Ancient Pacific Margin – An update on stratigraphic comparison of potential volcanogenic massive sulphide-hosting successions of Yukon-Tanana Terrane, northern British Columbia and Yukon[1]

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ABSTRACT

Now in its second year, the Ancient Pacific Margin National Mapping (NATMAP) project continues to make progress in elucidating the stratigraphic framework of Yukon-Tanana Terrane of northern British Columbia and Yukon. Updated composite stratigraphic sections for the Finlayson Lake district, Glenlyon, Wolf Lake and Jennings River areas, and from previous studies in the Aishihik Lake area and northern Dawson Range, show that Yukon-Tanana Terrane originated as a dynamic mid- to late Paleozoic (pericratonic) arc system. The evolution of this arc system was punctuated by arc- building events, arc rifting and development of back-arc basins, and episodes of contractional deformation between Late Devonian and early Pennsylvanian. Its development terminated in late Pennsylvanian time with the opening of a marginal basin and the subsequent mid-Permian calc-alkaline volcanism, high-pressure metamorphism and regional deformation of the terrane.

RÉSUMÉ

Dans sa deuxième année, le programme CARTNAT de la marge pacifique ancienne continue ses progrès dans l'élucidation des composantes stratigraphiques du terrane de Yukon-Tanana dans le nord de la Colombie-Britannique et le Yukon. Les révisions des coupes stratigraphiques composées pour les régions de Finlayson Lake, Glenlyon, Wolf Lake et Jennings River (de même que les régions préalablement à l'étude d'Aishihik Lake et de la partie nord du chaînon Dawson) indiquent que le terrane de Yukon-Tanana est dérivé d'un système dynamique d'arc (péricratonique) du Paléozoïque moyen à tardif. Entre le Dévonien tardif et le Pennsylvanien précoce, l'évolution de ce système d'arc fût marqué par des épisodes de construction d'île-en-arc, d'extension de l'arc, d'ouverture de bassins d'arrière-arc, et par des périodes de déformation en contraction. Celà se terminât par l'ouverture d'un bassin marginal au Pennsylvanien tardif et, par la suite, du volcanisme calco-alcalin, du métamorphisme de haute pression, et la déformation régionale du terrane au Permien moyen.

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INTRODUCTION

The Yukon-Tanana Terrane of Yukon, Alaska and northern British Columbia consists of lithologically diverse successions of meta-sedimentary and meta-volcanic rocks, and voluminous mid- and late Paleozoic granitic meta-plutonic bodies (Mortensen and Jilson, 1985; Mortensen, 1992). Significant volcanogenic massive sulphide deposits have been discovered in the terrane in the Delta and Bonnifield districts of Alaska and in the Finlayson Lake district of southeastern Yukon, and the potential for further discoveries is considered to be high. However, exploration for new deposits has been hindered by the

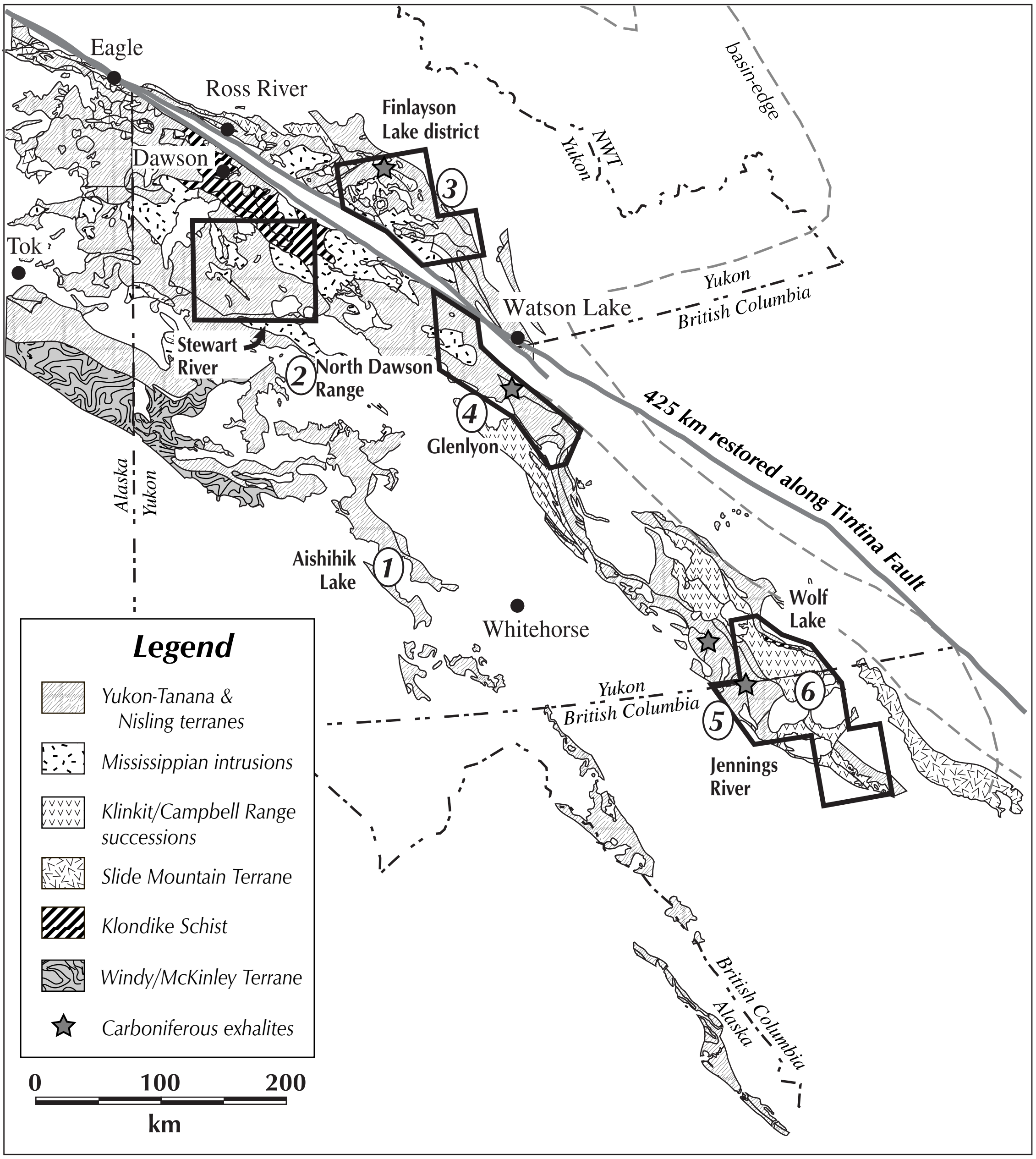

Figure 1. *Distribution of Yukon-Tanana and affiliated terranes (the 'pericratonic' terranes) prior to displacement along Tintina Fault. Areas to be mapped under the auspices of the Ancient Pacific Margin NATMAP Project are indicated. Numbers show the general location of composite stratigraphic columns shown in Figure 2 and discussed in the text: 1) Aishihik Lake; 2) Wolverine Creek, North Dawson Range; 3) Finlayson Lake district; 4) Glenlyon; 5) Northwest Jennings River; 6) South Wolf Lake – North Jennings River. Tectonic assemblage map modified after Wheeler and McFeely (1991).*

paucity of stratigraphic syntheses from the terrane as a whole. One of the goals of the Ancient Pacific Margin NATMAP (National Mapping Program) project is to address the deficiencies in stratigraphic information from the Yukon-Tanana Terrane.

Since inception of the project in 1999, members of the northern component of the Ancient Pacific Margin NATMAP (the Yukon-Tanana Working Group; Table 1; Fig. 1) have advanced the understanding of the stratigraphic framework of Yukon-Tanana Terrane. Sufficient geological mapping and U-Pb dating had been done after the first year to construct composite stratigraphic sections for areas along the extent of southeastern Yukon-Tanana Terrane and to attempt preliminary correlations between the various mapping projects (Nelson et al., 2000). In this paper, we update the composite stratigraphic sections to reflect new geological and geochronological data acquired over the past year and incorporate relevant information from previous studies (Fig. 2).

In 2000, the British Columbia Geological Survey Branch completed their commitment to the mapping of Jennings River area, the Yukon Geology Program continued mapping in the Finlayson Lake district and Glenlyon area, while the Geological Survey of Canada carried on with mapping in the Wolf Lake – Jennings River area and initiated a three-year program in Stewart River area (Fig. 1). The Geological Survey of Canada also flew a multiparameter geophysical survey along a northeast-trending swath over the Stewart River area as part of the Targeted Geoscience Initiative program (R. Shives, in preparation). New stratigraphic information from each of these areas is summarized in the following section.

FINLAYSON LAKE DISTRICT

D.C. Murphy and S.J. Piercey

(Fig. 2, column 3) Yukon-Tanana Terrane in Finlayson Lake map area (105G) and adjacent parts of Frances Lake area (105H; Fig. 1) consists of a number of fault- and/or unconformity-bound stratigraphic successions, some of which host volcanogenic massive sulphide deposits and occurrences (Murphy and Piercey, 1999a; Murphy, this volume; Fig. 2). The Late Devonian to early Pennsylvanian interval is represented by three successions, two in the footwall of the Money Creek thrust (Grass Lakes and Wolverine successions) and one in the hanging wall (un-named); these were juxtaposed in the Pennsylvanian. An un-named Pennsylvanian flysch-like succession

Table 1. *Yukon-Tanana Working Group.*

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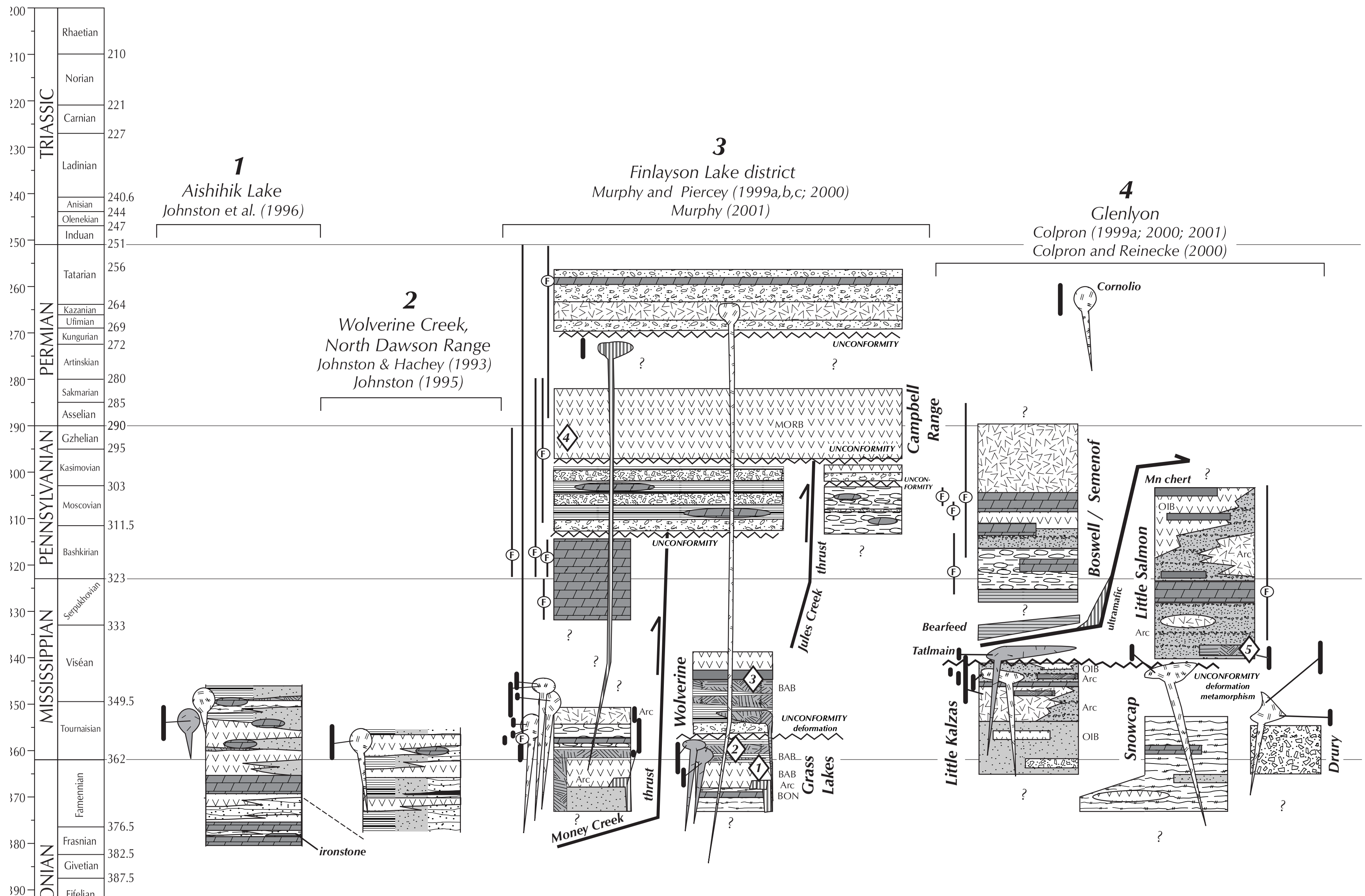

Figure 2. Composite stratigraphic columns for areas discussed in the text and located on Figure 1. Mineral occurrences: 1 – Fyre Lake deposit; 2 – Kudz Ze Kayah and GP4F deposits; 3 – Wolverine deposit; 4 – Money occurrence; 5 – Government showing; 6 – Cabin Lake and Cariboo Creek occurrences; 7 – Arsenault occurrence. Petrogenetic affinity of the volcanic successions is indicated where known: Arc = island arc; BAB = back-arc basin; BON = boninite; MORB = mid-ocean ridge basalt; OIB = ocean island basalt. (A coloured version of this diagram can be downloaded at www.geology.gov.yk.ca/publications/yeg00/YTTcorrelations2001.pdf)

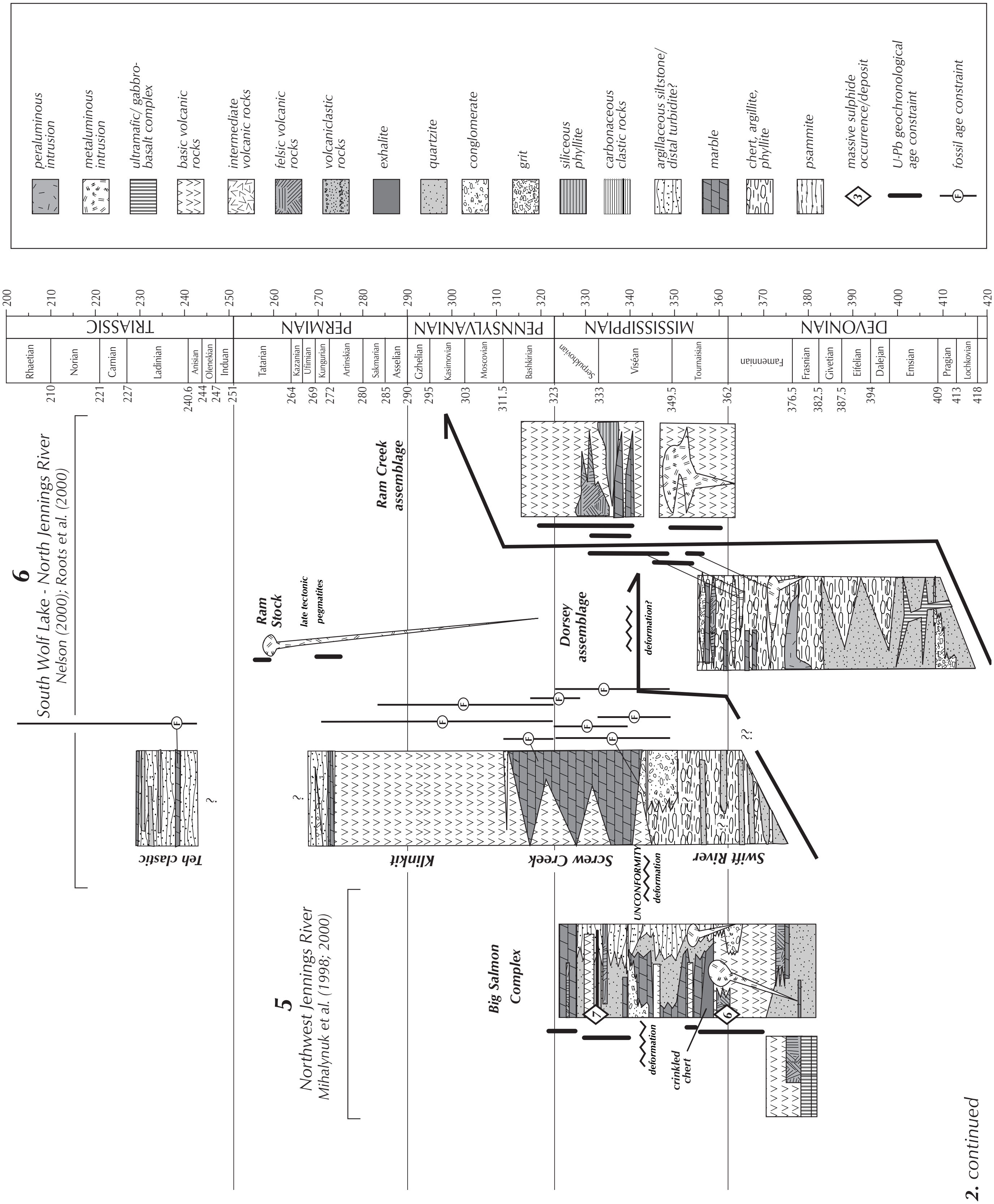

Figure 2. continued

unconformably overlaps the Money Creek thrust. This succession and subjacent rocks are in turn thrust over a probably Pennsylvanian succession along the Jules Creek thrust, which is in turn overlapped by late Pennsylvanian to Early Permian meta-basalt of the Campbell Range succession. An unconformably overlying polymictic conglomerate of probable mid-Permian age records an Early Permian history of arc magmatism, high-pressure metamorphism, uplift and erosion.

The Grass Lakes and Wolverine successions in the footwall of the Money Creek thrust record two phases of Late Devonian to early Mississippian continental arc and back-arc magmatism and sedimentation separated by an unconformity marking a period of deformation, uplift and erosion. The base of the Grass Lakes succession, and basement to the magmatic arc/back-arc system, comprises pre-Upper Devonian quartz-rich meta-clastic rocks, marble and pelitic schist. The initial magmatic deposits consist of Upper Devonian to lower Mississippian mafic schist, host of the Fyre Lake Cu-Co-Au deposit, with lesser amounts of carbonaceous meta-clastic rock, felsic meta-volcanic and -volcaniclastic rock, and marble. Geochemically, these rocks range from boninite - low Ti tholeiite and calc-alkaline arc suites to non-arc mid-ocean ridge basalts (MORBs) and Nb-enriched basalt, suggesting an early arc history followed by rifting. These rocks pass upward into early Mississippian massive sulphide-bearing (Kudz Ze Kayah and GP4F; Cu-Pb-Zn-Au-Ag bearing), high-field-strength-element-enriched (A-type; Whelan et al., 1987), felsic meta-volcanic and -volcaniclastic rocks, and carbonaceous phyllite that probably reflect an ongoing evolution toward a back-arc basin environment. The upper unit of the Grass Lakes succession consists of early Mississippian carbonaceous phyllite, quartzite, quartz-feldspar pebble meta-conglomerate and alkalic mafic schist. The Grass Lakes succession was intruded by early Mississippian peraluminous granitic meta-plutonic rocks, deformed, and re-intruded by slightly younger, late-kinematic, early Mississippian granitic meta-plutonic rocks, before the unconformable deposition of the Wolverine succession. Also of early Mississippian age, the Wolverine succession comprises mainly carbonaceous meta-clastic rocks, felsic schist and quartz-feldspar meta-porphyry of volcanic, volcaniclastic and subvolcanic intrusive protolith. A laterally persistent unit of exhalite-bearing, felsic meta-volcanic and -volcaniclastic rocks, and carbonaceous argillite caps the felsic meta-volcanic part of the succession, in the immediate hanging wall of the Wolverine Cu-Pb-Zn-Au-Ag massive sulphide deposit. Felsic meta-volcanic rocks are transitionally overlain by a meta-basalt member that is locally preserved beneath the unconformably overlying Pennsylvanian flysch. Geochemically, felsic rocks below the Wolverine deposit are A-type rhyolites similar to those in the Grass Lake succession whereas those above the deposit are lower in Zr, possibly reflecting a lower temperature of formation.

The Grass Lakes and Wolverine successions were overridden from the southwest by coeval volcanic-arc rocks, their subvolcanic intrusions and early Pennsylvanian bioclastic limestone along the Money Creek thrust. Although incompletely mapped, the lower part of the thrust sheet comprises island-arc tholeiitic and calc-alkaline basalt, basaltic andesite and lesser rhyolite, limestone, chert and dark argillite. These pass upward into intermediate to felsic meta-volcanic rocks (chloritic phyllite, muscovite-quartz phyllite and foliated rhyodacitic tuff breccia). Several calc-alkaline granodiorite to granite plutons of the early Mississippian Simpson Range plutonic suite intrude the stratified rocks. A laterally persistent crinoidal limestone of probable early Pennsylvanian age overlies the meta-volcanic rocks with sharp contact. Bedded barite and massive-sulphide-style prospects have been identified in the meta-volcanic rocks of the Money Creek thrust sheet. Plutons of the Simpson Range plutonic suite are locally altered and copper-stained, suggesting a potential for porphyry-style mineralization.

Both the hanging wall and footwall of the Money Creek thrust are overlain by a dark heterogeneous coarse clastic unit of probable Pennsylvanian age. This unit is composed of carbonaceous argillite, chert (mainly dark but also locally pink, tan and green), chert-pebble conglomerate, greywacke, volcano-lithic conglomerate, limestone-pebble conglomerate (mainly at base), diamictite (made up of pebble- to boulder-sized clasts of meta-volcanic and meta-sedimentary rocks in either an argillite or greywacke matrix) and rare quartz sandstone and limestone. As this dark clastic unit overlies both the hanging wall and footwall of the Money Creek thrust and is not displaced by the thrust, its probable Pennsylvanian age places an upper constraint on the age of the Money Creek thrust.

The rocks of the Money Creek thrust sheet and the unconformably overlying dark clastic unit are thrust to the northeast along the Jules Creek thrust. The footwall succession comprises a lower unit similar to the dark heterogeneous clastic unit, an unconformably overlying post-tectonic conglomerate and an upper unit of meta-basalt. The lower unit is predominantly dark argillite and chert, with lesser chert-pebble conglomerate and pink and green chert. It differs from the dark heterogeneous clastic unit in the scarcity of coarse-grained volcano-lithic clastic rocks. Only one metre-scale bed of greywacke was observed. Post-tectonic conglomerate overlies the lower unit, and its basal strata comprise angular breccia, made up of randomly oriented foliated clasts of the lower unit. The post-tectonic conglomerate is overlain with sharp contact by a variably foliated meta-basalt unit that resembles the Campbell Range basalt described below.

Late Pennsylvanian to Early Permian Campbell Range basalt overlies both the hanging wall and footwall of the Jules Creek thrust. As the basalt is not offset, displacement on the Jules Creek thrust was probably late Pennsylvanian in age. The Money volcanic-hosted massive sulphide prospect and numerous areas with anomalous Cu soil geochemistry occur in the Campbell Range basalt.

The eastern slopes of the Campbell Range are underlain by a heterolithic pebble to boulder conglomerate that, based on clast content, probably unconformably overlies older rocks of Yukon-Tanana Terrane. In addition to clasts derived from the above-described rock units, the conglomerate contains clasts of Permian arc-volcanic rocks, and blueschist and eclogite with Permian cooling ages (Mortensen et al., 1999). Although these types of rocks are found *in situ* elsewhere in Yukon-Tanana Terrane, they only occur as clasts in the Finlayson – Frances Lake area. The proximal nature of the conglomerate, however, suggests a nearby source.

GLENLYON AREA

M. Colpron

(Figure 2, column 4) Ongoing geological mapping and geochronological studies have led to the identification of distinct stratigraphic successions and two Mississippian magmatic suites within Yukon-Tanana Terrane of Glenlyon map area (Fig. 1). In the northwest, early to mid-Mississippian (343-346 Ma; Colpron et al., 2000) volcanic rocks of the Little Kalzas succession, which consist predominantly of plagioclase-phyric andesite, volcaniclastic rocks, and subordinate marble, rhyolite and alkali basalt, conformably overlie orthoquartzite of the Pelmac unit (Fig. 2; Colpron, 1999a). Geochemistry of volcanic rocks from the Little Kalzas succession suggests that they formed in a continental arc setting (Colpron, this volume). The Pelmac unit rests structurally above amphibolite-grade meta-sedimentary and meta-igneous rocks of uncertain age, which are found in central Glenlyon map area (units 6 b-c of Campbell, 1967; U. Schmidt, pers. comm., 1999). The Pelmac unit and overlying Little Kalzas succession (and subvolcanic intrusions of the Little Kalzas suite) were deformed by south-verging folds and metamorphosed to greenschist facies prior to the intrusion of the Tatlmain Batholith at ~340 Ma (Colpron et al., 2000).

In southeast Glenlyon, mid-Mississippian to early Pennsylvanian volcanic rocks of the Little Salmon succession unconformably overlie two distinct map units (Fig. 2; Colpron and Reinecke, 2000). To the east, the Little Salmon succession rests above the Drury unit, an arkosic grit and quartzite unit, which is intruded by an early Mississippian granodiorite. To the west, the volcanic rocks overlie a mixture of meta-sedimentary and meta-igneous rocks, which record a poly-metamorphic history – the Snowcap assemblage (Colpron, 2000). These rocks are intruded by diorite plutons of the Tatlmain/Little Salmon suite (*ca.* 340 Ma), which are likely subvolcanic to the Little Salmon succession. Accordingly, the Snowcap assemblage forms the basement onto which volcanic rocks of the Little Salmon succession were erupted. The relationship between the Snowcap assemblage and similar metamorphic rocks in central Glenlyon is unknown. They may be part of the same lithotectonic assemblage.

The Little Salmon succession is dominated by volcaniclastic rocks (both epiclastic and tuffaceous; Colpron and Reinecke, 2000). A prominent marble unit of late Mississippian – early Pennsylvanian age (E.W. Bamber *in:* Colpron and Reinecke, 2000) occurs in the lower part of the Little Salmon succession. Dacite and quartz-feldspar porphyry, dated at *ca.* 340 Ma (Colpron et al., 2000), mark the base of the sequence near Little Salmon Lake. The felsic volcanic unit hosts a small sulphide occurrence (Colpron, 1999b). Near Little Salmon Lake, volcanic rocks of the Little Salmon succession are typically of calc-alkaline composition; they record a second cycle of continental arc magmatism in the area (Colpron, this volume). These rocks pass along strike to the northwest into a sequence of alkali basalt, which contains manganiferous exhalative rocks (piedmontite chert; Colpron, this volume).

Both the Little Kalzas and Little Salmon successions have mixed calc-alkaline (Arc = island arc) and alkaline (OIB = ocean island basalt) geochemical signatures (Fig. 2). In the Little Kalzas succession, alkali basalt both underlies and overlies the calc-alkaline volcanic rocks. In Little Salmon succession, alkali basalt appears to be laterally continuous with the calc-alkaline andesite. The occurrence of alkaline rocks within continental arc sequences of Yukon-Tanana Terrane is most reasonably interpreted to indicate episodic rifting of the arc (Colpron, this volume). It is also noteworthy that the two main pulses of arc magmatism documented here are punctuated by an episode of contractional deformation (Colpron et al., 2000).

The Boswell/Semenof succession is juxtaposed with the Snowcap assemblage along Big Salmon Fault (Colpron, this volume). This succession consists of dark grey slate, greywacke and chert-pebble conglomerate, limestone, volcaniclastic rocks and andesitic greenstone of Pennsylvanian age (Fig. 2; Tempelman-Kluit, 1984; Tempelman-Kluit *in:* Gordey et al., 1991; Poulton et al., 1999). Although it is not currently considered part of Yukon-Tanana Terrane (Wheeler et al., 1991 included it in Slide Mountain Terrane; Gordey and Makepeace, 1999, in Quesnel Terrane), the resemblance of Boswell/Semenof succession to recently identified Pennsylvanian strata in Yukon-Tanana Terrane of Finlayson Lake district (Murphy, this volume; Fig. 2, column 3) requires a re-evaluation of its tectonic setting. Dark grey siliceous phyllite (and subordinate graded sandstone, conglomerate and marble) of the Bearfeed allochthon, which sits in klippen overlying the Little Salmon succession (Colpron, 2000), is possibly correlative with the base of the Boswell/Semenof succession.

SOUTHERN WOLF LAKE – NORTHERN JENNINGS RIVER AREA

J.L. Nelson and C.F. Roots

(Fig. 2, column 6) This set of three sections represents all of the allochthonous (non-North American) rocks in the Wolf Lake/Jennings River area (Fig. 1), with the exception of the Big Salmon Complex. From east to west, the three columns represent: the Ram Creek assemblage, the Dorsey assemblage, and a stratigraphic composite that includes the Swift River succession, Screw Creek limestone and Klinkit succession.

The Ram Creek assemblage contains tracts of mafic to rhyolitic meta-tuffs with local limestone and chert sequences. Two U-Pb dates from felsic tuffs are late Mississippian (Nelson, 2000), coeval with tuffs in the Big Salmon Complex (Figure 2, column 5) and Little Salmon succession (Figure 2, column 4). One metaplutonic body within the Ram Creek assemblage is of early Mississippian age (Nelson, 2000); in another, the U-Pb systematics allow for either an early or a late Mississippian age (Roots and Heaman, 2001).

The Dorsey assemblage structurally overlies the Ram Creek assemblage across an east-verging, post-mid Permian but pre-Early Jurassic thrust fault (Stevens and Harms, 1995; Stevens and Harms, 2000). The Dorsey assemblage is a siliceous succession including quartzite and quartzo-feldspathic meta-sedimentary protoliths, intermediate to mafic meta-tuff, meta-chert, quartz-augen felsic meta-tuff and marble; meta-basic bodies (amphibolite/garnet amphibolite) are concentrated near its base. Highly deformed early Mississippian granitoids range from granite to gabbro. The Dorsey assemblage is characterized by medium- to high-pressure metamorphic mineral assemblages, where they have not been obscured by retrograde overprinting. The oldest rocks in it are pre-early Mississippian, and could be much older. A quartz-augen meta-rhyolitic tuff in the upper part of the Dorsey assemblage in southern Yukon has yielded an early Mississippian U-Pb age (Roots and Heaman, 2001). This lends strength to the argument, based on dated granitoids, that the Dorsey assemblage represents an early Mississippian arc and its pericratonic substrate. The rhyolite is highly foliated to protomylonitic, and contains microcline, relict coarse muscovite and rare garnets. Its state of strain and degree of metamorphism are indistinguishable from the rocks that surround it. Thus the major deformation/metamorphism of this assemblage was probably between early Mississippian and mid-Permian, the age of the post-kinematic Ram stock that intrudes the Dorsey assemblage in southern Yukon (Stevens and Harms, 1995).

West of, and structurally above the metamorphic Dorsey assemblage, three units occur in a folded but consistent stratigraphic sequence. The lowest of these, the Swift River succession, comprises dark-coloured chert and argillite with interbeds and intervals of quartzite, greywacke and quartz-feldspar grit. It overlies the Dorsey assemblage on a contact that is sharp to gradational in terms of lithology, and gradational in metamorphic grade: garnet and biotite persist upwards into the lowest Swift River rocks. The oldest age of the Swift River succession is unknown. It is stratigraphically overlain by the Screw Creek limestone, which contains mid-Mississippian (Viséan) as well as Pennsylvanian fossils. Evidence that this contact is a regional late Mississippian unconformity is as follows: 1) Locally the uppermost part of the Swift River succession consists of pebble- to boulder-conglomerate with chert, argillite and quartzite clasts, and a grit-greywacke-rich sequence. 2) The Screw Creek limestone contains layers of chert pebbles, presumably derived from the underlying Swift River succession, as well as volcanic debris that links it to the overlying/ interfingering Klinkit succession. 3) Finally, in the northern part of the area, the Swift River succession is eliminated, and undated but probable Screw Creek-equivalent limestone, and associated volcanic rocks of the Klinkit succession, lie directly above the Dorsey assemblage.

The Klinkit succession has two distinct facies. A volcanic/ epiclastic facies dominates most of the area, containing green chloritic meta-tuffs and breccias, volcanic-derived meta-siltstone and minor mafic flows, light-coloured limestone and siltstone-argillite layers. This widespread volcanogenic sequence occurs from west-central Wolf Lake map area in the north, through Swift River/ McNaughton Creek and into west-central Jennings River map area south of the Simpson Peak batholith. A much more restricted facies only outcrops west of the Seagull Batholith. There, the Screw Creek limestone is overlain by an unusual non-volcanic quartz-clastic sequence, characterized by thin-bedded limy siltstone and argillite, with black chert intervals.

The top of the Klinkit succession in west-central Jennings River area is a variable succession of meta-siltstone through quartzite with chloritic meta-tuff layers. The youngest unit, the Triassic 'Teh clastic' succession, consists of interbedded black argillite, meta-siltstone and quartzite, with minor chert, fetid limestone and conglomerate (T. Harms, pers. comm., 1999). Three limestone localities yielded Triassic conodont fauna (M. Orchard, pers. comm. to T. Harms, 1997). The 'Teh clastic' succession overlies a variety of units. North of Klinkit Lake, it appears to conformably overlie a 70-m-thick succession of mixed limestone, mafic to intermediate volcaniclastics and minor argillite. This succession in turn overlies the main volcanogenic Klinkit succession. However, in at least one locality, between the southern lobes of the Simpson Peak and Nome Lake batholiths, it directly overlies metamorphosed and multiply foliated Swift River succession phyllites in a presumed unconformable relationship.

NORTHWEST JENNINGS RIVER AREA

M.G. Mihalynuk

(Fig. 2, column 5) In 2000, fieldwork in northwest Jennings River (Fig. 1) focused on examination of a manganiferous meta-chert marker horizon within the Big Salmon Complex referred to as the 'crinkle chert' (Mihalynuk et al., 1998). This marker can be traced for over 80 km in northern British Columbia. It is lithologically similar to a unit known from the Little Salmon area (Colpron and Reinecke, 2000), 250 km to the north, but geological evidence indicates that the two are probably not coeval. The maximum age of the Little Salmon Mn-chert is constrained as late Mississippian by the maximum age limit of fossils in underlying strata (Fig. 2, column 4). On the other hand, the minimum age of the Big Salmon Complex crinkle chert is older than middle Mississippian, based on dykes that cut overlying strata (Mihalynuk et al., 2000).

Prior to 2000, it was not possible to unambiguously establish the origin of the crinkle chert on field evidence alone. It could be interpreted as a pure meta-siltstone, but it lacks clastic sedimentary textures. It could be metamorphosed radiolarian chert that lacks fossil radiolaria because of the high degree of strain to which the unit has been subjected.

Field investigations in 2000, however, revealed stratiform magnetite layers near the top of the crinkle chert unit. These layers, up to a decimetre thick, are best explained as hydrothermal in origin. Furthermore, evaluation of existing geochemical data from the crinkle chert also indicates a hydrothermal, not hydrogenous genesis (Mihalynuk and Peter, 2001). A seafloor hydrothermal source for the crinkle chert unit underscores the potential for volcanogenic massive sulphide mineralization in the area.

AISHIHIK LAKE AREA

S.T. Johnston

(Fig. 2, column 1) The Aishihik metamorphic suite (Erdmer, 1991) is commonly included in Nisling Terrane (Gordey and Makepeace, 2000), but is here considered part of Yukon-Tanana Terrane. It occurs outboard (west) of accreted oceanic and oceanic-arc terranes (Stikinia and Cache Creek) in southwest Yukon (Fig. 1). The suite is penetratively deformed and metamorphosed, having experienced regional synkinematic metamorphism ($P < 10$ kbar) in the early Jurassic, and high T – low P metamorphism associated with the emplacement of the Ruby Range plutonic suite in the latest Cretaceous and early Tertiary.

The Aishihik suite is divisible into two units, and dips regionally to the northeast, exposing the structurally deepest rocks to the southwest. The younging direction of the suite is unknown. A structurally lower unit of feldspathic quartz-mica schist and marble, with minor mafic and felsic meta-volcanic rocks, is locally characterized by ironstone (magnetite) lenses. The marble horizons form continuous layers (up to 50 m thick) that can be traced for kilometres. The heterogeneous upper unit consists of equal volumes of clastic sedimentary and igneous rocks, and is commonly separated from the lower unit by a conspicuous marble – amphibolite layer >1 km thick. Carbonaceous quartzite, micaceous quartzite, and discontinuous lenses of marble are intimately interfoliated with meta-igenous rocks comprising thick sequences of mafic to intermediate volcanic rocks, and both I- and S-type granitoid intrusions.

The Aishihik metamorphic suite is intruded by, and is older than, the Aishihik Batholith (U-Pb zircon age of 185.6 +2.0 / -2.4 Ma). A U-Pb zircon age determination of a sample of a two-mica, peraluminous orthogneiss from the Upper Aishihik metamorphic suite is consistent with crystallization between 351.5 ± 2.0 and 343.8 ± 0.8 Ma (inheritance and lead loss prevent a more precise age determination). Because the igneous rocks in the upper unit appear to be intimately interlayered with the clastic rocks, pointing to an original depositional relationship, we interpret this age to be close to the age of the associated sedimentary rocks. Both the Aishihik Batholith and the two-mica orthogneiss are characterized by an inherited zircon component with a Paleoproterozoic average age (Johnston et al., 1996).

NORTHERN DAWSON RANGE

S.T. Johnston

(Fig. 2, column 2) A heterogeneous mix of carbonaceous clastic and meta-igneous rocks with minor marble and calc-silicate rocks (Johnston and Hachey, 1993) occurs as wall rocks to, and xenoliths and septa within the mid-Cretaceous Dawson Range Batholith. The younging direction of this suite is unknown. The structurally lowest portions of the suite consist of thick sections of carbonaceous to tan quartzite. These pass up section into a more igneous dominated sequence. Minor amounts of felsic schist and amphibolite are interlayered with quartz-mica schist, quartzite, discontinuous lenses of marble, and large volumes of metaluminous orthogneiss interpreted as intrusions. These include the Selwyn gneiss, which caps the sequence to the northeast. The suite is definitely older than the 105 Ma Dawson Range Batholith and also intruded by probable Early Jurassic plugs. A U-Pb zircon age of 357.9 ± 3.5 (Johnston, 1995; S. Johnston and J. Mortensen, unpublished data, 1995) for a sample of orthogneiss interpreted as an intrusive body, may provide a minimum age constraint for the metaclastic and metavolcanic rocks in northern Dawson Range.

STEWART RIVER AREA

J.J. Ryan and S.P. Gordey

Geological mapping during the summer of 2000 near Thistle Creek represents the first of a three-year program in the Stewart River area (115N-O). Because this project is in its early stage, the lack of geochronological and/or paleontological constraints, and uncertainties as to the stratigraphic younging of these rocks preclude inclusion of a stratigraphic column for Yukon-Tanana Terrane in the Stewart River area. What follows is a brief discussion of the tectonostratigraphic associations identified in the Thistle Creek area (115O/3); more detailed descriptions of these rocks are given in Ryan and Gordey (2001a; 2001b).

Yukon-Tanana Terrane in the Thistle Creek area comprises polydeformed and metamorphosed amphibolite facies gneisses and schists intruded by younger plutonic rocks. The gneisses exhibit a shallowly inclined, high-strain regional foliation (S_T), formed through transposition of bedding (S_0), unit contacts, an earlier foliation (S_1?), and minor veins. Regional correlations of plutonic suites indicate that the transposition event was post-Carboniferous and pre-Jurassic (Mortensen 1992). Although primary stratigraphy is obscured by the transposition as well as by later open folds and faults, the area is clearly dominated by two fault-bounded tectono-stratigraphic associations: 1) polyphase grey orthogneiss in garnet-amphibolite schist/gneiss, interpreted herein as a meta-volcano-plutonic complex; 2) interstratified garnet-amphibolite schist/gneiss and meta-sedimentary schist and paragneiss derived from psammite, semipelite and quartz arenite, collectively interpreted as a meta-volcano-sedimentary succession.

Amphibolites, which are the most widespread rock type, have been intensely tectonized. Heterogeneous compositional layering and local vestiges of primary textures such as breccia clasts or pillow selvages indicate derivation from mafic volcanic to volcaniclastic rocks. Quartz-sericite schist, likely derived from felsic volcanic rocks or hypabyssal intrusions, are locally interlayered with the amphibolites. The interfingered meta-felsites and amphibolites are consistent with bimodal volcanism, possibly in an arc setting.

Grey and white-banded quartzites are generally in fault contact with the gneisses and schists, and their stratigraphic relationships are equivocal. An occurrence of meta-conglomerate along the Yukon River exhibits quartz and tonalite clasts in a matrix of quartzofeldpathic schist. The conglomerate grades locally to impure quartz arenite, and is adjacent to an occurrence of grey quartzite.

Three bodies of potassic feldspar augen granite gneiss in Thistle Creek map area may correlate with a suite of Devono-Mississippian augen granites dated regionally at ca. 360 Ma (Mortensen, 1992). These have experienced complete transposition deformation. Young, leucocratic granitic plutons and/or dykes crosscut the gneisses. Some carry a weak foliation in their margins, and others exhibit weak boudinage. A pluton and several smaller satellite bodies and dykes in the central part of the map area consist of syenogranite with large potassic feldspar phenocrysts. They are completely undeformed, and are likely Cretaceous or younger. Rare young, quartz-potassic feldspar porphyritic rhyolite to rhyodacite stocks in the area are of probable Tertiary age.

Recognition of the Thistle Creek area as containing abundant meta-volcanic rocks has significant implications for its economic potential. The few occurrences of felsic schist in the area may be prospective for syngenetic mineralization (both Kudz Ze Kayah and Wolverine deposits are hosted in felsic volcanic rocks; Murphy, 1998 and references therein). Exploration will have to take into account that primary geochemical (e.g., alteration), structural and lithological signatures have been strongly modified by the high metamorphic grade and state of strain.

SUMMARY

The integration of stratigraphic, structural, geochronological and geochemical data depicts the Yukon-Tanana Terrane as a dynamic mid- to late Paleozoic pericratonic arc/back-arc system. Episodic magmatism prevailed in most parts of the terrane between Late Devonian and early Pennsylvanian time. During this period, the terrane experienced multiple cycles of arc build-up, arc rifting and the development of back-arc basins. It is near the end of two such cycles that the rich, polymetallic Kudz Ze Kayah and Wolverine deposits were formed in the Finlayson Lake district. In other parts of the terrane, hydrothermal activity is indicated by the occurrence of manganiferous siliceous exhalites (e.g., the 'crinkle chert' marker in the Big Salmon complex) and numerous base-metal occurrences (Fig. 2).

These arc/back-arc cycles were punctuated by episodes of apparently contractional deformation. The oldest deformational event, of early Mississippian age, separates the two magmatic cycles identified in the Finlayson Lake district. A younger, mid-Mississippian episode of contractional deformation, first identified in northwest Glenlyon area, may well have affected much of the southern Yukon-Tanana Terrane (Fig. 2). This deformational event closely follows the cooling of eclogites at 346 Ma in the terrane in Frances Lake area (Erdmer et al., 1998). At least two additional episodes of northeast-directed thrusting are inferred to have occurred during Pennsylvanian time in the Finlayson Lake district; these events have not yet been recognized elsewhere in the terrane.

Late Mississippian – early Pennsylvanian time was a period of significant carbonate deposition in Yukon-Tanana Terrane. By late Pennsylvanian time, much of the terrane was overlain by basic volcanic rocks of the Campbell Range, Semenof and Klinkit successions. These rocks represent the most definite tie between the various parts of the terrane. They probably record the development of a marginal basin, which may have persisted into Early Permian time.

By mid- to Late Permian time (*ca.* 270-260 Ma), a magmatic arc developed in the Klondike region (Klondike Schist; Mortensen, 1990), while other parts of Yukon-Tanana Terrane were undergoing regional deformation and high-pressure metamorphism (e.g., Erdmer et al., 1998). The record of these events is in part preserved in the Permian conglomerate, which unconformably overlies Yukon-Tanana Terrane in Finlayson Lake, Frances Lake and Watson Lake areas. Mid-Permian metaluminous plutons elsewhere in the terrane (Cornolio pluton, Ram stock, and small intrusions in Finlayson Lake district; Fig. 2) are likely the southern extent of the Klondike magmatic arc.

Work continues in documenting the stratigraphic successions and in characterizing the volcanic sequences of Yukon-Tanana Terrane. These data will also be compiled on a common base (with the Tintina Fault restored) with the objective of constructing a set of paleogeographic maps for the Paleozoic of Yukon-Tanana Terrane. These maps will identify what geological environments were operative at different times in the evolution of the terrane and highlight areas where information is lacking. Furthermore, documentation of the various geological environments represented in Yukon-Tanana Terrane will assist in identifying regions which may be prospective for deposition of syngenetic sulphide deposits in this and correlative parts of the Canadian Cordillera.

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