Preliminary investigation of the bedrock geology of the Livingstone Creek area (NTS 105E/8), south-central Yukon

***Maurice Colpron*[1]**
Yukon Geological Survey

Colpron, M., 2005. Preliminary investigation of the bedrock geology of the Livingstone Creek area (NTS 105E/8), south-central Yukon. *In:* Yukon Exploration and Geology 2004, D.S. Emond, L.L. Lewis and G.D. Bradshaw (eds.), Yukon Geological Survey, p. 95-107.

ABSTRACT

The Livingstone Creek area is underlain by metasedimentary and metaigneous rocks of Yukon-Tanana Terrane. It is intruded by at least five distinct suites of intrusive rocks of probable Mississippian to Late Cretaceous ages, at least three of which provide timing constraints on the development of tectonic foliations. Two phases of isoclinal folding, the development of a transposition foliation and late, northeast-vergent open folds characterize the ductile deformation in the area. Brittle-ductile dextral strike-slip deformation is localized along the north-trending d'Abbadie fault zone in the eastern part of the area. Bedrock in the area has potential for lode gold, copper-gold massive sulphide and nickel (platinum-group element?) mineralization along d'Abbadie Fault.

RÉSUMÉ

La région du ruisseau Livingstone est occuppée par les roches métasédimentaires et métaignées du terrane de Yukon-Tanana. Elles sont recoupées par au moins cinq suites de roches intrusives distinctes, dont les ages probables varient du Mississippien au Crétacé tardif, et dont trois d'entre elles permettent de dater la formation de foliations tectoniques. Deux phases de plissement isoclinaux, le développement d'une foliation de transposition et des plis ouverts tradifs de vergence nord-est caractérisent la déformation ductile dans la région. Une déformation de type décrochement dextre cassant-ductile est localisée le long de la zone de faille d'Abbadie, dans le secteur oriental de la région. Les roches de cette région sont propices à une minéralisation d'or en filon, de sulfures de cuivre-or massifs, et de nickel (platine?) le long de la faille d'Abbadie.

---

[1] *maurice.colpron@gov.yk.ca*

INTRODUCTION

The Livingstone Creek area, 80 km northeast of Whitehorse (Fig. 1), is a placer camp which has seen intermittent mining operations since the 1898 discovery of gold in the area (Bostock and Lees, 1938; Levson, 1992), but for which a lode source remains elusive. Published bedrock geology maps of the area are limited to reconnaissance-scale (1:250 000) studies of Bostock and Lees (1938) and Tempelman-Kluit (1984). Subsequent studies of the Livingstone Creek and surrounding areas provided more detailed descriptions of the bedrock geology. They primarily focused on the structural evolution of the region (e.g., Hansen, 1989; Harvey et al., 1996, 1997; Gallagher et al., 1998; de Keijzer et al., 1999; Gallagher, 1999; de Keijzer, 2000).

The Livingstone Creek area is underlain primarily by metasedimentary and metaigneous rocks of Yukon-Tanana Terrane (YTT; Figs. 1 and 2). Metasedimentary rocks in the east and northeast part of the area are traditionally assigned to Cassiar Terrane. For reasons outlined in this paper, I entertain the hypothesis that these rocks may also be part of YTT. To the west, YTT is juxtaposed against Late Paleozoic rocks of the Semenof Block along the Big Salmon Fault (Simard, 2003). The eastern part of the Livingstone Creek area is dissected by the north-striking d'Abbadie fault zone (Fig. 2).

In this region, YTT is traditionally considered to be only ~10-15 km wide. This narrow part of the terrane corresponds to the Teslin Suture Zone of Tempelman-Kluit (1979), a zone of highly strained rocks which were orginally interpreted to have developed in a subduction zone setting during Early Mesozoic convergence of Stikinia and North America (e.g., Tempelman-Kluit, 1979; Hansen, 1989, 1992). Subsequent studies of this portion of YTT have shown that ductile deformation features in the Teslin zone are the result of development of an early (late Paleozoic?) transposition foliation superposed by younger (early Mesozoic?) northeast-verging folds (e.g., de Keijzer et al., 1999; Gallagher, 1999). Regional studies of YTT have shown that the terrane is composed of a series of mid- to late-Paleozoic arc and back-arc successions built upon a metasedimentary basement of continental margin affinity (Colpron and Yukon-Tanana Working Group, 2001; Colpron, 2003). Detailed structural

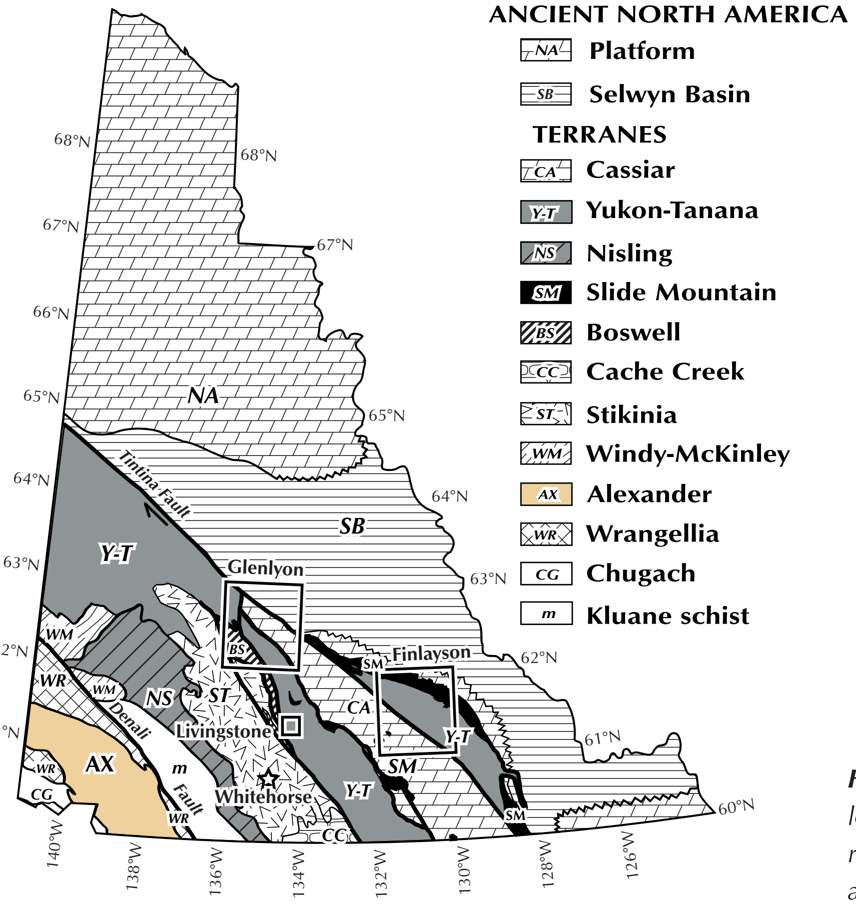

Figure 1. Terrane map of Yukon showing the location of the Livingstone Creek area with respect to the Glenlyon and Finlayson Lake areas (modified after Wheeler et al., 1991).

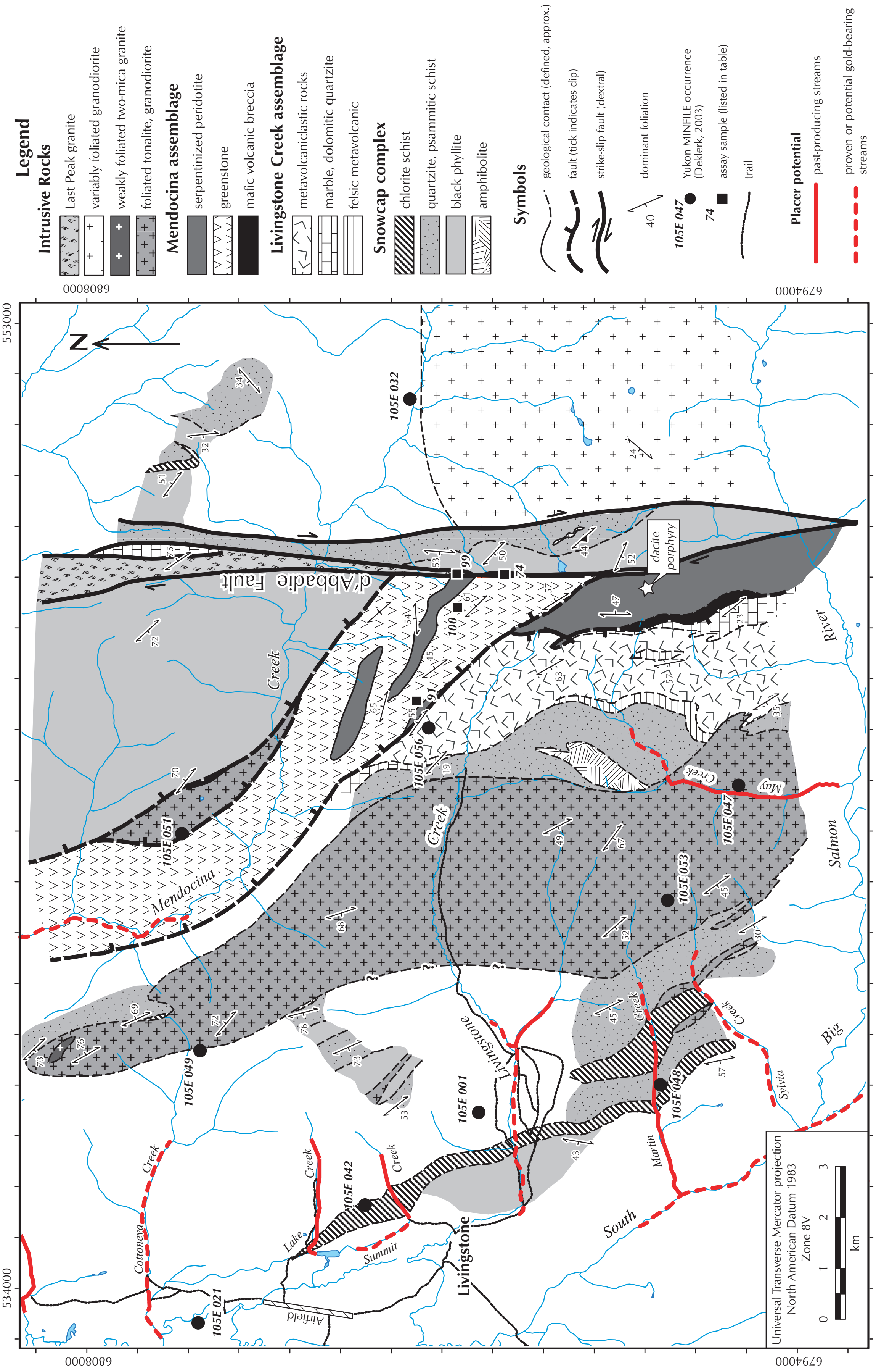

Figure 2. Preliminary bedrock geology map of the Livingstone Creek area. Placer potential from Lipovsky et al. (2001).

and geochronological studies of the Livingstone Creek area, and the adjacent Dycer Creek area to the north, were most recently conducted by Harvey et al. (1996, 1997) and Gallagher (1999).

Bedrock mapping of the Livingstone Creek area at 1:50 000-scale by the Yukon Geological Survey was initiated in 2004 to establish the stratigraphic framework of Yukon-Tanana Terrane (YTT) in the area, and to place the Livingstone Creek area within the context of recent studies of YTT in the Finlayson Lake and Glenlyon areas of Yukon (e.g., Colpron and Yukon-Tanana Working Group, 2001; Colpron, 2003, Fig. 1). This study will provide the basis for compiling unpublished maps produced as part of the graduate theses of Gallagher (1999) and de Keijzer (2000), and unpublished preliminary observations made by J.L. Harvey in 1995-1996. This report summarizes preliminary observations of the bedrock geology of the Livingstone Creek area and some hypotheses to be tested with future field and geochronological studies.

LAYERED ROCKS

Three distinct successions of metasedimentary and metavolcanic rocks are recognized in YTT of the Livingstone Creek area (Fig. 2). They are, from west to east, the Snowcap complex, the Livingstone Creek assemblage and the Mendocina assemblage. Metasedimentary rocks northeast of Mendocina Creek, and those that occur in strands within and to the east of d'Abbadie fault zone, were previously assigned to Cassiar Terrane by Tempelman-Kluit (1979), Wheeler et al. (1991) and Gordey and Makepeace (2000). However, they are lithologically similar to rocks of the Snowcap complex to the west and are therefore described with this succession. Their terrane affinity is briefly discussed below.

SNOWCAP COMPLEX

Quartzite, psammitic schist, carbonaceous phyllite and chlorite schist exposed on alpine ridges along Livingstone Creek resemble the Snowcap complex of Glenlyon map area (Colpron et al., 2002, 2003) and are thus tentatively correlated with it. These rocks are divided into two belts by a sheet of tonalite orthogneiss which dips moderately to the southwest (Fig. 2). To the west, and structurally above the orthogneiss, the few exposures of Snowcap complex visited in 2004 consist of intercalated platy quartzite and quartz-muscovite-biotite schist (Fig. 3a). The schist and quartzite are locally graphitic and typically strongly foliated. The quartzite is locally fractured and injected with quartz veins on the ridge above Summit and Lake creeks. Calcareous chloritic schist is present in ridge exposures between Livingstone and Sylvia creeks. The rock is light to medium green in colour and variably siliceous, suggesting a metasedimentary protolith for this unit. Between Martin and Sylvia creeks, the chlorite schist is associated with <10-cm-thick buff-weathering siliceous marble layers. A single marble layer, ~3 m thick, occurs at the contact between Snowcap quartzite and the tonalite orthogneiss body north of Livingstone Creek.

To the east of, and structurally below the tonalite orthogneiss sheet, the Snowcap complex is only poorly exposed and consists predominantly of psammitic schist, quartzite and amphibolite. The schist is light grey to light green in colour, fine- to medium-grained and composed primarily of muscovite, plagioclase, quartz and minor chlorite. Quartzite exposures are restricted to the immediate vicinity of the tonalite orthogneiss body. It is light grey to white in colour and strongly foliated. North of Livingstone Creek, the quartzite contains biotite porphyroblasts. East of May Creek, garnet porphyroblasts in the quartzite are partially pseudomorphed by chlorite. Dark green to black, fine-grained garnet amphibolite is restricted to a few exposures on the ridge between Livingstone and May creeks (Fig. 2).

A similar succession of graphitic phyllite, quartzite and minor chlorite schist and marble also occurs northeast of Mendocina Creek, within the eastern slice of the d'Abbadie fault zone and along one alpine ridge east of the fault (Fig. 2). Although only a cursory examination of these rocks was conducted in 2004, there is no apparent reason to separate them from those of the Snowcap complex to the west. Harvey et al. (1997) and de Keijzer (2000) reached similar conclusions but considered these rocks as part of Cassiar Terrane following Tempelman-Kluit (1977, 1979, 1984). It is proposed here that these metasedimentary rocks may be part of YTT because they were intruded by Mississippian granitoid plutons to the north of the Livingstone Creek area (Hansen et al., 1989; Gallagher, 1999; de Keijzer, 2000; S.D. Carr, pers. comm., 2000). Tonalite to granodiorite plutons of Mississippian age are characteristic of the metasedimentary basement of YTT (Snowcap complex, Colpron, 2003; Colpron et al., 2003), but not of the miogeoclinal rocks of Cassiar Terrane which only contain rare alkalic plutons of Devonian age.

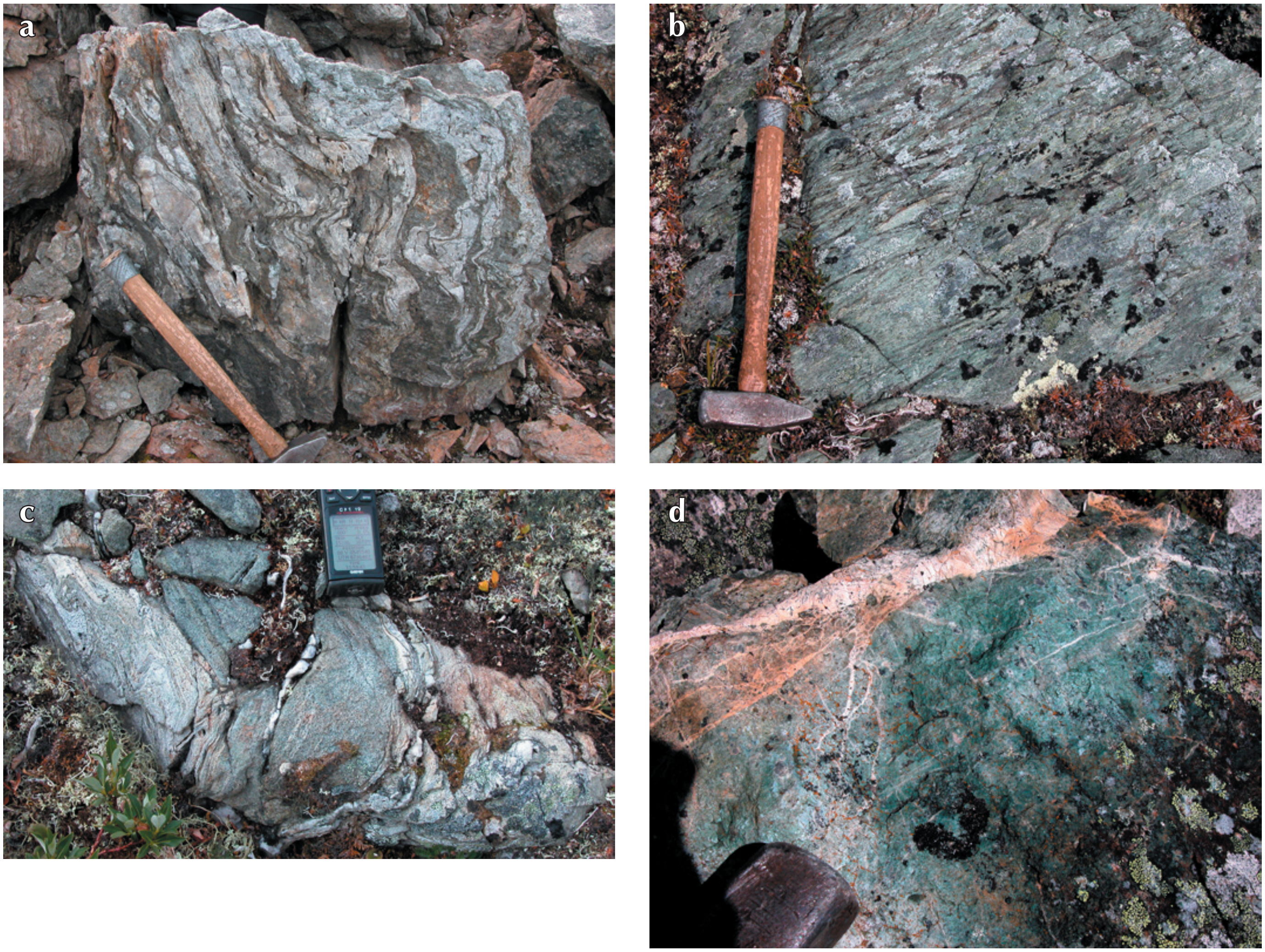

Figure 3. (a) *Interlayered and folded quartzite and pelite of the Snowcap complex near Martin Creek;* ***(b)*** *plagioclase-rich aggregates in metavolcaniclastic rock of the Livingstone Creek assemblage, east of May Creek;* ***(c)*** *band of felsic metavolcanic rock (white) folded within quartz-plagioclase-chlorite schist of the Livingstone Creek assemblage, east of May Creek;* ***(d)*** *serpentinite injected by felsic dyke at the headwater of May Creek. Note silicification halo (light grey) near felsic veins.*

LIVINGSTONE CREEK ASSEMBLAGE

The succession of light green to light grey quartzite, quartz-muscovite-plagioclase-chlorite schist and minor greenstone exposed at the headwaters of May and Livingstone creeks was informally named the Livingstone Creek assemblage by Harvey et al. (1997). This name is provisionally retained in this report. The rock is generally fine grained, but locally contains chlorite discs up to 5 mm in diameter and plagioclase-rich aggregates up to 5 cm long (lapillis?) suggesting a volcaniclastic origin (Fig. 3b). Massive chlorite schist is rare and commonly contains fine-grained hornblende in addition to chlorite, plagioclase and epidote. Rocks of the Livingstone Creek assemblage are generally less penetratively deformed than rocks of the Snowcap complex to the west.

Light green quartzite and schist of the Livingstone Creek assemblage are gradational with buff-weathering dolomitic quartzite and marble to the east. The quartzite preserves well-rounded quartz grains and contains 1- to 2-cm-thick marble horizons. It grades into massive dolomitic marble to the east. Light grey marble also occurs as 1- to 2-m-thick layers in the metavolcaniclastic rock, most abundantly north of Livingstone Creek.

Fine-grained, white-weathering muscovite-plagioclase-quartz schist occurs in horizons 10 cm to 1 to 2 m thick along the western contact of the Livingstone Creek assemblage, as well as within the metavoclaniclastic rocks (Fig. 2). This white schist is typically finely laminated and intercalated with the light green schist and quartzite (Fig. 3c). It locally contains 1 to 2 mm quartz eyes. This rock is interpreted as a felsic metavolcanic rock and is likely derived from a tuffaceous protolith.

Rocks of the Livingstone Creek assemblage resemble metavolcaniclastic rocks of the Lower Mississippian Little Kalzas formation in the Glenlyon map area (Colpron, 1999; Colpron et al., 2002, 2003). Like the Little Kalzas formation, rocks of the Livingstone Creek assemblage were likely deposited in an arc setting.

MENDOCINA ASSEMBLAGE

The ~3-km-wide, northwest-trending belt of greenstone and associated serpentinite which extends from the headwaters of Livingstone Creek into lower Mendocina Creek were described by Harvey et al. (1997) as the Mendocina assemblage. This name is provisionally retained for this report. The greenstone is generally fine grained and phyllitic, rarely massive. Patches of medium- to coarse-grained plagioclase-hornblende-rich greenstone occur sporadically in the finer grained rock and likely represent dismembered gabbro dykes. Metagabbro is most commonly found in proximity to, and within, the serpentinite.

Serpentinite forms a large massif at the headwater of May Creek, and occurs as smaller bodies within the greenstone north of Livingstone Creek (Fig. 2). The rock is generally bottle-green in colour and soft, although silicification patches within the serpentinite are common. They form centimetre to metre patches and appear related to abundant small felsic dykes and a dacite porphyry plug found in the May Creek massif (Fig. 3d). Coarse magnetite is common in association with silicification patches.

A few thin (<5 m) marble layers are present in the greenstone near d'Abbadie Fault. A single band (<20 m wide) of felsic schist occurs in association with carbonaceous phyllite within greenstone of the Mendocina assemblage. Graphitic phyllite is common at the contacts between greenstone and serpentinite north of Livingstone Creek.

The association of greenstone, metagabbro, serpentinite and minor carbonaceous phyllite and felsic schist of the Mendocina assemblage resembles the Upper Devonian Fire Lake formation of the Finlayson Lake district (Murphy et al., 2001, 2002) and is tentatively correlated with this unit. The Fire Lake formation is host to the Fyre Lake polymetallic massive sulphide deposit (Yukon MINFILE 105G 034, Deklerk, 2003).

INTRUSIVE ROCKS

At least five distinct suites of intrusive rocks are present in the Livingstone Creek area. The oldest suite corresponds to strongly foliated and locally gneissic tonalite to granodiorite. This suite occurs as one large sheet and a few dykes within metasedimentary rocks of the Snowcap complex (Fig. 2). The rock is generally fine-grained and light to medium grey in colour. Hornblende and biotite are common constituents and are locally concentrated in melanocratic bands up to 10 cm wide (Fig. 4a). Muscovite locally makes up to 15% of the granodiorite. These rocks resemble foliated tonalite-granodiorite of the Simpson Range plutonic suite (ca. 345 to 355 Ma) which is typical of YTT in Yukon (e.g., Mortensen and Jilson, 1985; Stevens, 1994; Colpron et al., 2002; Ryan and Gordey, 2004).

Weakly foliated two-mica granite is a volumetrically small but widespread intrusive suite in the Livingstone Creek area. It occurs as: (1) small dykes in psammitic schist of the Snowcap complex south of Livingstone Creek; (2) a >3-m-wide lens at the contact between greenstone and serpentinite of the Mendocina assemblage north of Livingstone Creek; and (3) a small plug (<100 m) and a dyke swarm (Fig. 4b) in metatonalite north of the headwaters of Cottoneva Creek. The rock is usually white in colour, medium- to coarse-grained and locally pegmatitic. Dykes of two-mica granite are typically 10 to 20 cm wide (up to 40 cm locally) and concordant with the dominant foliation. The dykes are invariably weakly foliated and locally display pinch-and-swell structures suggesting that the granite was emplaced during development of the dominant foliation (Fig. 4c).

Variably foliated diorite to granodiorite exposed east of d'Abbadie Fault, between Mendocina Creek and the South Big Salmon River, is generally considered to be Paleozoic in age on the basis of the localized high strain in the granodiorite and of a poorly resolved discordant U-Pb zircon age (Tempelman-Kluit, 1984; Hansen et al., 1989; Harvey et al., 1997). The rock is most commonly K-feldspar porphyritic and weakly foliated (Fig. 4d), but locally has a shallow, northwest-dipping protomylonitic

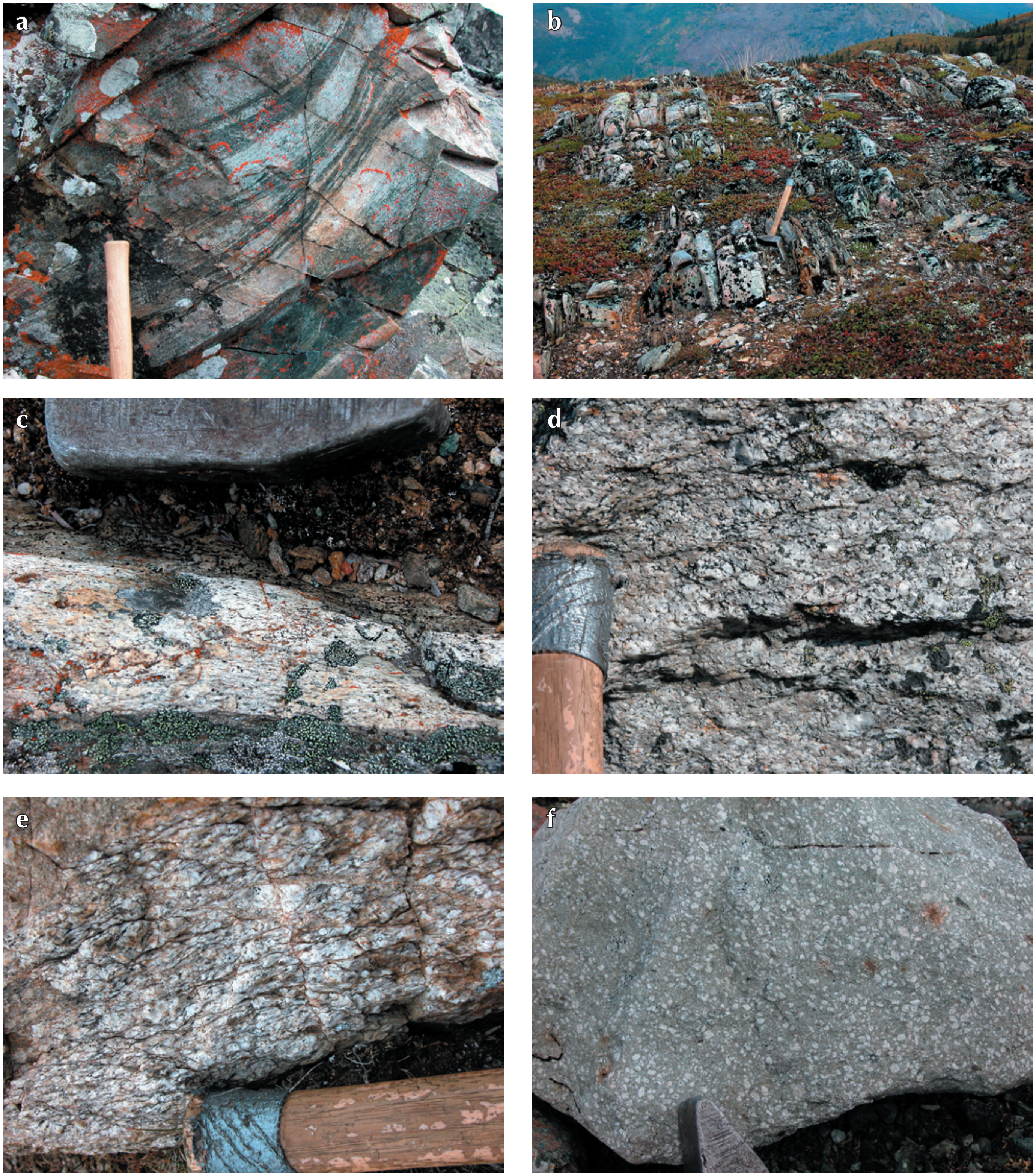

Figure 4. ***(a)*** *Banded hornblende tonalite gneiss, south of Livingstone Creek;* ***(b)*** *steeply dipping two-mica granite dykes (white) intruding grey tonalite gneiss; headwaters of Cottoneva Creek;* ***(c)*** *close-up of a granite dyke (white) showing development of the regional foliation in the dyke. Wall rocks are grey tonalite orthogneiss; headwaters of Cottoneva Creek;* ***(d)*** *weakly foliated K-feldspar porphyritic granodiorite east of d'Abbadie Fault;* ***(e)*** *coarse-grained, foliated Last Peak leucogranite (ca. 96 Ma, Gallagher, 1999) within the d'Abbadie fault zone north of Mendocina Creek;* ***(f)*** *dacite porphyry.*

fabric with K-feldspar porphyroclasts, and shear bands indicating a top-to-the-east sense of shear. The granodiorite is cut by a less deformed, fine-grained hornblende-biotite diorite. Along its western edge, the granodiorite body is strongly altered and truncated by the vertical d'Abbadie fault zone (Fig. 2). Although it is locally highly strained, the granodiorite has similar composition to granodiorite of the Cretaceous Quiet Lake Batholith to the southeast, which is locally foliated (Tempelman-Kluit, 1977), and for which preliminary geochronological analysis indicates a complex zoning pattern of zircons with Proterozoic-, Paleozoic- and Cretaceous-age domains (C.J.R. Hart, pers. comm., 2004). Further field and geochronological studies of this granodiorite body are required to precisely determine its age and relationship to the adjacent Quiet Lake Batholith.

The Last Peak granite (Harvey et al., 1997; Gallagher, 1999) occurs in the northern part of the map area within the western strand of the d'Abbadie fault zone (Fig. 2). It consists of a variably foliated and altered, medium- to coarse-grained white biotite granite (Fig. 4e). Gallagher (1999) reported a U-Pb monazite age of ca. 96 Ma from the Last Peak granite and suggested that the granite was emplaced during deformation along the d'Abbadie fault zone.

Finally, a small plug of dacite porphyry (30 x 80 m) intruded the serpentinite at the headwaters of May Creek (Fig. 2). The porphyry consists of a light green fine-grained dacite matrix which supports up to 25% plagioclase (up to 7 mm long) and rare quartz phenocrysts (Fig. 4f). Contacts with the serpentinite are covered by talus, but the fresh and undeformed nature of the dacite clearly suggests a relatively young age for this rock. Numerous small felsic dykes commonly found in brecciated parts of the serpentinite are inferred to be related to this dacitic phase of intrusion.

STRUCTURE

At least three generations of ductile structures are preserved in rocks of the Livingstone Creek area. The earliest structures correspond to a pervasive foliation and rare isoclinal folds (Fig. 5a) which are for the most part transposed by the second generation of structures. The second phase of deformation resulted in the development of a regional, penetrative transposition foliation, which is axial planar to tight to isoclinal folds. The transposition fabric is locally protomylonitic within the tonalite gneiss body and along lithological contacts in the western part of the area. It generally dips moderately to the southwest in the western part of the Livingstone Creek area, and moderately to steeply to the northeast, northeast of the fault inferred to mark the contact between the Mendocina assemblage and rocks to the west (Fig. 2). It commonly contains an elongation lineation. East of d'Abbadie fault zone, the dominant foliation typically dips gently to the west-northwest. The dominant foliation is everywhere folded by northeast-verging open folds (Fig. 5b).

The d'Abbadie fault zone is a steep, north-striking brittle-ductile fault zone which extends across the eastern part of the Livingstone Creek area (Figs. 2, 5c). Deformation features related to the d'Abbadie Fault are restricted to localized cataclastic structures (cm-scale) and development of a steeply dipping anastomosing cleavage (Fig. 4e). Gallagher (1999) reports the presence of kinematic indicators consistent with dextral strike-slip displacement along d'Abbadie Fault. He also suggested that the ca. 96 Ma Last Peak granite was emplaced during displacement along d'Abbadie Fault. An apparent dextral offset of ~4 km has been estimated on d'Abbadie Fault (Harvey et al., 1996). Detailed descriptions of the structural style and evolution of adjacent areas to the north are presented in Gallagher (1999) and de Keijzer (2000).

MINERAL POTENTIAL

An estimated 50,000 ounces (1.6 million grams) of gold has been recovered from placers of the Livingstone Creek area since 1898 (W. LeBarge, pers. comm., 2004); however, its lode source remains elusive. The gold typically occurs as coarse (>1 cm) nuggets and is commonly associated with magnetite, suggesting a nearby source and potentially a skarn style of mineralization. Alternatively, the coarse magnetite (and the gold) may have been derived from serpentinite of the Mendocina assemblage to the east; although this would have required more than 10 km of westerly glacial transport of the gravels prior to deposition in the gold-bearing streams (Fig. 2).

Quartz veins containing disseminated sulphide minerals occur as foliaform veins in the bedrock at the headwaters of the past-producing streams and were considered a potential source for some of the gold (Stroink and Friedrich, 1992). However, the lack of magnetite and coarse gold in the veins argues against them being the major source for the placer gold. Despite the numerous

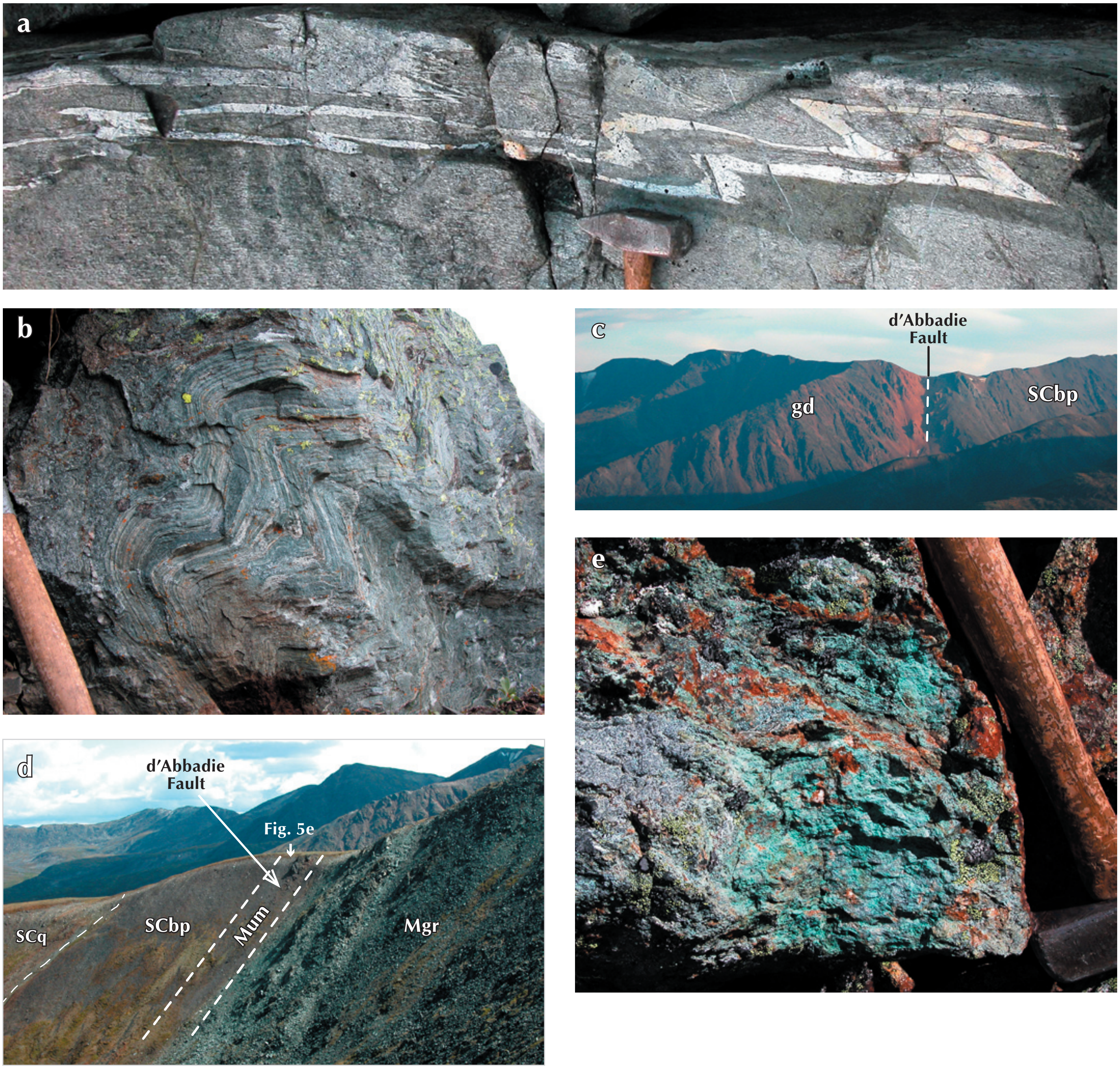

Figure 5. (a) *Two phases of folds in tonalite orthogneiss south of Livingstone Creek. Early isoclinal folds are refolded by tight folds associated with the regional transposition foliation;* ***(b)*** *looking south at northeast-vergent open folds of the transposition foliation in light green quartzite of the Livingstone Creek assemblage, north of Livingstone Creek;* ***(c)*** *looking south at d'Abbadie fault zone between Mendocina Creek and South Big Salmon River. At this location, the fault juxtaposes black graphitic phyllite of the Snowcap complex (SCbp) against variably foliated granodiorite (gd) to the east. Note strong gossan along the fault;* ***(d)*** *oblique view to the southeast of the d'Abbadie Fault near Mendocina Creek. Here the fault juxtaposes greenstone of the Mendocina assemblage (Mgr) against black phyllite (SCbp) and quartzite (SCq) of the Snowcap complex to the east. A sliver of silicified ultramafic rock (Mum) occurs within the fault;* ***(e)*** *silicified ultramafic rock with annabergite and nickeline mineralized rock in the d'Abbadie fault zone (sample 74-1 to -4; Table 2).*

__Table 1.__ Yukon MINFILE occurrences for the Livingstone Creek area (Deklerk, 2003).

MINFILE	Name	Status	Deposit type	Commodities
105E 001	Livingston	showing	vein	Au-Ag-Pb-Cu
105E 020	Sylvia	showing	vein	Pb-Zn-Cu-Au-Ag
105E 021	Cottoneva	unknown	unknown	
105E 032	Mendocina	unknown	unknown	
105E 042	Lake	unknown	unknown	
105E 047	Maybe	anomaly	unknown	Pb-Au
105E 048	Marbee	unknown	unknown	
105E 049	Little Violet	unknown	unknown	
105E 051	Gord	unknown	unknown	
105E 053	Deet	showing	vein	Ag-Au-Zn-Sb-Pb-As
105E 056	Brenda	unknown	unknown	

signs of past bedrock exploration activity in the area, there is very little documentation of this work (Table 1).

The possible correlation of greenstone and serpentinite of the Mendocina assemblage with the Fire Lake formation opens the potential for this belt to host copper-cobalt-gold massive sulphide mineralization similar to that at the Fyre Lake deposit in the Finlayson Lake district (Yukon MINFILE 105G 034, Deklerk, 2003; Sebert et al. 2004; Hunt, 2002). Disseminated pyrite and pyrrhotite occur at several locations within the greenstone, and malachite and chalcopyrite were observed at one locality (Fig. 2; Table 2, samples 91, 100).

Silicified ultramafic rock in the d'Abbadie fault zone are mineralized in nickeline and annabergite (Figs. 5d,e) and samples returned anomalous values in nickel, cobalt, arsenic and antimony (sample 74-1 to -4; Table 2). This rock was likely altered by circulation of hydrothermal fluids along d'Abbadie Fault, thereby establishing the potential for further mineralization along this fault zone. Well-developed gossans along segments of the d'Abbadie Fault (Fig. 5c) are consistent with fluid migration along the fault.

ACKNOWLEDGEMENTS

Eri Boye and Jim Coates provided assistance in the field. Karl Ziehe of Heli Dynamics Ltd. of Whitehorse got us there, and back, safely. Dr. Sharon Carr of Carleton University is thanked for providing unpublished notes and maps from her students (C. Gallagher and J.L. Harvey), reading an earlier version of this report and continuing discussions.

REFERENCES

Bostock, H.S. and Lees, E.J., 1938. Laberge map-area, Yukon. Geological Survey of Canada, Memoir 217, 33 p.

Colpron, M., 1999. Glenlyon Project: Preliminary stratigraphy and structure of Yukon-Tanana Terrane, Little Kalzas Lake area, central Yukon (105L/13). *In:* Yukon Exploration and Geology 1998, C.F. Roots and D.S. Emond (eds.), Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, p. 63-72.

Colpron, M., 2003. A stratigraphic framework for the pericratonic terranes of the northern Cordillera. Geological Association of Canada – Mineralogical Association of Canada – Society of Economic Geologists Joint Annual Meeting, Abstracts, vol. 28.

Colpron, M. and Yukon-Tanana Working Group, 2001. Ancient Pacific Margin – An update on stratigraphic comparison of potential volcanogenic massive sulphide-hosting successions of Yukon-Tanana Terrane, northern British Columbia and Yukon. *In:* Yukon Exploration and Geology 2000, D.S. Emond and L.H. Weston (eds.), Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, p. 97-110.

Table 2. *Selected assay results from the Livingstone Creek area.*

		74-1	74-2	74-3	74-4	91	99-1	99-2	100
		silicified ultramafic rock nickeline + annabergite				disseminated pyrite-pyrrhotite	altered granite		disseminated pyrite-chalcopyrite
Mo	**ppm**	1.11	1.35	1.05	1.53	0.77	1.28	2.05	0.65
Cu	**ppm**	9.69	12.44	5.02	18.83	73.98	102.01	49.14	280.00
Pb	**ppm**	1.30	9.25	1.63	3.39	0.43	2.26	7.39	0.52
Zn	**ppm**	6.1	34.6	14.3	20.7	47.0	56.9	121.7	41.0
Ag	**ppb**	38	57	33	69	14	82	49	895
Ni	**ppm**	741.1	79.7	45.8	3409.5	35.9	26.9	42.4	35.3
Co	**ppm**	32.7	6.9	2.8	140.3	30.8	4.1	7.2	48.6
Mn	**ppm**	47	30	42	35	617	41	88	459
Fe	**%**	1.19	0.76	1.23	1.75	4.50	1.92	3.63	4.79
As	**ppm**	1414.9	1576.6	426.8	3068.6	1.6	10.2	10.0	1.0
U	**ppm**	0.1	0.1	0.1	0.1	<0.1	0.3	0.4	<0.1
Au	**ppb**	4.0	0.4	0.8	3.4	0.5	0.9	2.2	2.5
Th	**ppm**	0.1	<0.1	0.1	<0.1	<0.1	0.3	0.8	<0.1
Sr	**ppm**	5.2	11.9	17.2	1.5	6.5	6.1	4.1	12.1
Cd	**ppm**	0.06	0.16	0.05	0.34	0.04	0.11	0.17	0.04
Sb	**ppm**	137.25	271.86	35.14	1822.10	0.68	8.80	10.20	0.24
Bi	**ppm**	0.03	0.03	0.07	0.03	<0.02	0.05	0.08	<0.02
V	**ppm**	9	21	8	22	102	100	30	81
Ca	**%**	0.02	0.02	0.01	0.01	0.85	0.01	0.01	0.92
P	**%**	0.001	0.001	0.003	<0.001	0.096	0.036	0.034	0.134
La	**ppm**	1.1	<0.5	0.6	<0.5	1.6	0.9	2.7	0.9
Cr	**ppm**	173.4	217.1	66.2	269.5	42.4	49.9	26.0	39.0
Mg	**%**	0.02	0.02	0.01	0.02	1.70	0.01	0.02	1.97
Ba	**ppm**	112.2	12.1	38.3	34.1	15.1	9.9	31.5	40.1
Ti	**%**	<0.001	<0.001	0.001	<0.001	0.332	0.003	0.003	0.430
B	**ppm**	<1	<1	<1	<1	1	1	1	<1
Al	**%**	0.19	0.25	0.19	0.28	1.90	0.74	0.33	1.85
Na	**%**	0.007	0.002	0.001	0.001	0.055	0.003	0.002	0.011
K	**%**	0.01	0.01	0.03	<0.01	0.05	0.01	0.06	0.01
W	**ppm**	0.1	0.2	<0.1	0.2	<0.1	0.3	0.4	<0.1
Sc	**ppm**	0.6	1.4	0.6	1.6	3.3	6.7	2.6	1.6
Tl	**ppm**	0.13	0.37	0.04	0.67	<0.02	0.02	0.07	<0.02
S	**%**	0.11	0.01	<0.01	1.24	0.43	<0.01	<0.01	1.5
Hg	**ppb**	91	157	51	158	<5	31	41	<5
Se	**ppm**	0.7	0.9	0.3	2.9	0.9	0.2	0.2	1.7
Te	**ppm**	0.02	0.04	0.03	0.07	<0.02	0.04	0.04	0.03
Ga	**ppm**	1.9	1.7	0.8	13.4	4.9	2.7	1.3	3.0
UTM-E		548085	548085	548085	548085	545566	548078	548078	547410
UTM-N		6799693	6799693	6799693	6799693	6801492	6800718	6800718	6800686

Note: Sample were analysed by ICP-MS at Acme Analytical Laboratories in Vancouver, British Columbia.

Colpron, M., Murphy, D.C., Nelson, J.L., Roots, C.F., Gladwin, K., Gordey, S.P. and Abbott, J.G., 2003. Yukon Targeted Geoscience Initiative, Part 1: Results of accelerated bedrock mapping in Glenlyon (105L/1-7,11-14) and northeast Carmacks (115I/9,16) areas, central Yukon. *In:* Yukon Exploration and Geology 2002, D.S. Emond and L.L. Lewis (eds.), Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, p. 85-108.

Colpron, M., Murphy, D.C., Nelson, J.L., Roots, C.F., Gladwin, K., Gordey, S.P., Abbott, G. and Lipovsky, P.S., 2002. Preliminary geological map of Glenlyon (105L/1-7,11-14) and northeast Carmacks (115I/9,16) areas, Yukon Territory (1:125 000 scale). Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, Open File 2002-9; also Geological Survey of Canada, Open File 1457.

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. 39, p. 479-494.

de Keijzer, M., 2000. Tectonic evolution of the Teslin zone and the western Cassiar terrane, northern Canadian Cordillera. Unpublished Ph.D. thesis. University of New Brunswick, 391 p.

Deklerk, R., 2003. Yukon MINFILE 2003 - A database of mineral occurrences. Yukon Geological Survey, CD-ROM.

Gallagher, C., Brown, R.L. and Carr, S.D., 1998. Structural geometry of the Cassiar Platform and Teslin zone, Dycer Creek area, Yukon. *In:* Slave-Northern Cordillera Lithospheric Evolution (SNORCLE) Transect and Cordilleran Tectonic Workshop Meeting, F. Cook and P. Erdmer (eds.), Lithoprobe Report No. 64, p. 139-151.

Gallagher, C.S., 1999. Regional-scale transposition and late large-scale folding in the Teslin Zone, Pelly Mountains, Yukon. Unpublished M.Sc. thesis. Carleton University, 199 p.

Gordey, S.P. and Makepeace, A.J., 2000. Bedrock geology, Yukon Territory. Geological Survey of Canada, Open File 3754, 1:1 000 000; also Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, Open File 2001-1.

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.

Hansen, V.L., 1992. Backflow and margin-parallel shear within an ancient subduction complex. Geology, vol. 20, p. 71-74.

Hansen, V.L., Mortensen, J.K. and Armstrong, R.L., 1989. U-Pb, Rb-Sr, and K-Ar isotopic constraints for ductile deformation and related metamorphism in the Teslin suture zone, Yukon-Tanana Terrane, south-central Yukon. Canadian Journal of Earth Sciences, vol. 26, p. 2224-2235.

Harvey, J.L., Brown, R.L. and Carr, S.D., 1996. Progress in structural mapping in the Teslin suture zone, Big Salmon Range, central Yukon Territory. *In:* Slave-Northern Cordillera Lithospheric Evolution (SNORCLE) Transect and Cordilleran Tectonic Workshop Meeting, F. Cook and P. Erdmer (eds.), Lithoprobe Report No. 50, p. 33-44.

Harvey, J.L., Carr, S.D., Brown, R.L. and Gallagher, C., 1997. Deformation history and geochronology of plutonic rocks near the d'Abbadie Fault, Big Slamon Range, Yukon. *In:* Slave-Northern Cordillera Lithospheric Evolution (SNORCLE) Transect and Cordilleran Tectonic Workshop Meeting, F. Cook and P. Erdmer (eds.), Lithoprobe Report No. 56, p. 103-114.

Hunt, J.A., 2002. Volcanic-associated massive sulphide (VMS) mineralization in the Yukon-Tanana Terrane and coeval strata of the North American miogeocline, in the Yukon and adjacent areas. Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, Bulletin 12, 107 p.

Levson, V., 1992. The sedimentology of Pleistocene deposits associated with placer gold bearing gravels in the Livingstone Creek area, Yukon Territory. *In:* Yukon Geology, Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, Volume 3, p. 99-132.

Lipovsky, P.S., LeBarge, W., Bond, J.D. and Lowey, G., 2001. Yukon placer activity map. Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, Open File 2001-30, 1:1 000 000 scale.

Mortensen, J.K. and Jilson, G.A., 1985. Evolution of the Yukon-Tanana terrane: evidence from southeastern Yukon Territory. Geology, vol. 13, p. 806-810.

Murphy, D.C., Colpron, M., Roots, C.F., Gordey, S.P. and Abbott, J.G., 2002. Finlayson Lake Targeted Geoscience Initiative (southeastern Yukon), Part 1: Bedrock geology. *In:* Yukon Exploration and Geology 2001, D.S. Emond, L.H. Weston and L.L. Lewis (eds.), Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, p. 189-207.

Murphy, D.C., Colpron, M., Gordey, S.P., Roots, C.F., Abbott, G. and Lipovsky, P.S., 2001. Preliminary bedrock geological map of northern Finlayson Lake area (NTS 105G), Yukon Territory (1:100 000 scale). Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, Open File 2001-33.

Ryan, J.J. and Gordey, S.P., 2004. Geology, Stewart River area (Parts of 115 N/1,2,7,8 and 115 O/2-12), Yukon Territory. Geological Survey of Canada, Open File 4641, 1:100 000 scale.

Sebert, C., Hunt, J.A. and Foreman, I.J., 2004. Geology and lithogeochemistry of the Fyre Lake copper-cobalt-gold sulphide-magnetite deposit, southeastern Yukon. Yukon Geological Survey, Open File 2004-17, 46 p.

Simard, R.-L., 2003. Geological map of southern Semenof Hills (part of NTS 105E/1,7,8), south-central Yukon (1:50 000 scale). Yukon Geological Survey, Open File 2003-12.

Stevens, R.A., 1994. Geology of the Teslin suture zone in parts of Laberge (105E/1), Quiet Lake (105F/4) and Teslin (105C/11, 13, 14) map areas, Yukon Territory. Geological Survey of Canada, Open File 2768, 1:50 000 scale.

Stroink, L. and Friedrich, G., 1992. Gold-sulphide quartz veins in metamorphic rocks as a possible source for placer gold in the Livingstone Creek area, Yukon Territory, Canada. *In:* Yukon Geology, Exploration and Geological Services Division, Yukon Region, Indian and Northern Affairs Canada, vol. 3, p. 87-98.

Tempelman-Kluit, D.J., 1977. Quiet Lake (105F) and Finlayson Lake (105G) map areas, Yukon Territory. Geological Survey of Canada, Open File 486, 1:250 000 scale.

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.

Tempelman-Kluit, D.J., 1984. Geology, Laberge (105E) and Carmacks (105I), Yukon Territory. Geological Survey of Canada, Open File 1101, 1:250 000 scale.

Wheeler, J.O., Brookfield, A.J., Gabrielse, H., Monger, J.W.H., Tipper, H.W. and Woodsworth, G.J., 1991. Terrane Map of the Canadian Cordillera. Geological Survey of Canada, Map 1713A, 1:2 000 000 scale.