Tracking Yukon-Tanana Terrane VMS Host Stratigraphy and Intrusion-Related Gold in the Southern Sylvester Allochthon (Beale Lake Map Area, 104I/14N)

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INTRODUCTION

This report describes a new mapping project in the Cassiar Mountains, located 70 kilometres northeast of Dease Lake in northern British Columbia. The area is attractive for two reasons. First, it contains rocks that are likely correlative with those of the Yukon-Tanana Terrane, a tract with known volcanogenic massive sulphide potential. Second, combined geological and regional geochemical data suggest possible intrusion-related gold mineralization within it.

The Beale Lake area, bordering the northeast side of the mid-Cretaceous Cassiar Batholith, is largely underlain by the Sylvester Allochthon, a stack of thrust sheets of oceanic to pericratonic arc affinity that overlies the para-autochthonous Cassiar Terrane (Figure 1).

The structurally highest sheet is a highly deformed pericratonic assemblage (Gabrielse, 1998). Like the Yukon-Tanana Terrane, it contains early Mississippian intrusions. The YTT in the Finlayson Lake belt in southern Yukon hosts several significant volcanogenic massive sulphide deposits associated with early Mississippian volcanic suites. Over the past 4 years, the Ancient Pacific Margin Natmap project has traced pericratonic Yukon-Tanana Terrane stratigraphy continuously southwards from the Finlayson belt into the Jennings River map area of northern B.C., where equivalent strata, including Mississippian felsic volcanic rocks and exhalative units, occur within the Big Salmon Complex and Dorsey assemblage (Mihalynuk *et al.* 1998, 2000, Nelson 1999, 2000). It has been suggested that the pericratonic assemblage in the Sylvester Allochthon is a direct southeastward extension of the Dorsey assemblage, interrupted by the Cassiar batholith (Harms, 2000; Nelson, 2001). The present project is in hot pursuit of these crucial early Mississippian volcanogenic hosts.

The second rationale for this study sprang from identification of strong gold and related anomalies (Bi, As, Hg) in the Cry Lake Regional Geochemical Survey (RGS) release (Jackaman, 1996), a suite of elements commonly associated with intrusion-related gold mineralization. Sets of gold-bearing veins are known in the area, notably the Nizi and Beale Lake properties; but RGS anomalies occur outside areas of documented mineralization as well. The Nizi veins in the northeastern corner of the Beale Lake map area have been interpreted as Eocene in age and epithermal in origin (Plint *et al.*, 1997), whereas the Beale Lake veins show at least in part a bismuth-tungsten association that may place them at a deeper level in a intrusion-related system (Durfeld and Fleming, 2001). The regionally extensive mid-Cretaceous Cassiar batholith underlies most of southern Beale Lake map area, and the Eocene Major Hart pluton is located 20 kilometres to the southeast (Figure 2).

Field mapping in 2001 completed the northern half of the Beale Lake map sheet, 104I/14. The adjacent map area, 104I/15, will be covered in future work. Results of exploration significance are: recognition of bipartite Dorsey assemblage in the uppermost, pericratonic unit of the Sylvester Allochthon, with felsic volcanic rocks in its upper part; and discovery of several new mineral showings, including veins that enlarge the potential area of interest for intrusion-related gold significantly beyond that previously reported.

REGIONAL GEOLOGY

The northern Cry Lake map area is partly underlain by the Sylvester Allochthon, which outcrops between the Cassiar Batholith to the southwest, and subadjacent Paleozoic continental shelf strata of the Cassiar Terrane to the northeast and south (Figure 2, from Gabrielse, 1998). Previous mapping in the McDame map area to the north showed that the allochthon comprises three distinctive, stacked tectonic elements (Nelson, 1993). Structurally lowest are late Paleozoic oceanic rocks of the Slide Mountain Terrane, overlain (depositionally?) by Middle to Late Triassic sedimentary strata. Above a thrust fault lie late Paleozoic island arc rocks assigned to the Harper Ranch subterrane of Quesnellia. Early Mississippian and older pericratonic and arc rocks occur at the structurally highest level. This pericratonic unit was first recognized by Gabrielse and Harms (1989). Harms (1990) and Harms *et al*. (1993) referred to it as the Rapid River tectonite. In northern Cry Lake area, Gabrielse (1998) distinguished the pericratonic unit, which he called the siliceous tectonite unit, from the rest of the allochthon. He also defined two large mid-Permian plutons. His work has provided an excellent framework for further subdivision.

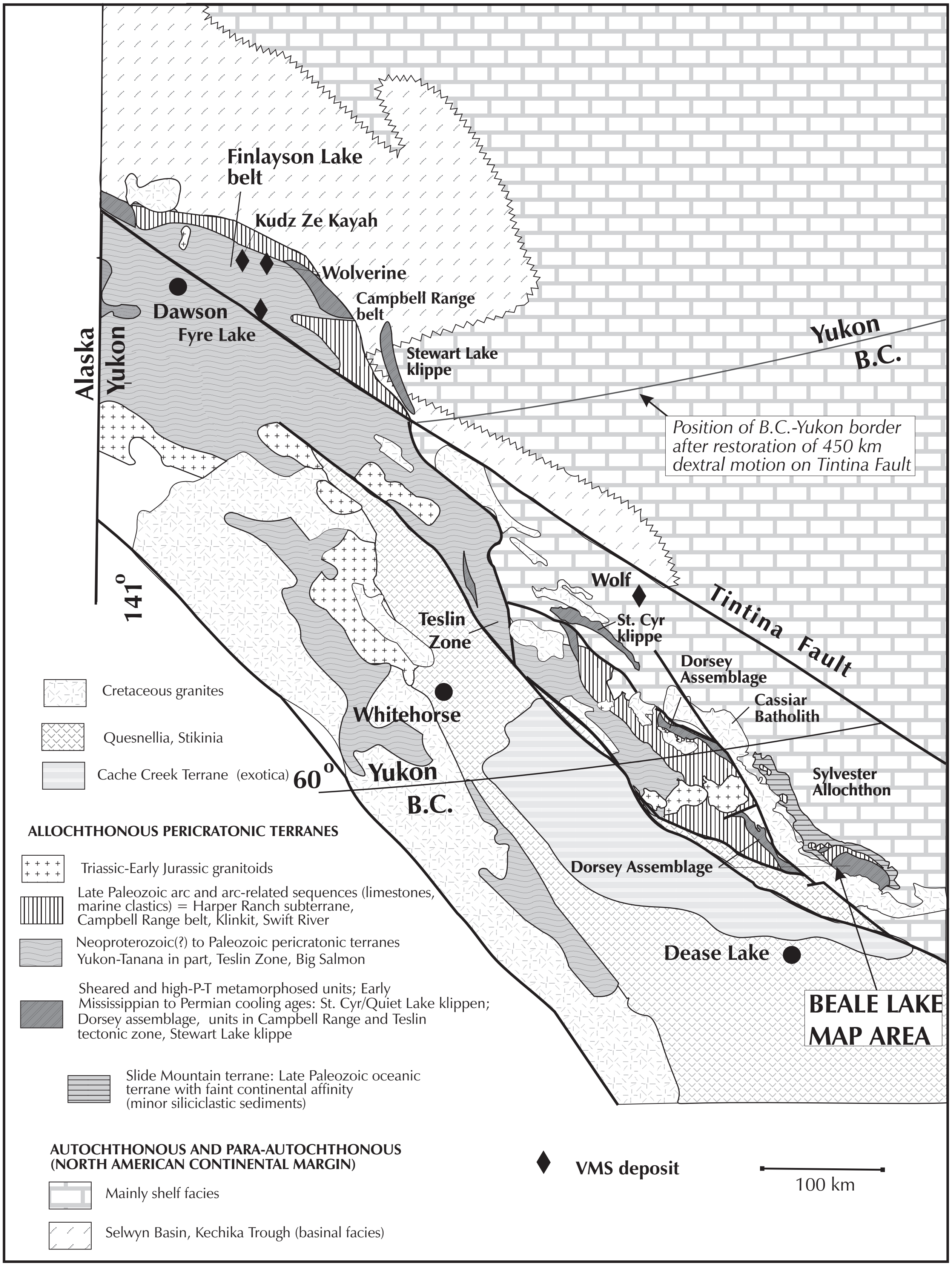

Figure 1. Regional geological setting of the Yukon-Tanana and surrounding terranes, Yukon and northern British Columbia.

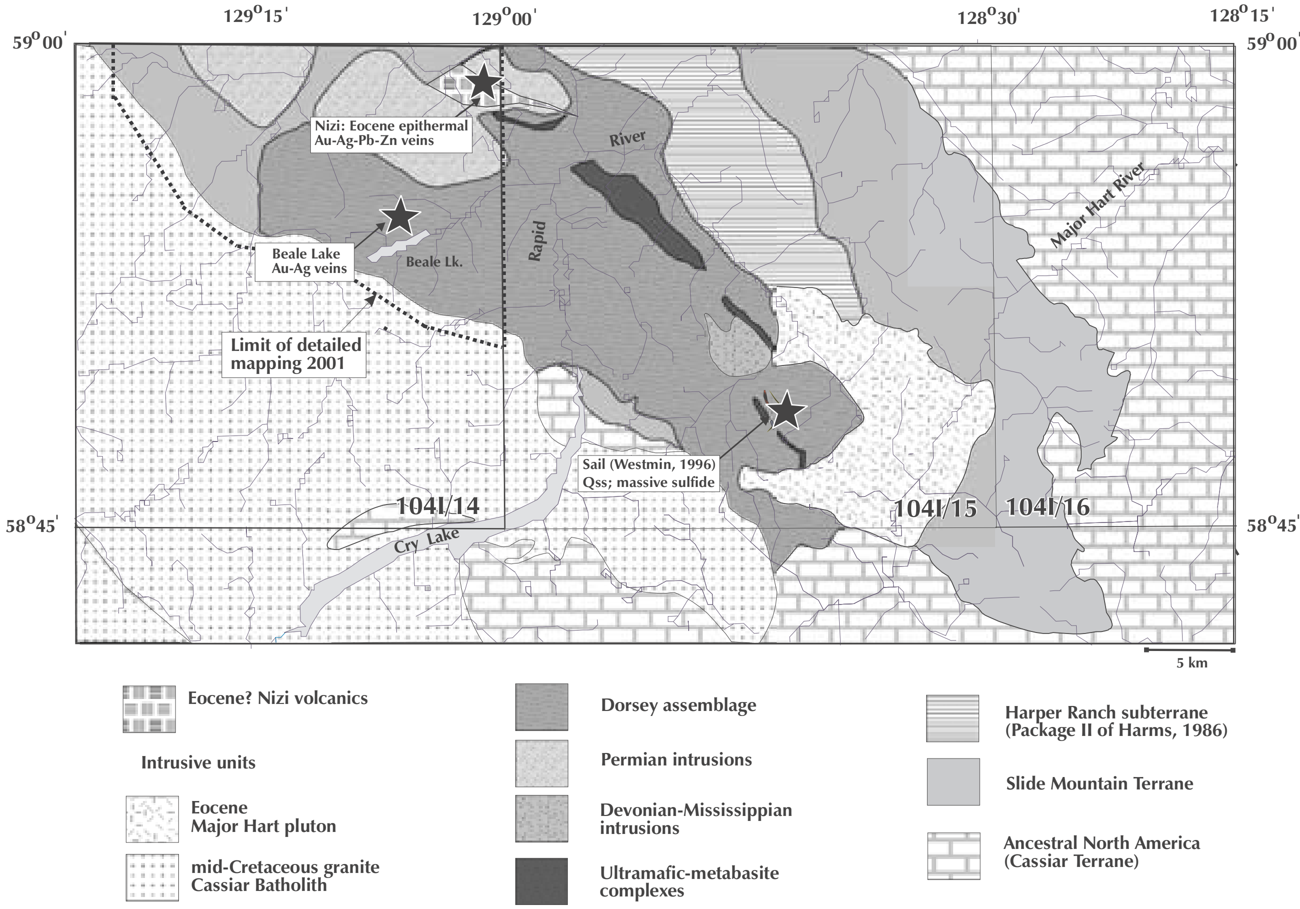

Figure 2. Geological setting of northern Cry Lake map area, prior to this project. Geology from Gabrielse (1998), Harms (1986), and Plint *et al.* (1997).

LOCAL GEOLOGY

The Sylvester Allochthon in northern Beale Lake map area comprises a set of stacked thrust slices folded into an upright syncline-anticline pair (Figure 3, 4).

Its general structure mirrors that seen farther north between the Dease River and the Yukon border. The structurally lowest slivers, truncated to the southwest by the Cassiar Batholith, are ultramafite, gabbro and basalt; they probably form a southern strike extension of Slide Mountain Terrane exposures along the Stewart-Cassiar Highway near Cassiar. They also correspond to Package I of Harms (1986). Above them, across a highly sheared contact, lies the Four Mile assemblage, a set of thrust slices of more diverse character, including widespread felsic to intermediate volcanic rocks of probable arc affinity. The volcanic rocks are intruded by the mid-Permian Meek and Nizi plutons. These rocks show a similar tectonic environment to Harper Ranch subterrane panels exposed farther north, for instance the Huntergroup volcanics and an unnamed Permian pluton in the headwaters of Big Creek near the Yukon border (Nelson and Bradford, 1993).

The Beale Mountain Thrust, exposed for many kilometres on the western face of Beale Mountain above the Four Mile River valley, spectacularly marks the base of the deformed and metamorphosed pericratonic allochthon (Figure 6a). It juxtaposes amphibolite and metasedimentary rocks, which were ductilely deformed in early Mississippian time, above a virtually undeformed Pennsylvanian-Permian volcanic/plutonic footwall. Above the thrust, the deformed rocks can be divided into two units, which correspond to the lower and upper Dorsey assemblage in the southern Yukon and northern British Columbia west of the Cassiar Batholith (Roots and Heaman, 2001; Nelson, 1999, 2000). The lower unit consists of strongly deformed, garnet grade basinal sedimentary rocks - metachert, meta-argillite, pelite and quartzite - with large lenses of amphibolite and metagabbro. The well-foliated but less tectonized upper unit contains phyllite, quartzite, metachert and most significantly, quartz-feldspar porphyry rhyolite and dacite flows and tuffs.

The youngest rocks in the area are the Zinc Lake volcanic/intrusive suite, which outcrops near the informally named Zinc Lake on the Nizi property in the northeastern corner of the map area. Fine grained, undeformed andesite,

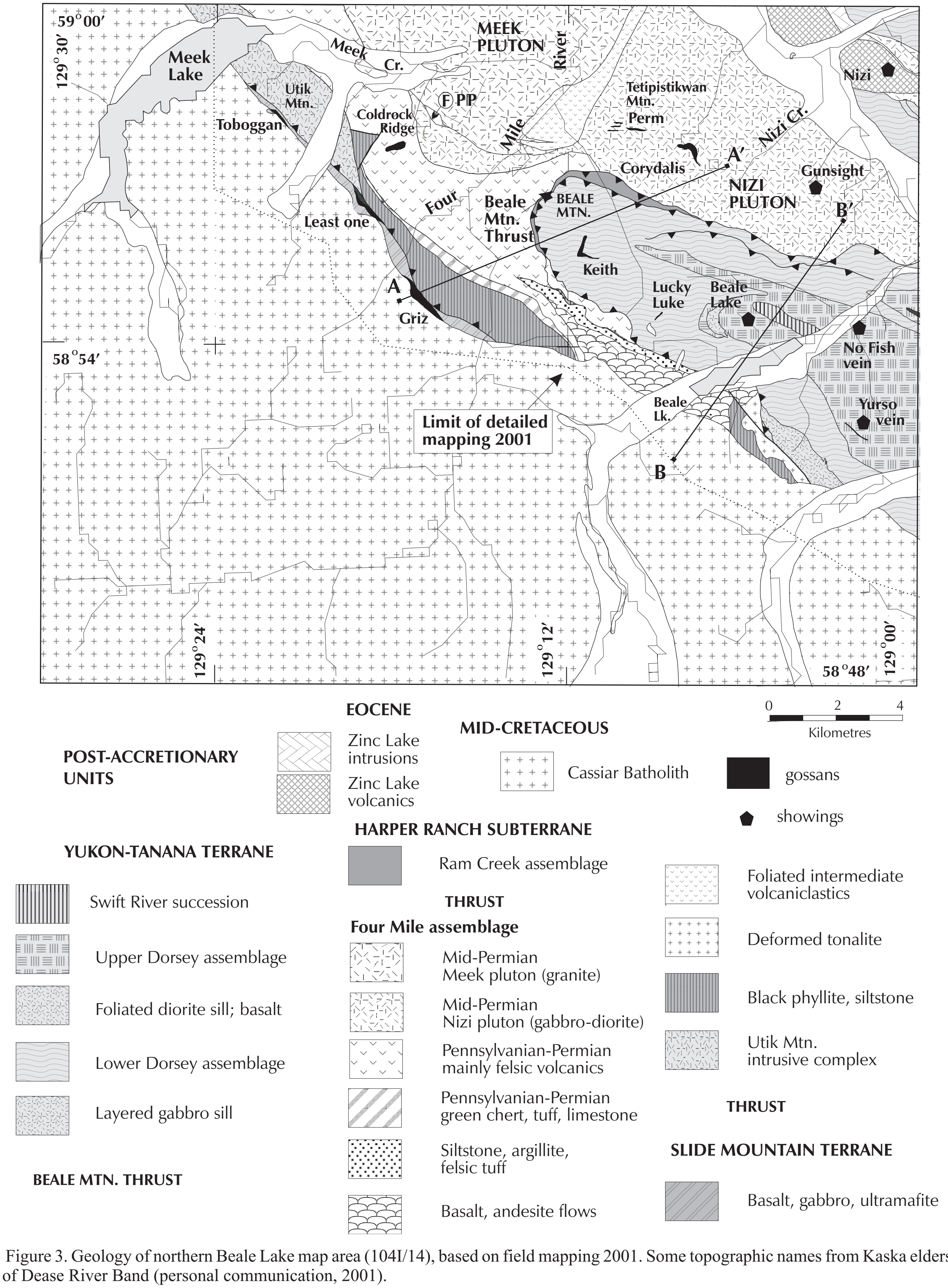

Figure 3. Geology of northern Beale Lake map area (104I/14), based on field mapping 2001. Some topographic names from Kaska elders of Dease River Band (personal communication, 2001).

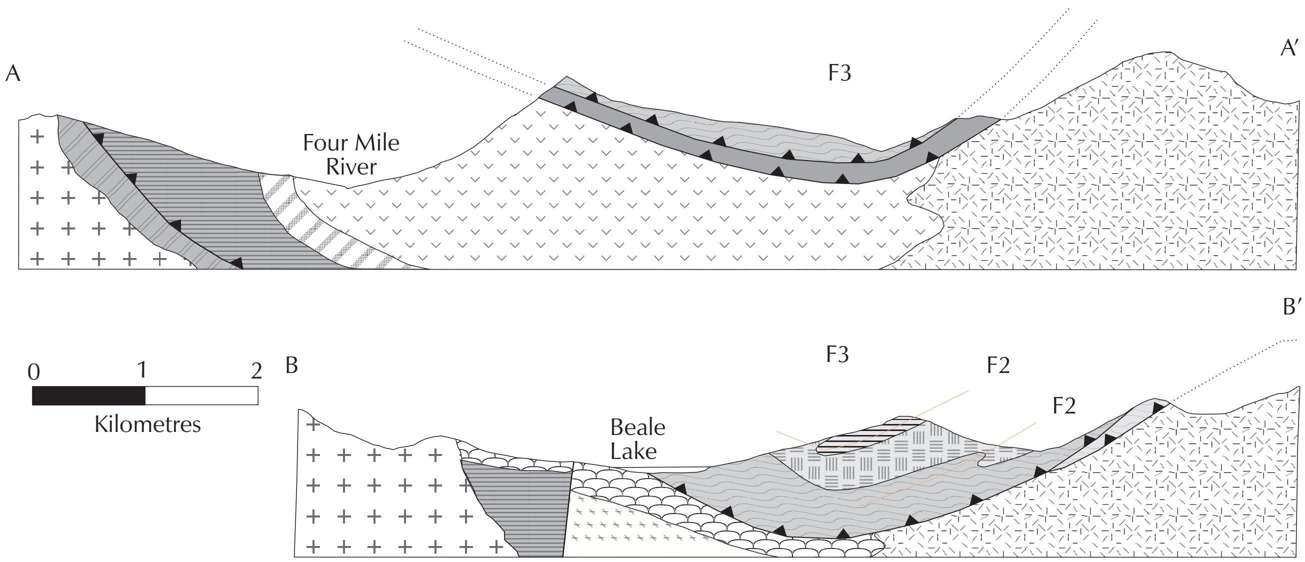

Figure 4. Cross sections of the Sylvester allochthon in the Beale Lake map area. *See* Figure 3 for geological legend and location of lines.

dacite and rhyolite flows and pyroclastic deposits are intruded by rhyolite and quartz-feldspar megacrystic dikes. This suite hosts the Nizi vein system. Galena lead signatures from the veins resemble other epigenetic, Cretaceous-Tertiary deposits of the Cassiar Terrane; the nearest correlative of the felsic intrusions is the Eocene Major Hart pluton. These observations led Plint *et al*. (1997) to assign an Eocene age to the suite. They termed it the Nizi volcanic sequence. The name Zinc Lake suite is proposed for the volcanic and associated intrusive rocks, to avoid confusion with the nearby Permian Nizi pluton.

SYLVESTER ALLOCHTHON

Rocks of the Sylvester allochthon are described in ascending structural order, *i.e.* Slide Mountain Terrane, Harper Ranch subterrane, and Yukon-Tanana Terrane (Dorsey assemblage). This order also corresponds to their pre-accretionary paleogeographic positions vis-à-vis North America, with a late Paleozoic Slide Mountain ocean the most inboard, a Yukon-Tanana pericratonic fragment most allochthonous, and a late Paleozoic Harper Ranch arc located between.

Slide Mountain Terrane

Ultramafic rocks, gabbro, basalt and minor argillite outcrop in a narrow northwesterly-trending strip located immediately northeast of the Cassiar Batholith. They lie structurally at the lowest exposed level in the Sylvester Allochthon in the Beale Lake map area (Figure 3). A few enclaves of texturally intact, serpentinized harzburgite tectonite hint at the ophiolitic affinity of this assemblage. Most rocks are highly sheared. The assemblage has been metamorphosed in greenschist facies with actinolite stable throughout. Most of the ultramafic bodies have been strongly altered to quartz-carbonate (-mariposite). No age control is available locally; however Slide Mountain basalt-sedimentary and ultramafite- gabbro panels near Cassiar have been dated as Mississippian through mid-Permian by conodonts and U-Pb methods (Nelson and Bradford, 1993).

Four Mile Assemblage (Harper Ranch Subterrane)

This group of thrust slices, informally termed the Four Mile assemblage, is bounded below by the Slide Mountain ultramafite/gabbro/basalt panel, and above by the Beale Mountain Thrust (Figure 3). The lowest slice, outcropping near Meek Lake in the northwestern part of the map area, consists of the Utik Mountain intrusive complex, a variable mafic complex with metasedimentary and metavolcanic screens. The main slice extends from south of Beale Lake, though the Meek Creek and Four Mile River drainages, into Nizi Creek to the northeast. It is structurally repeated on a secondary fault below the Beale Mountain Thrust on south Beale Mountain. Within these two repeated and related slices, undeformed volcanic rocks of varied compositions directly overlie a basement of polydeformed black phyllite, siltstone and argillite, which is cut by a tectonized tonalite/granodiorite pluton in exposures south of Beale Lake. The age of the undeformed volcanic rocks is constrained by a single Pennsylvanian-Permian conodont collection from a locality 6 kilometres east of Meek Lake (Gabrielse, 1998; *see* Figure 3). The mid-Permian Meek and Nizi plutons both show unequivocal intrusive contacts against volcanic country rocks in the main slice. The highest slice, directly below the Beale Mountain Thrust, consists of highly sheared, greenschist-grade metaplutonic and metavolcanic rocks that range from quartz-feldspar porphyries to gabbro. It is correlated with the Ram Creek assemblage, a strongly deformed, greenschist-grade assemblage with Mississippian plutonic and volcanic protoliths, which directly underlies the Dorsey assemblage west of the Cassiar batholith (Harms and Stevens, 1996; Nelson 2000).

The Utik Mountain intrusive complex is restricted to a single thrust slice, and does not resemble any other unit in the assemblage. Its component intrusions vary considerably in texture and composition, from clinopyroxene and hornblende gabbros cut by actinolite pegmatites, to fine grained hornblende-phyric basalt dikes with chilled margins. It contains rafts of chert and thin-bedded tuff and argillite, and at least one enclave of quartz-sericite schist, deformed and metamorphosed before intrusion. The variability of this complex, along with the prevalence of phenocrystic hornblende, suggests arc rather than oceanic affinity.

The black phyllite/siltstone/argillite unit forms the bases of both the main thrust sheet and of the structurally repeated sliver on south Beale Mountain. It is dominantly black and very fine grained. Laminated and cross-laminated siltstone beds are seen in places. This unit is characteristically foliated and crenulated, with several generations of folding evident. Post-kinematic andalusite, probably related to the Cassiar Batholith, is common in exposures north of Beale Lake. Diopside porphyroblasts occur in more calcareous lithologies south of Beale Lake. South of Beale Lake, this unit exhibits interfingering intrusive contacts with a coarse grained tonalite/granodiorite pluton. Textures in the pluton range from pristine, with only moderate replacement of original hornblende by biotite, to laminated mylonite unrecognizable as to protolith. This unit resembles polydeformed carbonaceous Devonian-Mississippian metasedimentary units, such as the autochthonous Earn Group and the Nasina Series of the Yukon-Tanana Terrane. It is overlain on abrupt, unsheared contacts in two well-exposed localities by undeformed volcanic and associated sedimentary strata.

The undeformed sequence is subdividable into several map units. The most widespread unit, which extends from south Beale Mountain to the northern border of the map area, is dominated by felsic, nearly aphanitic rhyolite and dacite flows and related pyroclastic deposits. The felsic unit reaches thicknesses of more than 2 kilometres. In outcrop the flow rocks are pale green, aphanitic, and commonly seamed with reticulating networks of fine chlorite veinlets. Lapilli tuffs, composed of matrix-supported angular felsic fragments, form pods and crude beds interspersed within the flows. Both Kspar-rich (rhyolitic) and Kspar-absent (dacitic) compositions have been confirmed by staining. In the northern part of the area, the felsic flow/tuff unit makes up most of the upper volcanic portion of the main thrust slice, above 100-300 metres of tuff, argillite and limestone. Excellent exposures of this steeply northeast-dipping sequence are seen on Coldrock Ridge between Meek Creek and the Fourmile River. Gabrielse (1998) reports recovery of Pennsylvanian-Permian conodonts from an outcrop that lies between the Meek pluton and a northwestern finger of the Nizi pluton (Figure 3). The locality is a breccia that contains limestone and felsic volcanic clasts in a pale green tuffaceous matrix (H. Gabrielse, pers. comm. 2001), underlain by sea-green, ribbon-bedded chert. Southward across the Four Mile River, the monotonous felsic unit interfingers with hornblende-plagioclase phyric andesites, well-bedded waterlain tuffs, and basalt, giving way along strike to other units. Farther to the southeast, two units predominate: a right side-up, northeast-facing volcanic-sedimentary unit, and an underlying basalt/basaltic andesite flow unit. The volcanic-sedimentary unit includes dark brown-grey argillite, siltstone, limestone, and tuff. The lapilli tuffs consist of white ash fragments in a brownish-grey, silt-mudstone matrix; they are in direct, depositional contact with dark green, nearly aphanitic basalt to andesite flows of the underlying unit. This relationship exhibits the compositional heterogeneity of the volcanic rocks in the Four Mile assemblage. They are thought to be of volcanic arc affinity, based on their basalt to rhyolite compositions, the predominance of felsic compositions, features like coarse lapilli tuffs and large phenocrysts, interfingering with clastic sediments, and their deformed metasedimentary basement.

The Meek and Nizi plutons are two compositionally distinct bodies arranged along regional trend in the northeastern part of the map area (Figure 3). They are mostly separated by a mildly foliated volcanic/volcaniclastic inlier, which consists of green porphyritic andesite to dacite flows and lapilli tuff. A finger of the Nizi pluton, extending along the western margin of the Meek pluton, is intruded by granitic and quartz-feldspar-phyric rhyolite dikes from it (Figure 5a).

Apophyses of both plutons intrude the felsic volcanic unit (Figure 5b). The southern boundary of the Nizi pluton below the deformed pericratonic rocks is not an intrusive contact, as reported in Gabrielse (1998), but a thrust fault with shear zones developed in both hanging and footwall (Figure 5c). Therefore the revised map interpretation is that both plutons lie in the footwall of the Beale Mountain Thrust, with the geologically younger Meek pluton intruding the Nizi pluton and both intruding rocks as young as Pennsylvanian-Permian.

The Nizi pluton is a very heterogeneous, multiphase body dominated by gabbro and diorite, with minor felsic tonalite and clinopyroxenite. Like compositions, textures in its component phases are strongly variable; hornblende in particular ranges from equant and poikilitic, replacing augite, to acicular. By contrast, the Meek pluton is a homogeneous granite. Typically coarse grained and equigranular, it consists of convex quartz intergrown with stubby plagioclase and orthoclase and lesser biotite. Neither pluton is strongly deformed, although zones of weak cataclasis affect them. Compositional layering and weak foliation are observed in the Nizi pluton, and its upper part adjacent to the Beale Mountain Thrust is highly sheared. The Meek pluton has been dated at 270±4 Ma by U-Pb methods on zircon, from a locality 1.5 kilometres west of the Four Mile River and .5 kilometres north of the Beale Lake map area. The same sample site yielded a 262±2 Ma U/Pb age on titanite, and a 266±4 Ma K/Ar age on biotite (Gabrielse *et al*., 1993). A K/Ar hornblende analysis from the Nizi pluton gave an

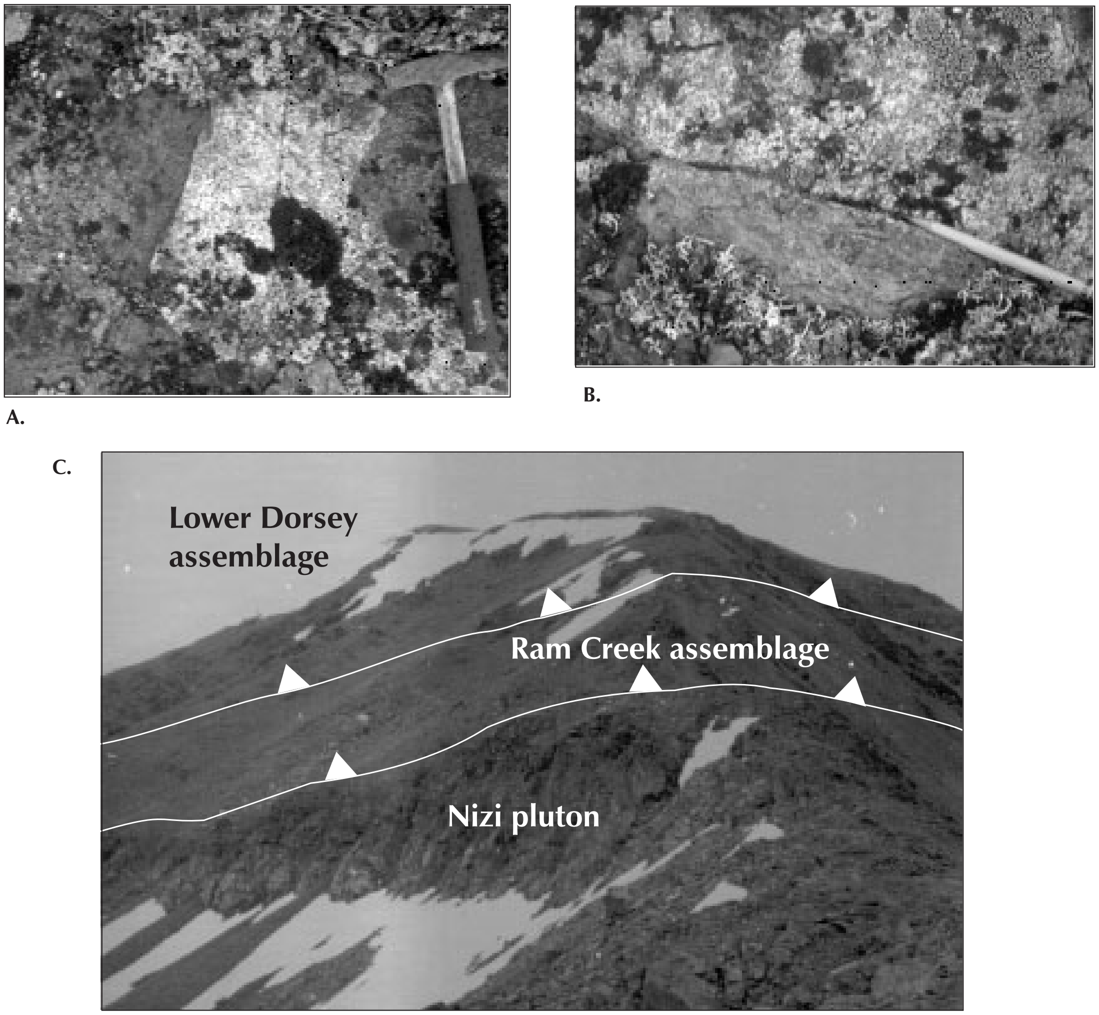

Figure 5. Key field relationships of the mid-Permian plutons. A) Dike of granite, texturally similar to, and probably an offshoot of Meek Pluton, cutting gabbro in an apophyse of the Nizi pluton. B) Nizi pluton diorite cutting undeformed felsic volcanic country rock of Four Mile assemblage. C) Upper thrust contact of the Nizi pluton below the Ram Creek and lower Dorsey assemblages.

age of 262±8 Ma (Hunt and Roddick, 1988). Therefore, although the Meek granite is geologically younger than the heterogeneous and more mafic Nizi pluton, in terms of available isotopic ages they are indistinguishable.

Dorsey Assemblage

The Dorsey assemblage is a layered sequence of metamorphic rocks intruded by deformed early Mississippian plutons, which lies structurally above the undeformed and weakly metamorphosed late Paleozoic rocks of the Four Mile assemblage. It occupies the core of a syncline that trends from Beale Mountain southeastwards across Beale Lake, and on the northeastern flank of the anticline that exposes the footwall Nizi pluton (Figure 3). It comprises two units, the upper and lower Dorsey assemblages, which are in contact across a layering-parallel, transitional zone. In spite of considerable penetrative deformation, and shearing particularly in the lower unit, these two units constitute an original and still readily interpretable stratigraphy. The term "tectonite" should be applied to these rocks with some caution, as they constitute neither broken formation nor tectonic melange.

Previous work suggested that the Permian Nizi pluton was emplaced into the metamorphic unit, constituting a common element with coeval plutons in the underlying panels (Gabrielse *et al.*, 1993). This study has documented a major fault, the Beale Mountain Thrust, between them. The existence of a Permian intrusive suite within the pericratonic assemblage, similar to the Ram Stock in the lower Dorsey Terrane near Swift River, Yukon (Stevens and Harms, 1995) and small pegmatites farther south in British Columbia (Nelson, 1999), has thus lost a major support. There is now only one known Permian intrusion within it, a small body between the Dease and Four Mile rivers in southern McDame map area (sample 89-SY-72A; Gabrielse *et al.*, 1993). However, a large, heterogeneous, unfoliated, diorite to tonalite body cuts the lower Dorsey assemblage northeast of Nizi Creek; part of it is exposed in the northeastern corner of Figure 3. In composition and texture it strongly resembles the nearby Nizi pluton, and could be its displaced roof. It has been sampled for U/Pb dating. In addition, sparse, greenish-black amphibolite rafts in the Nizi pluton indicate that it penetrated a basement not unlike the amphibolite-bearing lower Dorsey assemblage.

Lower Dorsey Assemblage

The lower Dorsey assemblage is an interlayered sequence of siliceous metasedimentary strata, amphibolite and metagabbro. The metasedimentary rocks, now fine grained quartzites, quartz-biotite-muscovite(-garnet-plagioclase) schists, marble and calc-silicates, probably had mostly chert, argillite and impure limestone protoliths. True pelites are rare; most micaceous rocks are dirty quartzites. Coarse-grained, pure, thickly layered orthoquartzites are also rare; the best example occurs near the exposed top of the unit on the west-facing spur north of Beale Lake. The interpreted metacherts form grey, ribbon-layered sequences. They tend to be highly pyritic. Some contain abundant garnets which may indicate manganese-rich compositions, and minor quartz-sericite schist suggests alteration.

Kyanite occurs in two samples from the lower Dorsey assemblage in the Sylvester Allochthon. In both cases it is relict, partly resorbed, and overgrown by muscovite. In one of these, from the west side of Beale Mountain, later fibrolitic sillimanite grows in the predominant fabric. This paragenetic sequence of kyanite to sillimanite mirrors aluminosilicate growth recorded in the lower Dorsey assemblage west of the Cassiar Batholith (Nelson, 2000). Harms *et al.* (1993) report amphibolite-grade assemblages of garnet-muscovite-zoisite and biotite-garnet-staurolite from pelites elsewhere in the deformed pericratonic assemblage.

Amphibolite occurs on all scales, from fine layers alternating with metachert and siliceous pelite to mountain-scale, lensoid bodies. Mineralogy varies from simple hornblende-plagioclase-quartz-titanite to garnet- and garnet-diopside-calcite-bearing varieties. The latter have a calcareous component in excess of that for normal basaltic rocks. It could be due to admixture with carbonate sediments, or seafloor alteration. In general these rocks show thoroughly metamorphic fabrics. Very fine, continuous titanite laminae could possibly reflect tuffaceous parentage. One example of plagioclase-quartz-garnet-filled amygdules(?) was noted.

Metamorphic fabrics in the amphibolites range from extremely foliated to nearly isotropic. The most foliated varieties consist of ribbons of very well aligned hornblende prisms, alternating with more felsic quartz-plagioclase-bearing laminae. Fine titanite trains parallel the layering. More equant and randomly oriented hornblende overgrows these textures, suggesting that peak metamorphism succeeded peak deformation. It is possible that the extremely foliated amphibolites inherited their fabrics from earlier phyllonites developed at lower metamorphic grade (J. Ryan pers. comm. 2001).

The metagabbros form a distinct, geologically younger suite than the amphibolites. Although foliated and sheared, they show clear relict plutonic textures, and never contain garnet. They may be cogenetic with a large layered gabbro body that intrudes the lower Dorsey assemblage south of Beale Lake. This body has strongly foliated and sheared margins. Apophyses of it show cross-cutting relationships with surrounding schists and amphibolites. Its unfoliated core is cumulate layered, involving sets of coarse and fine-grained gabbro, gabbro/leucogabbro, and gabbro/hornblendite rhythmites.

The lower Dorsey assemblage represents a pericratonic basin in which both intrusive and extrusive mafic material accumulated, possibly an intracontinental rift. Petrochemical analysis of amphibolites from west of the Cassiar Batholith shows a progression from N-MORB to E-MORB to within-plate compositions (Nelson, 2001). The metagabbros may belong to the syntectonic Mississippian intrusive suite identified by Gabrielse *et al.* (1998).

Upper Dorsey Assemblage

The upper unit of the Dorsey assemblage contrasts strongly with the lower unit. On both sides of Beale Lake, amphibolites abruptly disappear upsection, and well-foliated quartz-feldspar phyric metavolcanic rocks become important. They are accompanied by dark grey, grey, tan and green phyllite, quartzite with remnant quartz grains, and metachert. The identification of abundant felsic metavolcanic and epiclastic material in the upper part of the pericratonic unit is an important step in regional geological and metallogenetic correlations, since such rocks characterize both the metal-rich Finlayson Lake belt and, more locally, the upper Dorsey assemblage near Swift River (Roots and Heaman, 2001). U-Pb analyses are pending.

The felsic rocks include metamorphosed flows in which sparse quartz and feldspar porphyroclasts occur in finely (flow?-)laminated, dense, very fine grained quartz-plagioclase-Kspar matrix. Tuffaceous sequences show interbedding of phyllite, quartz- and feldspar-eye phyllite, and coarse volcaniclastics with abundant large quartz, plagioclase and Kspar augen in quartzo- feldspathic matrix. These are not mylonites; the textural variety is due to original interbedding of volcanic and clastic material, not to strain recrystallization. No papery, rusty quartz-sericite schists indicative of early hydrothermal alteration were seen in this area, although minor quartz-muscovite schists are present.

South of Beale Lake, large parts of the upper Dorsey assemblage are dominated by green and grey phyllite and quartzite. Sequences like this, which outcrop near Oblique Creek in southern Jennings River map area, were assigned to the Swift River succession (Nelson 1999). However, in the Beale Lake area the phyllite and quartzite clearly interfinger with quartz-feldspar phyric metatuffs. Perhaps the Oblique Creek metasedimentary sequences are a variant on the upper Dorsey assemblage, rather than the structurally overlying Swift River succession.

Mafic sills - well foliated metagabbros and in a few cases hornblendites - intrude the upper Dorsey assemblage. These bodies may belong to the same generation as the gabbros in the lower Dorsey assemblage.

Although well foliated, the upper Dorsey assemblage exhibits less obvious penetrative shearing than the lower Dorsey. Its metamorphic grade is apparently lower. Phyllites predominate over schists, original quartzite textures are preserved, and pale green, actinolitic hornblende is developed instead of deep green hornblende in the metagabbros. Mineralogically however, the metasedimentary rocks contain similar assemblages of muscovite, biotite and less common garnet.

Swift River Succession

A small area of dark-coloured chert, argillite, phyllite and white quartzite occurs in the synclinal core, structurally above the felsic metatuffs north of Beale Lake. These rocks are tentatively assigned to the Swift River succession, by analogy with sequences west of the Cassiar Batholith (Nelson, 1999, 2000).

POST-ACCRETIONARY UNITS

Cassiar Batholith

A portion of the regional, northwesterly-trending Cassiar Batholith (Figure 1) occupies the southern part of the map area. This body consists mainly of coarse grained granite and granodiorite, with pegmatitic and aplitic phases also present. One K/Ar biotite age of 107 Ma is available from this map area (GSC K/Ar 4063). This is typical of K/Ar ages for the batholith (Gabrielse, 1998, Table 8). Farther north, the eastern side of the batholith is cut by younger, Late Cretaceous stocks, which are asssociated with porphyry-skarn-manto mineralization (Panteleyev, 1980; Nelson and Bradford, 1993). In the Beale Lake area, distinct, cross-cutting bodies have not been identified, perhaps because the detailed mapping project terminated near the batholith margin. However, potentially younger, relatively fine-grained, quartz-feldspar megacrystic dikes lie along fractures in the country rocks east of the batholith; they may belong to the Late Cretaceous suite.

Zinc Lake Volcanics and Intrusions

Undeformed volcanic and volcaniclastic rocks and felsic intrusions outcrop in a northwesterly-striking belt in the northeastern corner of the map area, extending onto adjacent 104I/15 where Zinc Lake itself lies. These rocks were described in detail by Plint *et al.* (1997). Their contacts with the surrounding Dorsey assemblage and its intrusive bodies are unconformable or cross-cutting, and may in part be controlled by synvolcanic faults. Their overall outcrop pattern is that of a northwesterly-elongate graben. The felsic intrusions, which range from fine grained, glassy, flow-banded rhyolite to quartz-feldspar megacrystic granite, concentrate along the northeastern margin of the complex. Volcanic and volcaniclastic rocks range from andesites and andesite lapilli tuffs with tiny hornblende phenocrysts through dacites to flow-banded, aphanitic rhyolites. Two bulbous rhyolite bodies, possibly flow domes, were mapped on the ridge above Zinc Lake. The highest gold values on the property occur in this area (Plint *et al.*, 1997).

STRUCTURE

The Sylvester Allochthon is built of stacked, internally imbricated thrust packages, separated by major thrust faults, such as the Beale Mountain Thrust (Figure 6a).

Attitudes of these thrust faults, and of the units between them, have been affected by post-emplacement folding. Units and structures on the southwestern side of the allochthon, near the Cassiar Batholith, dip steeply northeast (Figure 4). This is a common feature along the length of the batholith, defining the western side of the “McDame synclinorium” of Gabrielse (1963). Forceful intrusion combined with crustal compression apparently caused the layered rocks to arch up over the eastern side of the batholith. Farther northeast, major contacts within the allochthon are warped into a series of upright, open, regional folds; for instance the syncline between Beale Mountain and Beale Lake, and the anticline that exposes the Nizi pluton (Figure 3). Prior to this (mid-Cretaceous?) folding event the allochthons probably lay above the Cassiar Terrane on nearly flat contacts.

Development of penetrative structures within the Four Mile assemblage was minimal, except for the black phyllite unit and Ram Creek assemblage. Strong shear fabrics are developed in the late Paleozoic volcanic rocks only within tens of metres of the Beale Mountain Thrust. By contrast, the Ram Creek assemblage is foliated, sheared, and mylonitized throughout. This is partly due to its position in the immediate footwall of the Beale Mountain Thrust; however, its degree of deformation vastly exceeds that developed in the Nizi pluton or the late Paleozoic volcanic rocks, even where they lie adjacent to the Beale Mountain Thrust. A twofold deformation history is suggested. A plagioclase porphyry dike, which cuts across structures in the Ram Creek assemblage but does not penetrate its external contacts, was collected for U/Pb dating.

The Dorsey assemblage is characterized by at least two episodes of penetrative deformation and shearing. One episode occurred in the early Mississippian, as shown by late synkinematic plutons of that age (Gabrielse *et al.*, 1993). A second, later shearing event accompanied its emplacement on top of the Four Mile assemblage as the hanging wall of the Beale Mountain Thrust (Figure 6a). This event must have postdated the youngest footwall rocks, the mid-Permian Meek and Nizi plutons. Distinct sets of fabrics and strain gradients can be related to these two events.

Ductile strain diminishes gradually upwards within the entire tectonite. The lower Dorsey assemblage contains sheath folds and very strong quartz stretching (E1) and mineral streaking (M1) lineations, associated with shear bands and c-s fabrics in appropriate lithologies. These features decrease to uncommon occurrence in the upper Dorsey assemblage. Rootlessly folded small leucosomes, a common feature of lower Dorsey amphibolites, do not appear in the upper Dorsey assemblage.

The E1 stretching and M1 streaking lineations show a pronounced northeasterly maximum at 58/18, and a lesser southwesterly one (Figure 6c). These represent measurements on the two limbs of the upright, F3

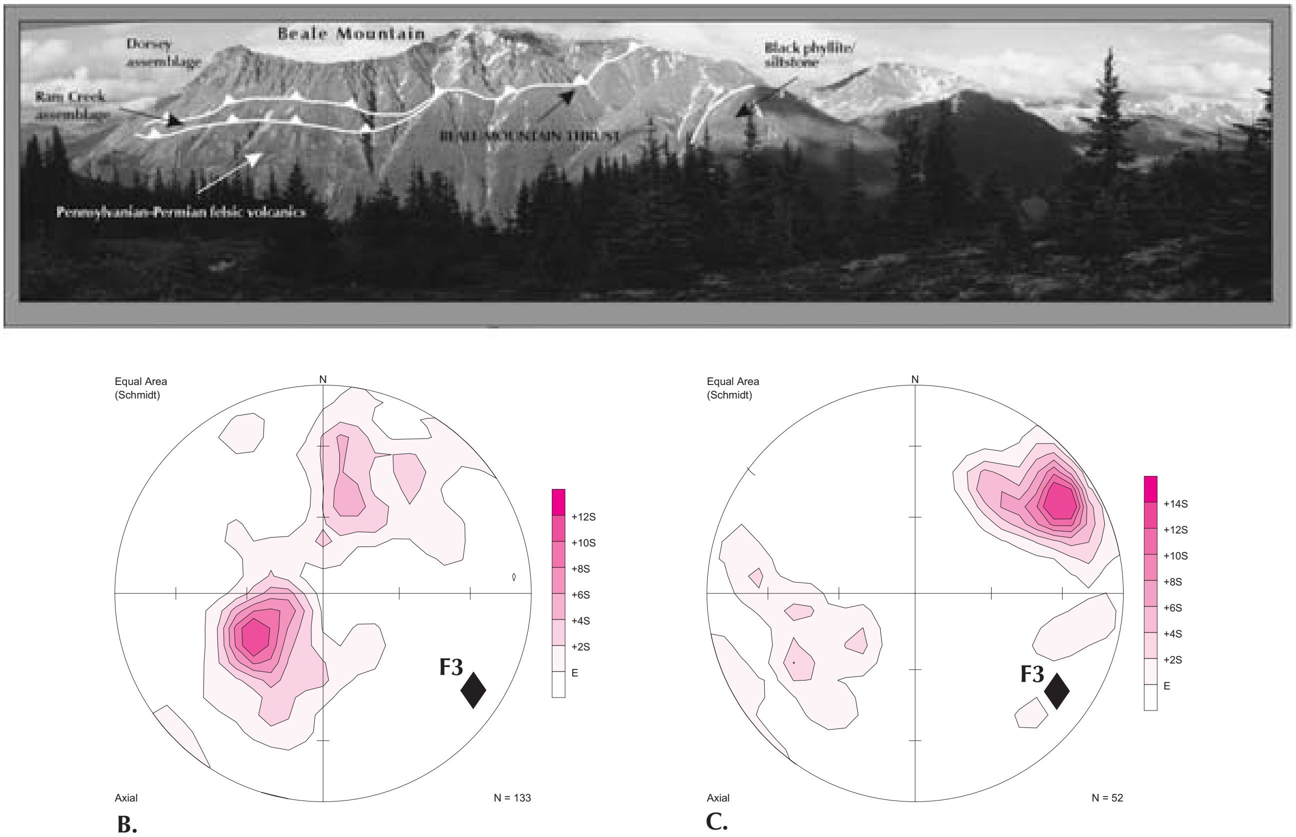

Figure 6. Structures in and around the Dorsey assemblage. A) The Beale Mtn. Thrust on Beale Mountain,. Note the gently dipping base of the upper pericratonic allochthon above rocks of the Harper Ranch subterrane. B) Attitudes of S1 foliation and transposed layering in the Dorsey assemblage. C) Early quartz stretching (E1) and mineral alignment (M1) in the Dorsey assemblage.

syncline, which also folded transposed layering and schistosity (S1) in the Dorsey assemblage (Figure 6b). Shear bands and asymmetric porphyryoclasts both in outcrop and thin section indicate tops to the northeast. Tentatively, this early tectonic event is assigned to the early Mississippian, probably immediately after deposition of the upper Dorsey assemblage. A pegmatite has been collected for U/Pb dating. Although it is cut by prominent mylonite zones, it locally crosscuts foliation in the amphibolite, and does not exhibit the stretching lineation that is so well-developed in its country rocks. These features fix its emplacement as late in the ductile shearing event.

Close-spaced shear zones are developed in rocks tens of metres from the Beale Mountain Thrust, including the lower Dorsey assemblage, the Ram Creek assemblage and the otherwise undeformed Four Mile assemblage. Shear bands indicate top-to-the-northeast motion on these subsidiary shears, and thus by implication on the main thrust fault. Interestingly, the post mid-Permian emplacement of the Dorsey assemblage on top of the subadjacent late Paleozoic arc assemblage followed the same sense as its much earlier internal deformation. Either the same large-scale crustal architecture controlled both, or crustal geometries shaped during the early Mississippian event influenced later accretion.

MINERAL OCCURRENCES AND MINERAL POTENTIAL

The Beale Lake map area is host to a diverse set of mineral occurrences and exploration possibilities, many of them documented here for the first time. Types of deposits represented include the following (Table 1):

1. Intrusion-related gold-silver-polymetallic veins.
2. Epithermal gold-silver-polymetallic veins.
3. Porphyry-style copper mineralization associated with zones of intrusive breccias and silicification in the Nizi pluton.

In addition, geological evidence supports the possible occurrence of the following deposit types in the area:

1. Syngenetic massive sulphide occurrences associated with pyrite-garnet-bearing (exhalative?) metachert in lower Dorsey assemblage.
2. Syngenetic massive sulphide occurrences associated with felsic volcanics and pyrite-garnet-bearing (exhalative?) metachert in upper Dorsey assemblage.
4. Mesothermal gold-quartz veins associated with quartz-carbonate-mariposite alteration in Slide Mountain ultramafic rocks.

Exhalites in Lower Dorsey Assemblage

Very rusty, pyritic metachert layers occur at two localities roughly at the same structural (and thus stratigraphic?) level in the lower Dorsey assemblage (Figure 3, Table 1). The layers are continuous over hundreds of metres to a kilometre of strike length, and are overall 5-10 metres thick. They contain two compositional varieties: dark grey, pyrite-rich chert with trace to abundant garnet, and white pyritic chert with minor, discontinuous quartz-sericite schist. Their mineralogy is consistent with that described from coticules, or metamorphosed Fe-Mn-silica exhalites. Geochemically, they are characteristically anomalous in manganese and barium (Table 2).

A sample from one very small occurrence, 01JN16-3, from near the top of the lower Dorsey assemblage 4 kilometres north of Beale Lake, contains over 17,000 ppm barium.

Potential for Syngenetic Sulphide Occurrences in Upper Dorsey Assemblage

The upper Dorsey assemblage near Beale Lake contains significant accumulations of felsic volcanic and volcaniclastic products. Exposures of blue-grey, yellow-stained phyllite similar to the "gunsteel" slates of the autochthonous Earn Group are associated with the felsic rocks. This suite is a probable equivalent of the early Mississippian upper Dorsey assemblage in the Swift River area, which in turn has been correlated with the felsic volcanic hosts of syngenetic massive sulfide deposits in the Finlayson Lake belt (Roots and Heaman, 2001). Thus, a geologically favorable environment for such deposits also exists within the upper Dorsey assemblage in the Sylvester Allochthon.

A 10 metre-thick section of rusty, pyritic chert, overlain by garnetiferous quartz-muscovite schist with unusually abundant tourmaline and apatite, is exposed on the west-facing spur north of Beale Lake. It is probably of sili-

TABLE 1
MINERAL OCCURRENCES, SHOWINGS AND ALTERATION ZONES, BEALE LAKE MAP AREA

	UTM east	UTM north	MINFILE number	Deposit type	Capsule description
Nizi A, B Zone	498637	6538060	104I032	Polymetallic veins Ag-Pb-Zn±Au.	samples assayed up to 12.0 g/tonne gold and up to 3428 g/tonne silver. These base metal zones are generally <20 centimetres wide and traceable for tens of metres.
Nizi H Zone	499240	6537900	104I032	Polymetallic veins Ag-Pb-Zn±Au.	Vein samples assayed up to 2.33 g/tonne gold and 627.43 g/tonne silver, 18.3% zinc and 7.% lead.
Nizi Surprise vein	499380	6537663	104I032	Polymetallic veins Ag-Pb-Zn±Au.	Chip/channel samples assayed up to 27.09 g/tonne gold and 1220.58 g/tonne silver over 2 metres.
Gunsight	496483	6534714	104I041	Polymetallic veins Ag-Pb-Zn±Au.	quartz vein with argentiferous galena, pyrite and sphalerite. One 20-centimetre sample contained .09 g/tonne Au, 110 g/tonne Ag, 8.36% Pb and 3.09% Zn.
Beale upper vein	494235	6529734	104I098	Polymetallic veins Ag-Pb-Zn±Au.	quartz vein + Au, Ag
Beale lower vein	494146	6530533	104I098	Polymetallic veins Ag-Pb-Zn±Au.	quartz-arsemopyrite-galena vein+Au, Ag
Yurso vein	498116	6525956		Polymetallic veins Ag-Pb-Zn±Au.	grab sample: Au (to 1250 ppb), Ag (greater than measurable using ICPMS technique), Bi (to 413 ppm), Pb (to 23,000 ppm), Sb (to 8000 ppm), anomalous Se, Te, Cu and Zn.
No Fish vein	497824	6529441		Polymetallic veins Ag-Pb-Zn±Au.	pyritiferous quartz vein with anomalous values of Cu, Te, Se, Ag, Mn
Perm	490989	6536006		Porphyry Cu	silicified intrusion breccia with disseminated pyrite, trace chalcopyrite
Corydalis	492624	6535272		Porphyry Cu	silicified intrusion breccia with disseminated pyrite, trace chalcopyrite
Keith	489414	6531816		Siliceous exhalite	chert + pyrite, garnet
Lucky Luke	491403	6529879		Siliceous exhalite	chert + pyrite, garnet
Toboggan	479062	6536436.6		Listwanite alteration	Fe-Mg carbonate-altered ultramafite, anomalous As, Sb, Mn
Least one	482128	6533259		Listwanite alteration	Fe-Mg carbonate-altered ultramafite, anomalous As, Sb, Mn
Griz	483689	6530499		Listwanite alteration	Fe-Mg carbonate-altered ultramafite, anomalous As, Sb, Mn

TABLE 2
LITHOGEOCHEMICAL DATA, 2001 SAMPLES, BEALE LAKE MAP AREA
(104I/14N)

				Element	Au	Au	Ag	Ag	As	W	Bi	Sb	Hg	Se	Te	Cd	Cu	Pb	Zn	Mn	Ba	Ni	Co	Cr
				Units	ppb	ppb	ppb	g/tonne	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
				Dectn Limit	0.1		2		0.1	0.2	0.02	0.02	5	0.1	0.02	0.01	0.01	0.01	0.1	1	0.5	0.1	0.1	0.5
Field Number	Showing	Description	UTM east	UTM north		Fire assay		ICES																
					Polymetallic veins																			
01JN14-10	Beale upper vein	quartz vein in trench	494216	6529765	2964.4	2716.2	29299	31.9	954.6	2.9	17.23	18.15	676	5	0.24	1.34	101.8	4707.86	155.9	70	17.2	9.3	0.8	123.4
01LL10-4	Beale lower vein	quartz vein + aspy	493526	6529703	816.6		556		2954.7	228.3	100.62	1.46	< 5	0.8	0.58	0.18	157.18	18.71	20.2	124	11.9	13.5	9.1	151.2
01LL10-1b	Beale Lake	quartz vein + gn, sp, py	494113	6530374	548.6		20871	23.4	95513.7	4.4	40.57	194.71	386	15.4	0.63	65.97	222.15	1776.76	5176.2	< 1	35.1	11.7	9.5	77.8
01JN24-5	Yurso vein	quartz vein + tetrahedrite	498167	6525917	1135.4	1142.1	99999	1824.5	99999	0.5	413.24	8159.74	527	10.4	0.35	174.56	918.03	22378.92	395	< 1	59.7	9	0.7	67.8
01JN24-5B	Yurso vein	weathered vein	498167	6525917	1254.8	1119.9	99999	797.2	99999	0.3	401.28	864.47	1112	9.9	0.19	149.21	289.02	23557.87	557.7	< 1	35.5	3.5	< 1	21
01JN25-4	Yurso vein	rusty brecciated qz vein	497570	6526455	161.7		10408	10.9	2004.6	1.2	3.05	46.12	36	0.2	0.03	1.27	21.87	548.41	13	196	49.9	6.4	2.9	103.7
01JN25-4B	Yurso vein	quartz vein + tetrahedrite	497612	6526413	394.1		99999	1040.7	4056.1	1.1	6.7	1061.97	1294	129.7	1.64	77.18	608.28	24188.78	2037.9	32	64.3	11.8	0.3	113.3
01JN25-5	Yurso vein	quartz vein + tet, aspy, sb	498046	6526102	523.7		99999	140.9	24687.9	< 2	0.45	7573.33	1746	1.1	0.03	777.3	124.89	10013.88	10382.2	180	59.5	10.5	5.3	131.2
01JN26-9	Nizi	quartz vein NW of main showings	497270	6540126	4.7		1665		687.8	1.5	0.31	17.75	359	0.3	0.04	20.01	14.94	343.19	587.4	1350	66.8	687.8	39.9	450.2
01LL20-5	No Fish vein	quartz vein + py, grey sulphide	497870	6529465	3.5		1253		15.1	4	0.66	5.56	7	13.1	0.24	0.05	136.95	8.67	18.2	217	64.2	25.9	85.7	135.7
01LL20-5rep	No Fish vein	quartz vein + py, grey sulphide	497870	6529465	3.1		1323		13	1.1	0.66	6.09	10	14.3	0.25	0.04	130.39	7.61	19.1	204	43.3	21	84.6	72.6
					Veins associated with listwanite-altered ultramafites																			
01JN1-6	Least one	listwanite-altered ultramafite	481660	6533747	21.6		137		21.7	1.4	0.83	48.48	35	0.2	0.04	0.05	9.96	0.71	25	551	54.8	822.7	52.5	458.9
01JN6-5A	Least one	quartz vein in carbonate-altered ultramafite	482361	6533140	1.9		1088		179.2	0.7	0.15	49.29	8	0.6	0.04	< .01	12.19	0.8	9.6	756	31.1	815	47.3	390.7
01JN6-5B	Least one	quartz vein in carbonate-altered ultramafite	482361	6533140	0.3		437		99.4	0.5	0.54	9.07	40	0.5	0.09	0.02	19.56	0.47	8.9	686	34.4	1513.5	79.6	319.2
01JN7-6	Griz	quartz vein in carbonate-altered ultramafite	483924	6530173	0.6		138		142.3	0.6	1.27	2.97	7	2.1	0.06	0.04	5.86	0.4	11.9	684	25.8	1404.9	81.2	218
01JN8-1	Griz	quartz vein in carbonate-altered ultramafite	483688	6530463	0.5		263		62.5	0.5	0.5	6.2	113	1.1	0.04	0.09	6.11	1.17	12.4	431	41.4	517.6	36.1	230.8
01JN8-2	Griz	quartz vein in carbonate-altered ultramafite	483484	6530644	3.3		1179		229.8	3.4	0.24	56.25	50	1.7	0.1	0.01	8.87	1.6	5.7	459	60	592	44.9	278.4
01JN9-6B	Toboggan	silicified zone in fault	478807	6536738	8		524		50.1	1.1	0.28	5.5	13	5.1	0.06	< .01	10.23	9.29	11.5	42	111.7	10.7	2.7	83.6
					Pyrite-garnet cherts (coticules)																			
01JN13-2	Keith	pyritic chert/coticule	489071	6532542	0.9		260		1	1.2	0.37	0.11	17	3.5	0.41	0.1	110.92	8	33.7	1006	41.7	20.6	12.1	97.2
01LL8-3	Keith	rusty chert + scorodite	489553	6531843	0.5		291		26.3	1.8	0.2	0.45	10	0.4	0.18	0.19	44.95	26.2	53.6	658	112.3	22	9.6	99.3
01LL8-3B	Keith	rusty chert boulder	489553	6531843	0.2		338		17.5	2.5	0.19	3.31	9	2	0.11	0.65	104.81	20.17	37	143	28.1	32.5	9.7	140.5
01JN16-3		pyrite-graphite chert (coticule)	492061	6532135	2.8		158		3.9	1.5	0.12	0.22	55	2.8	0.04	1.67	78.81	5.93	90.1	103	17411.5	53.3	10.1	118.2
01JN20-7		blonde chert, top of black phyllite unit	487568	6529831	2.2		90		3.9	0.9	0.14	1.16	12	0.3	0.04	0.45	62.63	11.26	27.7	112	223.1	6.6	2.1	54.4
01JN23-6		pyritic chert	499851	6529299	1.4		467		9.1	4.8	0.12	1.51	60	2.6	0.11	1.41	45.78	10.58	53.2	63	14.6	23.4	9.7	156.2
01LL7-7A		pyritic chert (coticule)	493008	6529711	1.6		1161		73.4	2.5	0.3	1.87	17	1.4	0.09	0.62	59.15	45.74	35.7	268	2024	24.9	3	148.1
01LL11-2		dissem. pyrite	491600	6529971	6.8		244		50.1	7.5	0.43	0.22	< 5	0.7	0.08	0.1	103.72	9.44	76.3	658	364.2	65.2	28	121.1
01LL11-4B	Lucky Luke	pyritic chert	491482	6529821	1.4		184		138	1.1	0.36	0.89	6	1.6	< .02	0.33	60.47	12.38	42.9	359	99.7	10.1	3.9	60.1
01LL11-4C	Lucky Luke	pyritic chert	491482	6529821	1.5		303		7	1.5	0.76	0.12	< 5	0.5	0.03	0.23	75.38	9.1	80.7	756	199	61.5	34	99.5
01LL11-5A	Lucky Luke	quartz vein + minor pyrite	491423	6529780	0.7		91		35.8	1.9	0.06	1.06	< 5	0.1	< .02	0.23	19.95	6.18	17.5	587	8.3	21.2	8.4	139.5
01LL11-5B	Lucky Luke	black chert, dissem. pyrite	491423	6529780	2.7		182		5.6	0.4	0.07	0.32	6	1	0.04	0.37	62.94	4.19	75.5	603	86.3	86.1	42.5	76.9
01LL11-5C	Lucky Luke	rusty dike	491423	6529780	1.1		282		6	0.4	0.09	0.28	5	2.1	< .02	0.38	85.61	5.77	80.6	460	53.7	43.8	5.6	133.9
01LL12-7B		pyritic chert	494387	6532219	2.3		121		8.9	1.1	0.05	0.32	6	0.8	0.05	0.18	58.69	4.01	47.3	67	13.7	11.5	13.7	83.9
01LL13-4		chert + pyrite, graphite	492549	6532954	< 2		218		9.7	1.4	0.18	0.53	13	1.5	0.13	0.32	62.81	15.3	38.9	186	19.3	24.7	15.5	129.6

TABLE 2
LITHOGEOCHEMICAL DATA, 2001 SAMPLES, BEALE LAKE MAP AREA
(104I/14N)

					Disseminated sulfides with intrusive breccias in Permian intrusions																			
01JN17-3		silicified intrusive breccia + sulfides	490164	6535444	2		62		4.4	0.9	0.06	0.27	34	1.6	< .02	< .01	27.37	5.65	4.3	44	34.1	4.6	3.8	48.5
01JN17-5	Perm	silicified intrusive breccia + sulfides	491017	6535998	1.3		211		1	0.6	0.58	0.07	17	3	0.06	0.01	82.96	14.58	8.8	242	35.7	15.1	59.7	65
01JN18-4	Corydalis	silicified intrusive breccia + sulfides (py, po, cpy)	492691	6535145	1.3		1226		17.5	1	0.18	0.72	222	1.1	< .02	1.3	1139.98	2.91	490.9	183	20.6	18	16.9	99.6
01JN18-4rep	Corydalis	silicified intrusive breccia + sulfides (py, po, cpy)	492691	6535145	0.9		1824		42.7	0.5	0.28	5.84	253	1.6	0.02	1.72	1405.63	18.31	476.7	192	22.6	15.3	18.7	97
					Gossans in felsic volcanics of Four Mile package																			
01JN3-11		pyrrhotite-pyrite gossan in Penn-Perm felsic volx	482961	6535472	1.6		99		11.9	0.6	0.13	1.17	29	< .1	0.02	0.09	21.35	14.86	50.8	435	730	4.8	5.5	31.4
01JN15-4		silicified felsic flow with dissem., veinlet pyrite	490114	6530011	3.3		38		2.3	0.4	0.09	0.31	< 5	0.2	0.04	0.04	63.97	10.25	64.2	868	406.7	8.3	11	51.6
01JN15-5		silicified felsic flow with dissem., veinlet pyrite	489983	6529464	4.3		355		108	0.9	0.25	1.04	11	1.2	0.06	0.24	83.8	16.68	73.6	770	107.2	11.5	13.8	52.7
01JN10-2		rusty dacite	480926	6540001	14.9		190		62.9	1.4	1.42	4.3	51	0.1	0.03	0.04	14.38	15.45	12.4	57	253.2	7.3	1.9	60.5
					Other gossans																			
01LL1-3		gossan in mafic intrusive complex	479544	6537016	2		640		59.1	0.6	0.14	19	9	2.1	< .02	1.2	75.41	49.01	38.8	375	50.4	4.2	11.8	53.8
01LL17-5		gossan in basalt, abundant pyrite	493156	6526692	53.9		434		8.1	0.3	0.55	0.64	12	6.2	1.25	0.1	229.79	5.96	16.5	96	35.8	65.9	139.2	64.1
01LL17-1		pyritic black argillite	494666	6525387	< .2		1976		4	1.9	0.23	0.23	< 5	20.7	0.06	1.65	76.23	7.43	260.1	237	219.2	88.3	8.2	219.9
01LL12-5		amphibolite + dissem. pyrite	494071	6532127	92.9		63		14.7	0.8	0.14	0.32	< 5	0.4	< .02	0.04	70.97	2.31	34.8	443	9.4	14.5	14.4	32.7
01LL12-8		sheared garnet amphib. + pyrite	494182	6532628	3.2		150		3	0.4	0.2	0.3	15	0.6	0.08	0.09	109.86	14.98	131.4	923	106.3	28	38.3	25.2

NOTES
Analysis of steel milled crushed rock prepared by ACME Analytical
ARMS = Aqua regia digestion - ICPMS
ACM = ACME Analytical, Vancouver
99999 = recommended re-assay

ceous exhalative origin. Like the pyritic-garnetiferous cherts of the lower Dorsey assemblage, it contains anomalous manganese and barium (sample 01LL7-7a, Table 2).

Porphyry-Style Mineralization in the Nizi Pluton

Prominent gossans, including the Perm and Corydalis showings, occur within the Nizi pluton. They are cross-cutting, linear, probably fracture-controlled zones, with west-northwesterly trends. The Perm is a prominent gossan on the bare west face of Tetipistikwan Mountain above the Four Mile River, roughly 50 metres across and 600 metres in strike length. The Corydalis gossan crosses a spur ridge of the mountain in the headwaters of Nizi Creek. Somewhat less intense than the Perm, it is 200 metres across and 600 metres in strike length. Within the gossans, plagioclase-porphyry dikes and zones of finely comminuted intrusive breccia cut the main-phase tonalites, diorites and gabbros of the pluton. The intrusive breccias incorporate angular clasts of their country rocks. They characteristically contain rounded, milled single-crystal plagioclase and hornblende fragments in a matrix of dust-sized rock debris cemented by secondary silica. Many are laced with fine quartz veinlets. Disseminated pyrite and lesser chalcopyrite occur throughout the matrix, as well as in fractures in the surrounding country rock. Samples from these gossans contain 1100-1400 ppm Cu, with anomalous Ag, Zn and Hg (Table 2).

These gossans are not described in assessment reports, although very old claim posts lie on them. The posts may date from early exploration of the Kirk or Four Mile property (MINFILE 104P 027; Gabrielse, 1963, p. 113). The Four Mile property, a shear-hosted copper-silver prospect, is located in McDame map area 10 kilometres to the north in the Four Mile River valley. It was staked for the first time by Beale Carlick, the Kaska trapper and prospector after whom Beale Lake and Beale Mountain were named.

Quartz-Carbonate-Mariposite Alteration Zones and Mesothermal Gold Vein Potential

Ultramafic bodies in the belt of Slide Mountain rocks along the eastern margin of the Cassiar Batholith are extensively altered to orange-weathering iron-magnesium carbonate, veined with quartz and carrying significant mariposite in some areas. This type of alteration is associated with the gold-quartz veins of the Cassiar camp (Pantaleyev and Diakow, 1982, Nelson and Bradford, 1993). Three alteration zones are exposed on ridges, separated by overburden-covered valleys. Overall the system extends over 8 kilometres along strike. Our samples were mildly anomalous in As, Sb, and Mn, as well as the ultramafite-related suite Ni-Co-Cr.

Polymetallic Veins

Polymetallic veins are the best-known deposit type in the Beale Lake map area. The Nizi property has been the target of several advanced exploration programs, including drilling. The current Beale Lake claims (previously held as the Keel and the Flag claims) and the RN claims have been systematically prospected and geochemically sampled. This report and the companion geological map (Nelson and Lepage, 2002) document and precisely locate the known showings, as well as previously unreported veins discovered in the course of field work this year.

Nizi Epithermal Vein System (MINFILE 104I-032)

Mineralization on the Nizi property is a vein-stockwork system with associated hydrothermal brecciation, cospatial and probably cogenetic with the relatively young Zinc Lake volcanic/intrusive suite ("Nizi volcanics" of Plint *et al.,* 1997). Known veins occur over a northwesterly-elongate area 2 kilometres long by 1 kilometre wide.Two distinct mineralization styles are present: sulphide-poor, gold-silver-quartz veins and stockworks associated with pervasive silicification, and sulphide-rich iron carbonate-sphalerite-galena veins associated with pervasive carbonate alteration. Six main mineralized areas have been outlined, the Zinc Lake Zone, Discovery Vein/Surprise Vein, Grizzly Ridge Vein, H Zone, Gully A Zone and B Zone, mainly through the exploration and drilling programs of Gold Giant Minerals Incorporated in 1987-1992 (Cavey and Chapman, 1992; McIntosh and Scott, 1991). In 1996, Madrona Mining drilled six holes, five in the Discovery/Surprise vein area, and one to test the southeastern extension of the Zinc Lake Zone (Plint *et al*., 1997). The core from this project is stored at the east end of Beale Lake.

The Discovery/Surprise Vein area represents the best exploration target identified to date on the Nizi Property. It is characterized by multistage, microcrystalline quartz-carbon-sulphide-barite stockworks with very fine-grained pyrite, galena, sphalerite, chalcopyrite, tetrahedrite and acanthite. Assay values up to 41.0 g/t Au were obtained from these veins, with typical channel samples returning 1.5 to 30 g/tonne Au and 190 to 1200 g/tonne Ag over 1-2 metres (Bond, 1993).

The Gully A and B zones are iron carbonate-microcrystalline quartz-rhodochrosite-sphalerite-galena-pyrite veins; the H Zone, banded carbonate-quartz-sphalerite-galena-pyrite veins. Both are controlled by north-striking subvertical fractures and/or shears. A 1.8 metre chip sample of H Zone sphalerite-galena- pyrite-carbonate-rhyolite breccia returned values of 2.26 g/t Au, 278.1 g/t Ag; best grab sample assays from the Gully Zone are 11.38 g/t Au and 22.4 g/t Ag (Bond 1993).

Plint *et al*. (1997) show that the galena lead isotopic signature of the Nizi plots above, and near the very young end of the shale curve defined by Godwin and Sinclair (1982). It is similar to lead from veins and skarns near the Seagull Batholith, the Cassiar gold-quartz veins, Midway, Butler Mountain and other Cretaceous-Early Tertiary epigenetic deposits in the Cassiar area (Bradford, 1988). The coincident centering of the alteration halo and the gold-quartz veins around the rhyolites near Zinc Lake strongly favors cogenesis between Nizi volcanic activity and the epithermal event. Gabrielse (1994) assigned the kaolinized quartz-orthoclase porphyry rhyolite on the Nizi property to the Eocene suite, by correlation with the Major Hart pluton

(Figure 2). The entire Zinc Lake volcanic/intrusive sequence is tentatively assigned to the Eocene. It is thus possible that igneous/hydrothermal systems ranging from intrusion-related to epithermal may extend from the Major Hart pluton as far north as the Four Mile River.

Beale Lake Intrusion-Related Vein System (MINFILE 104I-098)

Gold and silver-bearing quartz-sulphide veins were first discovered on the ridge north of Beale Lake in 1982-3 by the Cassiar Joint Venture, who conducted grid soil sampling and prospecting (Fleming, 1983). In 1996, following the Cry Lake regional geochemical data release (Jackaman, 1996), the ground was restaked in 1996 by Westmin Resources Ltd., and contour soil sampling and limited prospecting carried out (Jones, 1997), mainly aimed at volcanogenic massive sulphide-style targets. The current property owners have collected new, and reinterpreted existing, soil geochemical data; and conducted further prospecting (Durfeld and Fleming, 2001). Their work identifies a set of veins with overall dimensions of 1 by 2 kilometres, which comprises two compositionally and spatially distinct styles of gold mineralization. To the west, quartz-arsenopyrite- pyrite-scheelite veins are associated with Au-As-W-Bi anomalies. To the east, quartz-base metal sulphide veins are associated with anomalous values of Au, As, Pb, and local Ag, Zn, Sb, Cu and Bi. They suggest a zoned, intrusion-related gold system.

The Beale Lake veins are hosted by metamorphosed sedimentary and volcaniclastic rocks of the upper Dorsey assemblage. Our traverses in 2001 relocated some of the sampled veins, including a prominent trench in silicified vein breccia from which Durfeld and Fleming (2001) report 27 and 41 g/tonne Au in grab samples, and a quartz-arsenopyrite-galena vein from which they report 2.5 g/tonne Au, 5.5 g/tonne Ag. Repeat grab samples from these veins returned geochemically highly anomalous Au and Ag (Au to 2716 ppb by fire assay) (Table 2). Although in the alpine, much of the property is covered by overburden. Mineralized quartz vein float throughout the area hints at additional, unexposed veins.

Gunsight (MINFILE 104I-041)

The Gunsight showing was discovered during preliminary exploration in 1992, on claims adjoining the Nizi property to the south (RN Group; Termuende, 1993). It is a west-northwesterly-striking quartz vein with argentiferous galena, pyrite and sphalerite. One 20-centimetre sample contained .09 g/tonne Au, 110 g/tonne Ag, 8.36% Pb and 3.09% Zn. The vein is associated with brecciated hornblende granodiorite of the Permian Nizi pluton. This vein may relate to the Nizi system, to the Beale Lake veins, or to the porphyry-style occurrences near the headwaters of Nizi Creek. It was not visited this season.

New Discoveries

Two polymetallic veins were encountered during 2001 traverses southeast of Beale Lake, on ground not covered by assessment reports. One, the No Fish vein, outcrops in a waterfall in a north-draining creek. It is 2-8 centimetres wide and strikes west-northwest. The other, the Yurso vein, outcrops in the pass at the head of the creek, where it has been traced as subcrop over 1000 metres along a northwesterly strike (Nelson and Lepage, 2002). The No Fish vein contains pyrite, and a grey metallic mineral. It is anomalous in Cu, Se, Te, Ag, Mn and Co (Table 2). The Yurso vein contains arsenopyrite, pyrite, stibnite and tetrahedrite. Analyses show it to be highly anomalous in a broad suite of metals, including gold (to 1250 ppb), silver (to 1824 g/t), bismuth (to 413 ppm), lead (to 23,000 ppm), antimony (to 8000 ppm), as well as Se, Te, Cu and Zn. Heavily oxidized vein fragments of secondary base metal sulphates and carbonates, such as anglesite and smithsonite, are abundant in float downslope from the projected vein trace. The largest pieces of vein material are 20-30 centimetres in their shortest dimension (Figure 7).

The fracture that hosts the Yurso vein is also occupied by granite porphyry dikes that contain round quartz and orthoclase megacrysts. They may be offshoots from the nearby Cassiar Batholith, or younger, Late Cretaceous-Eocene intrusions. Some show strong argillic alteration, which also affects rocks of the upper Dorsey assemblage around the vein.

These vein occurrences are on strike with, and 2 to 5 kilometres southeast of the Beale Lake vein set. They suggest that it may extend through the low-lying country around Beale Lake and, potentially, onto 104I/15. The granite porphyry dikes that accompany them lend strength to the inferred connection between late plutonic activity and gold mineralization.

CONCLUSIONS

This investigation of the Beale Lake map area has produced some significant changes to our understanding of the southern Sylvester Allochthon. Most important, it has firmly established and made specific the correlation of the uppermost, deformed pericratonic allochthon with the Dorsey assemblage west of the Cassiar Batholith. This relationship was previously published only in abstracts, as a suggestion based on perceived general similarities. It is now clear that the same two twofold unit subdivision can be

Figure 7. Typical chunk of the Yurso vein, rusty-stained quartz with pyrite, arsenopyrite, tetrahedrite and stibnite.

equally applied to the Dorsey assemblage in its type area, and to the pericratonic assemblage in the Sylvester Allochthon. The lower unit, with its extensive cliff-forming amphibolites, is recognizable in localities from the Swift River valley in southern Yukon (Stevens and Harms, 1985) to the west face of Beale Mountain. The upper unit, with its felsic volcanic component, is probably equivalent to Mississippian felsic units in the Yukon-Tanana Terrane, including those known to host volcanogenic massive sulphide deposits.

Structurally below the Dorsey assemblage, the Sylvester Allochthon can be divided into two distinct assemblages, a lower one of oceanic and a middle one of island arc affinity. This accords with the gross structure of the allochthon between the Dease River and the Yukon border. The mid-Permian Meek and Nizi plutons form parts of a single complex that intrudes the middle, arc-related, assemblage. Referred to here as the Four Mile assemblage, it shares a broad age and affinity with Division III, the middle unit of the allochthon farther north. However, in detail these two units differ significantly enough to warrant separate unit names. As exposed in the Huntergroup Range and on Juniper Mountain near Cassiar, Division III is dominated by Pennsylvanian-Permian augite-phyric basaltic andesites and limestone-limestone breccia-chert sequences (Nelson and Bradford, 1993). In contrast, the most extensive unit in the Four Mile assemblage is a complex of nearly aphanitic dacite to rhyolite flows. The deformed phyllite is also unique to this area. This diversity is typical of island arc sequences, which can comprise a wide variety of volcanic sources and evanescent sedimentary environments.

Polymetallic, precious metal-bearing veins are widespread in the eastern part of the map area, including the epithermal Nizi vein system associated with young volcanic rocks in the north, and the deeper, intrusion-related Beale Lake system. The latter is now shown by new discoveries this summer to extend at least 5 kilometres south of Beale Lake. These results, combined with the pattern of Au and Ag and As, Sb, Bi and Hg in stream sediments that extends from Beale Lake area to the eastern border of Cry Lake map area (Jackaman 1996), suggests that the potential for further intrusion-related gold discoveries is alive and well in the Cassiars.

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