

The three 'Windy McKinley' terranes of Stevenson Ridge (115JK), western Yukon

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ABSTRACT

Rocks assigned to the Windy McKinley Terrane occur in Stevenson Ridge and Kluane map areas of western Yukon. Based on new mapping in Stevenson Ridge area, rocks mapped as Windy McKinley Terrane have been divided into three fault-bound assemblages: 1) a structurally lowest assemblage of muscovite-quartz schist, calcsilicate schist, and minor marble, carbonaceous quartzite and schist, pebble meta-conglomerate and granitic meta-plutonic rocks; 2) an imbricated ophiolitic assemblage of meta-chert, probably intrusive greenstone, leucogabbro, variably serpentized dunite and harzburgite, and mafic greywacke; and 3) an assemblage of fine-grained clastic and calcareous rocks intruded and variably hornfelsed by voluminous Early Triassic (Mortensen and Israel, 2006) gabbro. Assemblage 1 probably correlates with Yukon-Tanana Terrane. Assemblage 2 more strongly resembles the Chulitna Terrane of Alaska rather than either the Windy or McKinley terranes as originally defined. Assemblage 3 resembles part of McKinley Terrane, as well as the Aurora Peak and Pingston terranes. These terrane re-assignments have implications for the area's mineral potential.

RÉSUMÉ

Les roches attribuées au terrane de Windy McKinley se trouvent dans la région des cartes Stevenson Ridge et Kluane au Yukon occidental. D'après de nouveaux travaux de cartographie dans la région de Stevenson, le terrane a été subdivisé en trois assemblages limités par des failles : 1) un assemblage structural inférieur de schiste à muscovite et quartz, de schiste à silicates calciques et de quantités mineures de marbre, de quartzite et de schiste carbonés, de conglomérat caillouteux métamorphisé et de roches granitiques plutoniques métamorphisées; 2) un assemblage ophiolitique imbriqué de chert métamorphisé, de roche verte probablement intrusive, de leucogabbro, de dunite et de harzburgite serpentinisées à des degrés variables et de grauwacke mafique; et 3) un assemblage de roches clastiques et calcaires à grain fin pénétrées et cornéennisées à des degrés variables par un volumineux gabbro du Trias précoce (Mortensen et Israel, 2006). L'assemblage 1 est probablement corrélé avec le terrane de Yukon-Tanana. L'assemblage 2 ressemble davantage au terrane de Chulitna en Alaska qu'aux terranes de Windy ou de McKinley auxquels il avait à l'origine été attribué. L'assemblage 3 ressemble au terrane de McKinley. Ces attributions à de nouveaux terranes ont des conséquences pour le potentiel minéral de la région.

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INTRODUCTION

One of the least understood components of Yukon geology is the Windy McKinley Terrane of western Yukon (Wheeler and McFeeley, 1991; Fig. 1). Occurring in two outcrop areas in southwestern Stevenson Ridge and north-central Kluane map areas, the rocks assigned to the terrane are generally poorly exposed and with local exception, have not been mapped in detail finer than 1:250 000 scale. Furthermore, no fossils have been extracted from rocks of the Windy McKinley Terrane in the Yukon and until recently, no isotopic ages have been determined. Modern lithogeochemical data are completely lacking. Consequently, neither the lithological character of the terrane is known in detail, nor are its age

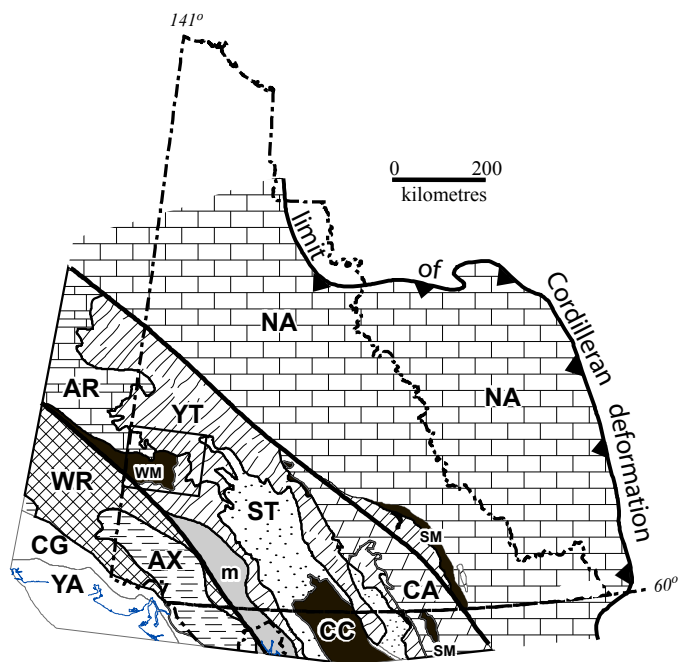


Figure 1. Terrane map of distribution of Windy McKinley Terrane in western Yukon and eastern Alaska (modified after Colpron and Nelson, 2006). Stevenson Ridge map area is indicated by box. **Laurentian elements:** NA = Ancestral North American margin; CA = Cassiar Terrane, North American continental margin displaced on Tintina Fault; AR = Alaska Range, parautochthonous North American continental margin; **Intermontane Superterrane:** SM = Slide Mountain Terrane; YT = Yukon-Tanana Terrane; ST = Stikinia; CC = Cache Creek Terrane; WM = Windy McKinley Terrane; m = undifferentiated metamorphic rocks; **Insular Superterrane:** WR = Wrangellia; AX = Alexander Terrane; CG = Chugach Terrane; YA = Yakutat block.

or geodynamic setting(s). The interpretation of the terrane's role in the evolution of the North American Cordillera and the assessment of its mineral potential have largely been derived from proposed correlations with rocks in Alaska, where the Windy and McKinley terranes were originally defined.

The purpose of this report is to present the results of reconnaissance mapping of Windy McKinley Terrane in the southwestern corner of Stevenson Ridge area (NTS 115JK; Figs. 1 and 2). Outcrops were examined and mapped in a reconnaissance fashion along the Alaska Highway, and three upland areas along the western and southwestern borders of the Wellesley Basin, an extensive gravel- and swamp-dominated lowland area between the White and Donjek rivers (Fig. 2). When considered in the light of previous work on the 'type' Windy and McKinley terranes of Alaska, the new observations reported herein result in the following conclusions:

1. The rocks mapped as Windy McKinley Terrane in Stevenson Ridge map area can be divided into three fault-bound subdivisions, none of which resembles either Windy or McKinley terranes as defined in Alaska.
2. Rocks of the southern-most subdivision resemble the pre-Late Devonian Snowcap assemblage of Yukon-Tanana Terrane.
3. The most extensive subdivision, underlying much of the unexposed Wellesley Basin and surrounding areas, is an imbricated, but stratally intact, ophiolite, unlike the stratally disrupted mafic and ultramafic rocks of the Windy or McKinley terranes. Its character is more reminiscent of the Chulitna Terrane of the southern Alaska Range.
4. The remainder of the terrane, exposed mainly in sporadic outcrops on either side of the Alaska Highway from Snag Junction to the Alaska border, closely resembles descriptions of the Pingston or Aurora Peak terranes, Late Paleozoic and Early Mesozoic calcareous and pelitic phyllite-dominated terranes voluminously intruded by Triassic gabbro.

These new terrane assignments require a change in the way in which these rocks may be viewed in terms of mineral potential and their role in the tectonic evolution of the North American Cordillera.

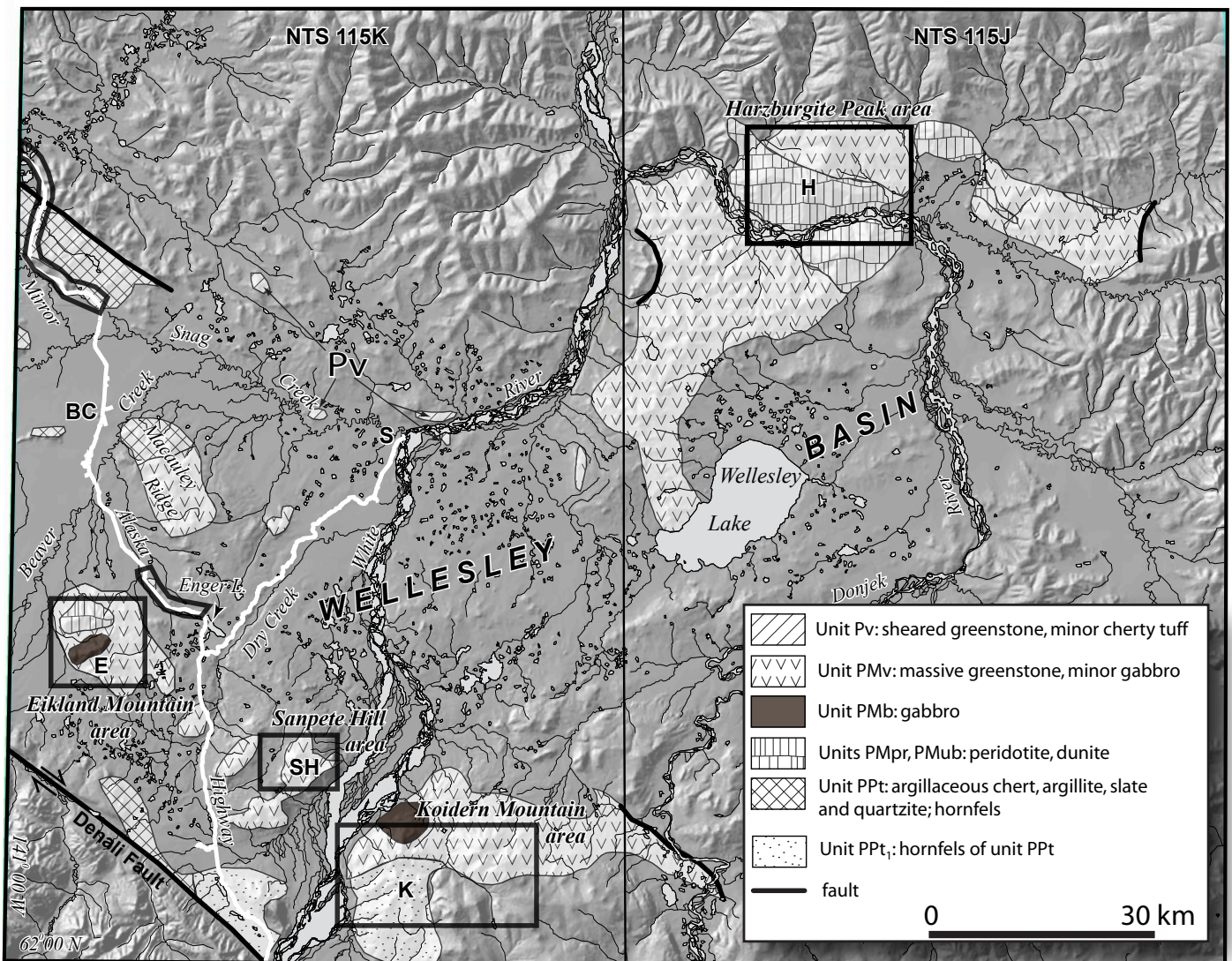


Figure 2. Southwestern Stevenson Ridge map area. Boxes indicate areas of reconnaissance mapping as well as areas examined in recent work by Mortensen and Israel (2006, areas along Alaska Highway), and Canil and Johnston (2003; Harzburgite Peak). Rock units outlined are from Tempelman-Kluit (1974). BC = Beaver Creek; S = Snag cabin site; E, SH, K, H = Summits of Eikland Mountain, Sanpete Hill, Koidern Mountain and Harzburgite Peak, respectively.

PREVIOUS WORK

Stevenson Ridge map area was first systematically mapped at 1:250 000 scale by Tempelman-Kluit (1974). The rocks that were later included in Windy McKinley Terrane comprise sheared greenstone, tuff and chert (unit Pv, *op. cit.*); peridotite (harzburgite and dunite, units PMpr and PMub, *op. cit.*); massive greenstone, also locally associated with chert (unit PMv, *op. cit.*); hornblende gabbro, spatially associated with massive greenstone and peridotite (unit PMb, *op. cit.*); and argillaceous chert and hornfels (unit PPT and PPT₁, *op. cit.*). Tempelman-Kluit

(1974) noted a similarity of these rocks with Cache Creek Group and on that basis, inferred a Late Paleozoic age. Petrographic descriptions of many of these rock units form the basis of a bachelor's thesis by Delich (1972).

The rocks of southwestern Stevenson Ridge map area that are northeast of the Denali Fault have been assigned various terrane names, starting with the original definitions of tectonostratigraphic terranes in the late 1970s based on work done primarily in Alaska. Coney *et al.* (1980) originally assigned them to the composite Pingston McKinley Terrane, an assignment that was later

superceded by Jones *et al.*'s (1984) application of the name 'Windy McKinley Terrane'. In spite of attempts to apply the name 'Windy Terrane' to these rocks (e.g., Nokleberg *et al.*, 1985, 1992, 1994), the Windy McKinley Terrane assignment has persisted into the most recent compilations and literature (Wheeler and McFeeley, 1991; Gordey and Makepeace, 2001; Canil and Johnston, 2003; Mortensen and Israel, 2006).

Nearly 30 years passed between Tempelman-Kluit's (1974) fieldwork and the start of the subsequent generation of bedrock geological research on Windy McKinley Terrane of Stevenson Ridge map area. Canil and Johnston (2003) described the rocks and relationships near Harzburgite Peak (Fig. 2); they interpreted the harzburgite body as a mantle tectonite massif, inferred that it was thrust to the north over sheeted dykes and gabbro, and concluded that all rock units were part of a large imbricated ophiolite complex. They further went on to correlate the rocks of Windy McKinley Terrane to the Seventy Mile – Slide Mountain Terrane. Mortensen and Israel (2006) investigated the western part of Windy McKinley Terrane exposed along the Alaska Highway and reported the preliminary results of U-Pb detrital-zircon and igneous isotopic dating studies. They describe the western part of the terrane as comprising mainly "...argillites interlayered with massive mafic flows and breccias (greenstones), all of which are intruded by large bodies of gabbro." (*op. cit.*); quartz-rich sandstone and limestone also occur in the argillite package. U-Pb isotopic analyses of baddeleyite and zircon from gabbro indicated a ca. 229 Ma (late Middle Triassic) crystallization age. U-Pb zircon analysis of detrital zircons yielded a spectrum of ages with peaks at 400-600 Ma, 900-1300 Ma, 1500-2000 Ma and 2500-2800 Ma. From these data, Mortensen and Israel (2006) inferred that Windy McKinley Terrane is a thrust flap of Wrangellia or Alexander Terrane on top of Yukon-Tanana Terrane.

THIS STUDY

Approximately three weeks were spent in Stevenson Ridge map area during the 2006 field season. During this time, outcrops of Windy McKinley Terrane rocks along the Alaska Highway were examined, as well as rocks in the following upland areas, Koidern Mountain, Sanpete Hill and Eikland Mountain (Fig. 2).

UNIT PPt, ALASKA HIGHWAY

Unit PPt is exposed in two areas along the Alaska Highway. A few outcrops occur in a 4-km-long stretch northwest of Enger Lakes, but the most extensive outcrops occur in the 10-km-long stretch north of where the highway crosses Mirror Creek (Fig. 2). In both areas, unit PPt is composed primarily of folded and foliated, medium to dark grey phyllitic argillite with variable amounts of interbedded tan-brown, variably calcareous quartz siltstone (Fig. 3a), sandstone and pebbly sandstone (Fig. 3b). North of Mirror Creek, tightly folded and strongly foliated dark-grey calcareous phyllite and argillaceous limestone predominate (Fig. 3c). Extensive bodies of dark, brown-green gabbro (Fig. 3d) are ubiquitous in these outcrops, intruding and imparting a hornfels texture on the host argillaceous rocks. Cherty, cream-coloured, green and pink calcsilicate rock and spotted porphyroblastic meta-pelite occur near intrusive contacts (Fig. 3e). Gabbro is fractured, veined and locally foliated; it is not possible to tell whether it is post-kinematic with respect to the host rocks.

KOIDERN MOUNTAIN AREA

The summit ridges of Koidern Mountain and an adjacent upland to the east afford the best opportunity to examine units PPt₁, PMv and PMb of Tempelman-Kluit (1974) and evaluate the relationships between them (Fig. 4). It also provides the best opportunity to evaluate Tempelman-Kluit's (1974) inference that unit PPt₁ is the hornfelsed equivalent of unit PPt. The units occur in a north-dipping structural succession which has been intruded by the Nisling Range Batholith, a body of mid-Cretaceous granodiorite. All units are offset by a previously unrecognized northwest-striking, post-mid-Cretaceous, dextral strike-slip fault with a horizontal offset of >4 km.

Unit PPt₁ underlies the southern part of the area, dipping to the north beneath the other rock units included in Windy McKinley Terrane. It comprises primarily slabby, psammitic biotite-muscovite-quartz schist (mineral modifiers in order of increasing amounts), intercalated with lesser biotite schist and biotite-muscovite metapelitic schist (Fig. 5a). Amphibolitic calc-silicate schist, marble (Fig. 5b), dark grey, somewhat carbonaceous schist and quartzite are minor constituents. The summit of Koidern Mountain is underlain by quartzofeldspathic schist inferred to be a granitic metaplutonic rock (Fig. 5c).

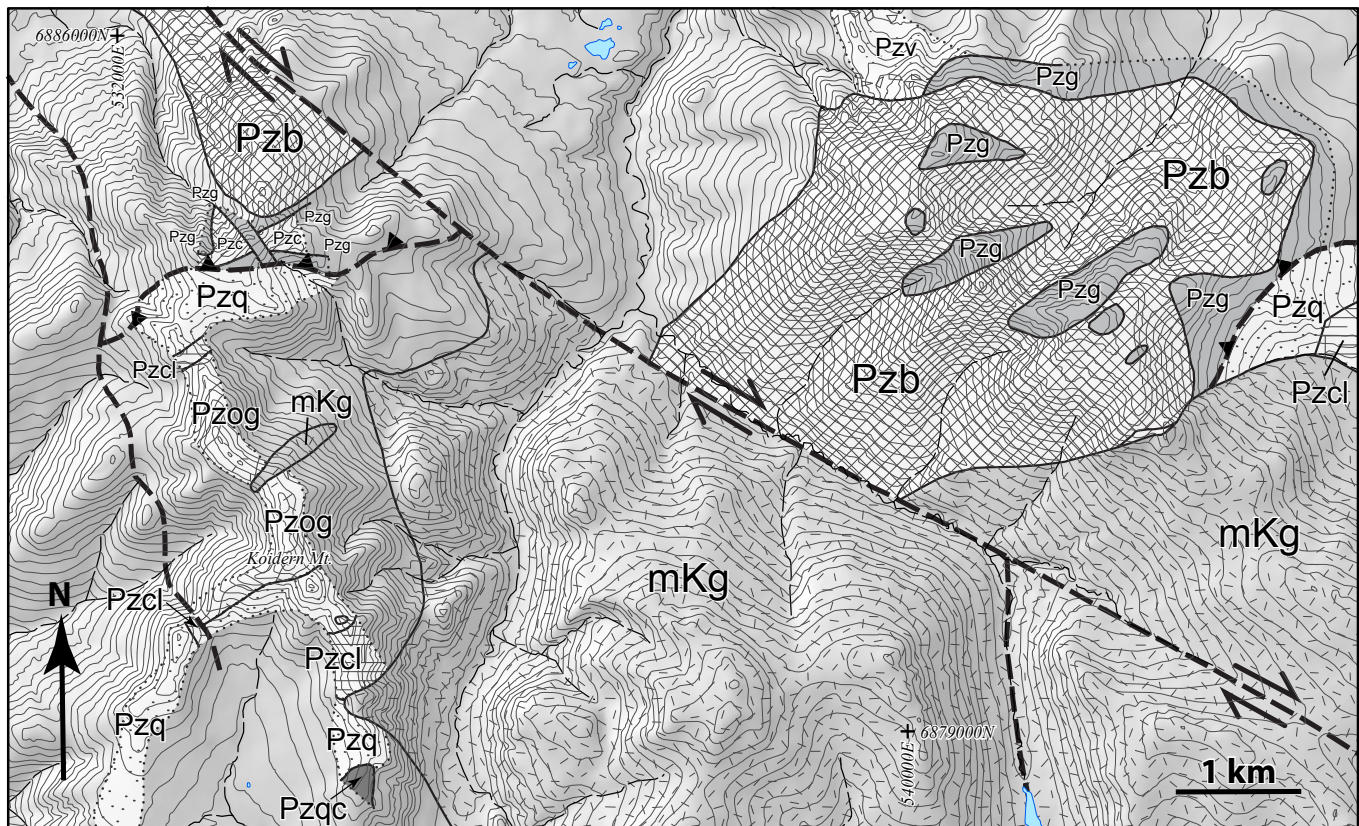


Figure 3. Rock types included in Tempelman-Kluit's (1974) unit PPt (argillaceous chert): **(a)** phyllitic argillite and sandstone (Station 06DM010); **(b)** pebbly calcareous quartz sandstone (Station 06DM006); **(c)** calcareous phyllite (Station 06DM031); **(d)** gabbro (Station 06DM001); **(e)** spotted hornfels within a few metres of contact with massive gabbro. Protolith was probably argillite; calc-silicate hornfels locally developed.

In contrast to the strongly recrystallized, primarily quartz-rich metasedimentary rocks of unit PPT₁, unit PMv comprises massive, greenschist-grade greenstone, chert and dark argillite. Greenstone is dark green, massive and fine grained (Fig. 6a); it is generally well fractured and cut by pale green epidote-quartz veins. Bodies of greenstone are generally concordant with respect to bedding in the strongly foliated chert, although one example of a cross-cutting body was noted. The discordant body had a slightly coarser grained diabasic texture and is clearly intrusive. With rare exception (Fig. 6b), volcanic features and textures are lacking in the other bodies, suggesting that these may be sills rather than flows. Chert is thin- to medium-bedded (ribbon-bedded to 40 cm) and is

observed in many colours of matte grey, tan, green and pink (Figs. 6c, d). In the northern part of the upland area east of Koidern Mountain, unit PMv also includes tightly folded, dark green, mafic greywacke (Fig. 6e), intercalated with dark green argillite and pale green, cherty, fine-grained tuff (Fig. 6f); these rock types were not included in Tempelman-Kluit's (1974) original description.

Unit PMb in this area consists of two portions of a gabbro stock that are several square kilometres in size and that are offset along a post-mid-Cretaceous strike-slip fault. The stock is composed of generally massive and fractured, but locally foliated, medium- to coarse-grained gabbro and leucogabbro (Fig. 6g). Mafic minerals are blocky and appear to have been converted to chlorite and/or



LEGEND

mKg biotite-hornblende granodiorite

contact, approximate

faults

strike-slip thrust unknown

Unit PPT₁ of Tempelman-Kluit (1974)

Pzog foliated granitic metaplutonic rock

Pzcl calc-silicate schist and marble

Pzq biotite-muscovite-quartz psammitic schist

Pzqc medium-grey, carbonaceous phyllite and quartzite

Units PMv, PMb of Tempelman-Kluit (1974)

Pzb leucogabbro and gabbro

Pzvc mafic greywacke, green argillite and cherty tuff

Pzg massive greenstone

Pzc ribbon- to medium-bedded chert

Figure 4. Reconnaissance geology of Koidern Mountain area (UTM zone 7).

actinolite. Preliminary thin-section work suggests that the original mafic mineralogy may have been pyroxene rather than hornblende as reported by Tempelman-Kluit (1974). The occurrence of gabbro dykes cutting massive greenstone and numerous blocks and rafts of greenstone in the gabbro stock indicate that gabbro intrudes and post-dates unit PMv. However, greenstone dykes locally intrude gabbro (Fig. 6a), suggesting that they are broadly coeval.

The contrasts in composition, degree of metamorphic recrystallization and metamorphic grade between unit PPT₁ and units PMv and PMb imply different and likely unrelated geological histories. A faulted contact is inferred to separate these units. The contact is not exposed, but can be constrained to within 20 m. A zone of foliated and lineated feldspathic greenstone (metadiabase or metagabbro; Fig. 7) is immediately above the contact. The north-dipping foliation is defined by the parallel orientation of chlorite and the long axes of elongate feldspars, and also by a weak, discontinuous

compositional layering or lenticularity. A second foliation occurs within the foliation-parallel compositional lenses; this internal foliation is locally sigmoidal, deflecting to the boundaries of the lenses, and locally, asymmetrically folded. The north-trending and north-plunging lineation is defined by chlorite smears and the long axes of sub-parallel feldspar porphyroclasts. When combined with the orientation of the lineation, the sense of inclination of the two foliations in the shear zone and the vergence of asymmetrical folding of the internal foliation suggests that the fault separating unit PPT₁ and units PMv and PMb is a south-directed thrust fault.

SANPETE HILL

Sanpete Hill is underlain exclusively by monotonous massive greenstone of unit PMv, except in the lower slopes overlooking the White River which are underlain by granodiorite. Three textural variants of greenstone were observed: massive, fine-grained greenstone (most



Figure 5. Schists of Tempelman-Kluit's (1974) unit PPT₁ in the southern part of Koidern Mountain area: **(a)** psammitic biotite-muscovite-quartz schist (Station 06DM062); **(b)** isolated outcrop of marble (view to southeast from Station 06DM141); **(c)** band of medium-grained, quartzofeldspathic rock intercalated with quartz-rich metasedimentary schist near margin of granitic metaplutonic rock (Station 06DM062). Quartzofeldspathic band is inferred to be a transposed dyke.





Figure 6. Rock types in Tempelman-Kluit's (1974) units PMv (massive greenstone), PMb (gabbro), Koidern Mountain area. **(a)** Massive, fine-grained greenstone dyke intruding gabbro; **(b)** Bomb-like feature in generally massive greenstone (Station 06DM114). This is the only feature reminiscent of a volcanic origin for massive greenstone of unit PMv. **(c)** Medium-bedded, grey chert (Station 06DM073); **(d)** Section through unit PMv: massive greenstone and chert at top, chert and argillite below (Station 06DM074); **(e)** Mafic greywacke and argillite (Station 06DM122); **(f)** Folded cherty tuff (Station 06DM124); **(g)** Leucogabbro (Station 06DM077). Width of photo is about 1 m.



Figure 7. Foliated and lineated greenstone above contact with underlying schists of unit PPT₁ (Station 06DM081). Foliation dips to the north and is locally folded (one hinge visible in shadowed area to left of hammer head).

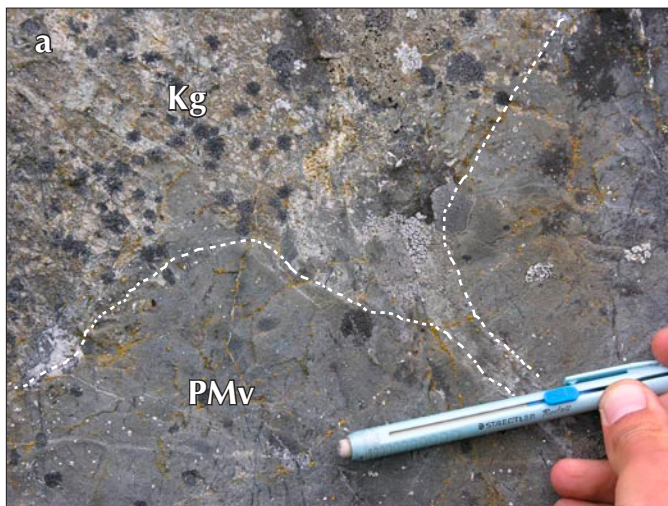


Figure 8. Textural variation in greenstones of Tempelman-Kluit's (1974) unit PMv, Sanpete Hill:

(a) massive greenstone (PMv) intruded by granite (Kg) (Station 06DM097); (b) feldspar-porphyritic greenstone with fine-grained groundmass (Station 06DM098); (c) feldspar-porphyritic greenstone with medium-grained diabasic groundmass (Station 06DM100).

common, Fig. 8a); massive, feldspar-porphyritic, fine-grained greenstone (less common, Fig. 8b); and massive, feldspar-porphyritic diabase (rare, Fig. 8c). All textural variants are unfoliated, despite the presence of fractures and veins. These rocks are interpreted as a sheeted dyke complex since volcanic textures were not observed.

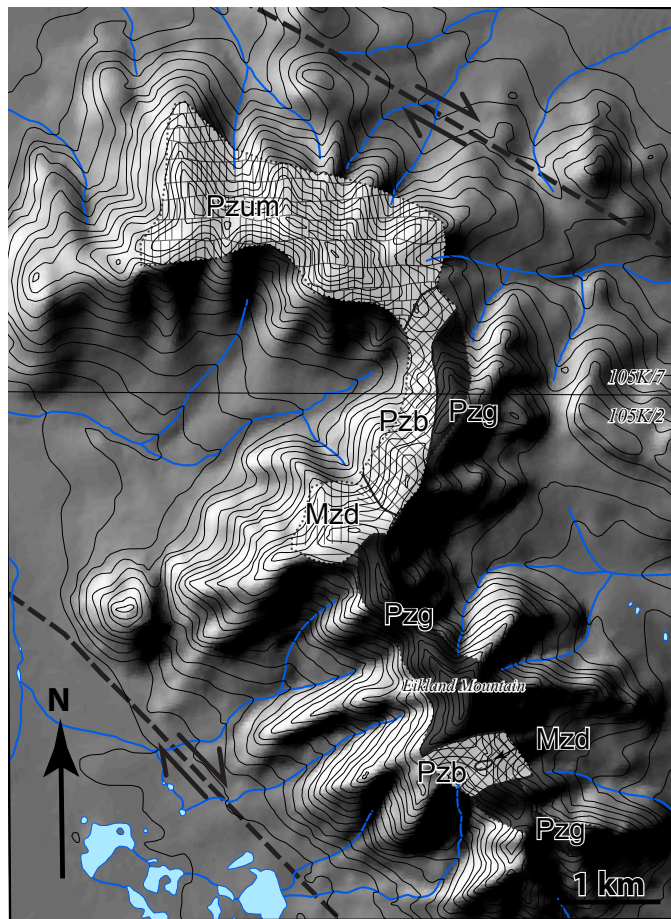
EIKLAND MOUNTAIN

According to Tempelman-Kluit (1974), the Eikland Mountain massif is underlain primarily by massive greenstone of unit PMv spatially associated with bodies of gabbro and partly serpentinized dunite and harzburgite. Traverses along the ridge crest of the massif indicate that these rocks occur in a southeastwardly dipping panel with massive greenstone and small bodies of gabbro in the south. Further to the north, these rocks are successively underlain by massive gabbro, foliated and lineated gabbro, and finally by layered, foliated and lineated, variably serpentinized harzburgite and dunite (Figs. 9, 10). The



contact between gabbro and greenstone is cut by an unfoliated body of leucogabbro or diorite (unit PMb of Tempelman-Kluit, 1974). This leucogabbro or diorite has a fresh appearance and different composition and texture, suggesting that it is younger than, and unrelated to, the host rocks.

Tempelman-Kluit (1974) mapped unit PMv in the area southeast of Eikland Mountain and extending to the Alaska Highway. In a small hilltop west of the highway and north of Dry Creek, unit PMv comprises unfoliated, polymictic, pebble to cobble conglomerate (Fig. 11).



Legend






	quartz diorite or gabbro	
	massive greenstone	
	gabbro and leucogabbro	
	variably serpentinized harzburgite and dunite	

Figure 9. Reconnaissance geology of Eikland Mountain.

Conglomerate clasts include various intermediate volcanic rock types, quartzite and amphibolite. The relationship of this rock unit to more typical greenstone of unit PMv is not known.

DISCUSSION

With these new observations, and those of Mortensen and Israel (2006) and Canil and Johnston (2003), some first-order questions about Windy McKinley Terrane in Yukon can start to be addressed. First of all, should all of



Figure 10. Harzburgite of Tempelman-Kluit's (1974) unit PMpr (Station 06DM159).



Figure 11. Polymictic conglomerate observed north of Dry Creek in the area of Tempelman-Kluit's (1974) unit PMv.

the rocks currently mapped as Windy McKinley Terrane be included in the terrane? Secondly, what are the relationships between the rock assemblages that are included in the terrane? Thirdly, what is the relationship between the rocks included in Windy McKinley Terrane and surrounding rocks of Yukon-Tanana Terrane? Fourthly, how do rocks in Yukon assigned to Windy McKinley Terrane compare with the Alaskan type localities of these terranes, that is, is the cross-border correlation with these terranes valid? Finally, what are the implications of any new insights into the nature and evolution of Windy McKinley Terrane for the mineral potential of Stevenson Ridge area?

From this study, it is not clear that all rocks of Stevenson Ridge map area mapped as Windy McKinley Terrane should be included in the terrane. Rocks currently included in Windy McKinley Terrane can be divided into three assemblages: 1) an assemblage of fine-grained and variably calcareous metaclastic rocks intruded by Middle Triassic gabbro (Mortensen and Israel, 2006; unit PPT of Tempelman-Kluit, 1974); 2) quartz-rich and locally calcareous metasedimentary and granitic metaplutonic schists such as those that underlie the southern part of the Koidern Mountain area and that have been inferred to be the hornfelsed equivalent of the rocks along the Alaska Highway (unit PPT₁ of Tempelman-Kluit, 1974); and 3) an ophiolitic assemblage (following Canil and Johnston, 2003) of massive greenstone, chert, gabbro and variably serpentized dunite and harzburgite as observed at Eikland Mountain, Sanpete Hill, and the northern part of Koidern Mountain area (units PMv, PMb, PMpr and PMub of Tempelman-Kluit, 1974). Subdivision 1 and 2 are sufficiently dissimilar as to cast doubt on Tempelman-Kluit's (1974) inference that one is the hornfelsed equivalent of the other. Several observations illustrate the differences between these units. For example, carbonaceous argillite is nearly ubiquitous in exposures of unit PPT and only a minor constituent of unit PPT₁; slabby psammitic schist (metasandstone) is the most common rock type in unit PPT₁, yet sandstone is only a minor constituent of outcrops of unit PPT; granitic metaplutonic rock is an important constituent of unit PPT₁, yet absent in outcrops of unit PPT; and finally, gabbro, which locally makes up more than 50% of the outcrops of unit PPT, was not observed in unit PPT₁ outcrops. Unit PPT₁ most strongly resembles rocks of Yukon-Tanana Terrane, in particular, the Snowcap assemblage, the oldest and generally structurally deepest assemblage of the terrane (*cf.* Colpron and Nelson, 2006). Consequently, unit PPT₁ is herein removed from Windy McKinley Terrane.

The nature of the relationship between the remaining two assemblages in Windy McKinley Terrane is not yet known. Gabbro is the only rock type in common between them, but it differs in grain size and texture. Contacts between the two assemblages have not been observed, but appear to coincide with pronounced northwest-trending topographic lineaments along which aeromagnetic trends are offset or truncated (Fig. 12). One of these lineaments coincides with the extension of the post-mid-Cretaceous strike-slip fault documented in the Koidern Mountain area, suggesting that these lineaments mark dextral strike-slip faults. Owing to the large number of northwest-trending topographic lineaments in the area, dextral strike-slip faults may be more important than previously recognized. Aeromagnetic trends are also truncated by northeast-trending, topographic lineaments, indicating the presence of a second previously unrecognized set of faults in the area.

The nature of the contacts between the assemblages of Windy McKinley Terrane and the rocks of the surrounding Yukon-Tanana Terrane is known only locally. In the Koidern Mountain area, units of the ophiolitic assemblage (units PMv and PMb) structurally overlie rocks herein correlated with Yukon-Tanana Terrane along a south-directed, pre-mid-Cretaceous thrust fault. Near where the Alaska Highway crosses the Alaska-Yukon border, unit PPT is juxtaposed against rocks of Yukon-Tanana Terrane to the north along a topographic and geophysical lineament, implying that the contact at this location could be a strike-slip fault. This inference is supported by the steep orientation of foliations in rocks on both sides of this contact.

The new information about these assemblages, in this and recent studies, provides the basis for a test of the assignment of these rocks to the composite Windy McKinley Terrane, which was made more than 20 years ago, on the basis of the reconnaissance mapping available at that time. Windy Terrane was originally defined on the basis of outcrop exposures in the southern part of Denali National Park, Alaska. It was originally described as a stratally disrupted assemblage with a characteristic feature being "...large blocks of limestone, mainly of Devonian age, floating in a matrix of sandstone, conglomerate and limy argillite that contains late Mesozoic fossils" (Jones *et al.*, 1982 and references therein). Other large blocks include "...altered basalt, serpentinite, green and maroon argillite (tuff), and recrystallized chert (possibly an ophiolitic assemblage)..." which are "...structurally associated with black siltstone and argillite that contain

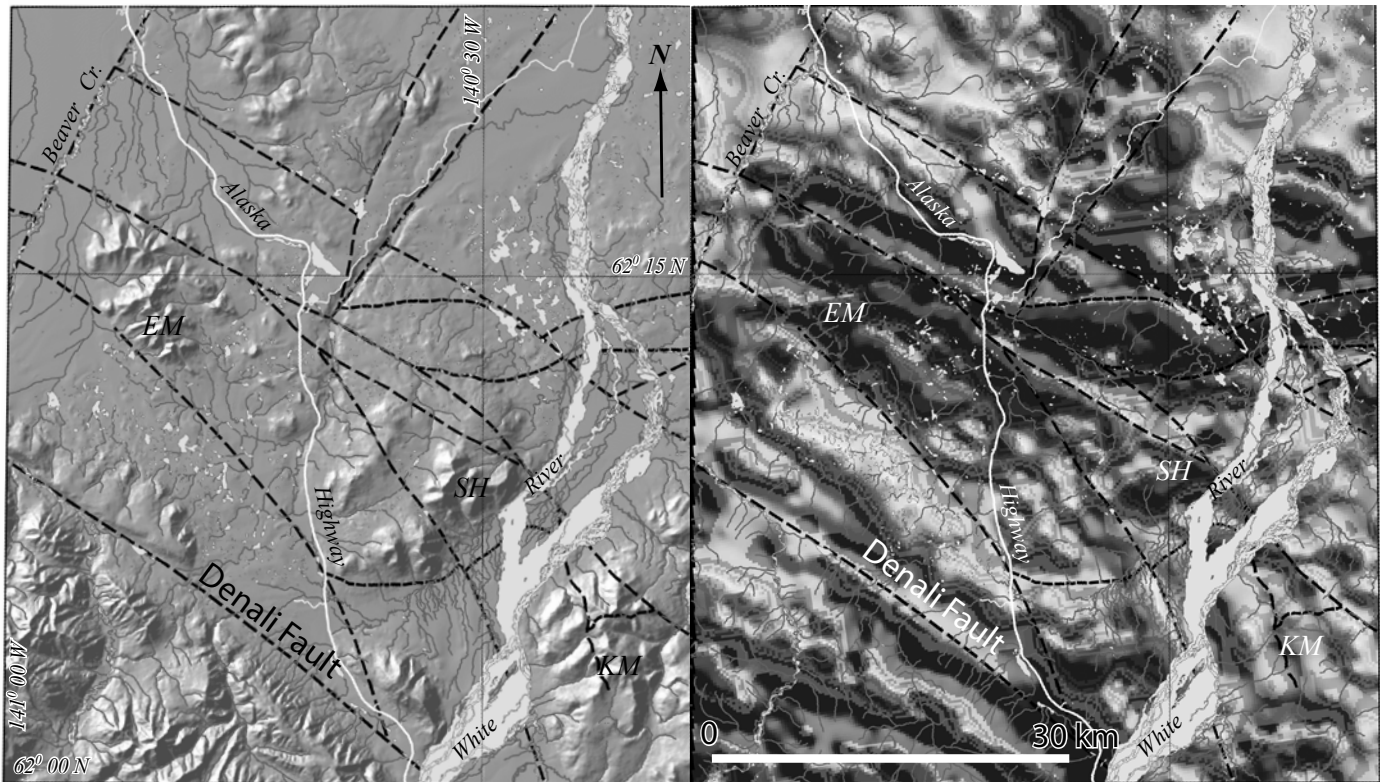


Figure 12. Digital elevation model with hill-shading and first vertical derivative aeromagnetic map of southwestern Stevenson Ridge map area with traces of dextral strike-slip and normal faults inferred from these data. EM = Eikland Mountain; SH = Sanpete Hill; KM = Koidern Mountain.

fossils, including a trilobite, of probable Silurian age" (*op. cit.*). Well rounded conglomerate clasts are dominantly greywacke and chert, the latter of which has yielded Mississippian, Triassic, Jurassic and Early Cretaceous radiolarian (*op. cit.*). McKinley Terrane was originally defined on the basis of outcrops in the eastern part of Denali National Park (Jones *et al.*, 1982 and references therein). It comprises three stratigraphic units. The lowest unit is composed of "...highly folded, fine-grained flyschlike rocks with abundant trace fossils and sporadic thin layers of displaced fossiliferous detritus, mainly bryozoans and rare brachiopods (*sic*) of late Paleozoic (Permian?) age" (*op. cit.*); the top of this unit also includes radiolarian chert and argillite containing Triassic fossils and enclosing slump blocks of Devonian limestone. The middle unit is several thousand metres thick and consists of pillow basalt with associated dykes and sills of gabbro and sporadic sedimentary interbeds containing Late Triassic monotid bivalves; the dykes and sills also cut the underlying sedimentary rocks. The uppermost unit consists of "...poorly fossiliferous, flyschlike assemblage of greywacke, argillite, minor

conglomerate and radiolarian chert that is of late Mesozoic (mainly Cretaceous) age" (*op. cit.*). With these descriptions in mind, it seems clear that the rocks in Stevenson Ridge map area that have been assigned to Windy McKinley Terrane bear little resemblance to the type Windy Terrane and only some similarity to the type McKinley Terrane. The extensive areas of relatively intact, although imbricated (Canil and Johnston, 2003), ophiolitic rocks in Stevenson Ridge map area are unlike the kilometre-scale blocks of disrupted ophiolitic rocks in the type Windy Terrane. Mélange-like stratal disruption, blocks of limestone, and thick pillow basalt sequences are not characteristics of either of the Stevenson Ridge assemblages. The variably calcareous and argillaceous siliciclastic rock assemblage of Stevenson Ridge area is lithologically similar only to the older part of the McKinley Terrane and is likewise intruded by voluminous amounts of Triassic, albeit Middle Triassic, gabbro (Mortensen and Israel, 2006). If this assemblage is indeed McKinley Terrane, the remaining parts of the terrane are notably absent in Stevenson Ridge map area.

Although unlike Windy Terrane and only partly resembling McKinley Terrane, the two assemblages in Stevenson Ridge map area are lithologically similar to other terranes in the Alaska Range. The Pingston Terrane, with which the Stevenson Ridge rocks were originally affiliated (Coney *et al.*, 1980), comprises an older, Pennsylvanian to Permian unit of tan-weathering phyllite, minor radiolarian chert, and very rare lenses of crinoidal marble, all of which are intruded by abundant gabbro and diorite. The younger unit is Late Triassic in age and consists of laminated, silty limestone, black sooty argillite and minor quartzite, also intruded by gabbro (Jones *et al.*, 1982). The Aurora Peak Terrane (Nokleberg *et al.*, 1985), which may correlate with the Pingston Terrane (*op. cit.*; Wilson *et al.*, 1998), consists of a relatively older unit of calc-schist, marble, quartzite and pelitic schist, and a relatively younger unit of metaplutonic rocks including metagabbro. Relatively intact ophiolitic rocks (basal serpentinite, gabbro, pillow basalt and chert) associated with intermediate to mafic volcanoclastic rocks make up the lower part of the Chulitna Terrane, a relatively narrow and lithologically and paleontologically distinctive terrane in the southern Alaska Range (Jones *et al.*, 1982). These terranes may appear to be a better match for the Stevenson Ridge rocks, but more information is needed before any terrane re-assignments would be credible. If these new correlations are indeed valid, they have implications for the magnitude of displacement of the Denali Fault (including the Hines Creek strand), implications that are beyond the scope of this paper.

The new appreciation of the nature of the rocks in southwestern Stevenson Ridge map area, derived from this and recent work by Canil and Johnston (2003) and Mortensen and Israel (2006), has implications for mineral exploration in the area. If, as inferred by Mortensen and Israel (2006), the McKinley- or Pingston-like assemblage of variably calcareous and argillaceous clastic rocks and gabbro is reminiscent of Wrangellia or Alexander Terrane, then gabbro in this assemblage could be a potential target for Cu-Ni-PGE magmatic sulphide deposits. If present, any volcanic rocks coeval with the voluminous gabbro bodies could potentially host volcanic-associated massive sulphide deposits. Ophiolitic terranes, such as the Chulitna-Terrane-like assemblage in Stevenson Ridge area, are known to host podiform chromite in their upper mantle-lower crustal sections, and Cyprus-style volcanic-associated massive sulphide deposits in their upper crustal sections. Finally, the re-assignment of Tempelman-Kluit's (1974) unit PPT₁ to Yukon-Tanana Terrane increases the local extent of this terrane. As Yukon-Tanana Terrane

locally hosts a diversity of massive sulphide deposits (e.g. the Finlayson Lake district, southeastern Yukon (Murphy *et al.*, 2006 and references therein)), this new area of Yukon-Tanana Terrane may also hold promise for these types of deposits.

SUMMARY

Rocks in southwestern Stevenson Ridge map area that have been correlated with Windy McKinley Terrane in Alaska were re-examined in 2006. These rocks have been subdivided into three assemblages, one of which probably belongs to Yukon-Tanana Terrane; one that may correlate with part of McKinley Terrane, but also resembles other terranes in Alaska such as the Pingston or Aurora Peak terranes; and an ophiolitic assemblage that may correlate with the Chulitna Terrane of the southern Alaska Range. Assessments of the region's mineral potential need to be revised in light of these new correlations.

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