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A. Zagorevski[1], M.G. Mihalynuk[2], S. McGoldrick[3], J.H. Bedard[4], M. Golding[5], N. Joyce[1], C. Lawley[1], D. Canil[3], A-S. Corriveau[6], A. Bogatu[7], A. Tremblay[8]

[1] Geological Survey of Canada, 601 Booth St., Ottawa, ON K1A 0E8
[2] Geological Survey and Resource Development Branch, BC Ministry of Energy and Mines, 1810 Blanshard St., Victoria, BC V8W 9N3
[3] School of Earth and Ocean Sciences, University of Victoria, Victoria, BC V8W 3P6
[4] Geological Survey of Canada, 490 rue de la Couronne, Québec, QC G1K 9A9
[5] Geological Survey of Canada, 605 Robson St., Vancouver, BC V6B 5J3
[6] Institut national de la recherche scientifique, 490 rue de la Couronne, Québec, QC G1K 9A9
[7] Département de géologie et de génie géologique, Université Laval, Pavillon Adrien-Pouliot, local 4309, 1065 avenue de la Médecine, Québec, QC G1V 0A6
[8] Département des sciences de la Terre et de l'atmosphère, Université du Québec à Montréal, 201 avenue du Président-Kennedy, local PK-6150, Montréal, QC H2X 3Y7

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[3] School of Earth and Ocean Sciences, University of Victoria, Victoria, BC V8W 3P6

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[8] Département des sciences de la Terre et de l'atmosphère, Université du Québec à Montréal, 201 avenue du Président-Kennedy, local PK-6150, Montréal, QC H2X 3Y7

Foreword

The Geo-mapping for Energy and Minerals (GEM) program is laying the foundation for sustainable economic development in the North. The Program provides modern public geoscience that will set the stage for long-term decision making related to investment in responsible resource development. Geoscience knowledge produced by GEM supports evidence-based exploration for new energy and mineral resources and enables northern communities to make informed decisions about their land, economy and society. Building upon the success of its first five-years, GEM has been renewed until 2020 to continue producing new, publically available, regional-scale geoscience knowledge in Canada's North.

During the summer 2016, GEM program has successfully carried out 17 research activities that include geological, geochemical and geophysical surveying. These activities have been undertaken in collaboration with provincial and territorial governments, northerners and their institutions, academia and the private sector. GEM will continue to work with these key collaborators as the program advances.

Introduction

Relicts of ancient oceanic crust that now comprise northwest BC and Yukon have diverse origins. Some may have formed adjacent to cratonic North America (Laurentia) while others are completely exotic. The Cache Creek terrane (Fig. 1) is considered exotic, because it contains fossil faunas that evolved isolated from

Laurentia, on the opposite shores of supercontinent Pangea, in the Tethyan Ocean realm (e.g., Monger 1977a; Monger and Ross 1971). Now these exotic Tethyan fossils are mainly found in limestone imbricated with chert, basalt, gabbro and ultramafic rocks that are exposed from southern British Columbia to southern Yukon. Its components have been variably interpreted to represent fragments of accreted seamounts, ophiolites and rifted arc complexes. Apparent entrapment of an exotic Tethyan terrane between the less exotic and highly mineralized arc terranes (Stikinia and Quesnellia) has driven tectonic models for crustal evolution of the northern Cordillera. For example, Mihalynuk et al. (1994) proposed oroclinal folding of the arc terranes about a hinge in Yukon to envelop the exotic Cache Creek terrane, but such models have proven difficult to test. Although the individual tectono-stratigraphic units are locally well characterized, their regional distribution is complicated by late deformation and intrusions, especially in Yukon, the “hinge zone” and crux of the oroclinal model. Lack of a testable tectonic model, precludes detailed tectonic reconstructions necessary to fully understand the distribution and significance of mineralization within Cache Creek and adjacent terranes.

The *Geological framework of ancient oceanic crust in northwestern British Columbia and southwestern Yukon* activity aims to develop testable geological model for the Cache Creek terrane in southern Yukon and northern British Columbia (Fig. 1). This activity is addressing the origin of individual units, the history of associated sedimentary basins, and the accretionary events that brought the various units together. Mountain-scale exposures in key areas elucidate tectonic processes that led to formation of oceanic terranes and associated syn- and epigenetic mineral deposits.

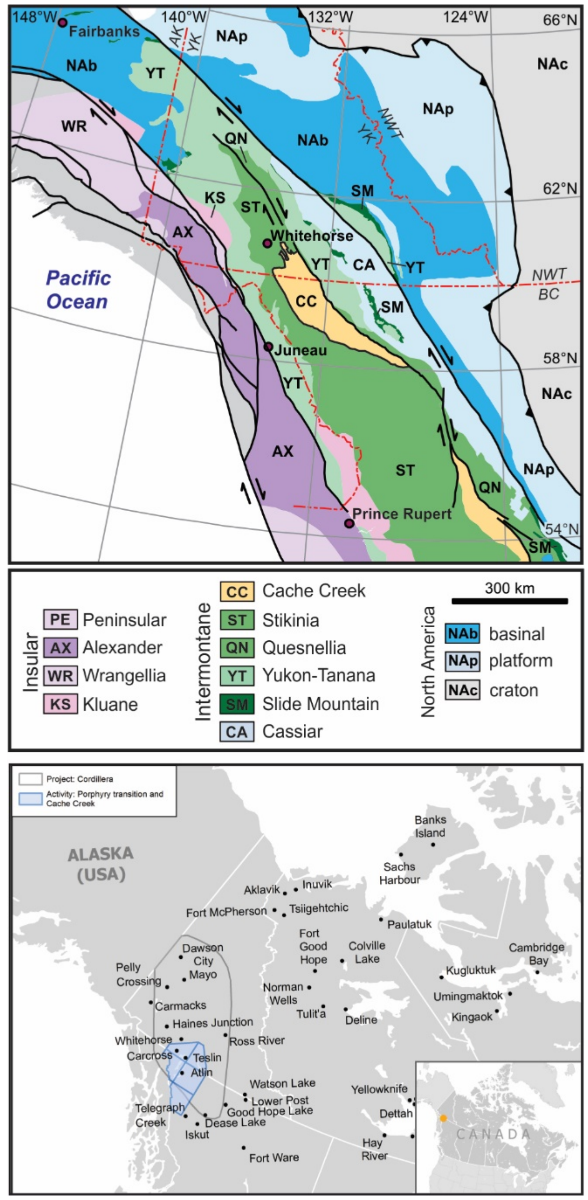

Figure 1 Terranes of the Northern Cordillera (from Colpron and Nelson, 2011). Bottom: GEM2: Cordillera project and *Geological framework of ancient oceanic crust in northwestern British Columbia and southwestern Yukon* activity footprints.

Geological background

The Cache Creek terrane is recognized as a composite oceanic terrane along its entire length (Fig. 2). A southeast-pointing wedge of Cache Creek that spans the Yukon-BC border is the largest contiguous part of the terrane. This “northern Cache Creek terrane” is well exposed in the Cry Lake and Dease Lake areas (NTS

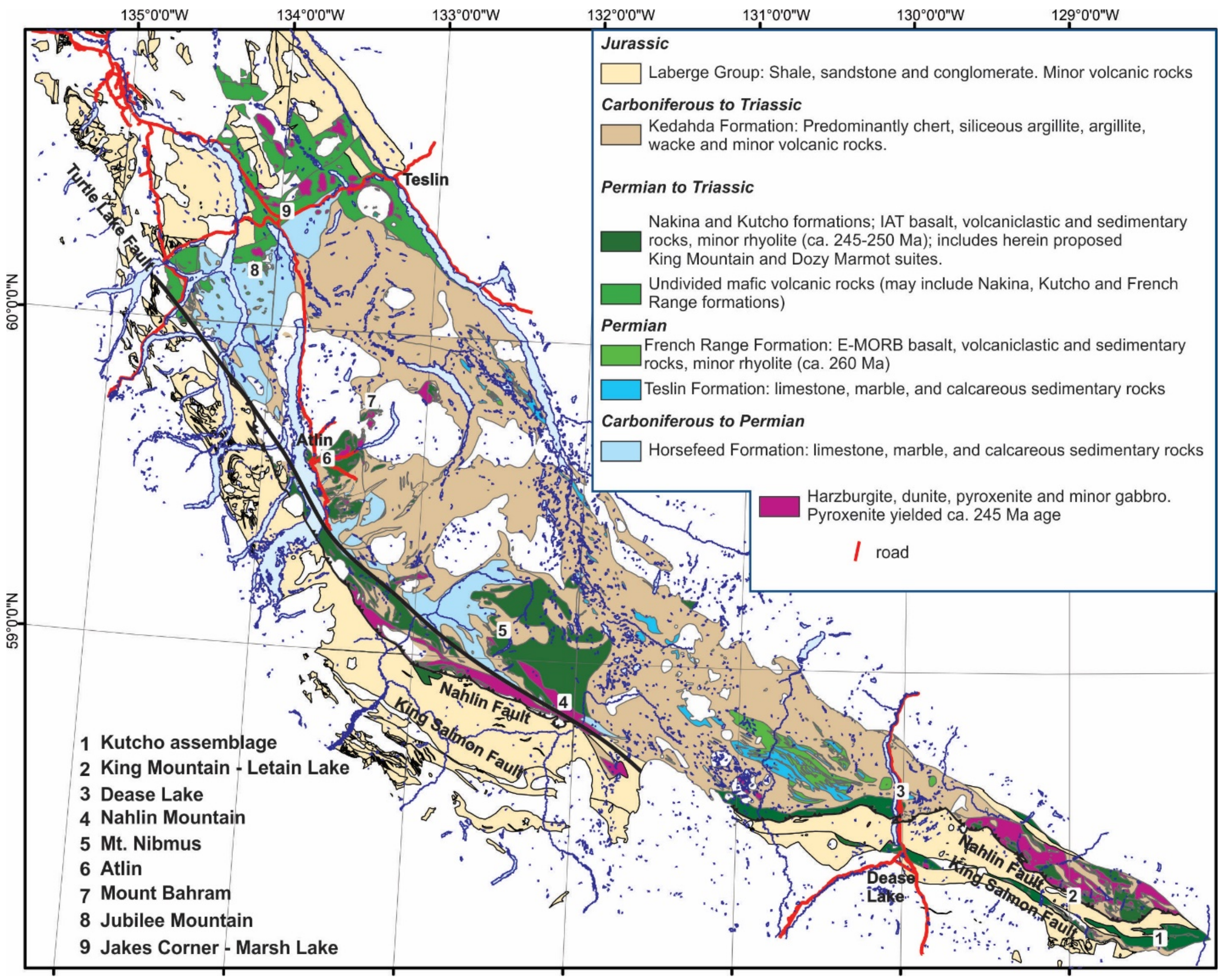

Figure 2 Simplified geology of the northern Cache Creek terrane showing the distribution of various tectono-stratigraphic units (simplified from Massey et al. 2005 and Colpron 2015)

104I, J), where it is divided into two major units: the Cache Creek Complex and the Kutcho assemblage (Fig. 2; Gabrielse 1998). They are separated by the Nahlin Fault which marks the southwest limit of the Cache Creek complex in most places (see discussion below). Kutcho assemblage is interpreted as an Early to Middle Triassic rifted arc complex (e.g., Childe and Thompson 1997; Gabrielse 1998; Schiarizza 2011), in which volcanogenic massive sulphides accumulated to form the Kutcho Creek deposit. Located in the hanging-wall of the King Salmon Fault, Kutcho assemblage comprises felsic to mafic volcanic and hypabyssal rocks and associated epiclastic sediments; all are unconformably overlain or structurally imbricated with turbiditic strata of the Jurassic Inklin Formation. Kutcho correlatives (Fig. 2) are reported to the northwest in the Nakina (English et al. 2010; Mihalynuk et al. 2003) and Marsh Lake areas (Bickerton 2013).

The Cache Creek complex contains conspicuous slabs of variably serpentinized ultramafic rocks up to 60 kilometres in length (Fig. 2) that are structurally juxtaposed with mafic volcanic and hypabyssal rocks and with sedimentary rocks including limestone, ribbon chert and siliciclastic rocks ranging in age from Carboniferous to Jurassic. Earliest studies to recognize the Cache Creek ultramafic rocks as exhumed mantle rather than of intrusive origin, interpreted them as ophiolite (i.e. spreading centre; e.g., Terry 1977) and/or a seamounts (i.e. ocean island/plateau with carbonate atoll; e.g., Monger 1977b) that were in part coeval with and overlain by deep water basinal strata, mainly ribbon chert. Subsequent workers followed these interpretations and noted that ophiolitic components were predominant (e.g., Ash 1994; English et al. 2010; Gabrielse 1998; Mihalynuk et al. 1994, 1999). However, no consistent tectono-stratigraphy exists and relationships between interpreted seamount and ophiolite components and between abundant mantle tectonites and rare crustal cumulates, remain undefined.

Goals and objectives

Resolution of tectono-stratigraphy and structural relationships between the tectonic panels is key to reconstructing the geological history of the Cache Creek terrane and its mineral deposits. GEM research continues to focus on improving understanding of the mantle, constraining relationships between mantle and crust, determining the extent and kinematics of intra-oceanic detachment(s), composition and provenance of arc-derived Mesozoic siliciclastic sequences, and establishing locations of sutures within the Cache Creek terrane.

Preliminary results

Mantle rocks

Variably serpentinized ultramafic rocks are present throughout the northern Cache Creek terrane, although the largest exposures occur in the hanging wall of the Nahlin Fault (Fig. 2; Terry, 1977). They are mainly composed of mantle harzburgite tectonite with variably abundant foliation-concordant layers and rare discordant dykes of orthopyroxenite. Dunite dykes, layers and pods are common but volumetrically minor. A single U-Pb age from an ultramafic body in southernmost Yukon constrains their age as 245.4±0.8 Ma (Gordey et al., 1998).

Regional geochemical investigations of the Nahlin suite peridotites (this study; Babechuck et al., 2010; Canil et al., 2006) indicate that the majority of samples have <2% Al_2O_3 like fore-arc mantle produced by high degrees of partial melting. Most samples have TiO_2 <0.05%. Primitive mantle (PM) normalized multi-element profiles of individual massifs are variable. The most depleted samples have Yb between 0.1 and 0.01PM values, with MREE as low as 0.001PM, and significantly lower abundances of REE overall than Thetford Mines forearc peridotites which are interpreted to have been generated by high degree partial melting and interaction with boninite melts (Page et al., 2009). Most profiles show some degree of LREE-Th-LILE enrichment indicating derivation by flux melting above a subduction zone.

Mineral abundances and compositions also indicate high degrees of partial melting. Clinopyroxene is generally scarce and orthopyroxene occurs in low modal proportions. Chromite is unzoned, and is characterized by Cr# ranging from 32 to 58 and low TiO_2 and NiO concentration. Magnesian olivine end-member content (denoted as forsterite, $Fo_{x\%}$), of harzburgite varies between Fo_{90} to Fo_{92} ; in dunite it is up to Fo_{94}. Magnesium number (100MgO/(MgO + FeO)) in mole %, Mg#) of enstatite and diopside are 91.3-91.6 and 92.9-94.2 respectively, and they are characteristically low in Al_2O_3 and Cr_2O_3. Lithogeochemical and mineral compositions both indicate a large range in degrees of partial melting (18-32%) for these peridotites.

Nahlin ophiolite (Fig. 2) is the largest and best-preserved of the Cordilleran ophiolites. Recent bedrock mapping at Peridotite Peak (NTS 104K15), Menatatuline Range and Nahlin Mountain (NTS 104K16, ~80 and 100 km

Figure 3 Representative photographs of northern Cache Creek terrane. A. Structural imbrication and late faulting juxtaposes limestone, basalt and chert with peridotite, Nahlin Mountain area. B. Clinopyroxene in harzburgite, Menatatuline Range area. C. Cumulate gabbro within mantle section, Menatatuline Range area. D. Gabbro (black) intruding into sheared peridotite (dun), Jubilee Mountain area. E. Well-bedded Horsefeed formation limestone, Tagish Lake area. F. Ophiolitic gabbro and peridotite form klippe above Horsefeed Formation marble, Jubilee Mountain. G. Ophiolite is thrust over Horsefeed Formation limestone, Mount Nimbus.

southeast of Atlin, British Columbia) shows that the ophiolite body is structurally disrupted (Fig. 3a), and lacks significant lower crustal cumulates and any sheeted dyke complex. Whole rock geochemistry of the spinel harzburgite and rare lherzolite samples (Fig. 3b) from Peridotite Peak and the Menatatuline Range show strong depletion (<1 wt % Al_2O_3 and ~45 wt % MgO), probably due to melt extraction. Inversion modelling of the clinopyroxene REE data from these samples yields tholeiitic melt compositions with flat chondrite-normalized REE patterns similar to the gabbroic rocks and basalt of the Nakina Formation, which are island arc tholeiite. The similarity in chemistry suggests that these volcanic and intrusive rocks are related, and may be derived from melting of the Nahlin ophiolitic mantle.

Mineral chemical data from olivine-orthopyroxene-clinopyroxene-spinel peridotites were analysed by LA-ICP-MS and electron microprobe to constrain their thermal history. Preliminary results from 2-pyroxene and olivine-spinel Fe-Mg exchange thermometry imply a difference in thermal history between the mantle at Peridotite Peak and Menatatuline Range. Results from the 2-pyroxene solvus thermometer (T_{BKN}, Brey and Köhler, 1990) indicate that Menatatuline Range samples record systematically higher core temperatures (1017 – 1187 °C) compared to samples from Peridotite Peak (823 – 935 °C). Application of the Ca in orthopyroxene ($T_{Ca\text{-}in\text{-}opx}$, Brey and Köhler, 1990) and 2 pyroxene REE partition (T_{REE}, Dygert and Liang, 2015) thermometers yields a similar temperature distribution. At Menatatuline Range, $T_{Ca\text{-}in\text{-}opx}$ records temperatures of 1108 – 1285 °C and TREE results range from 957 – 1306 °C, whereas at Peridotite Peak, samples preserve cooler temperatures of 893 – 987 °C ($T_{Ca\text{-}in\text{-}opx}$) and 881 – 1180 °C ($T_{REE}$). Olivine-spinel Mg-Fe exchange thermometry (Ballhaus et al., 1991) record cooling through 685 – 736 °C and 630 – 672 °C at Menatatuline Range and Peridotite Peak, respectively.

On-going work will further constrain the thermal history of the Nahlin ophiolite, focusing on Al-in-Ol thermometry by LA-ICP-MS, and Ca-in-Ol geospeedometry. Thermometry results will be compared to the wet and dry peridotite solidi to discriminate between a possible suprasubduction zone and mid-ocean ridge setting. Temperature-grain size variations will be related to cooling rate using the closure temperature equation of Dodson (1973), in an effort to constrain possible modes of exhumation and tectonic setting. Harzburgite samples collected in 2016 from Nahlin Mountain, located ~15 km southeast of Menatatuline Range, will be analyzed to examine along-strike variations within the Nahlin ophiolite.

Layered gabbro and peridotite

Crustal cumulate rocks are volumetrically minor but have been previously documented at King Mountain (Gabrielse, 1998; Zagorevski et al., 2015) and Nahlin Mountain (Terry, 1997). A cirque exposure of layered, foliated to granular-textured cumulate gabbronorite is well exposed at King Mountain (Zagorevski et al., 2014, 2015) and extends to adjacent ridges. These cumulates probably formed during ascent of evolved, multiply-saturated magmas derived from a deeper chamber. Rhythmically layered, foliated gabbronorite contains ~5% oxides and locally layers are boudined and folded, probably during compaction- flattening and intra-cumulate shear. A 300m thick continuous section at King Mountain records two fractional crystallization cycles. Inverse trace element models show that the gabbronorite cumulates are compositionally akin to boninites. The lowest Mg# rocks in the differentiation cycles are interpreted to record episodic co-accumulation of Fe-Ti oxides, with the decrease in melt FeO content triggering sulphide immiscibility.

Hornblendite and hornblende tonalite veins are locally transposed into the layered cumulates, forming flaser gabbros with 5-50% cm-scale lensoid. Hornblendite replaces the foliated gabbro-norite, greatly increasing REE contents. Amphibole oikocrysts show evidence of internal deformation and record temperatures > 750°C. $^{40}Ar/^{39}Ar$ dating of hornblende in hornblendite veins at King Mountain yielded ca. 250 Ma preliminary cooling ages (N. Joyce, unpublished data). U-Pb zircon dating of quartz diorite cross-cutting the cumulate gabbronorite yielded a ca. 255 Ma crystallization age (N. Joyce, unpublished data).

Hypabyssal rocks

Fine-grained, massive to fragmental mafic rocks occur throughout the northern Cache Creek terrane. Massive mafic rocks have been generally mapped as volcanic flows, even though extrusive textures were lacking (e.g., Gabrielse, 1998; Mihalynuk et al., 1999, 2003). Exposures in the King Mountain area were identified as sub-parallel basalt and gabbro dykes comprising a sheeted dyke complex (Zagorevski et al., 2014). A trondhjemite dyke cutting the sheeted dyke complex yielded ca. 252 Ma preliminary crystallization age (U-Pb titanite, N. Joyce, unpublished data). Sheeted dykes range in composition from depleted arc tholeiites to boninites. Additional exposures of sheeted dyke complex were previously suggested to the northwest (Zagorevski et al., 2015), however continued detailed work revealed that some of these sheeted intrusions form sheeted sill complexes as they appear to parallel crust-mantle contact. Near Atlin for example, parts of Union Mountain are underlain by medium-grained gabbro to basaltic sill - sediment complex. Basaltic sills locally have an autoclastic texture, and contain large rafts (>20 m) and pods of radiolarian ribbon chert and limestone.

Crust-mantle relationships within ophiolite

Crust and mantle lithologies are commonly imbricated and cut by late faults, obscuring primary relationships. In many localities, upper crustal lithologies (i.e. hypabyssal, volcanic and sedimentary rocks) lie structurally above mantle rocks with no intervening lower or middle crustal rocks (Fig. 4a; e.g., Mihalynuk et al., 2003; Zagorevski et al., 2014). This relationship is consistent from Nahlin Mountain to Teslin area. Variably serpentinized ultramafic rocks are commonly dissected by fine to coarse-grained gabbroic dyke swarms. Dykes range from centimeter to decameter scale. Some gabbroic bodies are emplaced at the transition between serpentinized mantle and upper crustal lithologies. These gabbro intrusions are strongly varitextured, and range from fine grained to pegmatitic on a decimeter scale (Fig. 3c). One such intrusion in Jake's Corner area yielded ca. 245.72 Ma age (R. Friedman, unpublished data). Detailed mapping of gabbroic intrusions at various localities confirmed intrusion into peridotite. Gabbro locally forms reticulated vein and dyke swarms suggestive of a low confining pressure due to pre-intrusion exhumation of the mantle peridotite. However, gabbro dykes may also locally display ductile dismemberment into isolated pods and boudins within spinel- and plagioclase-bearing peridotite (Zagorevski et al., 2015). Although exhumed to plagioclase crystallization depth, the gabbro-peridotite massif behaved in a ductile manner, indicating a steep geothermal gradient consistent with rapid exhumation below a detachment.

Detailed mapping of the detachment characteristics in Atlin area reveals serpentine matrix-supported conglomerate with peridotite, gabbro, diabase, basalt, limestone and chert clasts. This unit is interpreted to record exhumation of the mantle to form sea floor (i.e. ocean core complex). Detachments were

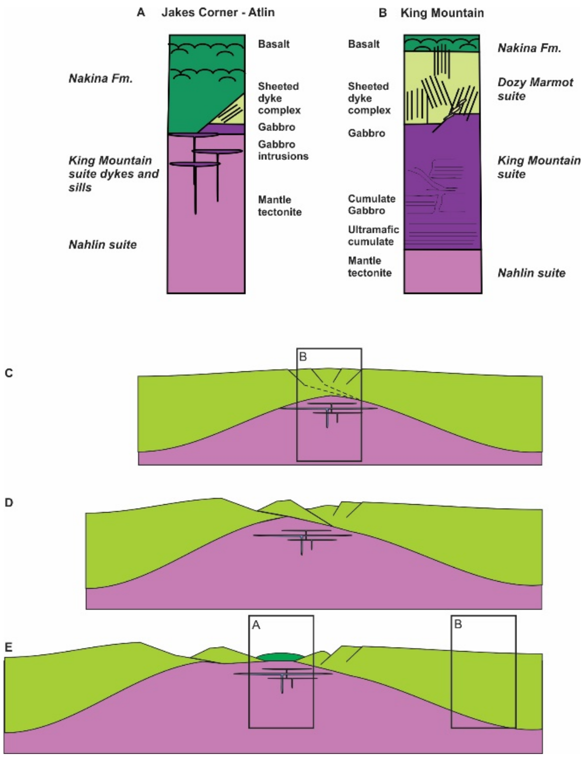

Figure 4 Comparison of ophiolitic pseudo-stratigraphy in the Cache Creek terrane and schematic tectonic model for the observed relationships. A. Pseudo-stratigraphy in the Jakes Corner and Atlin area indicates excision of middle to lower crust. B. Pseudo-stratigraphy in the King Mountain area suggests Penrose-style ophiolite. C-E. Development of oceanic core complex by rifting of an ophiolitic spreading centre where extension is accommodated by emplacement of vertical sheeted dykes and listric normal faults (C). E. Extension is localized along a fault and is tectonically accommodated. Magma emplacement continues. F. Mantle is exhumed onto the sea floor. Continued magmatism results in eruption of Nakina Formation basalt directly onto the sea floor.

subsequently intruded by hypabyssal gabbro of island arc tholeiite composition (Fig. 3d).

Ophiolitic stratigraphy

Structurally dismembered, Penrose-style ophiolite components (Anonymous, 1972) are well exposed in the King Mountain area (Zagorevski et al., 2015). Nakina Formation basalt and related hypabyssal rocks, the upper crustal component of the ophiolite, are predominantly exposed further to the northwest, such as in the Nahlin Mountain-Nakina Atlin and Teslin areas immediately above Nahlin suite ultramafic rocks. This lack of lower and middle ophiolitic crust distribution suggests removal by structural excision along an intra-oceanic detachment zone, well known in intra-oceanic core complexes (e.g., Ohara et al., 2003). Ophiolitic spreading appears to have been accommodated magmatically in the southeast and tectonically in the northwest (Zagorevski et al., 2015). Such a relationship may result from progressive rifting of a supra-subduction zone ophiolite, with initial rifting accommodated magmatically in the King Mountain area and tectonically in Atlin-Jake's Corner area (Fig. 4).

Kedahda Formation

Kedahda Formation is a lithologically distinctive and aerially extensive unit characterized by thinly bedded chert and pelite, commonly termed "ribbon chert". These units are locally interbedded with limestone, sandstone and conglomerate containing abundant volcanic and hypabyssal fragments and lesser amounts of plagioclase, mafic minerals, argillite chips and quartz (e.g., Monger, 1975; Mihalynuk et al., 2003). Conodonts and radiolaria generally yield Mississippian to Early Jurassic ages. Much of the ribbon chert is of Middle Triassic age (e.g., Gordey et al., 1991; Mihalynuk et al., 2003, 2004). In the Nakina and Marsh Lake areas, quartz-bearing siliciclastic rocks yielded ca. 244 Ma ages (M. Villeneuve, unpublished data; Mihalynuk et al., 2003; Bickerton, 2013).

U-Pb provenance of Late Triassic siliciclastic rocks consistently yield Late Triassic to Early Jurassic maximum depositional ages (<210 Ma) and characteristic Stikinia and Kutcho arc provenance (ca. 210 to 220, 250, 320 Ma; N. Joyce unpublished data). Clastic samples from Yukon also yield a completely unexpected population of Proterozoic and Archean zircon cores mantled by ca. 204 Ma zircon. These data indicate that by the Late Triassic, clastic sediments deposited on and structurally interleaved with exotic Cache Creek terrane components were in close proximity to active Stuhini-Lewes River-Nicola arc and that parts of the Stuhini-Lewes River-Nicola arc had already interacted with continental basement. Whether this continental basement was contiguous with ancestral North America or was an intraoceanic ribbon derived from it or some other craton, is not known (cf. Unterschutz et al., 2002).

Horsefeed Formation

Fieldwork was carried out during the summer of 2016 to better understand the Carboniferous and Permian Horsefeed Formation (Fig. 3e; Golding et al., 2016). Carboniferous sections on Sentinel Mountain were collected for conodonts in order to constrain the age of the lower part of the Horsefeed Formation. Sections near Horsefeed Creek that were previously identified as Permian in age (Monger, 1976), were collected together with samples of fusulinids, in order to facilitate inter-calibration of the two biostratigraphic schemes. Additional reconnaissance samples were collected in conjunction with the BCGS mapping program in the Turtle Lake map area (NTS 104M/16) from Mount Stovel, Mount Cloutier, and Peninsula Mountain, in order to determine the age of the Horsefeed Formation in this map area.

Once processed, the conodont samples will be analyzed in conjunction with existing archive material to improve conodont biostratigraphy in the Cache Creek terrane. In particular, this should lead to age refinement of the Horsefeed Formation. Future work will include a comparison of the conodont faunas form the Stikine and Cache Creek terranes in order to help constrain their relationship from Carboniferous to Triassic times.

Syn-and post-obduction structures

Thrust faults are recognized throughout the northern Cache Creek terrane; however, linking these faults to tectonic history is not straight forward. Previous mapping in the King Mountain area revealed at least two generations of thrust faults. First generation thrust faults (D_1) are very shallowly-dipping structures which emplace Nahlin ultramafic suite over chert, fine grained siliciclastic rocks, limestone and basalt (Zagorevski et al., 2015). These structures appear to be the primary control on the distribution of ophiolitic rocks. A second set of moderately to steeply northeast dipping thrusts (D_2) imbricates D_1 structures, resulting in interleaving of Nahlin ultramafic suite mantle and structurally underlying "Kedahda Formation" as well as (re-)imbrication of ophiolitic stratigraphy.

Re-evaluation of tectonic relationships further north has revealed similar degree of complexity. In the Mt. Nimbus area, ophiolitic rocks are thrust over Mississippian limestone that is interbedded with ocean island basalt (Fig. 3g). Even though it may have been reactivated, this thrust demarcates the suture between upper plate arc rocks (ophiolite) and subducting plate (limestone platform). In the Jubilee Mountain area, the same juxtaposition is preserved: an isolated klippe of ultramafic rocks intruded by gabbro structurally overlies Horsefeed Formation limestone (Fig. 3f). Identification of such suture localities is critical for unravelling the tectono-stratigraphy of the northern Cache Creek terrane as it is the primary contact in the thrust stack that was later reworked by D_2 folds and thrusts and even younger strike slip faults.

Turtle Lake map area structure

Structural relations across much of the Cache Creek terrane are more typically cryptic, such as in the Turtle Lake area, centered ~40 km northwest of Atlin. Across this low-standing area, isolated mountains provide good exposures, but geological linkages between them are tenuous. For example, in the southern map area, excellent exposures on Sunday Peak show strands of the Nahlin Fault occupied by lenses of serpentinized harzburgite and hypabyssal basalt

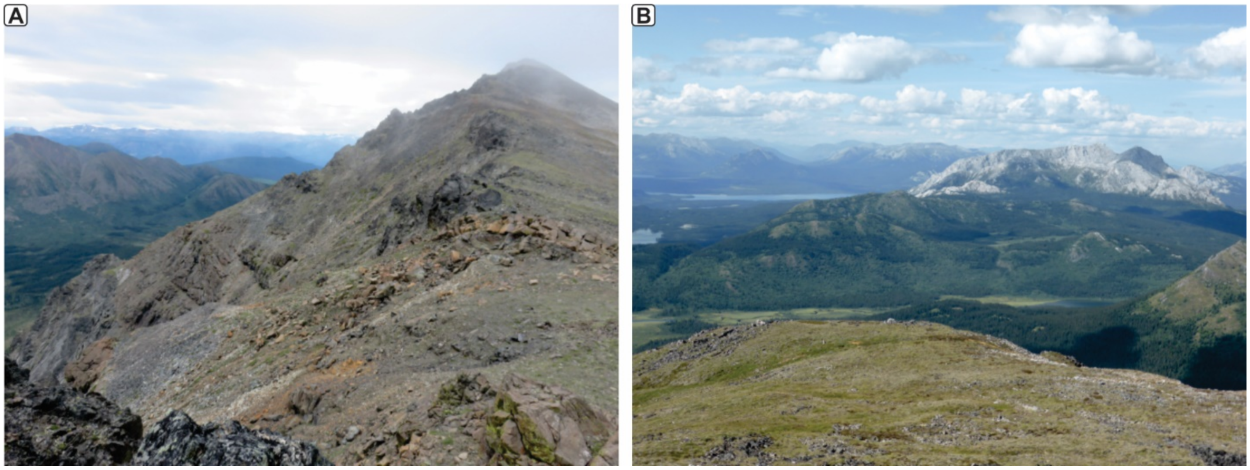

Figure 5 Representative photographs of Turtle Lake area. A. Jurassic Laberge Group strata are juxtaposed with serpentinized Harzburgite along a steep fault, Sunday Peak. B. Lowlands in Turtle Lake area are generally underlain by recessively weathering chert.

separating Early Jurassic Whitehorse Trough strata from the predominantly massive Horsefeed Formation limestone (Fig. 5a). Low areas between mountains of limestone are in part underlain by chert, which weathers recessively and is probably more abundant than it appears (Fig. 5b). Strongly disrupted ribbon chert forms narrow, east-trending domains between massive limestone layers up to 3 km thick. However, nowhere in the carbonate layers can an undisrupted section be identified that is more than a few hundred metres thick. More commonly, layers of structurally imbricated volcanic and sedimentary rocks, too thin to show accurately on maps at 1:50 000 or smaller scale, separate limestone panels. In proximity of the Nahlin fault, these units swing toward the southeast, into parallelism with the fault. The Nahlin Fault has probably been modified by strike-slip deformation that predates thermal metamorphism of the fault zone by the nearby Sunday Peak intrusion. Sunday Peak intrusion is assumed to be of Late Cretaceous age based on lithologic similarity with the closest dated intrusion to the southeast (Mihalynuk et al., 1992). Sunday Peak intrusion was collected for confirmatory age determination.

Like the Turtle Lake area, the original accretionary fabric of other parts of the northern Cache Creek terrane appear significantly modified by superimposed strike-slip deformation. Like at Sunday Peak, the effect is especially conspicuous where peridotite massifs are duplicated and juxtaposed with supracrustal rocks along steep fault zones. These fault zones have strike lengths of hundreds of kilometres (>>200km, e.g., probably linking the modified Nahlin Fault at Sunday Peak with steep faults in Nahlin area: Turtle Lake Fault on Fig. 2) and appear to bound Cretaceous basins or volcanic centers, such as the ~77 Ma (Mihalynuk et al., 1999) Windy Table suite well exposed at Graham Inlet and on the BC-Yukon border. Reconstructing the motion on these Cretaceous and younger faults will be critical to any tectonic reconstruction of the region.

Gold Mineralization

Aside from massive sulphide mineralization discovered during the Federal Targeted Geoscience Initiative in 2002 (Joss'alun occurrence; Mihalynuk et al., 2004), syngenetic mineralization accumulations of are not well known in the northern Cache Creek terrane. The terrane is well known for its placer deposits which have long been affiliated with listwanite-altered (quartz – carbonate - Cr-mica) ultramafic rocks (Ash, 1994) as have the famous placer deposits of California (e.g., Ferguson and Gannett, 1932). Yet, despite more than a century of lode gold exploration, no continuous gold production has been won from listwanite lodes.

Analysis of angular, proximal placer grains from Feather Creek in the Atlin camp (Sack and Mihalynuk, 2004) revealed gold nuggets with intergrowths of thorite and cassiterite. Within northern BC these minerals are rare except within and around the Surprise Lake batholith, where they are common. Thus, a genetic association between a load source of the Atlin placer gold and the batholith was inferred, although the possibility of multiple sources was not ruled out.

In 2016 gold-quartz veins were discovered in bedrock on Otter Creek (a north-flowing drainage between Feather Creek and the Surprise Lake batholith). Host rocks are graphitic calcareous phyllite containing coarse pyrite cubes, which is cut by extensively clay-altered dykes centimetres to ~1 m thick. Millimetre white mica flakes are a conspicuous part of the alteration assemblage of both the dykes and gold-bearing phyllite. Both the altered dykes and country rocks were sampled for geochemical characterization and white mica was collected for $^{40}Ar/^{39}Ar$ age determination in order to test for geochemical and/or temporal linkage with the ~80 Ma (Mihalynuk et al., 1992; Smith and Arehart, 2010) Surprise Lake batholith.

Conclusions

The northern Cache Creek terrane in part comprises components of structurally dismembered supra-subduction zone ophiolite. The distribution of ophiolitic components is most easily explained by magmatically-accommodated extension in the southeast and tectonically-accommodated extension in the northwest. Tectonically - accommodated extension resulted in juxtaposition of upper crustal and mantle lithologies in an intra-oceanic setting along a detachment. The ophiolite was obducted onto the carbonate platform and associated rocks that are in part represented by the Horsefeed, French Range and Teslin formations. Subsequent D_2 re-imbrication of the shallow-dipping D_1 thrust faults resulted in young-over-old and shallow-over-deep relationships across D_2 thrust faults. Parts of mapped Kedahda Formation appear to overlie all components and likely represent an overlap sequence. Regional compilation and reinterpretation of the tectono-stratigraphy is on-going.

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