The Slide Mountain ophiolite, Big Salmon Range, south-central Yukon: Preliminary results from fieldwork

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ABSTRACT

The Dunite Peak area of the Big Salmon Range, south-central Yukon, exposes klippen of mafic-ultramafic strata belonging to the Slide Mountain terrane that structurally overlie metasedimentary strata of the Yukon-Tanana terrane. Previous workers also infer the suture between the allochthonous Yukon-Tanana terrane and parautochthonous Cassiar terrane close to this area. This study forms the groundwork for a detailed investigation of the timing and kinematics of closure of the Slide Mountain ocean, and its involvement in subsequent collisions between Yukon-Tanana and Cassiar terranes. At present, a variety of tectonic models may be applied to ophiolite formation and subsequent obduction and deformation of the Slide Mountain terrane in this region. We consider these models and postulate future investigations that should be undertaken to ascertain their validity and applicability to the NW Cordilleran orogenic evolution.

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INTRODUCTION

The NW Cordillera (Fig. 1) comprises multiple terranes that formed and were deformed prior to and during their accretion to the North American continent (NAC; Nelson *et al.*, 2013). Determination of the timing and kinematics of terrane accretion is fundamental to our understanding of the NW Cordillera and of accretionary orogens in general. Such understanding can be gained through targeted, integrated geochronological, thermobarometric and structural studies (PTtD studies – Pressure, Temperature, time, Deformation) of terrane interactions (*e.g.,* Berman *et. al.*, 2007; Staples *et al.*, 2013).

The Slide Mountain terrane (SMT) is an oceanic terrane comprising chert, mid-ocean ridge basalt (MORB), gabbro, serpentinized mantle peridotite and associated marine sedimentary rocks, with its type section described from Sliding Mountain, northern British Columbia (BC; Orchard and Struik 1985; Struik and Orchard 1985; Nelson *et al.*, 2013).

The SMT is reported from southeastern and north-central BC and south-central Yukon (Fig. 1) and typically forms either isolated klippen overlying peri-Laurentian/parautochthonous terranes, or thrust-bound enclaves juxtaposed between peri-Laurentian/parautochthonous terranes (*e.g.,* Tempelman-Kluit 1979; Erdmer 1985; Struik and Orchard 1985; Nelson 1993; de Keijzer *et al.*, 1999; Fallas *et al.*, 1999; Colpron *et al.*, 2005, 2006, 2016; Nelson *et al.*, 2013; Petrie *et al.*, 2015; Isard *et al.*, 2016).

Many of the gaps or inconsistencies in our understanding of the SMT are intrinsically linked to the regional evolution of the NW Cordillera and its constituent terranes. As such, the protracted deformation history recorded by the SMT prior to, and during terrane accretion makes it an ideal target for investigating the kinematic evolution of the NW Cordillera. Additionally, occurrences of the SMT across the Cordillera are relatively well-defined as the dominance of mafic-ultramafic assemblages and associated basinal sedimentary units make it easy to distinguish from neighbouring peri-Laurentian and parautochthonous terranes. Importantly, this forms a vital opportunity to investigate terrane interactions at well-defined terrane boundary interfaces with targeted PTtD studies.

Here, we present preliminary results from field activities in 2016 (*see* also Parsons *et al.*, 2016a,b) that form the groundwork for a detailed PTtD study that will focus on the timing and kinematics of accretion of the SMT with the peri-Laurentian Yukon-Tanana terrane and parautochthonous Cassiar terrane (Fig. 1). Our field results indicate that the Dunite Peak area is characterized by a predictable stacking of tectono-stratigraphic units, with marine-facies metasedimentary rocks at the base of the thrust stack overlain by mafic-ultramafic rocks of the Slide Mountain ophiolite.

THE SLIDE MOUNTAIN TERRANE

Interpretations based on current understandings of the SMT propose the Slide Mountain ophiolite formed in a back-arc setting between the peri-Laurentian and parautochthonous terranes between Devonian and Mississippian times (Tempelman-Kluit 1976, 1979; Orchard amd Struik 1985; Nelson 1993; Roback *et al.*, 1994; de Keijzer *et al.*, 2000; Murphy *et al.*, 2006; Colpron *et al.*, 2007). Extensive basaltic volcanism and minimal sedimentation recorded between Late Pennsylvanian and Early Permian times suggest that Slide Mountain ocean was perhaps as large as 3000 km wide (Nelson 1993). Closure of Slide Mountain ocean is proposed between Mid Permian and Middle Triassic times during accretion of the Yukon-Tanana terrane (YTT) and the Quesnellia terrane (QT) to the North American continent (NAC). Final closure of Slide Mountain ocean was completed by the Late Triassic, followed by deposition of an overlying sedimentary cover sequence overlapping SMT, YTT, QT and NAC (de Keijzer *et al.*, 2000; Colpron *et al.*, 2005, 2006). Subsequently, SMT recorded deformation relating to late accretion of outboard terranes during final amalgamation and transpression of the NW Cordillera between Jurassic and Cretaceous times (Colpron *et al.*, 2005; Berman *et al.*, 2007).

Recent advances in the understanding of the Cordilleran orogen indicate some caveats and inconsistencies in the existing model: (*1*) interpretation of Slide Mountain ocean as a back arc basin is disputed by geochemical data which suggest that some exposures of the SMT are more indicative of a calc-alkaline setting rather than an ocean spreading center (Fallas *et al.*, 1998; Fallas *et al.*, 1999). (*2*) Current models for the closure of Slide Mountain ocean involve westward subduction of the SMT beneath the YTT (Tempelman-Kluit 1979; Berman *et al.*, 2007; Nelson *et al.*, 2013). In such a situation the YTT must represent the upper plate of a west dipping subduction zone. However, SMT rocks overlie eclogite-bearing basement assemblages of the YTT suggesting that SMT

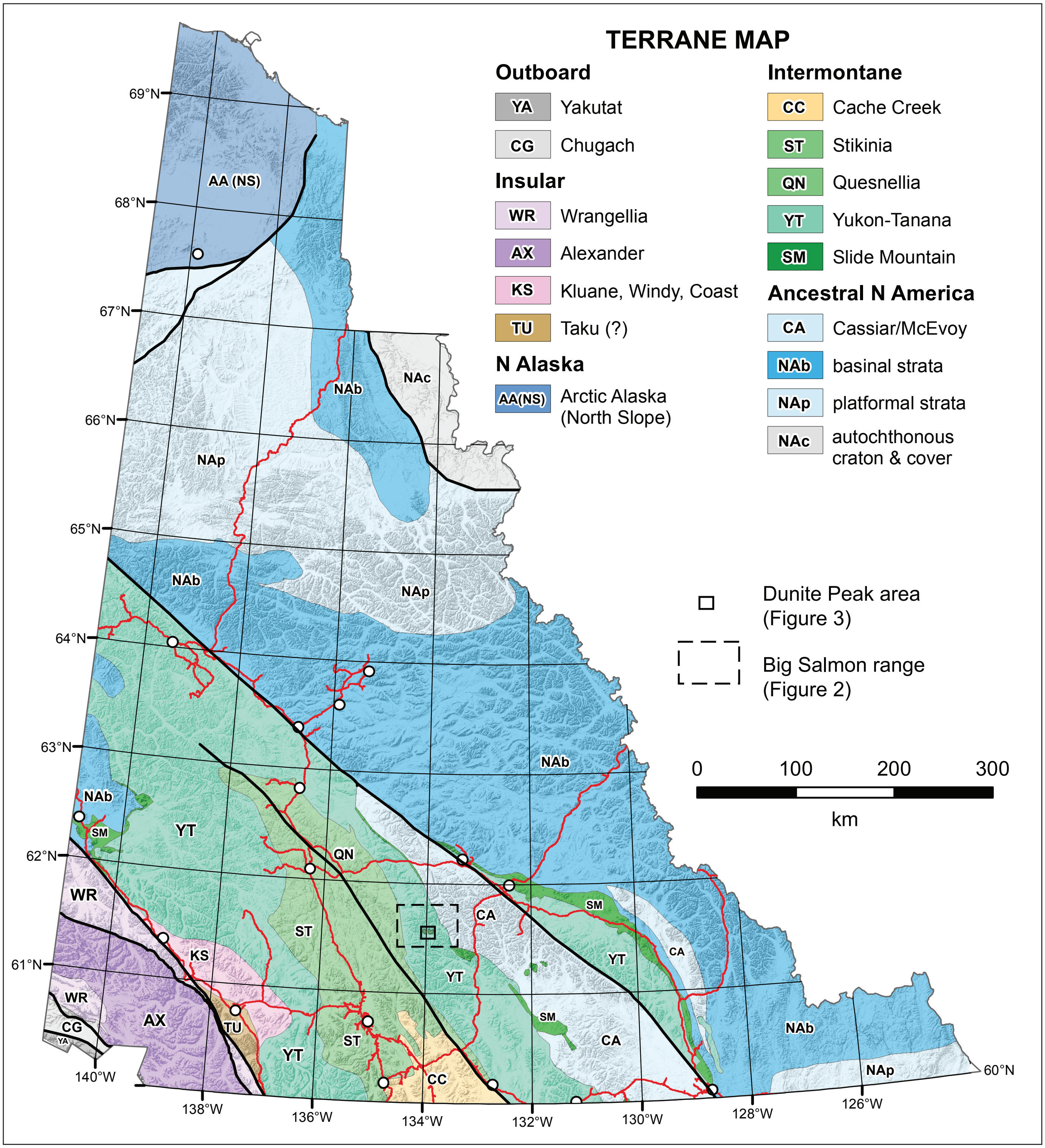


Figure 1. Geological terrane map of Yukon. Dashed and solid lined boxes outline areas of Fig. 2 (Big Salmon Range) and Fig. 3 (Dunite Peak area), respectively. Modified after Colpron et al. (2016).

was part of the overriding plate while YTT was part of the subducting plate (*e.g.,* Tempelman-Kluit 1979; Petrie *et al.*, 2015). (*3*) The timing of collisions between terranes prior to and during the Jurassic-Cretaceous amalgamation of NW Cordillera is disputed and it is unclear whether the YTT collided with other outboard island arc terranes before or after its accretion to the NAC (*e.g.,* Berman *et al.*, 2007). (*4*) Recent work from south-central Yukon has dated basaltic rocks of the Tower Peak assemblage of the SMT as Cretaceous (Isard *et al.*, 2016). This may indicate that some mafic-ultramafic assemblages currently mapped as SMT are in fact part of a much younger sequence of rocks. (*5*) The kinematics of emplacement of the SMT are yet to be determined and it is not yet clear whether SMT was emplaced as imbricated thrust slices (*e.g.,* Tempelman-Kluit 1979; Petrie *et al.*, 2015) or as a crustal-scale recumbent nappe (de Keijzer *et al.*, 1999).

The geology of the Dunite Peak area in the Big Salmon Range (Fig. 2), south-central Yukon is characterized by two klippen of mafic-ultramafic assemblages overlying metasedimentary rocks belonging to the YTT and/or Cassiar terrane (CT) (Tempelman-Kluit 1979; de Keijzer *et al.*, 1999; Colpron *et al.*, 2016). The elevated and rocky terrain allows for multiple foot traverses through vertical structural transects of both klippen that extend from the underlying basement rocks of the YTT/CT through the entire sequence of overlying metasedimentary rocks and into the overriding mafic-ultramafic assemblages of the SMT. Importantly, these traverses provide access to the SMT and YTT boundary, making the Dunite Peak area an excellent location to investigate the PTtD evolution of the SMT and its interaction with peri-Laurentian/parautochthonous terranes at a multitude of temporal and spatial scales during the tectonic evolution of the NW Cordillera.

METHODS

Initial reconnaissance of the study area was conducted over two days by AJP, JJR and CVS via helicopter-assisted spot checks of key locations. Following this, AJP and MC conducted 15 days fieldwork across the study area, staged from 3 different fly-camps. Fieldwork objectives concerned, (*a*) bedrock lithology identification and determination of a recognizable and mappable stratigraphy; (*b*) collection of structural and kinematic data; and (*c*) collection of samples for petrological, microstructural, thermobarometric, geochemical and geochronological analyses. A total of 135 samples were collected from 206 stations. In addition to mapping on 1:20 000 scale field slips, station waypoints, structural data, photographs and samples were also digitally recorded and geospatially referenced using the GSC field data collection system (GanFeld) on a ruggedized handheld computer. The preliminary map (Fig. 3) was constructed using ArcGIS 10.2, drawn from digitized and geospatially referenced copies of field slips. Note that this is a 'work-in-progress' map and the final draft is likely to differ after the use of structure contours (Bennison *et al.*, 2013) and cross section construction to better constrain unit boundaries.

RESULTS

DUNITE PEAK TECTONOSTRATIGRAPHY

Through detailed mapping of these klippen and metasedimentary rocks, we have determined a recognizable lithostratigraphic framework (Figs. 3 and 4) that can be applied to the whole of the study area. This framework is described in order of relative structural position from the lowermost to highest recognizable units. Where possible, these units have been tentatively assigned to pre-existing tectonostratigraphic assemblages common throughout the NW Canadian Cordillera (Colpron *et al.*, 2006, 2016), however, these assignments require further investigation through geochemical, geochronological and thermobarometric sample analyses before they can be robustly justified.

Unit Sc1: Interbedded marble and metapelitic schist

Unit Sc1 is mapped in the eastern half of the study area and forms the structurally lowest unit, dominated by marble interbedded with subordinate metapelitic schist. Marble layers are typically 0.5-3 m thick and commonly contain calcite veins. Subordinate schist layers are typically <0.5 m thick, characterized by biotite + quartz ± feldspar ± garnet (Fig. 4a). Some outcrops contain white kyanite.

The base of Unit Sc1 was not observed and in most cases only the top of this unit was directly mapped due to limited exposure and access in colluvium-filled valley bottoms. The structural thickness of Unit Sc1 marble is at least 400 m on the basis of mountain-side exposures in the southern part of the map area.

This unit is currently designated within the amphibolite facies Snowcap assemblage of the YTT (Colpron *et al.*, 2006, 2016). The presence of high metamorphic

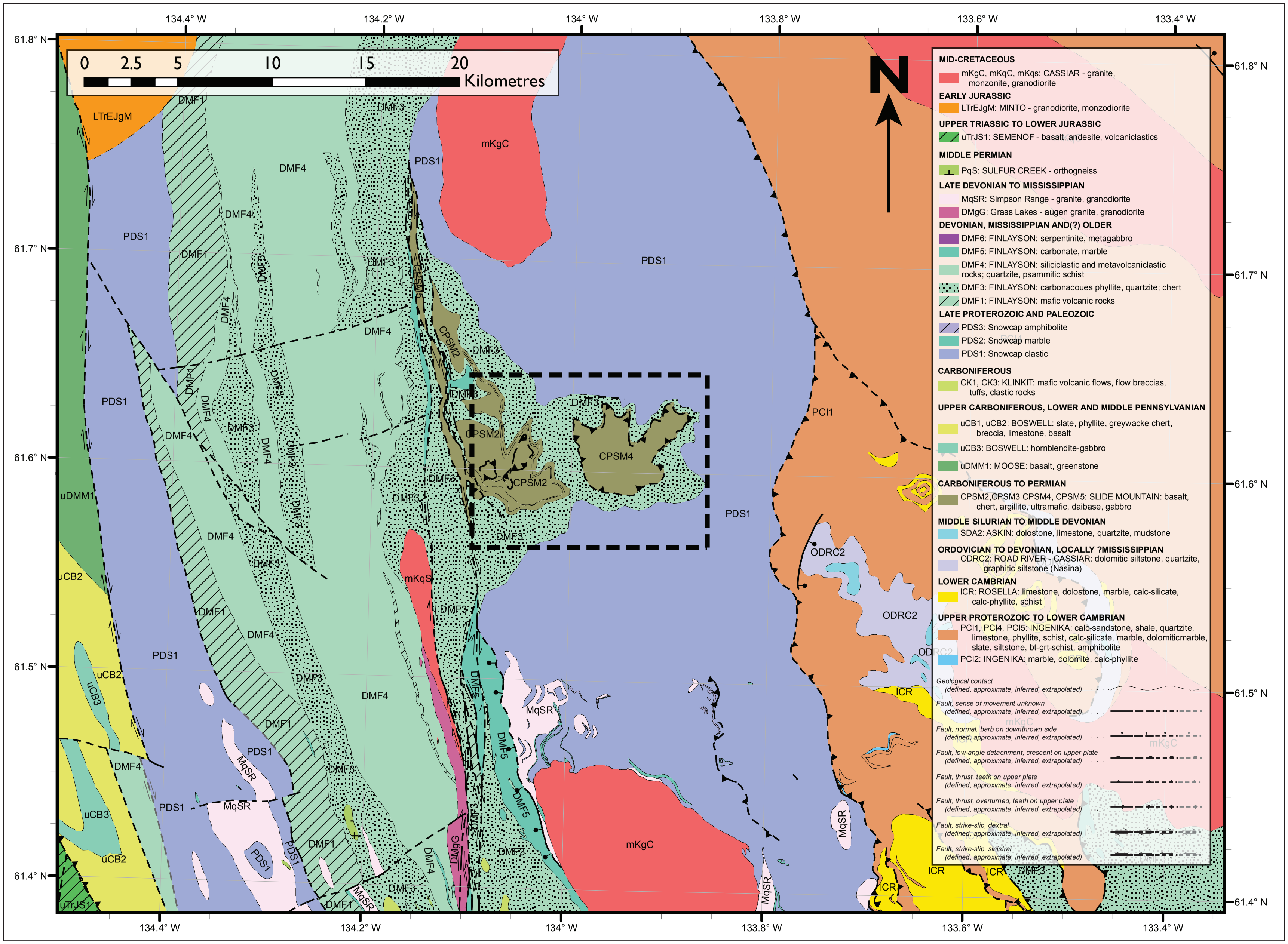
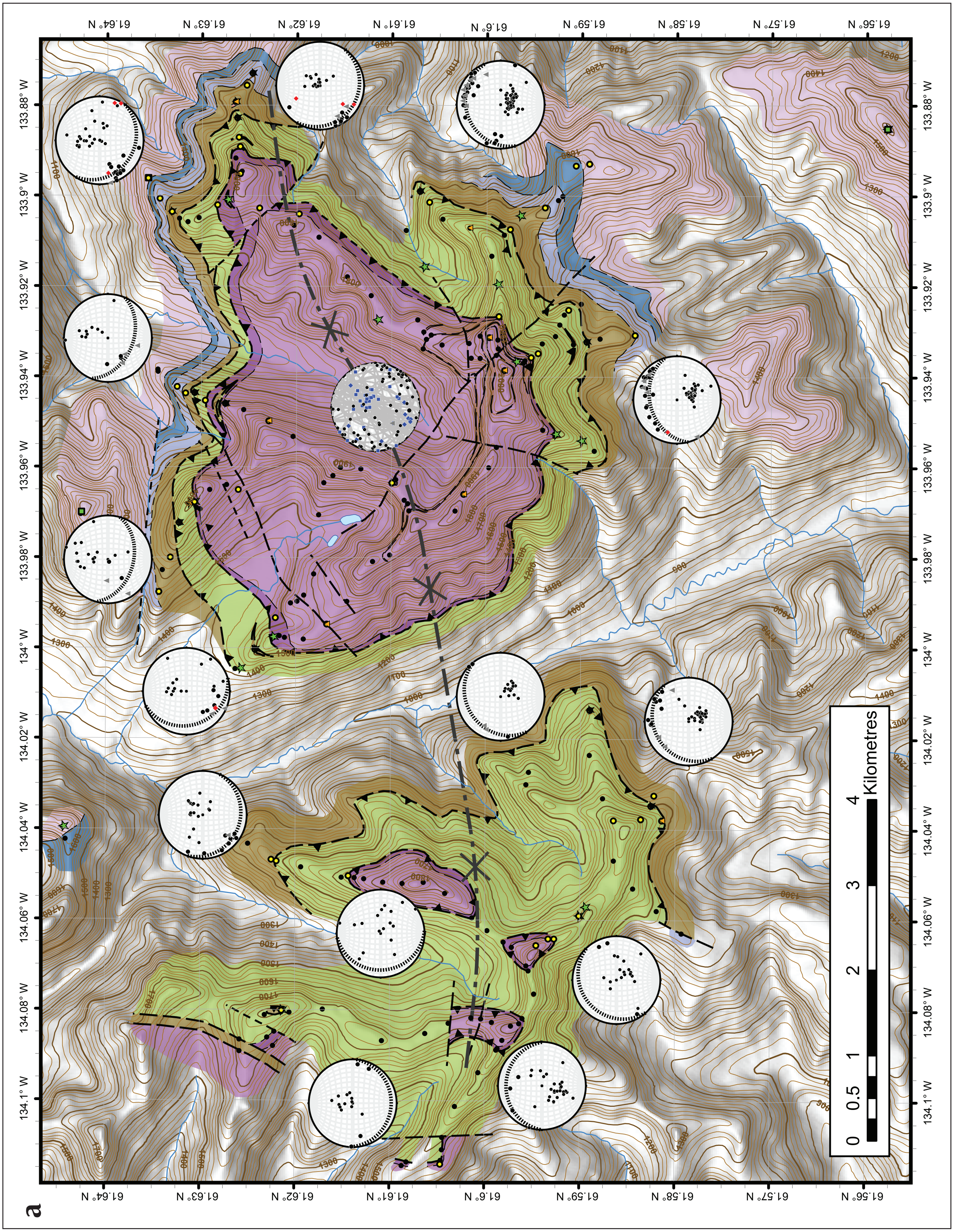


Figure 2. *Geological map of the Big Salmon Range. Dashed box outlines the Dunite Peak area. See Fig. 1 for location with respect to Yukon. Modified after Colpron et al. (2016).*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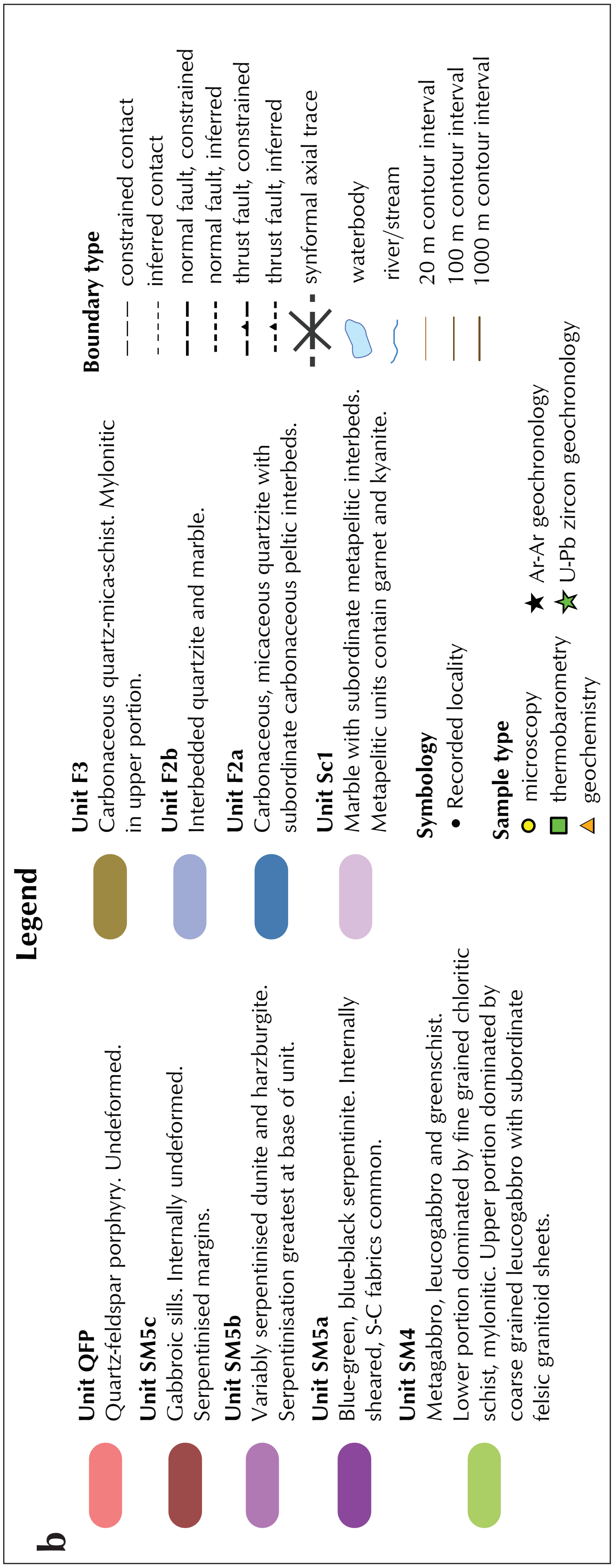

***Figure 3. (a)** Preliminary geological map of the Dunite Peak area and **(b)** legend, from fieldwork conducted in 2016. See Figures 1 and 2 for location of study area with respect to Yukon. Structural data are presented on stereonets positioned next to the corresponding traverses from which they were collected. For stereonet symbology refer to Fig. 8.*

grade mineral assemblages indicated by the garnet±kyanite metapelitic layers conforms to such interpretations. However, the occurrence of thick marble units within the Snowcap assemblage is not reported elsewhere.

Unit F2a: Micaceous quartzite

Unit F2a is mapped on the northern and southern margins of the eastern klippe and comprises carbonaceous grey-brown micaceous quartzite with subordinate carbonaceous pelitic layers. This unit has a strong foliation and a fissile appearance. These rocks characteristically display a strong quartz stretching lineation.

The basal contact with the underlying marble and schist of Unit Sc1 is not observed and it is unclear if the boundary between these units is stratigraphic or structural in nature. These rocks are currently designated as part of the Finlayson assemblage of the YTT (Colpron *et al.*, 2006, 2016). The carbonaceous nature of the sediment is similar to the Nasina Group (Dawson, 1903), which is included in the Finlayson assemblage in the Stewart River area of West Yukon (Colpron *et al.*, 2006; Berman *et al.*, 2007). However, without age constraints and without knowledge of the nature of the basal contact with Unit Sc1, it is possible that they are part of the underlying assemblage (Snowcap) or another tectonostratigraphic unit characterized by basinal sedimentation.

Unit F2b: Interbedded quartzite and marble

Unit F2b is mapped on the northern and southern margins of the eastern klippe and comprises a lower portion of white quartzite, overlain by an upper portion of interbedded quartzite and marble with subordinate carbonaceous calc-silicate layers. The unit is strongly foliated and appears mylonitic in some places. Strong quartz and calcite stretching lineations are commonly observed. Quartz and calcite veins within these rocks usually preserve evidence of ductile shearing (Fig. 4b).

The basal contact with the underlying micaceous quartzite in Unit F2a is not observed, however the style of deformation and recrystallized appearance of quartzites within these units is sufficiently similar to suggest that Unit F2a and F2b derive from a single stratigraphic sedimentary sequence.

At present rocks in Unit F2b are assigned to the Finlayson assemblage (Colpron *et al.*, 2006, 2016). As with the underlying units, further work is required to confirm this and determine whether these rocks are also part of the same sedimentary sequence as the lowermost marble and schist in Unit Sc1.

Unit F3: Quartz-mica-schist

Unit F3 is mapped on the northern and eastern margins of the western klippe and the northern, western and southern margin of the eastern klippe. This unit is the structurally highest metasedimentary unit and directly underlies the mafic-ultramafic klippen.

Unit F3 contains a carbonaceous quartz-mica-schist that is highly sheared and displays a strong mylonitic foliation (Fig.4c,d). Small (<1 mm) euhedral garnet porphyroblasts are identified in this unit at one locality. The intensity of the mylonitic fabric increases up-section. Sheared quartz layers record non-coaxial deformation, whilst isoclinally folded layers also suggest a degree of coaxial flattening. The basal contact with the underlying interbedded quartzite and marble unit (Unit ScF2b) is not observed and it is not clear whether Unit F3 is part of the same sedimentary sequence or whether a structural discontinuity exists between them. In addition to residing at the top of the metasedimentary sequence, thrust bound slivers of Unit F3 are also identified within the overlying mafic-ultramafic sequence.

At present, this unit is assigned to the Finlayson assemblage due to its carbonaceous nature (Colpron *et al.*, 2006, 2016) but, as with other carbonaceous sediment, the tectonic affiliation of this unit is uncertain.

Unit SM4: Metagabbro, leucogabbro and greenschist

Unit SM4 extends across most of the mapping area bounding the steep cliffs and ridges of the eastern klippe and underlying most of the elevated topography above the tree line on the western klippe. This unit may be divided into a lower portion of fine-grained, chloritic metagabbro and greenschist (Fig. 4e) and an upper portion of coarse-grained metagabbro, leucogabbro (Fig. 4f) and subordinate felsic sills (possibly trondhjemite) and pyroxenite. Pyroxenite and leucogabbro dominate the lithology of this unit at the upper contact with overlying ultramafic rocks and form foliation-sub-parallel compositional layering. This compositional layering (Fig. 5) appears to represents multiple intrusive layers that are comparable to the layered gabbro section of an ophiolite, located at the mantle transition zone (*e.g.*, Dilek and Furnes, 2014). On the eastern margin of the east klippe a small outcrop of pillow basalt is also identified within this unit.

Acicular metamorphic hornblende is common throughout this unit and often forms a mineral lineation, along with chlorite. Unit SM4 is pervasively deformed, and displays a strong mylonitic fabric at its base. Towards the top of the unit, high-temperature ductile shear fabrics are observed (Fig. 5), some of which appear to preserve partial melt textures relating to layered intrusions. A crenulation cleavage and associated intersection lineation is sometimes observed and is more common in chloritc sections. Metagabbro in the middle of this unit is often folded with foliation sub-parallel axial planes that may be associated with the observed crenulation cleavage. A secondary foliation, sub-parallel to the main tectonic foliation and/or compositional layering is sometimes observed in the upper section.

The basal contact of Unit SM4 is rarely observed on the eastern klippe and forms a ductile sheared contact with the underlying quartz-mica-schist (Unit F3). Unit SM4 is also internally thrust faulted, as indicated by significant variations in structural thickness, occasional absence of the fine-grained chloritc basal section and repetition of the SM4-F3 unit boundary within a single structural section. For this reason it is not possible to subdivide Unit SM4 into mappable single-lithology units.

Unit SM4 is currently assigned to the Slide Mountain terrane (Colpron *et al.*, 2006, 2016) based on its dominance of mafic assemblages and association with overlying ultramafic rocks.

Figure 4. ***(a)*** *Unit Sc1 – Garnet-mica schist with rotated garnet porphyroblasts.* ***(b)*** *Unit F2b – quartzite with sheared quartz veins.* ***(c-d)*** *Unit F3 – quartz-mica-schist with intrafolia folds and shear fabric.* ***(e)*** *Unit SM4 – fine-grained metagabbro.* ***(f)*** *Unit SM4 – coarse-grained leucogabbro.* ***(g)*** *Unit SM5a – sheared serpentinite.* ***(h)*** *Unit SM5b – foliated serpentinized harzburgite.*

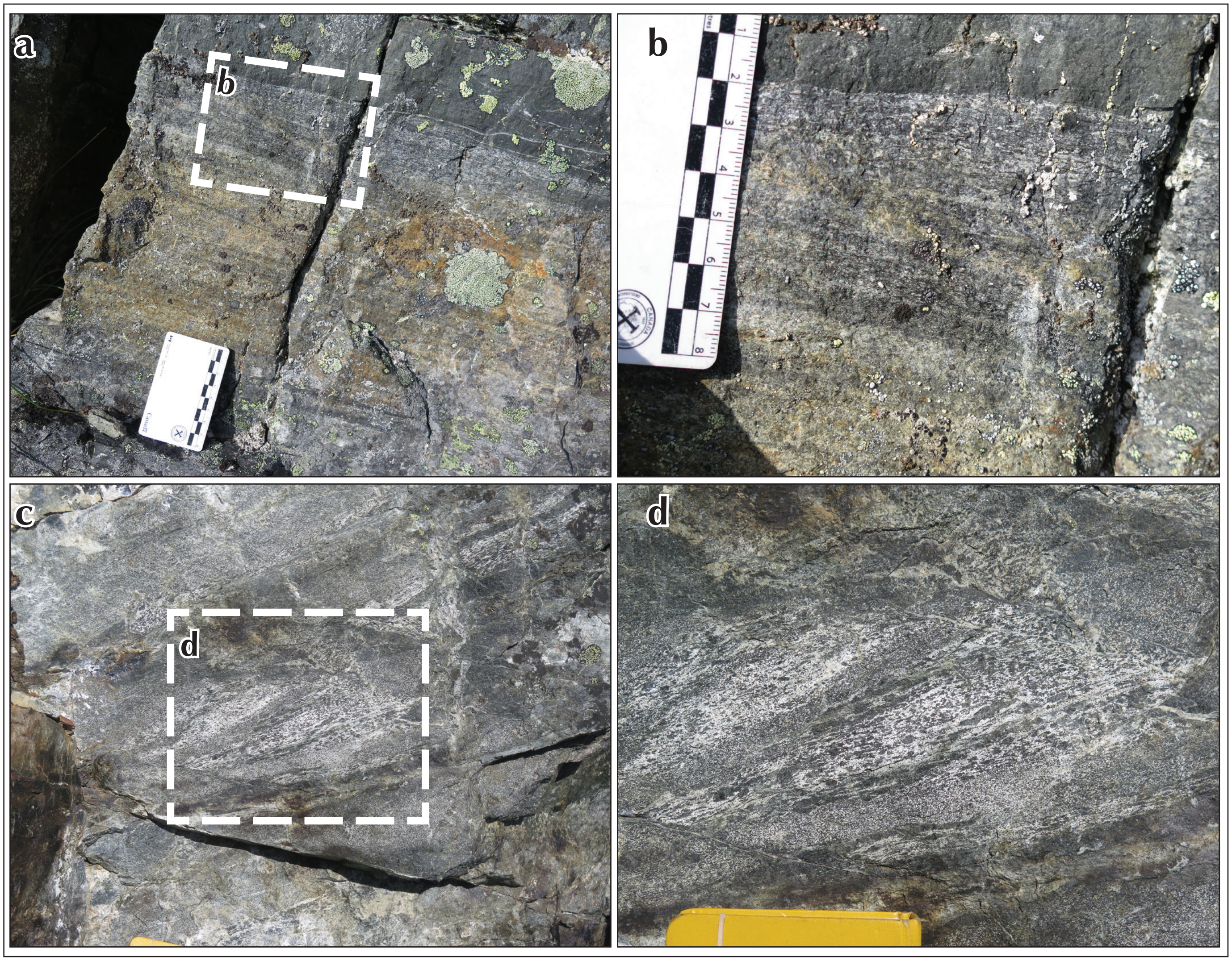

*Figure 5. Ductile deformation of layered gabbro and leucogabbro, Unit SM4. Dashed box on **(a)** outlines area shown in **(b)**. Dashed box on **(c)** outlines area shown in **(d)**.*

Unit SM5a: Serpentinite

Unit SM5a is ubiquitously observed in the basal section of the ultramafic sequence across the study area. This unit is approximately 5-50 m thick (Figs. 6 and 7) and is composed of distinct, highly deformed blue-green and dark-blue-black 'fish-scale' serpentinite (Fig. 4g). Unit SM5a is pervasively sheared and commonly displays well-defined mineral stretching lineations, S-C fabrics and folds. The basal contact forms a sheared structural discontinuity with the underlying metagabbro (Unit SM4). This unit forms part of the Slide Mountain terrane (Colpron *et al.*, 2006, 2016).

Unit SM5b: Serpentinized harzburgite and dunite

Unit SM5b is the structurally highest unit in the study area and is found at the top of the mafic-ultramafic klippen, forming distinct orange-weathered high rocky peaks and ridges (Figs. 6 and 7). This unit comprises variably serpentinized harzburgite and dunite (Fig. 4h). The degree of serpentinization is greatest at the base of this unit and decreases up-section. Close to the base of this unit, planar sheets of gabbro and serpentinite form crosscutting intrusions within the mantle peridotite (Unit SM5c, *see* below). In the western klippe only the lowermost portion of Unit SM5b defined by the high degree of serpentinization is observed.

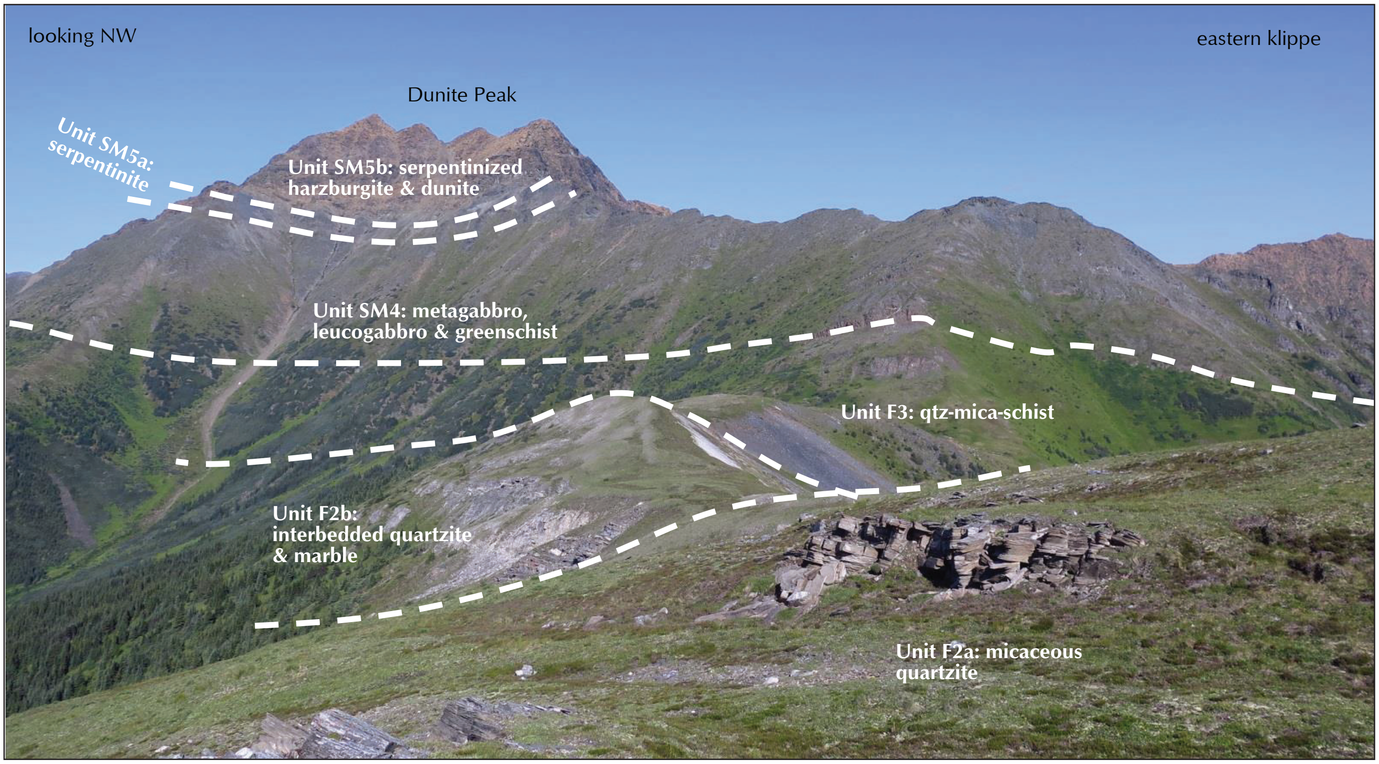

Figure 6. *View of the Dunite Peak and the eastern klippe and its constituent stratigraphy.*

Variations in pyroxene content and distribution define compositional layering that sometimes occurs parallel to an internal foliation (Fig. 4h). Some of these foliations may preserve an original high temperature mantle fabric, although further investigation at a microstructural scale is required to confirm this. Deformation within this unit is confined to the basal section, where changes in colour, corresponding to different degrees of serpentinization pick out fault bound slivers. Shearing is also observed along the margins of serpentinite-gabbro intrusions (Unit SM5c), which form planar detachment surfaces. The basal contact with the underlying serpentinite is a 1-5 m thick, diffuse zone of shearing characterized by S-C fabrics and cataclasite. Unit SM5b is part of the Slide Mountain terrane (Colpron *et al.*, 2006, 2016).

Unit SM5c: Gabbroic intrusive rocks and associated serpentinite

The ultramafic rocks of Unit SM5b are cut by linear, subhorizontal gabbroic sills with thicknesses of 2-4 m (Fig. 7). These gabbro sills are medium grained (1-3 mm) and display no signs of internal deformation. The margins of these sills are composed of very fine grained, black, homogeneous serpentinite which typically display evidence of shearing and faulting. The orientation of these sills typically crosscuts the regional tectonic foliation observed toward the base of Unit SM5b and in Unit SM5a and SM4. Only steep, brittle normal faults appear to alter the orientation of these sills.

Unit QFP: Quartz-feldspar-porphyry

Unit QFP is a quartz-feldspar-porphyry observed at only one locality in the northeastern corner of the mapped area. Here, it forms a 10 m wide dike at the structural interface between Units F3 and SM4. Unit QFP is a light grey, fine-grained porphyritic rock with large, euhedral, equant quartz and feldspar phenocrysts (1-10 mm) plus small phenocrysts of biotite and hornblende (1-2 mm). This unit is undeformed and the boundaries of the dike are not observed.

REGIONAL STRUCTURE

Stereographic projections of structural data collected from all units except Unit SM5b,c (Fig. 8a,b) reveal a regional foliation striking approximately ENE-WSW with a variable dip of 0-50°. Mineral and intersection lineation

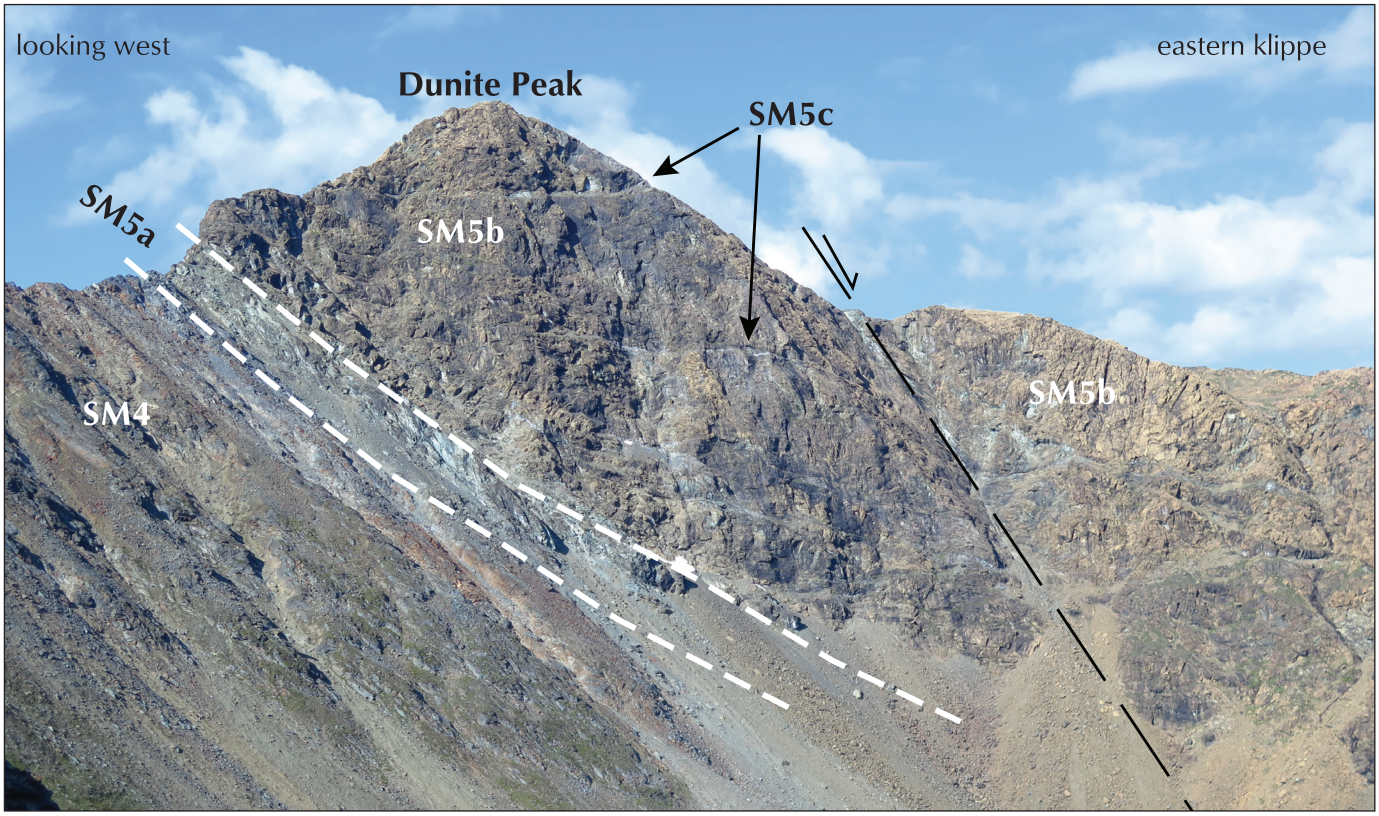

Figure 7. *View of ultramafic-mafic complex of the Slide Mountain terrane on Dunite Peak (eastern klippe). Subhorizontal gabbroic intrusions (Unit SM5c) are visible crosscutting variably serpentinized harzburgite and dunite (Unit SM5b).*

orientations form concentrations around a NE-SW azimuth with a 10-20° plunge (Fig. 8), whereas fold hinge and axial plane orientations vary across the region. Segregation of structural data into spatially defined groups (Fig. 3) demonstrates that these data define an open synform with an ENE-WSW trending axial trace, plunging gently to the west. The current spread of mineral lineation and fold hinge orientations suggest that these formed prior to folding and correspond to NE-SW directed shearing.

Structural data from the ultramafic rocks of Unit SM5b record a wide range of foliation orientations (Fig. 8c). A majority of these foliations strike approximately NE-SW with a steep to subvertical dip. It is not clear if these foliations correspond to an original mantle fabric or relate to deformation and/or serpentinization during/after emplacement. The steepest fabrics may represent an axial planar fabric to the regional synform.

Macrostructural analysis has also led to the identification of several shear zones. Shear fabrics, mylonitic fabrics and folding within the quartz-mica-schist of Unit F3 and metagabbro and greenschist at the base of Unit SM4 suggest that the boundary between these units corresponds to an important structural discontinuity, which may define the Slide Mountain – Yukon-Tanana terrane boundary (Fig. 3). Additionally, the basal serpentinite layer of the ultramafic sequence (Unit SM5a) forms a shear zone between the ultramafic (Unit SM5b) and underlying gabbroic rocks (Unit SM4; Fig. 3). Repetition of Units F3, SM4 and SM5a at the mafic-metasedimentary interface (Fig. 3) indicates thrust imbrication. Sheared veins within the structurally lowest metasedimentary units may indicate the presence of other shear zones that are as yet unrecognized.

Several steep, late faults have been identified across the study area (Figs. 3 and 7). Slickensides in these faults display a range of orientations, of which some correspond to strike-slip motion and others, dip-slip motion. Consideration of the westward dip of the regional synform indicates that a N-S trending, east dipping normal fault probably exists along the valley separating the klippen in order to account for the topographically higher position of the ultramafic basal contact west of the valley, relative to the east.

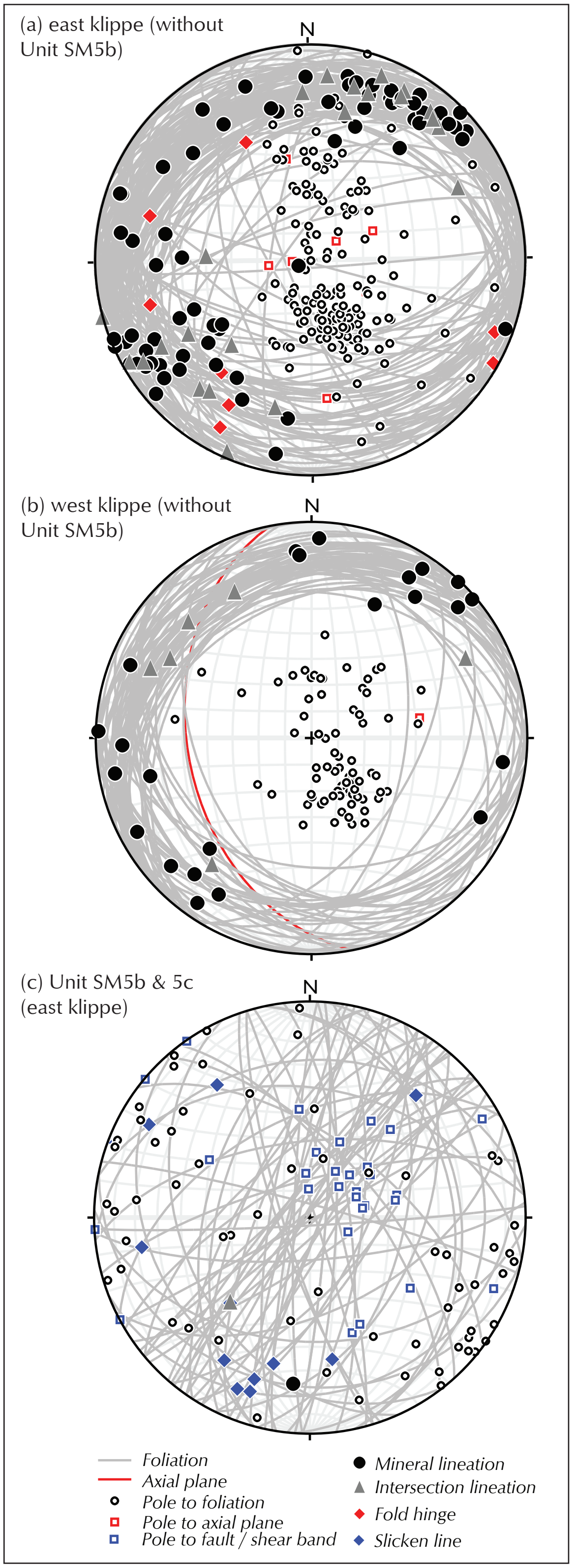

Figure 8. *Equal-area, lower hemisphere projection stereonets of structural data collected from;* ***(a)*** *the eastern klippe (excluding data from Unit SM5b);* ***(b)*** *the western klippe (excluding data from Unit SM5b); and* ***(c)*** *Unit SM5b on the eastern klippe.*

METAMORPHIC DISCONTINUITIES

Metamorphic indicator minerals such as garnet, kyanite, chlorite and amphibole suggest that metamorphic grade appears to decrease up-section. The structurally lowermost rocks in Unit Sc1, which exhibit kyanite and garnet are indicative of amphibolite facies metamorphism. The absence of useful metamorphic mineral indicators in the overlying metasedimentary rocks of units F2a, F2b and F3 means it is unclear if a metamorphic discontinuity exists between these units and Unit Sc1. Between Unit F3 and Unit SM4, an up-section decrease in metamorphic grade is expected due to the dominance of chlorite and epidote in Unit SM4, which are absent in Unit F3. Unit SM4 is distinctly greenschist facies, whereas Unit F3 may be amphibolite to upper greenschist facies. Further analytical work will be carried out to investigate the presence and nature of these proposed metamorphic discontinuities.

PETROGENESIS AND OBDUCTION/ EMPLACEMENT MECHANISMS OF MAFIC-ULTRAMAFIC ROCKS

Determination of the petrogenesis and subsequent obduction/emplacement mechanisms of the mafic-ultramafic rocks of the SMT (Units SM4 and SM5) is key to understanding SMT-YTT-NAC interactions and the tectonic evolution of the area. Mapping of the Dunite Peak area indicates that the ultramafic rocks (Unit SM5) structurally overlie the mafic rocks (Unit SM4; Figs. 3, 6 and 7). The close association of ultramafic and mafic rocks may reflect the complex intrusive relationships between sections of layered mafic-ultramafic rocks and layered gabbro typically recognized in the mantle transition zone of ophiolites (e.g., Dilek and Furnes, 2014; Goodenough *et al.*, 2014). Alternatively, these rocks may have formed in an ocean core-complex setting comprising exhumed mantle peridotite intruded by syn-extensional gabbroic sills (e.g., Miranda and Dilek, 2010). It is also possible that the mafic rocks comprise a distinct tectonostratigraphic unit unrelated to the ophiolite. Determining the relationship between these rocks is complicated further by deformation that occurred during ophiolite emplacement and subsequent deformation episodes that culminated in collapse of the Cordilleran orogen (e.g.*,* de Keijzer, 2000; Berman *et al.*, 2007; Staples *et al.*, 2016).

The structural arrangement of tectono-stratigraphic units in the Dunite Peak area can be interpreted as an imbricate stack formed during out-of-sequence thrusting (*e.g.,* Tempelman-Kluit 1979; Petrie *et al.*, 2015) and/or the overturned limb of a crustal-scale recumbant nappe (*e.g.,* de Keijzer *et al.*, 1999). Interestingly, strata observed at the western margin of the study area are reversed in structural position with Unit SM5b overlain by Unit SM5a, which in turn is overlain by Unit SM4 in the southwest and Unit SM4 overlain by Unit F3 in the northwest. The occurrence of low grade rocks structurally overlying high grade rocks may also indicate that the structural detachment between units F3 and SM4 may have accommodated late-stage extensional deformation, perhaps related to the nearby d'Abbadie fault as proposed by de Keijzer (2000).

TERRANE AFFILIATION

Terrane affilations that have been applied to the Dunite Peak area need to be tested. Whilst the carbonaceous rocks of units F2 and F3 are lithologically similar to the Nasina Group of the Finlayson assemblage, the lack of any hard constraints on these basinal rocks is problematic. Since they occur structurally below the ophiolite, they may form part of the subducting plate. The large thickness of carbonate rocks in Unit Sc1, also included in YTT, has not been reported in other areas where YTT is exposed, and these rocks may be more comparable to the Rosella Formation (Unit ICR, Fig. 2) within the Cassiar terrane (CT; *e.g.,* Fritz, 1980; Colpron *et al.*, 2016). In this respect, units F2 and F3 are also lithologically similar to carbonaceous metasediment of the Road River Group (*e.g.,* Fritz, 1985; Pyle *et al.*, 2003) or Earn Group (*e.g.,* Campbell, 1967) of the Cassiar terrane (CT; Colpron *et al.*, 2016), which commonly overlie the Rosella Group. Correct terrane assignment is critical to understanding the developing models of emplacment for the SMT in the Dunite Peak area (*e.g.,* Tempelman-Kluit, 1979; Hansen, 1989; Fallas *et al.,* 1999; de Keijzer *et al.*, 1999), as well as the location for the fundamental allochthon-autochthon boundary in the northern Cordillera, and requires further investigation.

SUMMARY AND CONCLUSION

The preliminary work in the Dunite Peak area has identified a mappable tectonostratigraphy. From structurally lowest to highest, it includes interbedded marble and metapelitic rock (Unit Sc1), micaceous quartzite (Unit F2a), interbedded quartzite and marble (Unit F2b), carbonaceous quartz-mica-schist (Unit F3), metagabbro, leucogabbro and greenschist (Unit SM4) and serpentinite (Unit SM5a), and serpentinized harzburgite and dunite (unit SM5b). At present the petrogenetic setting of the mafic-ultramafic rocks is not known and it is unclear whether the structural arrangement of these strata represents an imbricated stack of thrust slices, an overturned limb of a recumbent nappe or an original intrusive arrangement between crust and mantle. Tectonostratigraphic units are pervasively sheared and often imbricated by thrust faults. Shear zones have been identified between Units SM5 and SM4 and between Units SM4 and F3. The latter may correspond to the Slide Mountain and Yukon-Tanana terrane boundary. The structural break between units SM4 and F3 also appears to reflect a metamorphic discontinuity that emplaces low grade over high grade rocks. The regional structure is defined by an open, west-plunging ENE-SWS-striking synform. This fold has deformed earlier mineral lineations and folds observed at outcrop scale. Steep normal and/or strike slip faults have subsequently deformed the regional synform.

Ongoing work will investigate the petrogenesis of the mafic-ultramafic rocks, test terrane affiliation and interactions and establish a PTtD framework. These results will then be used to elucidate the nature of the Slide Mountain terrane and its interaction with other terranes in the NW Cordillera.

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REFERENCES

Bennison, G.M., Olver, P.A. and Moseley, K.A., 2013. An introduction to geological structures and maps. New York, USA, Routledge.

Berman, R.G., Ryan, J.J., Gordey, S.P. and Villeneuve, M., 2007. Permian to Cretaceous polymetamorphic evolution of the Stewart River region, Yukon-Tanana terrane, Yukon, Canada: P–T evolution linked with in situ SHRIMP monazite geochronology. Journal of Metamorphic Geology, vol. 25, p. 803-827.

Campbell, R.B., 1967. Geology of Glenlyon map-area, Yukon Territory (105L). Geological Survey of Canada, Memoir 352, 92 p.

Colpron, M., Gladwin, K., Johnston, S.T., Mortensen, J.K. and Gehrels, G.E., 2005. Geology and juxtaposition history of the Yukon-Tanana, Slide Mountain, and Cassiar terranes in the Glenlyon area of central Yukon. Canadian Journal of Earth Sciences, vol. 42, p. 1431-1448.

Colpron, M., Israel, S., Murphy, D., Pigage, L. and Moynihan, D., 2016. Yukon bedrock geology map. Yukon Geological Survey, Open File 2016-1, scale 1:1 000 000, map and legend.

Colpron, M., Nelson, J. and Murphy, D.C., 2006. A tectonostratigraphic framework for the pericratonic terranes of the northern Canadian Cordillera. *In:* Paleozoic evolution and metallogeny of pericratonic terranes at the ancient Pacific margin of North America, Canadian and Alaskan Cordillera, M. Colpron and J. Nelson (eds.), Geological Association of Canada, Special Paper, vol. 45, p. 1-23.

Colpron, M., Nelson, J. and Murphy, D.C., 2007. Northern Cordilleran terranes and their interactions through time. GSA TODAY, vol. 17, p. 4.

Dawson, G.M., 1903. GSC Annual Report, vol. 13, p. 41A-44A.

de Keijzer, M., 2000. Tectonic evolution of the Teslin Zone and the western Cassiar Terrane, northern Canadian Cordillera. MSc thesis, Utrecht University, Holland.

de Keijzer, M., Williams, P.F. and Brown, R.L., 1999. Kilometre-scale folding in the Teslin zone, northern Canadian Cordillera, and its tectonic implications for the accretion of the Yukon-Tanana terrane to North America. Canadian Journal of Earth Sciences, vol. 36, p. 479-494.

de Keijzer, M., Williams, P.F. and Carr, S.D., 2000. Reflections on Lithoprobe SNORCLE Line 31 in light of the structure of the Teslin zone in the Last Peak area (NTS map 105 E/9), southern Yukon Territory. *In:* Slave – North American Cordillera Lithospheric Evolution (SNORCLE) Transect and Cordilleran Tectonics Workshop Meeting Calgary, Alberta, F. Cook and P. Erdmer (eds), Lithoprobe Report vol. 72, p. 114–118.

Dilek, Y. and Furnes, H., 2014. Ophiolites and Their Origins. Elements, vol. 10, p. 93-100.

Erdmer, P., 1985. An examination of the cataclastic fabrics and structures of parts of Nisutlin, Anvil and Simpson allochthons, central Yukon: test of the arc-continent collision model. Journal of Structural Geology, vol. 7, p. 57-72.

Fallas, K., Erdmer, P., Archibald, D., Heaman, L. and Creaser, R., 1998. The St. Cyr Klippe, south-central Yukon: an outlier of the Teslin tectonic zone? LITHOPROBE SNORCLE Transect Meeting Report, p. 131-138.

Fallas, K., Erdmer, P., Creaser, R., Archibald, D. and Heaman, L., 1999. New terrane interpretation for the St. Cyr klippe, south-central Yukon. LITHOPROBE SNORCLE Transect Meeting Report, p. 130-137.

Fritz, W.H., 1980. Two new formations in the Lower Cambrian Atan Group, Cassiar Mountains, north-central British Columbia. Geological Survey of Canada Paper, vol. 80-1B, p. 217-225.

Fritz, W.H., 1985. The basal contact of the Road River Group—a proposal for its location in the type area and in other selected areas in the Northern Canadian Cordillera. Geological Survey of Canada Paper, Current Research, part B, vol. 85-1B, p. 205-215.

Goodenough, K.M., Thomas, R.J., Styles, M.T., Schofield, D.I. and Macleod, C.J., 2014. Records of Ocean Growth and Destruction in the Oman–UAE Ophiolite. Elements, vol. 10, p. 109-114.

Hansen, V.L., 1989. Structural and kinematic evolution of the Teslin suture zone, Yukon: record of an ancient transpressional margin. Journal of Structural Geology, vol. 11, p. 717-733.

Isard, S.J., Gilotti, J.A., McClelland, W.C., Petrie, M.B. and van Staal, C.R., 2016. Geology and U-Pb geochronology of low-grade mafic ricks from St. Cyr klippe and a marble from the footwall, Canadian Cordillera, Yukon. Geological Survey of Canada, Current Research 2016-1, p. 22.

Miranda, E. and Dilek, Y., 2010. Oceanic Core Complex Development in Modern and Ancient Oceanic Lithosphere: Gabbro-Localized versus Peridotite-Localized Detachment Models. The Journal of Geology, vol. 118, p. 95-109.

Murphy, D.C., Mortensen, J.K., Piercey, S.J., Orchard, M.J. and Gehrels, G.E., 2006. Mid-Paleozoic to early Mesozoic tectonostratigraphic evolution of Yukon-Tanana and Slide Mountain terranes and affiliated overlap assemblages, Finlayson Lake massive sulphide district, southeastern Yukon. *In:* Paleozoic evolution and metallogeny of pericratonic terranes at the ancient Pacific margin of North America, Canadian and Alaskan Cordillera, M. Colpron and J.L. Nelson (eds.), Geological Association of Canada, Special Paper 45, p. 75-105.

Nelson, J., Colpron, M. and Israel, S., 2013. The Cordillera of British Columbia, Yukon, and Alaska: Tectonics and metallogeny. Tectonics, Metallogeny, and Discovery: The North American Cordillera and Similar Accretionary Settings. Society of Economic Geologists Special Publication, vol. 17, p. 53-109.

Nelson, J.L. (1993). The Sylvester Allochthon: upper Paleozoic marginal-basin and island-arc terranes in northern British Columbia. Canadian Journal of Earth Sciences, vol. 30, p. 631-643.

Orchard, M.J. and Struik, L.C., 1985. Conodonts and stratigraphy of upper Paleozoic limestones in Cariboo gold belt, east-central British Columbia. Canadian Journal of Earth Sciences, vol. 22, p. 538-552.

Parsons, A.J., Ryan, J.J., Coleman, M. and van Staal, C.R., 2016a. 2016 report of field activities in the Dunite Peak area, Big Salmon Range, south central Yukon. GEM2 Cordillera Project. Geological Survey of Canada, Open File 8133, p. 1-9.

Parsons, A.J., Ryan, J.J. and van Staal, C.R., 2016b. Kinematics of emplacement of the Slide Mountain terrane in Central Yukon: Preliminary results from structural mapping, Dunite Peak, Big Salmon Range. Yukon Geoscience Forum 2016. Whitehorse, YT, Canada.

Petrie, M.B., Gilotti, J.A., McCelland, W.C., Van Staal, C. and Isard, S.J., 2015. Geologic Setting of Eclogite-facies Assemblages in the St. Cyr Klippe, Yukon–Tanana Terrane, Yukon, Canada. Geoscience Canada, vol. 42, p. 327-350.

Pyle, L.J., Orchard, M.J., Barnes, C.R. and Landry, M.L., 2003. Conodont biostratigraphy of the Lower to Middle Devonian Deserters Formation (new), Road River Group, northeastern British Columbia. Canadian Journal of Earth Sciences, vol. 40, p. 99-113.

Roback, R.C., Sevigny, J.H., Walker, N.W. (1994). Tectonic setting of the Slide Mountain terrane, southern British Columbia. Tectonics, vol. 13, p. 1242-1258.

Staples, R.D., Gibson, H.D., Berman, R.G., Ryan, J.J. and Colpron, M., 2013. A window into the Early to mid-Cretaceous infrastructure of the Yukon-Tanana terrane recorded in multi-stage garnet of west-central Yukon, Canada. Journal of Metamorphic Geology, vol. 31, p. 729-753.

Staples, R.D., Gibson, H.D., Colpron, M. and Ryan, J.J., 2016. An orogenic wedge model for diachronous deformation, metamorphism, and exhumation in the hinterland of the northern Canadian Cordillera. Lithosphere, vol. 8, p. 165-184.

Struik, L.C. and Orchard, M.J., 1985. Late Paleozoic conodonts from ribbon chert delineate imbricate thrusts within the Antler Formation of the Slide Mountain terrane, central British Columbia. Geology, vol. 13, p. 794-798.

Tempelman-Kluit, D.J., 1976. The Yukon Crystalline Terrane: Enigma in the Canadian Cordillera. Geological Society of America Bulletin, vol. 87, p. 1343-1357.

Tempelman-Kluit, D.J., 1979. Transported cataclasite, ophiolite, and granodiorite in Yukon: Evidence of arc-continent collision. Geological Survey of Canada, Paper 79-14, 27 p.