanic rocks that constitute the base of Stikinia in southern Yukon (Hart, 1997); however this relationship is not documented. The JMF shows lithological similarities with some Cache Creek terrane rocks in southern Yukon, but the detrital link between the JMF and the Whitehorse trough supports an origin within Stikinia (Hart, 1997).

Volcanic, clastic and carbonate rocks of the Upper Triassic LRG regionally overlie the JMF, but the relationship between the two is uncertain (Fig. 2; Hart, 1997). Tozer (1958) conducted mapping northeast of Lake Laberge and built upon the first stratigraphic framework established by Lees (1934) and Bostock and Lees (1938), and introduced seven formations: four massive or bedded limestone units, interbedded with volcaniclastic and mixed volcano-sedimentary units. Wheeler (1961) mapped the Whitehorse area, south of Lake Laberge, and divided the LRG into three belts to reflect lateral changes in lithology from west to east: at the base of the sequence to the west, a coarse-grained, mixed sedimentary and volcaniclastic unit occurs, and finer, more clastic lithologies are mapped to the east; the highest stratigraphic levels seem to be dominated by limestone across the three belts. The complex stratigraphy of the LRG emphasizes important lateral facies changes across southern Yukon. The latest stratigraphic framework for the LRG introduces five lithological units grouped in two formations (Hart 1997; Tempelman-Kluit, 1984, 2009):

- The Povoas Formation, comprises aphyric to pyroxene phyric basalt and volcanic breccia, geochemically distinguished from the underlying JMF by island arc calc-alkaline geochemical characteristics (Hart, 1997).
- The Aksala Formation, comprises greywacke-shale with thick limestone lenses, and is divided into four members that variably overlie the Povoas Formation: the Casca, Hancock, Mandanna (Tempelman-Kluit, 1984) and Sheldon members (Hart, 1997). The Casca Member is lithologically heterogenous and includes a variety of calcareous siltstone, argillite, sandstone and conglomerate. The Sheldon Member comprises conglomerate, and minor sandstone and limy siltstone, and is only reported at one locality (Hart, 1997). The Hancock Member comprises thick beds of massive to bedded limestone that form a northeast trending belt east of Lake Laberge. The Mandanna Member comprises well-bedded or massive, red and green weathering greywacke and volcanic sandstone, and is mainly observed west of Lake Laberge.

The LRG is overlain by the Lower to Middle Jurassic Laberge Group (Fig. 2), but the nature of the contact is uncertain (unconformable contact: Cairnes, 1910; Lowey, 2004, 2005, 2008; Lowey *et al.*, 2009; conformable contact: Bostock and Lees, 1938; Hart, 1997; Tempelman-Kluit, 1984). The Laberge Group corresponds to deltaic and deep marine sedimentation in the Whitehorse trough from the Early to Middle Jurassic, following shallow-water, arc-related deposition of the Upper Triassic LRG strata (Colpron *et al.*, 2015; White *et al.*, 2012). Stratigraphy of the Laberge Group includes shallow marine to fluvial and coal bearing sandstone, conglomerate and shale deposits of the Tanglefoot Formation exposed north of the trough (Hart, 1997; Lowey, 2004, 2008; Tempelman-Kluit, 1984, 2009), laterally partially equivalent to deep marine turbidite and mass-flow conglomerate successions of the Richthofen Formation mapped south of the trough (*e.g.*, Lowey, 2005; Tempelman-Kluit, 1984, 2009). The Nordenskiold Formation, a distinct crystal-lithic tuff (Tempelman-Kluit, 1984, 2009), occurs at multiple stratigraphic levels in both the Richthofen and Tanglefoot formations, and represents three volcanic events between 188 and 186 Ma (Colpron and Friedman, 2008).

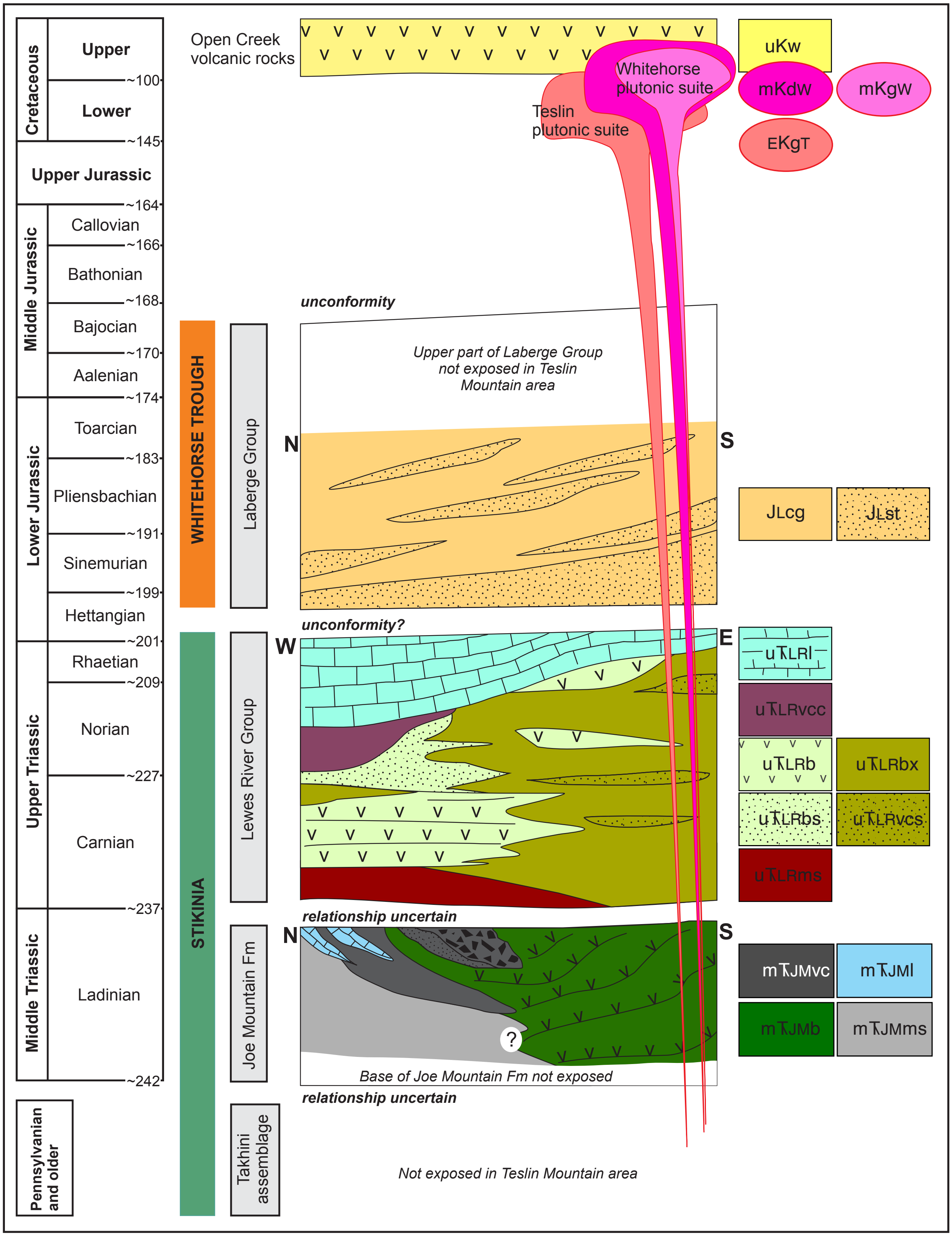


Figure 2. *Schematic stratigraphic relationships in the Teslin Mountain area based on summer 2015 mapping. See Fig. 3 for legend and description of map unit codes. Whitehorse trough extent after White et al. (2012). Stratigraphic age scale after Cohen et al. (2013; updated).*

The Middle Jurassic to Lower Cretaceous Tantalus Formation disconformably overlies the Laberge Group (*e.g.,* Tempelman-Kluit, 1984, 2009). This coal-bearing sequence of fluvial chert-pebble conglomerate and sandstone marks the end of deposition in the Whitehorse trough (White *et al.*, 2012).

STIKINIA STRATIGRAPHY

JOE MOUNTAIN FORMATION (MIDDLE TRIASSIC)

Aphyric basalt, and lesser volcanic breccia, mafic tuff and sedimentary rocks underlie high ridges and peaks near Teslin Mountain in the south and southeast of the mapped area, with a spatial extent of 6 by 16 km (Fig. 3). This sequence constitutes the geological continuity of the type section of the Middle Triassic JMF exposed at Joe Mountain about 13 km to the southeast (Hart and Hunt, 1994; Hart, 1997).

Four map units represent the JMF in the Teslin Mountain area (Figs. 2 and 3): (1) dark grey-green aphyric basalt (mTRJMb); (2) a volcaniclastic sequence including chaotic volcanic conglomerate, mafic tuff and volcanic sandstone (mTRJMvc); (3) a south dipping sedimentary sequence including carbonate rocks (mTRJMl); (4) clastic mudstone/sandstone (mTRJMms). Relationships between these map units are locally constrained, but interfingering and lateral facies variations are frequent (Fig. 2). To the north, the clastic sedimentary sequence is in erosional or structural unconformable contact with Upper Triassic volcaniclastic strata of the LRG (Fig. 3). West of Teslin Mountain, the JMF is inferred to be conformably overlain by north dipping sedimentary strata of the LRG (Fig. 3). East of the map area, JMF basalt is in contact with the Lower Jurassic Laberge Group along the Open Creek fault. Several large intrusions crosscut the JMF basalt, including an Early Cretaceous granodioritic intrusion of the Teslin Plutonic Suite in the south (EKgT), and Middle Cretaceous granodiorite to monzodiorite of the Whitehorse Suite in the east (mKgW; Fig. 3).

The thickness of the JMF is estimated at ~3000 m, including a ~1000 m thick sedimentary sequence to the north, and a cumulated thickness of 2000-2300 m for the basalt and volcaniclastic sequence. Previous thickness estimates indicate at least 3200 m for the JMF type section at Joe Mountain (Hart, 1997).

*Coherent basalt (*mTRJMb*)*

Grey to rusty-brown weathering, dark grey-green, fine to medium-crystalline, amygdaloidal or vesicular aphyric basalt constitutes the dominant lithology of the JMF at Teslin Mountain. It occurs as thick-bedded (up to 1-2 m), blocky, massive to pillowed lava flows (Fig. 4a). Phenocrysts include plagioclase (up to 5%) and minor pyroxene crystals or cumulates. Coherent basalt is locally finely vesicular or amygdaloidal, and in places interbedded with autobrecciated basalt. Chlorite alteration, quartz or carbonate veinlets and disseminated pyrite (1% or less) are commonly observed. The unit is magnetite-rich, and highest magnetic values (~80 SI) are measured in clasts of hematite-magnetite iron formation similar to previously mapped occurrences at Joe Mountain (Piercey, 2005).

Petrographic observations indicate that JMF basalt have an equigranular to porphyritic texture. Interstitial space between randomly oriented plagioclase ± pyroxene crystals is occupied by a microcrystalline plagioclase-rich groundmass (Fig. 5a,b). Locally altered orthopyroxene and clinopyroxene are identified, as well as minor olivine. Chlorite is the main alteration phase (up to 30%), accompanied by lesser carbonate alteration or micro-veining.

*Volcaniclastic sequence (*mTRJMvc*)*

West and north of Teslin Mountain, an ~100 m thick volcaniclastic sequence dominated by fine mafic ash tuff and chaotic volcanic conglomerate overlies the JMF basalt. Thick-bedded, polymictic, chaotic volcaniclastic conglomerate displays boulder-size clasts (30-50 cm) of quartz-plagioclase-phyric diorite, cherty glassy basaltic ash tuff, dark green finely crystalline basalt, and blocks of red-brick oxidized iron formation (Piercey, 2005). The conglomerate is interbedded with orange-brown-grey to tan weathering, pale grey-green, medium-bedded volcaniclastic sandstone, with angular dark basalt clasts (2%), quartz eyes (up to 15%) in a pale grey-green very fine matrix. North of Teslin Mountain, this unit is dominated by south-dipping, pale green weathering, dark green to grey, silicified, laminated mafic ash tuff. Disseminated pyrite is locally observed.

Petrographic observations of the quartz-phyric volcaniclastic sandstone indicate a relatively equigranular, fine-grained texture. Subangular quartz crystals are intact, the rest of the rock comprises a groundmass completely recrystallized into fine microcrystalline quartz, and extremely altered olivine or pyroxene fragments (Fig. 5c).

Possible fiammae are observed, which may correspond to compacted and elongated volcanic glass (Fig. 5c). The laminated mafic tuff displays a fine-grained texture and is dominated by isotropic ash material, with minor subangular quartz microcrysts (Fig. 5d). It is pervasively carbonate altered and displays parallel elongated fractures that may be the result of devitrification (Fig. 5d).

*Sedimentary sequence (*mT̄JMms and mT̄JMl*)*

A sedimentary sequence underlies the south dipping mafic and volcaniclastic strata of the JMF, and is bounded to the north by LRG volcaniclastic rocks (Fig. 3). Lenses of pale grey weathered thin-bedded calcareous mudstone and sandstone (mT̄JMl) occur within the JMF mafic ash tuff sequence (Fig. 4b). Farther north, brown-grey weathering, calcareous sandstone to pebble conglomerate contains rounded to subangular clasts of limestone, shell fragments, and fine-grained dark grey aphyric or plagioclase-phyric volcanic rock. This sequence grades northward into a south dipping mudstone/sandstone clastic sequence up to 100 m thick (mT̄JMms; Fig. 4c). Pale green, finely-laminated sandstone and mudstone dominate and contain less than 1% of disseminated sulphides. Coarse, matrix-supported angular conglomerate displays thick interbeds of laminated sandstone, and contains a majority of volcanic clasts and dark brown, very fine mudstone clasts in a sandstone-rich matrix. Bedded, brown grey weathering, pebble conglomerate is mapped closer to the upper contact.

Interpretation and age

Both the volcanic and clastic sequence of the JMF at Teslin Mountain suggest a shallow subaqueous environment of deposition. Basalt is generally pillowed, with subaerial, flow-banded, vesicular lava locally observed. Regular lamination within the mafic tuff sequence and the presence of pillows suggests deposition under water for at least part of the formation. The chaotic organization of the volcanic conglomerate and dominant volcanic clast composition indicate that only a minimum amount of reworking took place. The clastic sedimentary sequence and limestone lenses mapped north of Teslin Mountain suggest that a marginal shallow basin existed prior to and during JMF volcanism, at the margin of the volcanic center. A reaction rind surrounds the limestone lenses at the contact with the mafic tuff, suggesting that limestone was incorporated as the tuff was still hot. This sedimentary sequence may represent the base of the JMF north of Teslin Mountain, but a gradual lateral transition into to the mafic sequence is inferred towards the south (Fig. 2).

Conodonts extracted from limestone interbedded with JMF basalt at Joe Mountain returned a Middle Triassic (Ladinian) age (Hart, 1997). Additional conodont analysis is underway for the limestone lenses within the mafic tuff sequence near Teslin Mountain. This may provide some constraints on the age of this volcanic event and confirm the correlation with the type section of the JMF.

LEWES RIVER GROUP (UPPER TRIASSIC)

The Upper Triassic LRG is exposed in the west and centre of the Teslin Mountain map area (Fig. 3). Seven map units comprising clastic sedimentary, calcareous, volcaniclastic and mafic volcanic strata are defined based on lithology, stratigraphic associations and geographic distribution (Fig. 2).

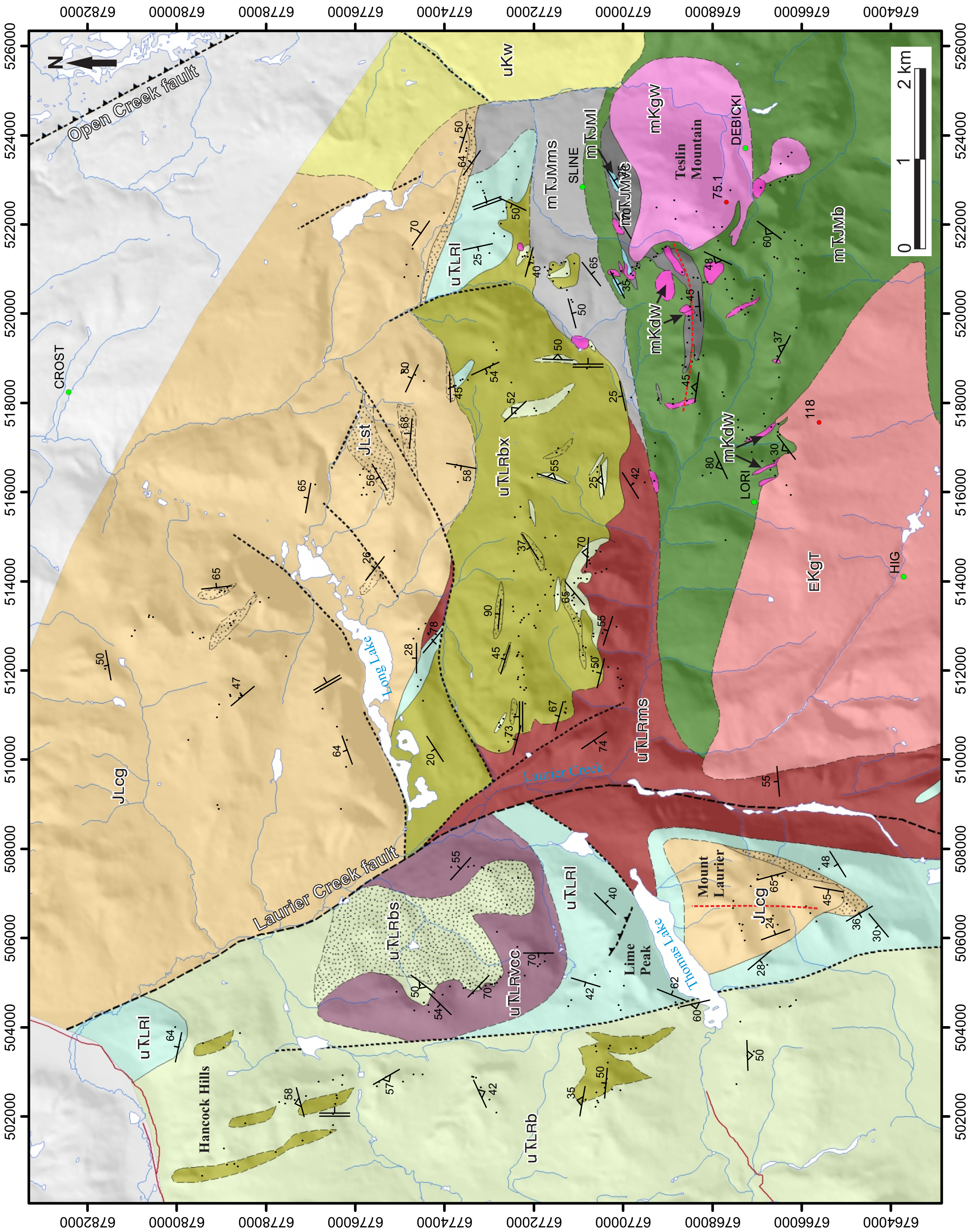
At most locations, the base of the LRG is not exposed but thickness estimations from the map and cross sections suggest that the group could be more than 2000 m. Previous thickness estimates for the LRG are between 2100 m (Tozer, 1958) to greater than 3000 m (Hart, 1997).

*Mudstone/sandstone (*uT̄LRms*)*

A north-dipping, ~800 m thick, well-bedded, clastic sequence of mudstone/sandstone is exposed east of Laurier Creek and south of Long Lake (Figs. 3 and 4d). It is in contact with JMF basalt to the south, possibly along a disconformity, and conformably underlies LRG volcaniclastic rocks described below. Rusty weathering of the mudstone towards the southern contact may indicate a nearby intrusive contact with the Teslin Plutonic suite (EKgT).

This unit comprises thin to medium-bedded, brown weathering, pale to dark green, fine-grained, lithic and crystal-rich laminated sandstone and mudstone and contains sparse plagioclase and mafic crystal fragments. Matrix-supported angular conglomerate interbeds contain a majority of volcanic clasts and dark brown very fine mudstone clasts in a sandstone matrix. Minor thin to medium-bedded calcareous sandstone and limestone occur in this sequence.

Similar rocks are inferred to extend along the Laurier Creek fault, east of Mount Laurier (Fig. 3), where a thick sequence of north-dipping thin to medium-bedded clastic and calcareous mudstone and sandstone was identified, however further mapping is required in this area to confirm association with this unit.


N
Open Creek fault
CROST
uKw
mKgW
Teslin Mountain
DEBICKI
75.1
SLINE
mTJMms
mTJMl
mTJMl
mTJMb
mKdW
mKdW
LORI
118
EKgT
HIG
0
1
2 km
JLcg
JLst
uTLRl
uTLRbx
uTLRms
Long Lake
Laurier Creek
Laurier Creek fault
uTLRbs
uTLRvcc
uTLRl
Lime Peak
Thomas Lake
Mount Laurier
JLcg
uTLRl
Hancock Hills
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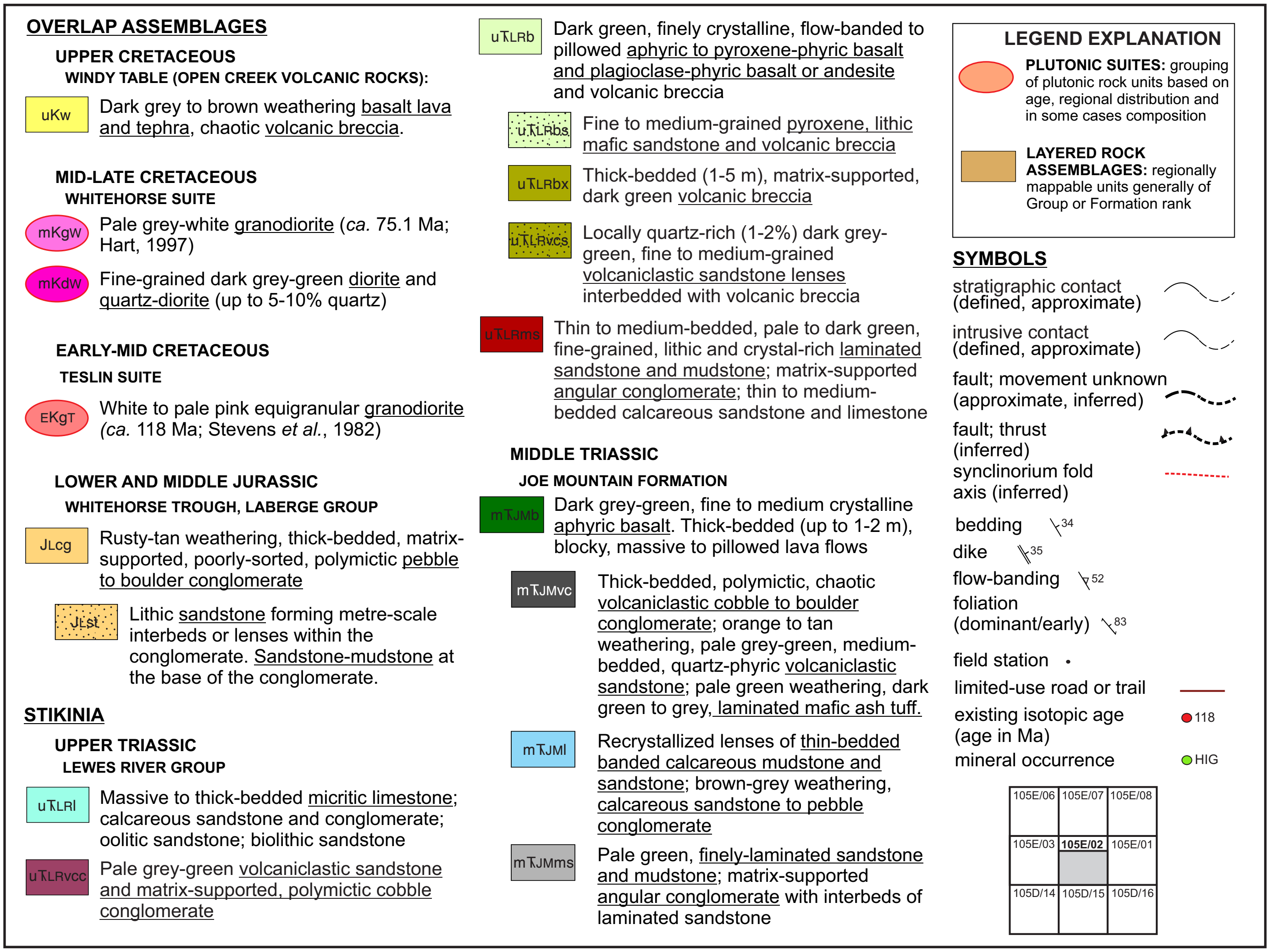

OVERLAP ASSEMBLAGES

UPPER CRETACEOUS

WINDY TABLE (OPEN CREEK VOLCANIC ROCKS):

uKw Dark grey to brown weathering basalt lava and tephra, chaotic volcanic breccia.

MID-LATE CRETACEOUS

WHITEHORSE SUITE

mKgW Pale grey-white granodiorite (*ca.* 75.1 Ma; Hart, 1997)

mKdW Fine-grained dark grey-green diorite and quartz-diorite (up to 5-10% quartz)

EARLY-MID CRETACEOUS

TESLIN SUITE

EKgT White to pale pink equigranular granodiorite (*ca.* 118 Ma; Stevens *et al.*, 1982)

LOWER AND MIDDLE JURASSIC

WHITEHORSE TROUGH, LABERGE GROUP

JLcg Rusty-tan weathering, thick-bedded, matrix-supported, poorly-sorted, polymictic pebble to boulder conglomerate

JLst Lithic sandstone forming metre-scale interbeds or lenses within the conglomerate. Sandstone-mudstone at the base of the conglomerate.

STIKINIA

UPPER TRIASSIC

LEWES RIVER GROUP

uŦLRl Massive to thick-bedded micritic limestone; calcareous sandstone and conglomerate; oolitic sandstone; biolithic sandstone

uŦLRvcc Pale grey-green volcaniclastic sandstone and matrix-supported, polymictic cobble conglomerate

uŦLRb Dark green, finely crystalline, flow-banded to pillowed aphyric to pyroxene-phyric basalt and plagioclase-phyric basalt or andesite and volcanic breccia

uŦLRbs Fine to medium-grained pyroxene, lithic mafic sandstone and volcanic breccia

uŦLRbx Thick-bedded (1-5 m), matrix-supported, dark green volcanic breccia

uŦLRvcs Locally quartz-rich (1-2%) dark grey-green, fine to medium-grained volcaniclastic sandstone lenses interbedded with volcanic breccia

uŦLRms Thin to medium-bedded, pale to dark green, fine-grained, lithic and crystal-rich laminated sandstone and mudstone; matrix-supported angular conglomerate; thin to medium-bedded calcareous sandstone and limestone

MIDDLE TRIASSIC

JOE MOUNTAIN FORMATION

mŦJMb Dark grey-green, fine to medium crystalline aphyric basalt. Thick-bedded (up to 1-2 m), blocky, massive to pillowed lava flows

mŦJMvc Thick-bedded, polymictic, chaotic volcaniclastic cobble to boulder conglomerate; orange to tan weathering, pale grey-green, medium-bedded, quartz-phyric volcaniclastic sandstone; pale green weathering, dark green to grey, laminated mafic ash tuff.

mŦJMl Recrystallized lenses of thin-bedded banded calcareous mudstone and sandstone; brown-grey weathering, calcareous sandstone to pebble conglomerate

mŦJMms Pale green, finely-laminated sandstone and mudstone; matrix-supported angular conglomerate with interbeds of laminated sandstone

LEGEND EXPLANATION

PLUTONIC SUITES: grouping of plutonic rock units based on age, regional distribution and in some cases composition

LAYERED ROCK ASSEMBLAGES: regionally mappable units generally of Group or Formation rank

SYMBOLS

stratigraphic contact (defined, approximate)

intrusive contact (defined, approximate)

fault; movement unknown (approximate, inferred)

fault; thrust (inferred)

synclinorium fold axis (inferred)

bedding 34

dike 35

flow-banding 52

foliation (dominant/early) 83

field station

limited-use road or trail

existing isotopic age (age in Ma) 118

mineral occurrence HIG

Figure 3. *Geology of the Teslin Mountain area (part of 105E/02), see map on previous page and legend above. Geology is based on 1:50 000 scale bedrock mapping conducted during the summer 2015. Intrusive contacts are after Tempelman-Kluit (1984) except where contact is indicated as "defined". Existing isotopic ages (K/Ar) after Stevens et al. (1982) and Hart (1997). Mineral occurrences from Yukon MINFILE (2015). Grid in UTM coordinates (zone 8, NAD 83).*

*Mafic volcanic sequence (*uŦLRb, uŦLRbs, uŦLRbx, uŦLRvcs*)*

A mafic volcanic sequence dominated by coherent basalt is exposed along a north-south belt in the western part of the map area, west of Lime Peak and Mount Laurier and in the Hancock Hills (Fig. 3). In the central part of the map area, this sequence is dominated by volcanic breccia, volcaniclastic sandstone and conglomerate, which show lithological similarities to the coherent lavas exposed to the west. Volcaniclastic rocks conformably overlie the clastic sedimentary sequence described above.

Coherent dark green-grey to rusty brown weathering, dark green, flow-banded to pillowed aphyric to pyroxene-phyric basalt (Fig. 4e) and plagioclase-phyric basalt or andesite dominate in the western part of the map area (uŦLRb). Basalt comprises very fine (<1 mm) plagioclase crystals (1-5%), small brown pyroxene crystals (1%) and minor olivine (<1%) in a finely crystalline aphyric groundmass. Amygdules or sparse small rounded (1-2 mm) to larger irregularly shaped (1-2 cm) vesicles are visible locally. Petrographic observations display a porphyritic texture of the basalt, with plagioclase, clinopyroxene and olivine phenocrysts in a microcrystalline, equigranular, plagioclase rich groundmass (Fig. 5e,f). Mafic crystals are locally strongly altered to chlorite. Carbonate alteration is pervasive.

Grey weathering, pale to dark grey-green, fine to medium-grained volcaniclastic sandstone and matrix-supported angular volcanic breccia (uTRLRbs) occur north of Lime Peak, locally interbedded with coherent basalt lava. Sandstone contains dark grey lithic volcanic lapilli and pyroxene crystals. Mafic volcanic breccia displays a pale green rubbly matrix, supporting subrounded, pyroxene-phyric basalt blocks (Fig. 4f). Beds are up to 20 m thick. Field relationships indicate that the volcaniclastic sandstone is overlain by the coarse, chaotic volcanic breccia along a subhorizontal contact that may be a depositional unconformity. The whole section is locally crosscut by carbonate veining.

Coherent basalt is locally overlain or interbedded with tan-rusty-grey weathering, dark green, matrix-supported volcanic breccia (uTRLRbx). Clasts (~ 40%) include brick-red, pyroxene, hornblende or plagioclase-phyric to aphyric, locally finely vesicular volcanic fragments. Subangular lapilli size clasts dominate, and larger clasts (20-30 cm) are subrounded. Thick-bedded (1-5 m), orange-brown-grey weathering, dark green, matrix-supported volcanic breccia also covers an area of ~12 by 4 km in the center of the map area, from the south end of Long Lake and east of Laurier Creek, northwest of Teslin Mountain (Figs. 3 and 4g). Clasts are subangular to subrounded, range from lapilli to block size, and are poorly sorted. Clast composition is volcanic, but display textural variability or various degrees of oxidation. They include red oxidized pyroxene or plagioclase-phyric basalt/andesite, vesicular to massive andesite, and lapilli size angular fragments of grey-green to red aphanitic volcanic rock. The matrix is a fine-grained, grey to green volcaniclastic sandstone, with ash to lapilli size fragments and disseminated plagioclase and pyroxene crystals. Petrographic observations of the breccia matrix indicate a relatively homogeneous clast composition. Typical clasts include plagioclase-clinopyroxene-phyric basalt with finely crystalline pyroxene-rich groundmass, and carbonate-filled vesicles (Fig. 5g).

Volcanic breccia is interbedded with lenses of volcaniclastic sandstone and coherent basalt. Brown weathering dark grey-green volcaniclastic sandstone (uTRLRvcs; Fig. 4h) is fine to medium-grained with subangular volcanic clasts up to 1 cm, and is locally quartz-rich (1-2%). Petrographic observations of this lithology indicate equigranular, fine-grained crystal tuff comprising plagioclase, altered pyroxene crystals, as well as clasts of very finely crystalline plagioclase-phyric basalt and volcanic glass (Fig. 5h). Metre-scale beds of coherent, massive, flow banded or pillowed basalt (uTRLRb) and angular lapilli mafic breccia are locally mapped within the volcaniclastic sequence. Basalt is tan to brown-grey weathering, dark grey-green, fine-grained, aphyric to hornblende (3-4%), pyroxene (2-3%; up to 10%) or plagioclase phyric (5-10%), with possible small crystals of olivine (1-2%).

Volcaniclastic sandstone (uTRLRvcc)

Volcaniclastic sandstone (uTRLRvcc) north of Lime Peak is interfingered with mafic sandstone, thick volcanic breccia and coherent pyroxene-phyric basalt of uTRLRb and uTRLRbs (Fig. 3). Its southern contact with uTRLRl limestone is masked within an east-west oriented valley. The unit is distinguished from other volcaniclastic sandstone by its color and composition. It comprises beige-brown weathering, pale grey-green, medium-grained volcaniclastic sandstone (Fig. 4i) and matrix-supported, polymictic cobble conglomerate, with locally calcareous plagioclase-mafic-rich sandstone matrix. Subangular to subrounded clasts (up to granule size) include dark green volcanic clasts, dark grey mudstone, beige fine-grained glassy rhyolite (?), finely vesicular plagioclase-phyric volcanic rock and plagioclase-rich sandstone. The sandstone locally displays up to 5-10% apple green opaque crystals which possibly result from alteration and replacement of mafic crystals. Secondary lithologies of this unit include calcareous bioclastic sandstone and mudstone and finely laminated sandstone and mudstone interbedded with the main volcanic sandstone unit. This sequence is distinct lithologically from sedimentary rocks observed to the east across Laurier Creek. Petrographic observations illustrate pervasive carbonate alteration in this unit, which masks the original mineralogy but preserves primary igneous textures. Plagioclase crystals are locally altered to sericite.

Limestone (uTRLRl)

Pale grey weathering limestone successions, between 20 and 500 m thick, are exposed along slopes and cliffs throughout the map area, at Lime Peak, west and south of Mount Laurier, south of Long Lake, and north of Teslin Mountain (Fig. 3). The main lithology comprises grey to pale yellow, finely to coarsely crystalline, massive to thick-bedded micritic limestone. Local interbeds of dark grey, fetid limestone, calcareous sandstone and conglomerate, oolitic sandstone or bioclastic wackestone

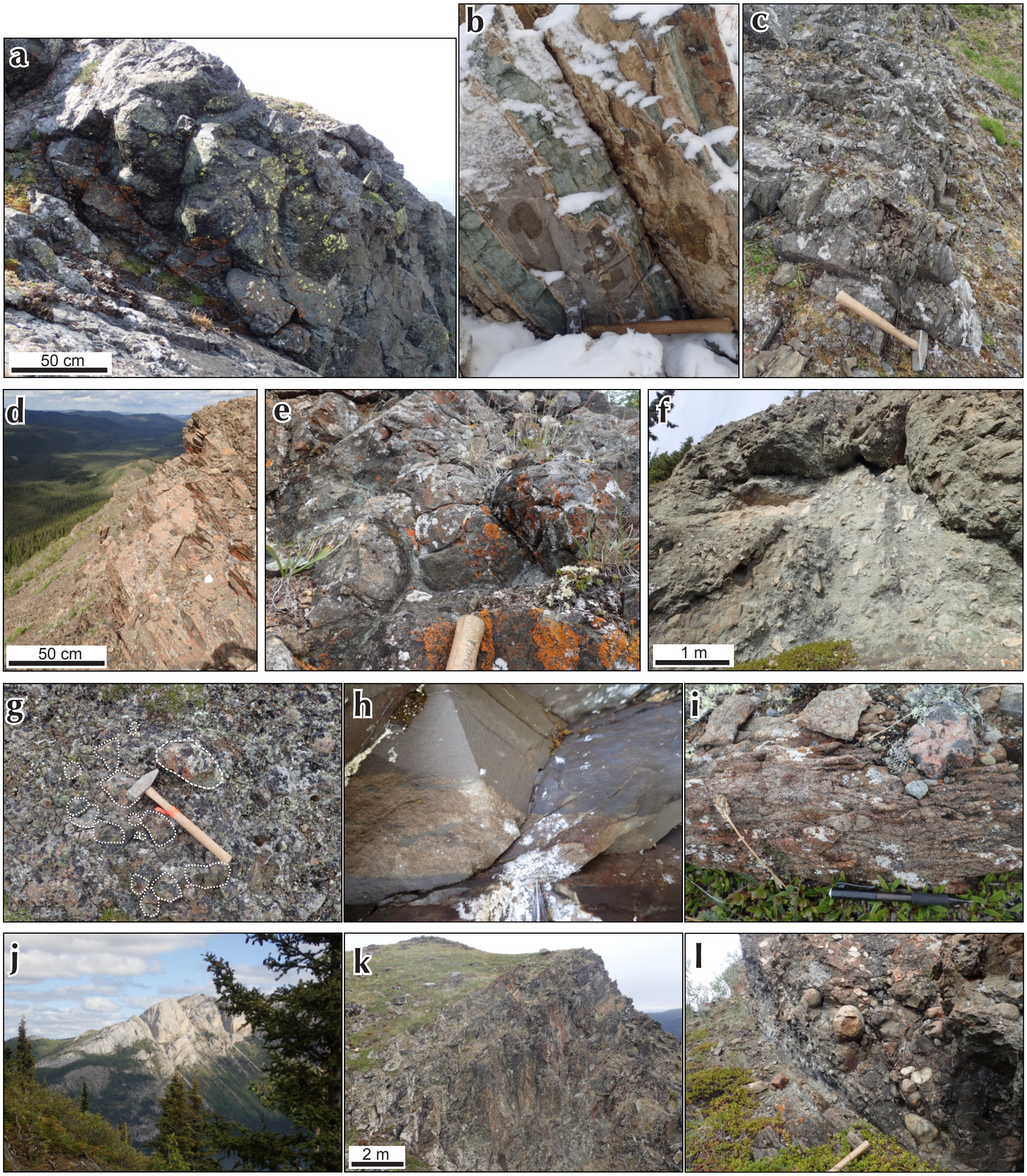

Figure 4. *Field photographs illustrating lithologies in the Teslin Mountain area. Joe Mountain Formation: (a) pillowed aphyric basalt; (b) limestone lense within laminated mafic tuff; (c) south dipping, finely bedded mudstone/volcanic sandstone sequence; Lewes River Group: (d) northeast dipping, finely laminated mudstone and sandstone; (e) pillowed pyroxene-phyric basalt; (f) matrix-supported, primary volcanic breccia; (g) partially reworked volcanic breccia possibly resulting from mass-flow depositional processes, with clasts of coherent basalt and volcaniclastic rocks shown by dashed outline; (h) volcanic sandstone; (i) beige brown weathered coarse-grained sandstone, locally grading into angular conglomerate; (j) northwest dipping limestone at Lime Peak; Laberge Gp: (k) boulder to cobble conglomerate underlain by thinly bedded mudstone and sandstone; (l) west-dipping, basal sandstone/mudstone sequence at Mount Laurier.*

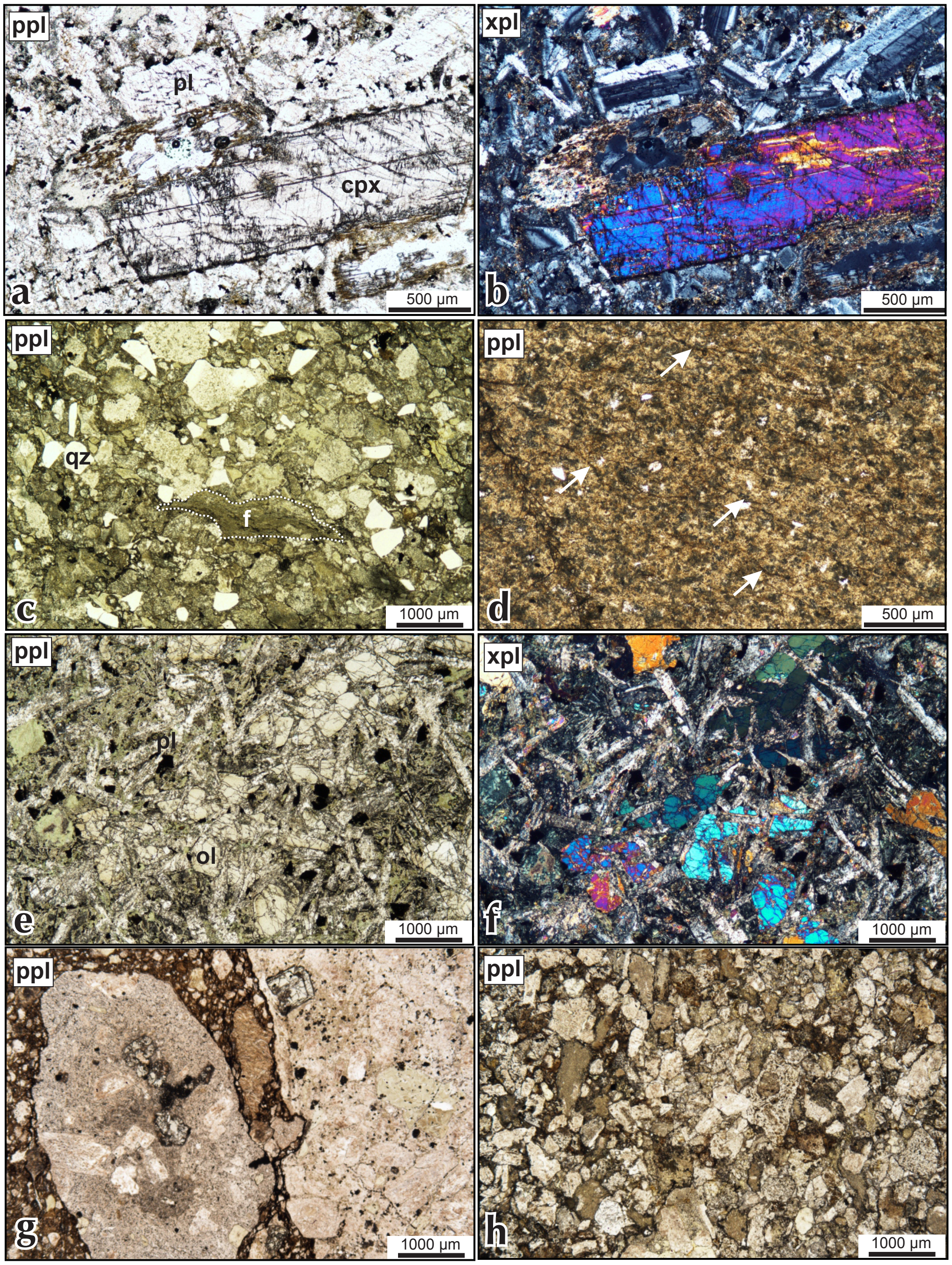

Figure 5. *Photomicrographs illustrating textures and mineralogy of selected units in the Teslin Mountain area (ppl = plain polarized light; xpl = cross polarized light). a-b and e-f are coherent rock types, c-d and g-h are volcaniclastic rock types: (a-b) Joe Mountain Formation, coherent basalt: clinopyroxene (cpx) phenocryst in an equigranular plagioclase-rich (pl) groundmass (shown in ppl and xpl); (c) Joe Mountain Formation, quartz-phyric volcaniclastic sandstone: subangular quartz grains (intact or recrystallized; qz), possible fiammae (f; dashed white outline), mafic crystal fragments and opaque volcanic glass fragments form the sandstone matrix; (d) Joe Mountain Formation, mafic ash tuff: isotropic, fine-grained ash, less than 1% very fine quartz crystals, pervasive carbonate alteration; fine dark brown fractures possibly represent compaction/devitrification features (indicated by white arrows); (e-f) Lewes River Group, coherent basalt: intergranular texture formed by plagioclase laths (pl), interstitial space is occupied by olivine crystals (ol), pervasive chlorite and carbonate alteration (shown in PPL and XPL); (g) Lewes River Group, volcanic breccia: composed of clasts of volcaniclastic rocks in a very fine grained pyroxene-rich matrix; (h) Lewes River Group, volcaniclastic sandstone: equigranular clasts and crystal fragments, grain-supported. Crystals include plagioclase and orthopyroxene, lithic fragments are very finely crystalline plagioclase phyric basalt.*

constrain bedding orientation at a few locations. The thickest and best exposed carbonate sequence is at Lime Peak, where more than 500 m of northwest to southeast dipping massive limestone is exposed (Fig. 4j). Lime Peak limestone is in possible fault contact with Lower Jurassic conglomerate at Mount Laurier.

Interpretation and age

The LRG in the Teslin Mountain area comprises mixed volcanic, clastic and carbonate units. The composition of most clastic units indicate a dominant volcanic source. Lateral lithological and textural variations, as well as thickness variations within units, reflect an active basaltic volcanic environment, with syn and post-volcanic erosion and sedimentation in an arc marginal basin.

Pillow structures in uŦLRb indicate a subaqueous environment of deposition. Layering of interbedded volcanic sandstone also suggests deposition under water. The volcanic breccia (uŦLRbs) is proximal, possibly a mass flow deposit as indicated by homogeneity of the clasts and the matrix, and chaotic internal structure. The volcaniclastic conglomerate that covers most of the central map area (uŦLRbx) may also result from mass flow deposit processes, associated with synvolcanic (?) erosion of the coherent basalt to the west. The mixed clast composition indicates mechanical integration of other lithologies during transport and deposition, but a chaotic internal organization and very rough layering suggest that the amount of reworking was restricted.

One macrofossil analysis was conducted on a sample from a bedded, fetid limestone located northwest of Lime Peak. The sample contains small columnal crinoid ossicles (columnals), bivalved shells and poorly preserved, indeterminate solitary scleractinian corals (R. Blodgett, pers. comm., 2015). The fauna assemblage in this sample is consistent with documented relatively shallow-water, high-latitude Upper Triassic shelf fauna from northern Canada (and Alaska) and consistent with previous paleontological studies in the Whitehorse trough (*e.g.*, Reid, 1980; Yarnell *et al.*, 1999). However, there is no certainty that other limestone occurrences, particularly those north of Teslin Mountain, represent the same stratigraphic level. Conodont analyses are underway to constrain the age of different limestone occurrences across the map area.

POST-ACCRETIONARY ROCKS

WHITEHORSE TROUGH – LABERGE GROUP

Thick bedded clastic pebble to boulder conglomerate and minor sandstone of the Lower Jurassic Laberge Group occupy the northern half of the Teslin Mountain area (Fig. 3), bounded to the west by the Laurier Creek fault, to the south by Long Lake, and to the east by the Teslin River. The Laberge Group is also exposed along the rugged ridge of Mount Laurier (Fig. 3). The mapped contact with the underlying LRG is either a disconformity (Mount Laurier), or an angular unconformity (south of Long Lake). Elsewhere, the base of the Laberge Group is covered.

The upper contact of the Laberge Group is not exposed in the Teslin Mountain area, therefore the estimated thickness of 2000 m for the Laberge Group is a minimum. Previous estimates report between 1000 and 3000 m (*e.g.,* Hart, 1997; White *et al.*, 2012) across the Whitehorse trough.

Pebble to boulder conglomerate (JLcg) and sandstone (JLst)

An ~30 m thick sequence of brown weathering, thin-bedded sandstone to mudstone (JLst) marks the base of the Laberge Group (Fig. 4k). At Mount Laurier, this west dipping fine clastic sequence overlies LRG limestone and underlies Laberge Group conglomerate (Fig. 3). The sandstone contains fine mafic crystals (biotite, pyroxene?), minor plagioclase, in a fine, dark grey groundmass. It displays cross-stratifications on weathered surfaces and grades upward into mudstone. Finely bedded laminated mudstone is grey-brown weathered, dark grey and very fine grained. A similar relationship between the LRG and Laberge Group conglomerate is mapped north of Teslin Mountain. There, fine, brown weathering sandstone and mudstone dip north beneath thick beds of cobble conglomerate.

Grey-brown-rusty to tan weathering, thick-bedded, dominantly matrix-supported, poorly-sorted, polymictic pebble to boulder conglomerate (JLcg; Fig. 4l) is exposed along steep ridges and cliffs. It includes rounded to subrounded clasts of a variety of compositions:

- Sedimentary clasts: dark grey, very fine grained mudstone; pale grey, featureless limestone mudstone or cherty limestone;

- Intrusive clasts: dark grey-green, plagioclase ± hornblende-phyric diorite; medium-grained, biotite-plagioclase-phyric granodiorite with minor quartz; grey pyroxene-plagioclase-phyric gabbro (?); feldspar-megacrystic intrusive rock; and
- Volcanic clasts: dark grey aphyric basalt; dark green amygdaloidal basalt; hornblende-phyric mafic volcanic rock; red-oxidized finely vesicular aphyric, aphanitic volcanic rock.

Bedding thickness ranges from 10-30 cm to locally metre-scale. Matrix is a pale yellow weathering, dark grey-green calcareous sandstone rich in biotite, quartz, feldspar, and hornblende. Lithic sandstone forms metre-scale interbeds or lenses within the conglomerate.

Metre-thick, locally well sorted, crystal-rich sandstone lenses are observed within the Laberge Group conglomerate at Mount Laurier. Sandstone is grey-green weathered, grey brown, medium to coarse-grained, with lenses of very fine, grey-brown-green mudstone. The matrix contains various crystals of quartz (~20%), feldspar (~60%), lithic fragments (~5%) and mafic crystals (up to 1-2%). Mudstone is orange-brown weathered, fine-grained, bedded to brecciated (fine angular clasts, matrix supported). Local rusty weathering occurs at contact with intruding hornblende-plagioclase-phyric diorite dikes.

Interpretation and age

Exposures of the Laberge Group in the Teslin Mountain area are dominated by pebble to boulder conglomerate, over finer clastic lithologies. The best exposures of the Laberge Group are towards its southern contact with the LRG in the central part of the map area or at Mount Laurier. North of Long Lake, the area is mostly covered. The conglomerate may be interpreted as a result of mass flow processes, possibly related to submarine channels or deltas.

The age of the Laberge Group is mostly constrained by detrital zircon analyses as being Late Triassic-Early Jurassic (~220-180 Ma; Colpron *et al.*, 2015). Additional detrital zircon samples will be analyzed as part of this study in order to better characterize the ages and provenance of the Laberge Group.

IGNEOUS ROCKS

*Teslin Plutonic Suite (*EKgT*)*

A large intrusive body of ~ 4 by 10 km is exposed between Mount Laurier and Teslin Mountain in the south of the map area (Fig. 3). It intrudes mainly JMF aphyric massive basalt, but also the LRG sedimentary succession to the west. Grey to tan weathering, white to pale pink, equigranular granodiorite contains plagioclase (50%), biotite (25-30%), quartz (15%) and hornblende (up to 5%). Crystal size is generally 2 to 3 mm. A weak foliation is expressed locally. The main intrusion is accompanied by various dike phases including a tan yellow weathering, pale pink, equigranular, fine to medium-grained quartz-rich granitoid with quartz (more than 50%), plagioclase (45%), biotite (5%) and hornblende-rich veins. The main intrusion was dated at ~118 Ma (K/Ar biotite; Stevens *et al.*, 1982).

*Whitehorse Plutonic Suite (*mKW*)*

Massive, blocky, medium-grained, grey weathering, pale grey-white granodiorite (mKgW) intrudes JMF basalt over an area of ~4 by 3 km at Teslin Mountain (Fig. 3). Mineralogy includes plagioclase (40-60%), K-feldspar (up to 15%), biotite (10-15%), hornblende (10-20%) and quartz (1-3%). The intrusion locally displays magmatic layering. The main intrusive phase also includes a number of diorite and quartz-diorite bodies (mKdW) that intrude JMF basalt and occur as small stocks or dikes up to 30 m wide. These small bodies are tan to grey weathering, massive, blocky, fine-grained dark grey-green diorite (1-2% quartz) and quartz-diorite (up to 5-10% quartz) dikes. Other phenocrysts include: plagioclase (10-15%, locally up to 50%), biotite or hornblende (5-15%).

The main granodiorite body found within the map area has a K/Ar age of ~75.1 Ma (Hart, 1997), but ages reported regionally for the Whitehorse Plutonic Suite are ~112-105 Ma (Colpron, 2011). New U/Pb radiometric dating is underway as part of this project.

Late Cretaceous (?) dikes

Grey-pink to rusty weathering, pale grey-pink, quartz-phyric rhyolite metre-wide (up to 5 m) dikes are mapped across the Teslin Mountain area (Fig. 3). They variably intrude LRG basalt or volcaniclastic rocks, and Laberge Group conglomerate. The dikes are aphyric to finely plagioclase-phyric. Finely to medium-crystalline pale pink to grey groundmass contains up to 10-60% plagioclase, 5-25% K-feldspar and 1-10% quartz phenocrysts. Hornblende or biotite phenocrysts comprise up to 1-5% of the rock. Where quartz veining is abundant, the rock is orange-pale brown weathering, highly silicified and clay altered. Dikes locally display a magmatic foliation and are generally oriented NS.

Based on crosscutting relationships, and the lack of deformation of these dikes, they are probably related to a Late Cretaceous magmatic event in southern Yukon, such as Carmacks volcanism (Cairnes, 1910; Bostock, 1936; Tempelman-Kluit, 2009) or Open Creek volcanism (*see* below).

*Open Creek volcanic rocks (*uKW*)*

Dark grey to brown weathering basalt lava and tephra and chaotic volcanic breccia is exposed northeast of Teslin Mountain (Fig. 3), possibly in unconformable contact with the underlying Laberge Group and JMF. Regionally, the Open Creek volcanic rocks (informal nomenclature by Tempelman-Kluit, 2009) comprise resistant, columnar-jointed, quartz-phyric dacite flows, ash and lapilli tuff, maroon weathering basal sedimentary and epiclastic rocks, dacite flows and flow breccia, and include dikes of quartz feldspar porphyry. Their age is constrained at ~80 Ma (whole rock, K/Ar; Tempelman-Kluit, 2009). Further field mapping is required to delineate and further characterize this unit.

DISCUSSION

A summary of stratigraphic and structural observations from the Teslin Mountain area, along with preliminary interpretations and future work directions, are presented below.

STRATIGRAPHY

Field observations constrain stratigraphic relationships in the Teslin Mountain area as follows:

- The oldest rocks in the map area, exposed at Teslin Mountain, belong to the Middle Triassic Joe Mountain Formation (JMF). These are dominated by aphyric, subaqueous basalt. North of Teslin Mountain, volcaniclastic rocks and mafic tuff overlie a mixed clastic and carbonate sequence inferred to represent deposition in a shallow to medium depth marginal basin beside the volcanic center. The volcaniclastic and sedimentary units are interpreted to be coeval with basaltic subaqueous volcanism;
- The Upper Triassic Lewes River Group (LRG) overlies the Middle Triassic JMF, but the contact is mostly covered, and therefore the relationship is uncertain. North of Teslin Mountain, south dipping sedimentary strata inferred to be part of the JMF are adjacent to volcaniclastic strata of the LRG which only display rough bedding orientation. The covered contact could be structural or stratigraphic, and in the latter case it is most likely unconformable;
- JMF and LRG basalts share similar compositions and textures, but distinct macroscopic and microscopic characteristics can be identified (Figs. 4 and 5). JMF basalt is dominantly aphyric, and microscope observations indicate the presence of both clinopyroxene and orthopyroxene. LRG basalt seems to be dominantly clinopyroxene-phyric. These petrographic and field observations will be soon complemented by new lithogeochemistry, which will be compiled with existing analyses from the LRG and JMF regionally;
- Important lateral lithological and textural changes occur within the Upper Triassic LRG across the map area (Fig. 2). Coherent basalt dominate to the west, whereas chaotic and coarse volcaniclastic deposits cover most of the central part of the map. These volcaniclastic deposits likely result from erosion of the basaltic belt to the west. Bedded, clastic sedimentary rocks with a high volcanic source content, pillow basalt, and few sedimentary structures suggest a shallow, subaqueous environment of deposition for this volcanic and volcaniclastic sequence;
- Previous stratigraphic frameworks of the LRG (Hart, 1997; Tempelman-Kluit, 1984, 2009) indicate that mafic volcanic rocks (Povoas Formation) form the base of the Upper Triassic stratigraphy. However, this study indicates that a well-bedded, at least 800 m thick, clastic-carbonate sedimentary sequence conformably underlies the LRG volcanic conglomerate and breccia south of Long Lake. The LRG volcaniclastic strata have strong lithological affinities with the pyroxene-phyric basalt exposed to the west, so they are inferred to be part of the same unit. Therefore the underlying sedimentary sequence either represents a previously unrecognized upper part of the JMF stratigraphy, or it is the base of the LRG. Clastic-carbonate sedimentation took place at least before the deposition of the LRG volcaniclastic sequence, but it may have been coeval with LRG basaltic volcanism;

- Pale grey weathered, competent LRG limestone strata constitute an ideal stratigraphic and structural marker in the Whitehorse trough. Upper Triassic fauna and a carbonate shelf reef environment is confirmed by one macrofossil analysis at Lime Peak. Additional mapping of these prominent strata will help to: (1) refine stratigraphic relationships within the LRG; (2) identify distinct episodes of carbonate sedimentation during LRG arc volcanism (*e.g.*, Lees, 1934; Tozer, 1958); and (3) constrain deformation of pre, syn and post-deformation; and
- The base of the Laberge Group comprises 10-30 m of sandstone, overlain by cobble to boulder conglomerate. An angular unconformity with the underlying LRG is mapped at one location. Elsewhere, the contact may be a disconformity (*e.g.*, Mount Laurier) or conformable. Most recent studies support a regional unconformity at the base of the Laberge Group (*e.g.*, Lowey, 2004, 2005, 2008; Lowey *et al.*, 2009). Further work is required to identify the timing of deposition of the Laberge Group with respect to the rest of the Whitehorse trough, and constrain better the environment of deposition.

STRUCTURE

Previous studies in the northern Whitehorse trough suggested that northwest-trending open folds, southwest-verging thrusts and folds, and extensional structures developed under a dextral transpressive regime controlled by regional northwest and north-striking strike-slip faults (White *et al.*, 2012).

Major faults outside of the Teslin Mountain area constrain the structural pattern in this area. These include the north-northwest trending dextral strike-slip Goddard and Teslin faults (Fig.1), which deform rocks of the LRG and Laberge Group along the eastern shore of Lake Laberge and along the Teslin River respectively. Faults in the Teslin Mountain area occur in covered valleys, and are inferred from field evidence such as non-conformable stratigraphic contacts, increased strata deformation, sharp topographic breaks or intense, localized rock alteration. Folding is inferred from variations of bedding attitude, but difficult to constrain due to the lack of foliation and cleavage plans, a problem previously reported by White *et al.* (2012). Structures reported on the map (Fig. 3) are interpreted based on a combination of field evidence and preliminary interpretation of aeromagnetic patterns (Miles *et al.*, 2015):

- Flow-banding and bedding measurements indicate a sharp change of bedding polarity within the JMF near Teslin Mountain (Fig. 3) between the south (north dipping strata) and the north (south dipping strata). This suggests an east-west-trending synclinal fold axis, with outer basalt limbs wrapping around an inner core of younger volcaniclastic rocks (Fig. 3);
- Variable bedding orientation of Laberge Group strata at Mount Laurier suggest folding of the sequence along a synclinorium axis (Fig. 3). North of Long Lake, bedding is relatively consistently dipping to the north at a relatively steep angle (50-70°);
- A corridor of deformation is constrained by the Laurier Creek valley immediately east of Mount Laurier (Fig. 3). To the west, the base of Mount Laurier comprises 100 m thick north-northwest dipping beds of LRG limestone overlain by Laberge Group sandstone and conglomerate. To the east, a thick north-dipping succession of well-bedded calcareous sandstone and mudstone and volcaniclastic rocks part of the LRG is exposed. The differences in lithologies, combined with a change of bedding orientation and a sharp topographic expression, suggest the existence of a north-trending structure running through the valley, here referred to as the Laurier Creek fault. The Laurier Creek fault extends north along the Laurier Creek valley, and defines a structural contact between Laberge Group conglomerate to the east and LRG volcano-sedimentary successions exposed in the Hancock Hills to the west (Fig. 3). The Laurier Creek fault was previously interpreted as an extensional structure (Tempelman-Kluit, 1984; Colpron, 2011). Similarly, the contact between LRG basalt (west of the map area), and younger LRG limestone at Lime Peak and Mount Laurier, may be an extensional structure (Fig. 3);
- Both Thomas Lake and Long Lake are southwest-northeast trending linear features that may correspond to structural boundaries (Fig. 3). At Thomas Lake, an inferred fault delineates Late Triassic LRG limestone and Lower Jurassic conglomerate of the Laberge Group. In addition, the jagged nature of the Laberge Group contact southeast of Long Lake (Fig. 3) suggests some post-Laberge Group lateral displacements; and

- A minor thrust (?) fault was observed within LRG limestone at Lime Peak (Fig. 3), and was previously reported by Reid (1980). Movement along this fault is unconstrained.

TECTONIC SETTING

Middle Triassic JMF volcanic rocks are the oldest rocks in the Whitehorse trough, and were previously identified as a unique occurrence in the Canadian Cordillera based on their field and geochemical characteristics (Hart, 1997). JMF mafic volcanism took place within an island arc or mid-oceanic ridge environment (Hart, 1997), with one or several volcanic centers surrounded by marginal basins. Upper Triassic LRG pyroxene-phyric basalt has a distinct geochemical signature related to an island arc setting (Hart, 1997). Synvolcanic exhumation of the Intermontane terranes led to erosion of the existing volcanic belt, mass-flow deposition events and the formation of thick volcaniclastic deposits in adjacent basins. The destruction of the arc was coeval with clastic and carbonate sedimentation in marginal basins. This setting explains complex stratigraphic relationships and lateral facies changes within the LRG. If both the JMF and LRG belong to Stikinia, these assemblages result from subduction of the Cache Creek oceanic crust beneath volcanic arcs that form the Intermontane terranes. Future work will focus at clarifying the uncertain affiliation of the JMF with Stikinia (Hart, 1997), and explain their geochemical and petrographic differences with LRG basalt.

The JMF and LRG form the depositional basement to the Whitehorse trough. Unravelling the Lewes River Group stratigraphy is critical in understanding the latest stages of Stikinia arc volcanism and the onset of Whitehorse trough marine sedimentation in the Early-Middle Jurassic. It is interpreted that the southern portion of the Whitehorse trough within the map area was developed as an active forearc basin (White *et al.*, 2012). Combined structural and stratigraphic analyses of the prominent LRG limestone strata across the Whitehorse trough will help constrain the deformation history of the trough.

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