Stratigraphy, Structure, Geochronology and Provenance of the Logjam Area, Northwestern British Columbia (NTS 104O/14W)

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INTRODUCTION

The Logjam area covers four parallel ridges oriented nearly perpendicular to the regional structural fabric between Screw Creek and Logjam Creek, approximately 300 km east of Whitehorse. The Logjam area is 30 km from the Logtung deposit and ninety percent of the area is above treeline (Figure 1). This area has been interpreted as straddling the contact of the Big Salmon Complex (Gabrielse, 1969) and the Klinkit Assemblage (Harms and Stevens, 1996) and therefore is of key geological importance (regional geology map in Mihalynuk *et al*., 2000, this volume). In contrast to the schistose, commonly greenschist facies rocks of the Big Salmon Complex immediately to the west, the Logjam area is underlain mostly by phyllitic metasedimentary rocks with a small outcrop area of schists in the northwest (Figure 2). Mapping was conducted during a ten-day period in September 1998, to gain a better understanding of the stratigraphy, structure, age and tectonic affinity of this poorly known package and its relationship to the Big Salmon Complex.

Field work focused on the documentation of stratigraphic and structural features within the study area and on the collection of key rock samples for isotopic and microfossil age determination. A U-Pb zircon age of a foliated tonalite and detrital zircon ages from a pebble conglomerate were determined. Provenance determinations were made from point-counts of greywacke, grit and pebble conglomerate samples.

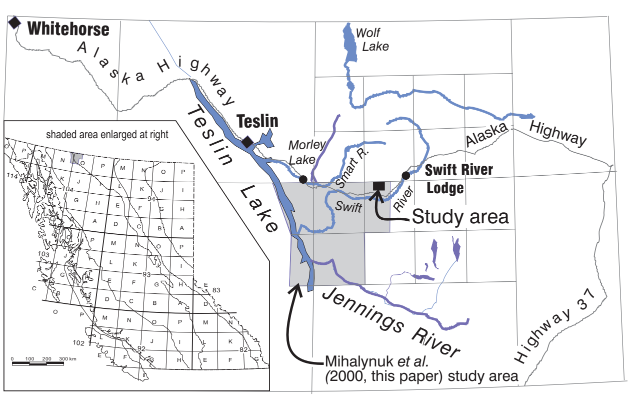

Figure 1. Location of study area; the Logjam area (Figure 2) is highlighted.

REGIONAL GEOLOGY

The Logjam area lies within the belt of pericratonic terranes that extends the length of the Canadian Cordillera and is situated between North American miogeoclinal rocks to the east and accreted terranes to the west. The recognition of pericratonic assemblages and changes in terrane nomenclature of northern British Columbia and southern Yukon are convoluted. Gabrielse (1969) included these rocks in his unit 12, which he divided into three members. The lower member (unit 12a) consists of quartzite, argillite, slate, ribbon chert, and discontinuous grey limestone. The middle member (unit 12b), laminated to thickly bedded limestone with Pennsylvanian fusilinids, is best exposed east of Screw Creek. Poole (1956) described some of the conglomerate in the 'Screw Creek' limestone as red or green chert pebbles in a limestone matrix. Facing indicators in the limestone, including channel scours and corals in growth position demonstrate that the limestone is repeated by recumbent, isoclinal folds (Mihalynuk *et al*., 2000, this volume).

Monger *et al*. (1991) considered the Logjam area to be part of the Dorsey Terrane, a succession of Upper Paleozoic sedimentary rocks that are not readily correlative with assemblages elsewhere in the Cordillera. Harms and Stevens (1996) subdivided the Dorsey Terrane into Dorsey, Swift River and Klinkit assemblages. The Logjam area was considered part of the Klinkit assemblage which has three informal units, from oldest to youngest: 1) Pennsylvanian Screw Creek limestone, 2) Butsih volcanics, 3) Triassic Teh clastics (T. Harms, personal communication, 1999). This assemblage was described as lithologically heterogeneous such that individual beds or composite horizons could not be followed along strike for more than a few kilometres (Stevens and Harms, 1995). Geochronological constraints, discussed below, preclude correlation of layered units with the Klinkit assemblage.

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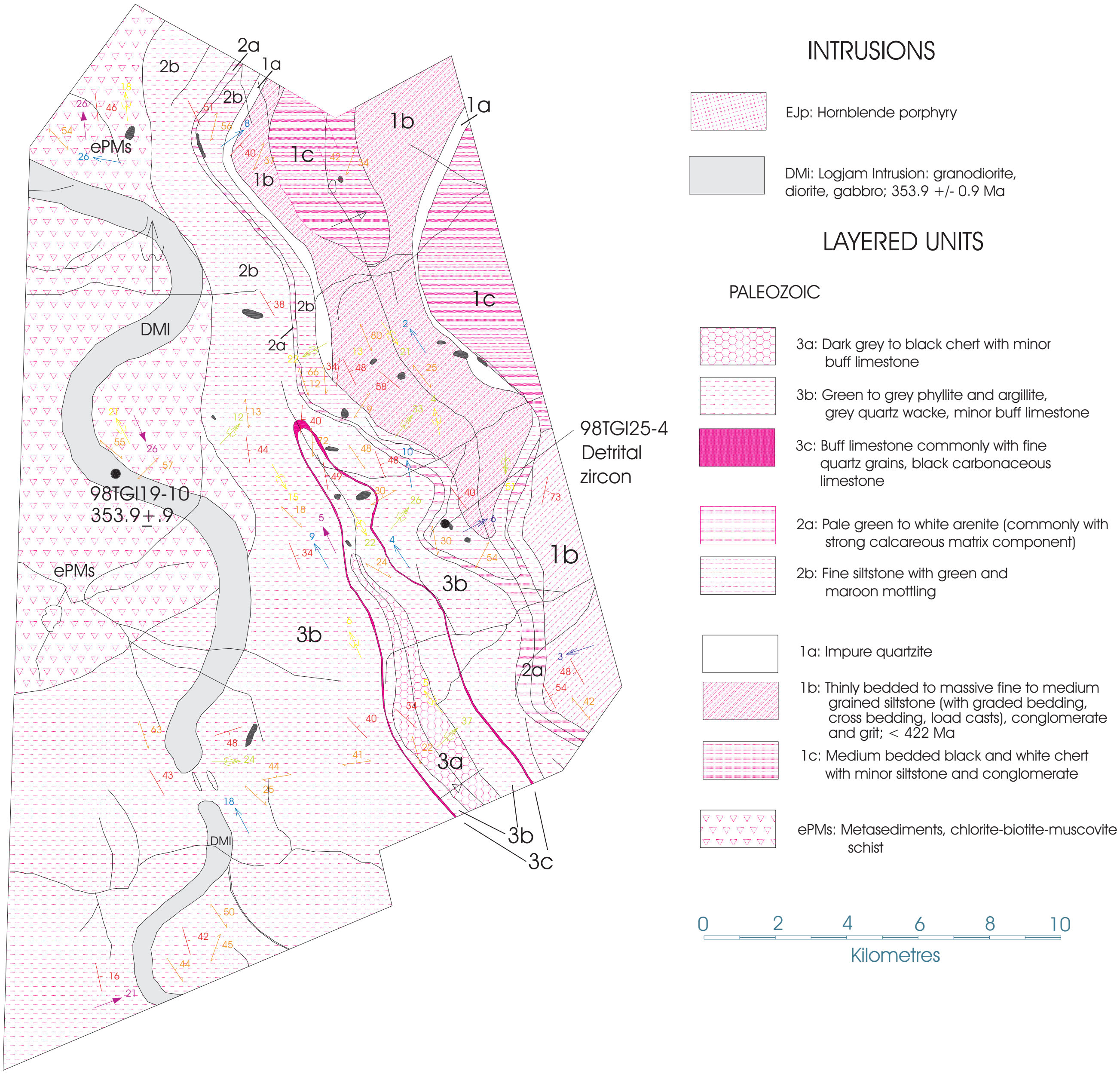

Figure 2. Regional geology map of the Logjam area with U-Pb sampling sites highlighted.

LAYERED UNITS

Three mappable and divisible stratified rock units are recognized in the Logjam area (Figure 2). In ascending stratigraphic order they are: 500 metres of brown, thinly bedded to massive siltstone, chert and impure quartzite (unit 1); 200 metres of green and maroon to white siltstone to sandstone (unit 2); and 300 metres of grey-black to green phyllite, wacke and limestone (unit 3; Figure 3). Insert Figure 3 here. Unit ePms is biotite schist with unknown stratigraphic relations. Contrary to the description of Stevens and Harms (1995), these units were found to be laterally continuous and were traced for more than 20 km across the study area. Relative age assignments are based on preserved way-up indicators within the brown siltstone unit and the position within a regionally significant anticline-syncline pair. U-Pb ages reported below indicate that units 1b to 3b were deposited between middle Silurian and earliest Mississippian (Claoué-Long *et al*., 1992).

Brown Siltstone, Chert and Impure Quartzite (Unit 1)

Rusty brown siltstone and black chert of unit 1 underlie most of the two northernmost ridges of the Logjam

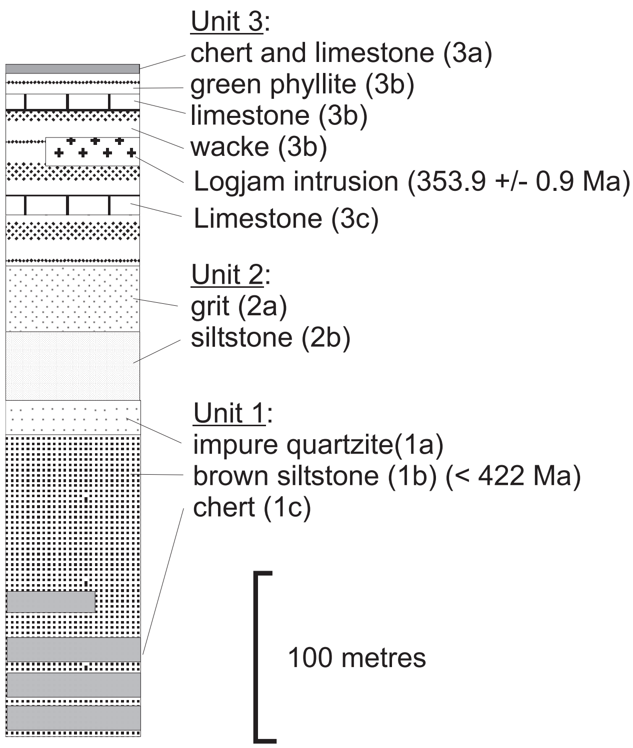

Figure 3. Stratigraphy of Logjam area with approximate lithological thicknesses.

area. They are interbedded on the metre- to outcrop-scale but can be separated at map scale into dominantly (>80%) chert (unit 1c) or dominantly (>90%) siltstone (unit 1b). A third subunit (unit 1a) consists of fractured, impure quartzite. Unit 1c is characterized by 1 to 20 metre thick beds of massive black and white chert interlayered with 1 to 4 metre thick beds of laminated to massive siltstone. Unit 1b consists of rusty orange to brown siltstone with scarce 0.5 to 3 metre thick beds of conglomerate, dolostone and chert. Thinly bedded to laminated siltstone of this unit contains primary sedimentary structures including graded bedding, channel scours, cross bedding and soft-sediment deformation features. At higher stratigraphic levels, the siltstone of unit 1b is commonly black and massive with a slightly calcareous matrix. A distinctive, 1 to 3 metre thick, grit to pebble conglomerate bed sits in unconformable sedimentary contact with siltstone within unit 1b at roughly the same stratigraphic level. A sample of grit from this dominantly conglomeratic horizon was collected for detrital zircon analysis. A single, thin interbed of green tuff containing mafic clasts (?) and chlorite- muscovite partings provides the only evidence within this unit for a distal volcanic source. A fractured, impure quartzite (unit 1a) above unit 1b has sharp (unconformable?) contacts with units 2b and 1b.

Green and Maroon to White Siltstone and Sandstone (Unit 2)

Unit 2 consists of quartz-rich siliciclastics which have been subdivided into members on the basis of colour and grain size. This map unit is differentiated petrographically from unit 1 by coarser, more rounded grains. Unit 2b varies between siltstone to fine grained sandstone with bright olive green and maroon irregular patches that cut bedding planes at random. These are probably diagenetic. Unit 2b siltstone grades into coarser unit 2a, which is a white to light green or pink arenite, commonly with a calcareous matrix. Unit 2a fines upwards into beds of wacke and impure arenite that comprise the basal portion of unit 3b.

Phyllite-Greywacke-Limestone-Chert Unit (Unit 3)

The phyllite-greywacke-limestone-chert unit is lithologically diverse. Unit 3c is a 5 to 10 m thick marker unit of tan, carbonaceous limestone within the compositionally variable package of phyllite, greywacke and limestone (unit 3b). Stratigraphically higher, in the core of a south plunging syncline, is a distinctive unit of black chert and buff limestone (unit 3a). Like unit 2, sedimentary grains in unit 3 are coarser and more rounded than in unit 1. However, unit 3 is differentiated petrographically from unit 2 by a higher matrix component and detrital biotite. Unit 3 is characterized by a muscovite-chlorite phyllitic cleavage but is differentiated from unit 1 and 2 by poorly developed biotite schistosity and epidote alteration. Metamorphic grade is unknown because both greenschist and sub-greenschist metamorphic assemblages are incomplete.

Two limestone beds, one black and the other tan-to-buff coloured, (unit 3c) provide excellent markers within unit 3b. The buff to orange massive limestone is <1.5 m thick with disseminated, rounded, medium-sized quartz grains (<5%). The black, massive to medium bedded limestone is 1.5 - 2.5 m thick and is gradationally interbedded above and below with thin phyllite or argillite horizons. The two carbonates are separated by up to 4 m of clastic sediments.

The siliciclastic component of unit 3b is green to grey to black phyllite and argillite and grey to black quartz wacke interbedded on the decimetre- to outcrop-scales. Lenses (<3m) of grey, massive limestone are common throughout unit 3b. Unit 3a is a distinct association of grey to buff thick bedded limestone and black and white, massive chert. Chert layers are up to ten times more abundant than carbonate and interbedded on decimetre- to metre-scale. Chloritic (tuffaceous?) phyllite is also characteristic of unit 3a.

Quartz-Biotite Schist (Unit ePms)

Quartz-biotite schist is structurally lower than most of units 1-3. Moderately to well developed schistosity, totally recrystallized quartz, and abundant metamorphic biotite (often retrograded to chlorite) differentiate these rocks from those described above. Chloritoid, a defining component of the meta-pelitic upper greenschist assemblage, was not observed so the metamorphic grade is uncertain. Most of the quartz domains are quartz segregations but some may be strained, coarse quartz grains suggesting a protolith of variable grain size. Metre-scale layers of grey-orange marble are inferred to be former carbonate horizons in a dominantly siliciclastic package. Unit ePms is a mappable unit but the protolith may be similar to unit 3. Outcrops of schists are mostly at higher elevations than the Logjam intrusion (described below). One outcrop downslope of the Logjam intrusion is marble and argillite; this is inferred to be part of unit ePms. The contact of unit ePms cuts across the strike of the units 1-3 so it may represent a disconformity or a fault surface but there are no demonstratable difference in metamorphic grade or degree of deformation across the contact. Unit ePms may be representative of the Big Salmon Complex.

INTRUSIVE ROCKS

Three plutons are found in the Logjam area. The largest intrusion is a moderately foliated tonalite and gabbro body informally called the Logjam intrusion. Foliated tonalite occurs as irregular fingers and pods in a more extensive and equally foliated gabbro body. Mutually cross-cutting intrusive relationships between tonalite and gabbro suggest that these phases are the same age and are possibly comagmatic. Variability in grain size and fabric intensity in the gabbro may be due to magmatic fluid enrichment and strain partitioning. The gabbroic body intrudes both unit ePms and unit 3b. On two ridges, it has a similar width and crops out at a similar altitude suggesting it is a continuous, slender body. The intrusive contact with unit 3b does not crop out but wacke flanks gabbro on both sides. A structural discontinuity seems unlikely because foliations do not change from one side of the body to the other. The foliation present in both plutonic phases is interpreted to record post-crystallization (solid-state)

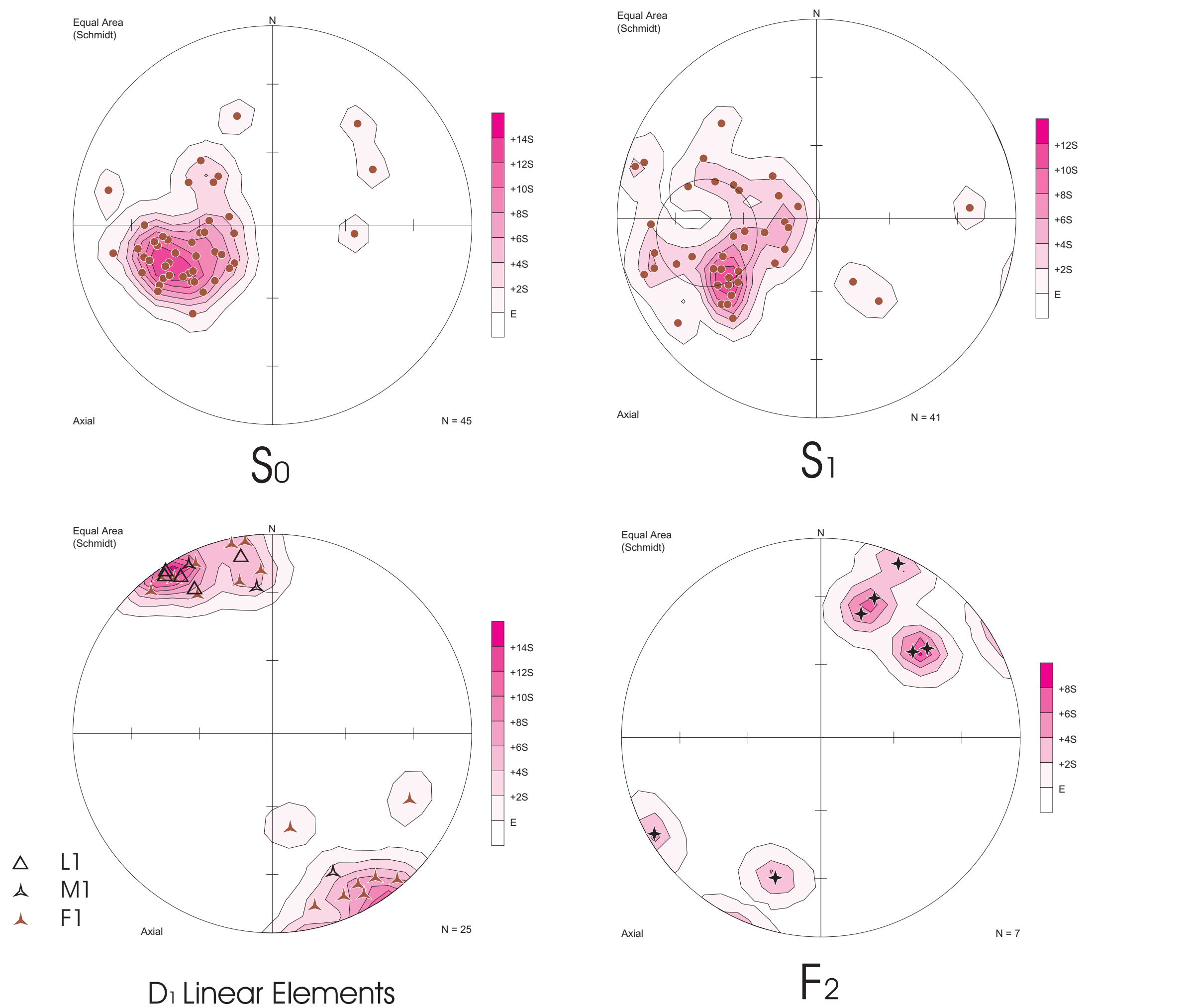

Figure 4. Schmidt equal area stereographic projections showing contoured poles to (a) bedding - S_0), and (b) foliation (S_1) and contoured plots of (c) intersection lineations - L_1, mineral lineations - M_1, and fold axes - F_1, and (d) later fold axes - F_2. Data contoured by Gaussian counting using a weighting function equivalent to a fractional counting area of 0.01. Contour intervals are 2, 4, 6, 8, 10, 12 &14 sigma.

deformation. The foliation is less intense than the schistosity in unit ePms suggesting that the intrusion is late synkinematic. Both units show evidence for later brittle microfractures (*i.e.* offset micas in unit ePms).

Two fine grained, unfoliated hornblende-porphyritic gabbroic intrusions cut all stratigraphic units and deformation fabrics. These intrusions exhibit medium grey fresh surfaces and rusty orange weathering surfaces; in the field they can be distinguished by the presence or absence of plagioclase phenocrysts. Trace element geochemical analysis will be conducted in attempt to further distinguish them and determine their tectonic affinity.

STRUCTURE

The Logjam area is a northeast-dipping homocline (units 1-3) flanked by the structurally lower ePms unit to the northwest. Although development of schistosity varies, fabric elements indicate the entire map area experienced the same deformational regime. The phyllite-wacke-limestone unit (unit 3), interpreted as higher in the stratigraphy, appears structurally lower than units 1 and 2 because it is the most pervasively deformed and is the only unit displaying quartz rodding and boudinage. Relatively intense foliation development in unit 3 can be explained by strain partitioning, or because a more suitable composition for phyllosilicate growth, or both.

Evidence of the earliest deformation (D_1) is a set of NNW and SSE trending folds (F_1) and related phyllitic axial planar cleavage (S_1; Figure 4). Insert Figure 4 here. The phyllitic cleavage is nearly parallel to compositional layers interpreted as transposed bedding (S_1 within 10 degrees and commonly within 3 degrees of S_0; Figure 4). Such widespread near bedding-parallel foliation is due either to transposition or to original high amplitude, isoclinal folding. Large-scale isoclinal folds probably mimic millimetre to metre-scale isoclinal F_1 folds. These folds are inclined to recumbent, and subhorizontal to shallowly plunging. S_0 and S_1 are asymmetric (Figure 4) suggesting a southwestern vergence for F_1. Strong coaxial quartz rodding lineations and stretched pebbles (5:1 aspect ratio) are interpreted as the transport lineations parallel to F_1 axis (Figure 4). All beds must be considered potentially transposed because of the presence of attenuated isoclinal folds. However, the local consistency of facing directions and their limb position suggest these data are significant. Metamorphism was likely to be roughly coeval with D_1 since metamorphic minerals such as chlorite are axial planar to F_1 folds.

Regionally important, kilometre-scale folds have been identified in the Logjam area by recognition of unit repetitions and a facing direction reversal. These folds are close to isoclinal and plunge gently to the southeast. Similar folds are observed in F_1 microstructure (Figure 4), although plunges to the southeast are more common. Units 3a and 3c appear to be cut off as they strike toward the north into this anticline (Figure 2); these units may be truncated by a fault that cuts up section to the north or may be folded within a south-plunging anticline. The latter possibility is favored, as it is supported by the repetition of unit 3c.

Second phase folds (F_2) are commonly at centimeter- to decimetre-scales. They are open to close, upright to inclined and shallowly to moderately plunging (Figure 4). Crenulated foliation surfaces are very common. D_2 crenulations deform tight centimetre-scale F_1 folds, providing age relations for these events. Rarely, later crenulations deforms D_2 crenulations folds. These suggest a later deformational event (D_3?), or more likely these are a product of progressive D_2 deformation because the crenulations have similar geometry. No mineral lineations accompany F_2 folds. Although northeast-striking phyllitic fabrics were identified in the field as S_2; these are never axial planar to F_2. An S_2 fabric that overprints S_1 fabrics was only observed in one outcrop, but even here the relationship was not clear. These observations and the fact that the style of fabric is indistinguishable suggest that S_2 may actually be a folded S_1. When all foliation fabrics are plotted together they outline a small circle suggesting that S_1 is folded by a moderately to weakly conical folds that are coaxial with F_2 (Figure 4). Therefore, phyllitic fabrics with northeastern orientations are considered to be S_1 surfaces folded by outcrop scale F_2 folds.

Late-stage brittle kinks were observed on bedding planes. A fault which juxtaposes units across a minor creek on the north-central ridge is intruded by a hornblende porphyry dike, characteristic of late dikes that crosscut all deformational features.

U-Pb GEOCHRONOLOGY

Three samples from the Logjam area were collected for U-Pb dating: a deformed tonalite from the Logjam intrusion, an undeformed hornblende-phyric intrusion and grit from the conglomeratic facies of unit 1b. The sample from a hornblende-phyric pluton (98TGL17-2) yielded no minerals datable by the U-Pb method. Zircon and titanite concentrates from the other two localities were prepared from representative ca. 10-20 kg samples using conventional crushing, grinding, Wilfley table, heavy liquid and magnetic separation techniques. The methodology for zircon grain selection, abrasion, geochemical preparation and mass spectrometry are described by Mortensen *et al*. (1995). U-Pb analyses were done at The University of British Columbia (Table 1, Figures 5, 6). Insert Table 1 and figures 5 and 6 here. Errors attached to individual analyses were calculated using the numerical error propagation method of Roddick (1987). The decay constants were those recommended by Steiger and Jäger (1977).

Analytical Results

(1) Logjam intrusion deformed tonalite: 98TGL-19-10

A representative sample of foliated tonalite from the Logjam intrusion yielded abundant, high quality, clear, colourless to pale pink zircons. Five analysed zircon frac-

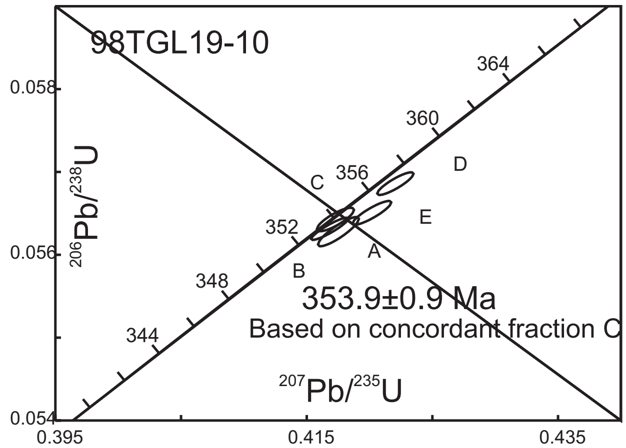

Figure 5. Standard concordia plot for deformed tonalite of the Logjam intrusion (98TGL19-10). Error ellipses are plotted at the 2 sigma level of confidence. U-Pb data are listed in Table 1.

tions cluster on and off of concordia between about 353 Ma and 358 Ma (*et al*). An assigned crystallization age of 353.9 ± 0.9 Ma is based on the $^{206}Pb/^{238}U$ age for concordant fraction C. Discordant fractions A, D and E give older 207Pb/206Pb ages (Table 1) and are inferred to contain minor inherited zircon.

The above age demonstrates that the Logjam intrusion is the product of Devono-Mississippian magmatism, which has been well documented throughout the pericratonic terranes in the Yukon and British Columbia (Murphy and Piercey, 1999; Mortensen, 1992). The Logjam tonalite intrudes unit 3b and its crystallization age thus constrains the minimum depositional age for unit 3b and stratigraphically lower units, and a maximum age for deformation in the area . The unfoliated Nome Lake batholith to the south, with a K-Ar age of ca. 180 Ma (Wanless *et al*., 1970), provides a mid-Jurassic minimum age constraint on deformation.

(2) Unit 1b grit detrital zircon analyses: 98TGL25-4

A grit sample from the conglomerate bed of unit 1b yielded abundant detrital zircons which vary from clear, colourless, well-faceted euhedral prismatic crystals to deep purple, naturally abraded ellipsoidal grains. Ten single grains selected from euhedral and rounded populations gave $^{207}Pb/^{206}Pb$ ages of 2777 Ma to 422 Ma. The $^{207}Pb/^{206}Pb$ ages for six concordant or nearly concordant analyses (2.0-0.1% discordant; Table 1, Figure 6) are interpreted as crystallization ages for these grains . The youngest concordant grain, (J), at 422 Ma, defines a maximum age for deposition of the conglomeratic facies of unit 1b and all stratigraphically higher units. These age constraints suggest that units between 1b and 3b are constrained to between Middle Silurian (*ca.* 422 Ma) and earliest Mississippian (*ca.* 354 Ma). Implications of the detrital zircon data set are further discussed below.

BIOCHRONOLOGY

Fourteen conodont samples were collected from limestone and dolostone beds and interbeds. All samples were barren of conodonts and other microfossils, providing no chronological constraints (M. Orchard, personal communication, 1999).

Provenance

To better constrain the evolution and provenance of units 1 to 3, a point count study was undertaken. Detrital

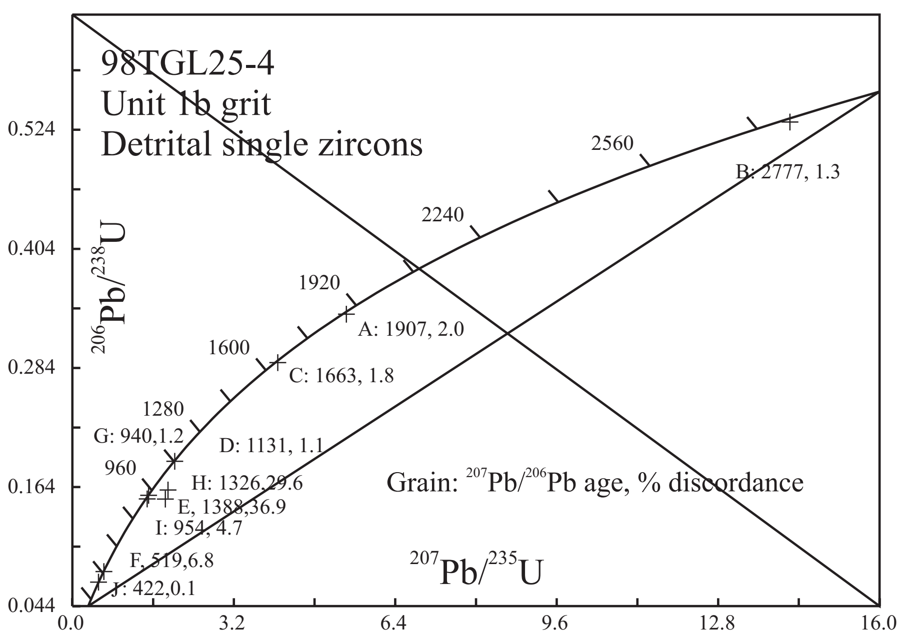

Figure 6.Standard concordia plot for detrital zircon grains in a grit sample from unit 1b (98TGL25-4). Error ellipses are plotted at the 2 sigma level of confidence; $^{207}Pb/^{206}Pb$ ages and discordancies are listed for each fraction on plot and in Table 1.

TABLE 1
U-PB ANALYTICAL DATA FOR THE LOGJAM AREA

Fraction[1]	Wt mg	U[2] ppm	ppm	^{206}Pb[4] / ^{204}Pb	Pb[5] pg	^{208}Pb[6] %	Isotopic ratios (1s,%)[7] ^{206}Pb/^{238}U	^{207}Pb/^{235}U	^{207}Pb/^{206}Pb	Apparent age (2s,Ma)[7] ^{207}Pb/^{206}Pb	%Discordant[8] (to origin)
98TGL19-10 deformed tonalite of Logjam intrusion: 353.9±0.9 Ma											
A p,eu	0.104	347	19	27055	5	6.1	0.05628 (0.16)	0.4175 (0.19)	0.05381 (0.10)	362.9 (4.3)	
B p,eu	0.11	371	20	10304	14	6.8	0.05631 (0.12)	0.4168 (0.18)	0.05368 (0.08)	357.8 (3.8)	
C p,eu	0.092	172	10	9150	6	8.2	0.05643 (0.13)	0.4173 (0.18)	0.05363 (0.10)	355.8 (4.6)	
D p,eu	0.112	281	16	17969	6	7.9	0.05686 (0.12)	0.4221 (0.17)	0.05384 (0.09)	364.2 (4.0)	
E p,eu	0.094	165	9	8110	7	8.5	0.05651 (0.13)	0.4202 (0.18)	0.05393 (0.09)	368.2 (4.2)	
98TGL25-4 Unit 1b grit: detrital single grain zircon analyses											
A c,vp,r	0.032	167	67	17985	6	18.5	0.33743 (0.11)	5.4315 (0.17)	0.11674 (0.07)	1907.0 (2.6)	2
B c,vp,r	0.016	228	144	19970	6	13.7	0.53135 (0.11)	14.2203 (0.16)	0.19410 (0.07)	2777.2 (2.3)	1.3
C c,pp,r	0.015	179	56	7732	6	11.7	0.28915 (0.12)	4.0719 (0.17)	0.10213 (0.08)	1663.3 (3.1)	1.8
D c,pp,r	0.016	643	123	16785	7	8	0.18955 (0.11)	2.0221 (0.16)	0.07737 (0.08)	1130.8 (3.1)	1.1
E c,y,r	0.007	58	9	699	6	10.8	0.15168 (0.15)	1.8460 (0.36)	0.08826 (0.29)	1388 (11)	36.9
F c,y, eu,pr	0.011	570	44	4181	7	7.2	0.07810 (0.16)	0.6214 (0.26)	0.05771 (0.18)	518.6 (8.0)	6.8
G c,pp, eu,pr	0.011	276	41	2353	12	4.7	0.15512 (0.17)	1.5056 (0.25)	0.07040 (0.15)	940.0 (6.1)	1.2
H c,y, eu,pr	0.007	171	32	2002	6	20.6	0.16075 (0.13)	1.8941 (0.21)	0.08546 (0.12)	1326.0 (4.7)	29.6
I c,y, eu,pr,b	0.01	311	45	4491	7	3.3	0.15205 (0.12)	1.4863 (0.18)	0.07089 (0.11)	954.3 (4.3)	4.7
J c,pp, eu,pr,s	0.007	792	57	1892	12	14.3	0.06761 (0.15)	0.5150 (0.27)	0.05524 (0.19)	422.0 (8.4)	0.1

[1] Upper case letter = zircon fraction identifier; All zircon grains >134mm, air abraded, and nonmagnetic on Franz magnetic separator at 2.0A° fieldstrength and 1° sideslope; Grain description codes: b= broken grain, c=clear, cls=colourless, e=elongate, eu=euhedral and faceted, g=grey, pp=pale, pr=prismatic, r=rounded and frosted, s=stubby, t=turbid; vp=vivid pink; y=yellow.
[2] U blank correction of 1pg ± 20%; U fractionation corrections were measured for each run with a double 233U-235U spike (about 0.005/amu).
[3] Radiogenic Pb
[4] Measured ratio corrected for spike and Pb fractionation of 0.0035/amu ± 20% (Daly collector) and 0.0012/amu ± 7% and laboratory blank Pb of 1-3pg ± 20%. Laboratory blank Pb concentrations and isotopic compositions based on total procedural blanks analysed throughout the duration of this study.
[5] Total common Pb in analysis based on blank isotopic composition
[6] Radiogenic Pb
[7] Corrected for blank Pb, U and common Pb. Common Pb corrections based on Stacey Kramers model (Stacey and Kramers, 1975) at the age of the rock or the 207Pb/206Pb age of the fraction.
[8] Detrital zircon analyses only; 207Pb/206Pb ages interpreted as crystallization ages for fractions 2% or less discordant.

grain abundances help discriminate between possible tectonic settings. Petrographic work was complimented by U-Pb detrital zircon ages which give Early Paleozoic and Precambrian crystallization ages (Table 1). The tectonic setting exerts a primary control on sandstone compositions, although relief, climate, transport mechanism, depositional environment and diagenesis all can be important secondary factors (Dickinson, 1985). The point counting methodology of Dickinson and Suczek (1979) was followed. Ten greywacke, grit and coarse siltstone samples, each representative of a unit, were point-counted with more than 300 points per slide at a spacing of 1 mm. Efforts were made to minimize uncertainty presented by differentiating matrix, identifying feldspars, metamorphism and diagenesis (Dickinson, 1970); difficult grains were counted as 'undifferentiated' which is not part of the tectonic discrimination. The detrital zircon grit sample was counted and compared with other samples, even though its grain size is an order of magnitude larger.

All three stratified units (1, 2 and 3) plot in the continental block or recycled orogen provenance on selected ternary tectonic discriminate diagrams (Figure 7). Insert figure 7 here. The total quartz-feldspar-lithics plot (Figure 7) best shows that each unit has a slightly different provenance with unit 3 in the continental block field and unit 1 and unit 2 in the recycled orogen field. The recycled orogen field includes deformed and uplifted supracrustal strata, dominantly sedimentary but also volcanic in part (Dickinson, 1985; Dickinson and Suczek, 1979). Continental block provinces include both stable cratons and basement rifts which yield arkosic sands. The grit of unit 1b plots well away from all other samples (Figure 7). This may show that the methodology is grain-size dependent because the provenance of a thin bed should compare to the provenance of the rest of the unit. The grit has little matrix and coarse sub-angular grains which suggest an alluvial setting and a proximal source.

Detrital zircon ages are also useful provenance indicators (Table 1; Figure 6). Six of ten analysed grains are concordant or nearly concordant (<2% discordance; Table 1). ^{207}Pb/^{206}Pb ages for these analyses are interpreted as crystallization ages of 2777, 1907, 1663, 1131, 940, and 422 Ma. Reliable age interpretations are not possible for the four more discordant analyses, especially highly discordant grains E and H. The paucity of usable data prevents meaningful statistical analysis. However, the six grains that provide reliable age information allow us to draw conclusions relevant to the geologic evolution of the Logjam area, and more generally to strata of the pericratonic terranes of the northern Cordillera.

Concordant ages of single grain zircons and the age constraints on the strata, allow comparison of unit 1b to the reference Devonian miogeoclinal sections of Gehrels *et al*. (1995; Silurian clastic sedimentary rocks are rare or absent in the miogeocline and not represented in reference sections). Gehrels *et al.* (1995) showed that age distributions of detrital zircons characterize different latitudes of the Cordilleran miogeocline. The ages of grains A and B (2.78 Ga and 1.91 Ga, respectively) are consistent with detrital ages that are common in Canadian and Alaskan reference miogeoclinal sections and rare or absent in Nevadan and Sonoran sections (Gehrels *et al*., 1995). Detrital zircons with similar ages, from pericratonic strata in the Yukon-Tanana Terrane in Yukon (Mortensen, 1992) and a correlative assemblage in the Coast Mountains of northwestern British Columbia, have been interpreted as consistent with derivation from northwestern North American cratonic sources (Gehrels and Kapp, 1998). The 1.66 Ga age for fraction C is consistent with derivation from recycled Belt Supergroup sediments in southern British Columbia and Montana (Ross *et al*., 1992). Gehrels and Kapp (1998) suggested this source for metasedimentary assemblages in the Coast Mountains of British Columbia with detrital zircons of a similar age. However, Gehrels *et al*. (1995) also suggested that grains of this age might have latitudinal significance for Nevada and Sonora. Grenvillian-aged grains (fraction C; ca.1.13 Ga), occur in Paleozoic sedimentary rocks younger than ca. 450 Ma throughout North America (Patchett *et al*., 1999), and are thus not latitudinally significant. The 940 Ma age for detrital grain G has not been previously encountered in Paleozoic strata of the miogeocline (Gehrels *et al*., 1995), and possible sources within the North American craton have yet to be identified. Finally, the age of 422 Ma (fraction J) matches detrital ages in Alaskan and to a lesser extent the southern British Columbian miogeoclinal reference sections (Gehrels *et al*., 1995) and the Alexander terrane of southeastern Alaska (Gehrels *et al*., 1996).

In summary, the ages of most detrital zircons from the Logjam area are consistent with detrital ages from other pericratonic terranes of the northern Canadian Cordillera and with those from Devonian reference sections of the North American miogeocline in Alaska and British Columbia. This suggests that strata from the Logjam area and northern pericratonic terranes was likely derived from the northwestern North American craton and Pre-

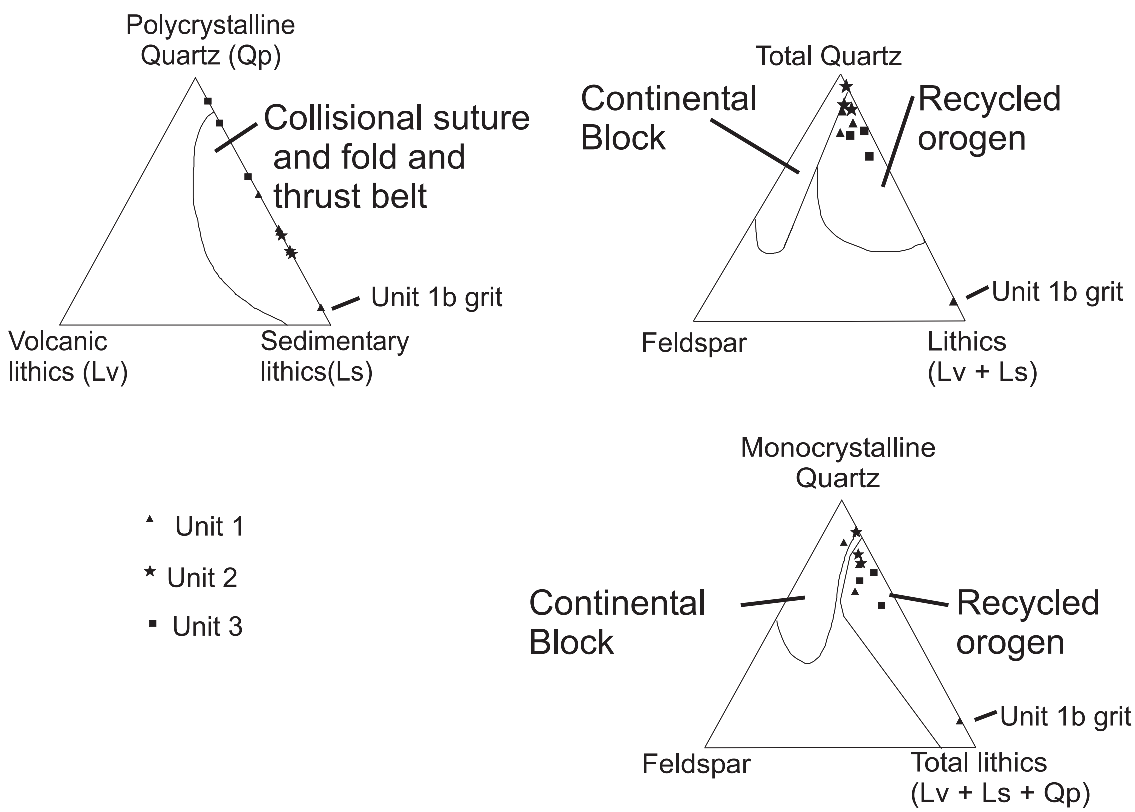

Figure 7.Ternary plots of point-count data from Units 1, 2 and 3; provenance fields after Dickinson (1985).

cambrian to Lower Paleozoic rocks of the northern miogeocline. The recycled nature of the grit from unit 1b is further confirmed by its recycled orogen provenance (Figure 7) and its primary constituent (sedimentary lithics). These conclusions should be considered preliminary until further detrital zircon ages are determined for the Logjam area and pericratonic terranes in general.

DISCUSSION

Mapping between Screw and Logjam Creeks produced a reliable local stratigraphy of three units: brown siltstone and chert (unit 1); green and maroon to white siltstone and sandstone (unit 2); and phyllite, wacke, and limestone (unit 3). Geochronologic constraints suggest that these units were all deposited in Middle Silurian to latest Devonian and subsequently deformed by two Mississippian to Middle Jurassic deformational events. Strata of this age are quite uncommon among pericratonic assemblages. Two examples are the Nasina quartzite within the Yukon-Tanana Terrane and an Upper Devonian siliciclastic unit within the Harper Ranch subterrane of the Quesnellia Terrane (Fritz *et al*., 1991). Mid-Paleozoic age constraints preclude correlation to the Triassic Teh clastics of the Klinkit assemblage roughly along regional strike 30 km to the south. Another possible correlation is with the units directly east of Screw Creek from the Logjam area. The black chert pebble conglomerate and red and green argillite that lie below the Screw Creek limestone may be correlative with the green and maroon siltstone (unit 2b). In this case, both green and maroon lithologies that were deposited between mid-Silurian and Devonian and units above unit 2b (unit 2a and 3) on the Screw Creek ridge must have then been removed by a pre-Pennsylvanian erosion event represented by the conglomerate lowest in the Screw Creek limestone. Although the Logjam area has a consistent stratigraphy and structure, the lack of protolith age constraints and equivocal regional stratigraphic correlations preclude a reliable assemblage assignment.

Relationships between units 1-3 and unit ePms, to the east, and the Big Salmon Complex, to the west, remain enigmatic. The contact between unit ePms schist and units 1, 2 and 3 might be due to compositional differences or strain partitioning. The outcrop distribution of ePms is not reconcilable with the geometry of fault emplacement. Although unit ePms displays a more developed schistosity than units 1-3, it may be the same metamorphic grade (all metamorphic assemblages are incomplete). Unit 3b may be a protolith for unit ePms; the relationship between the schist and the less deformed metasediments is the topic of an ongoing study. Deposition of units 1 to 3 might in part be coeval with the deposition of the lowest greenstone unit of the Big Salmon Complex (which is older than the ca. 366 Ma Mt. Hazel orthogneiss; Mihalynuk *et al*. 2000, this volume). Future work should be directed towards constraining protolith age, perhaps from the tuffaceous rocks, and dynamothermal events by dating the cross-cutting hornblende porphyry dikes.

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