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KINEMATIC ANALYSIS AND TIMING OF STRUCTURES IN THE BRIDGE RIVER COMPLEX AND OVERLYING CRETACEOUS SEDIMENTARY ROCKS, CINNABAR CREEK AREA, SOUTHWESTERN BRITISH COLUMBIA* (92J/15)

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KEYWORDS: Regional geology, structure, kinematic analysis, Bridge River complex, Taylor Creek Group, Silverquick conglomerate, Bralorne, Eldorado pluton, blueschist, deformation, strike-slip faulting, thrusting.

INTRODUCTION

The North Cinnabar Creek area is located approximately 200 kilometres north of Vancouver on the eastern flank of the Coast Range. The 12-square-kilometre study area is underlain by strongly deformed rocks of the Bridge River complex (informal) and an unconformably overlying synorogenic clastic sequence that is also deformed (Figure 1-7-1). The area is of particular interest because several fault-bounded panels of rocks belonging to the Bridge River complex contain newly discovered blueschist (Garver *et al.*, 1989a, b, and c; Garver, 1989). Detailed mapping (1:10 000; Figure 1-7-2) and kinematic analysis of the structures in this area was undertaken to better understand the structural setting of the blueschists. This recent effort was largely concentrated in the imbricated rocks of the Bridge River complex, which are exposed east of the Castle Pass fault and south of the unconformably overlying sedimentary sequence, and it follows earlier 1:20 000 mapping (Figure 1-7-2). The Castle Pass fault, which separates the different lithologic units of the Bridge River complex, was originally interpreted as a dextral strike-slip fault in the Castle Pass area some 10 kilometres along strike to the northwest (Glover *et al.*, 1988a and b; Schiarizza *et al.*, 1989a and b). Recent mapping, however, suggests that although a late history of dextral strike-slip faulting may be recorded along parts of the Castle Pass fault, this fault (and the Tyaughton Creek fault to the east) has a history of sinistral transpressional deformation (Schiarizza *et al.*, 1990).

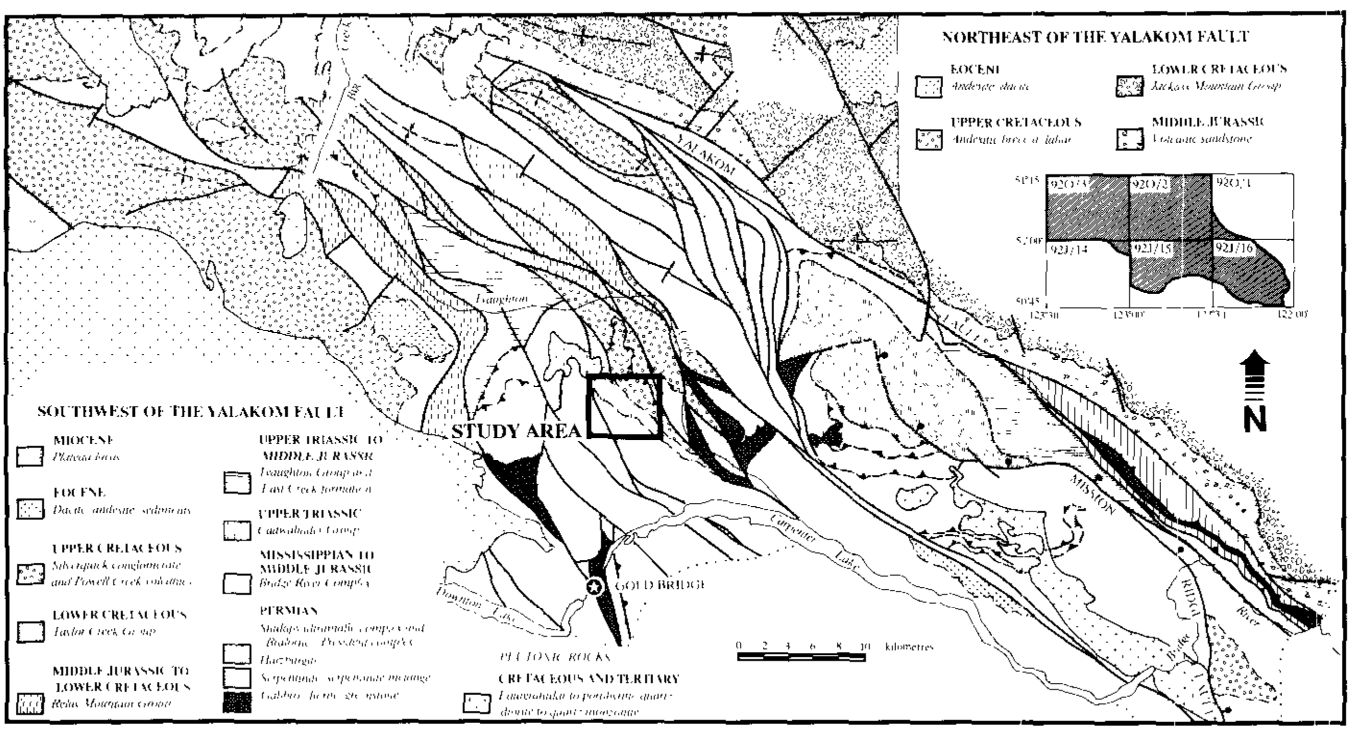

Figure 1-7-1. Generalized geology of the Taseko – Bridge River project area (from Schiarizza *et al.*, 1990). The study area is some 4 to 5 kilometres west of Tyaughton Lake, which is not shown on this map. Note the proximity of the 64 Ma Eldorado pluton directly to the north of the study area; it is not cut by northwest-trending strike-slip faults, but it does have faulted margins.

* This project is a contribution to the Canada/British Columbia Mineral Development Agreement.

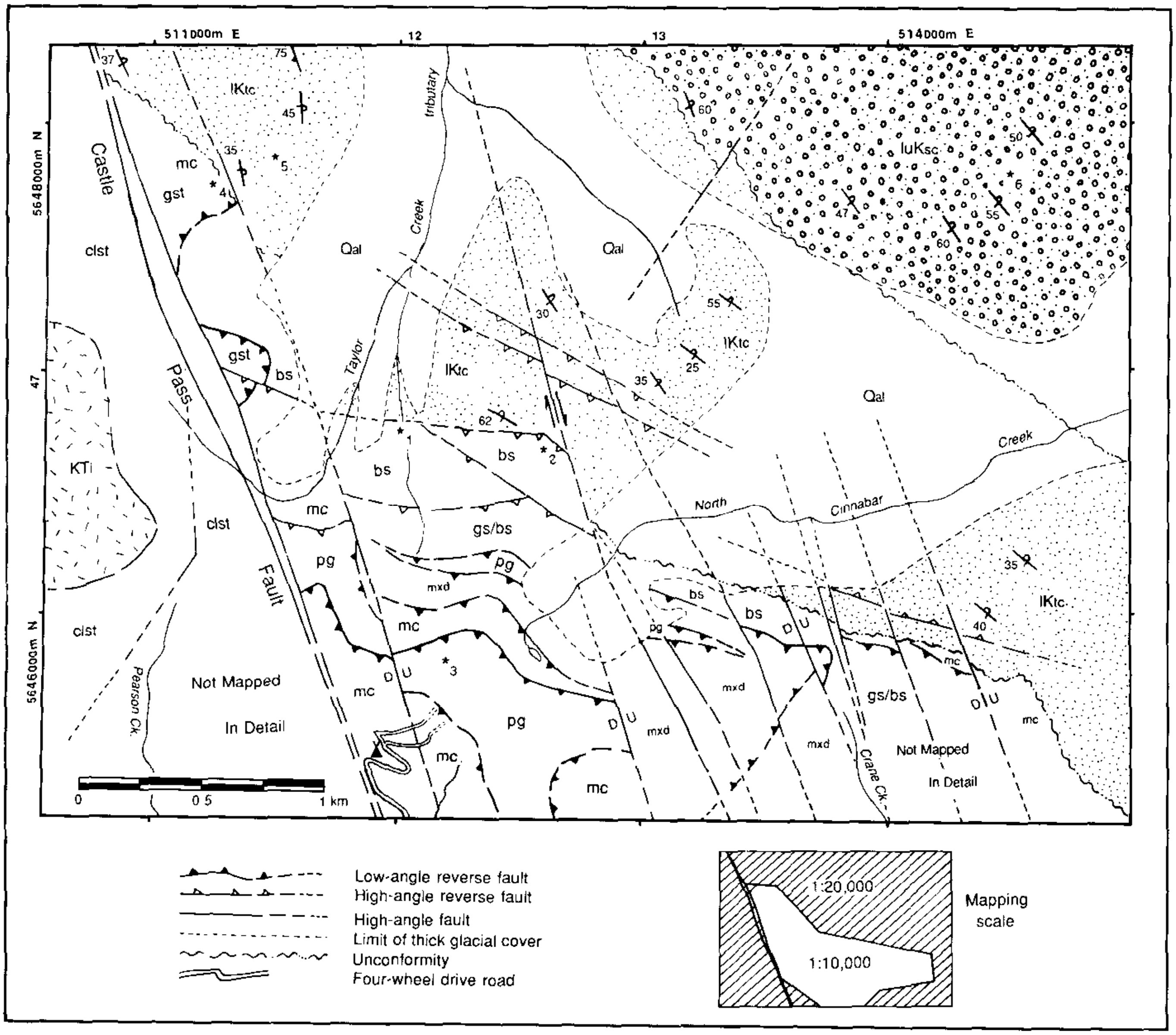

Figure 1-7-2. Simplified geologic map of the study area. Note that detailed mapping (1:10 000) was concentrated in the southern part of this area, east of the Castle Pass fault; the detail here is much better than elsewhere on the map sheet. The end of the Pearson Creek road, which begins near Tyaughton Lake, is shown on the southern part of the map. This four-wheel-drive road provides convenient access to the study area; camp sites are present at the end of the road. The Bridge River complex, which is unshaded, contains the following lithologies in this area: pg – prehnite-pumpyellite-grade pillowed greenstone; mc – highly deformed metachert; bs – blueschist; gs/bs – rocks the contain both green and blue schistose metamorphic rocks, both of which have blueschist-facies metamorphic minerals; mx – a mixed zone of lithologies that are similar to all lithologies in the Bridge River complex east of the Castle Pass fault; gst – massive greenstone without blueschist facies minerals; clst – clastic rocks, which occur east of the Castle Pass fault. These clastic rocks include black argillite, chert and volcanic-lithic sandstone and conglomerates, and minor interbedded chert. Other units include: KTi – a small stock that may be related to the Eldorado pluton to the north; lKtc- middle to upper Albian Taylor Creek Group; luKsc – Albian to Cenomanian Silverquick conglomerate; Qal – thick deposits of Quaternary alluvium. Numbers refer to dated rocks as follows: (1) white mica in blueschist gives 244±7 Ma (K-Ar, Garver *et al.*, 1989b), 217±5 Ma (Rb-Sr, Garver *et al.*, 1989b), 218.1±1.2 Ma (Ar/Ar, Archibald *et al.*, 1989); (2) blueschist from several outcrops give 195±6, 222±8, and 250±9 Ma (wholerock, Garver *et al.*, 1989b; an Ar/Ar sample from this locality is in progress, Archibald, personal communication, 1990); (3) conodonts from limestone interbedded with pillowed greenstone are early Norian (Upper Triassic – P. Schiarizza, unpublished data); (4) conodonts from bedded chert give a Triassic age (P. Schiarizza, unpublished data); (5) middle to upper Albian (Lower Cretaceous) ammonites from the Taylor Creek Group (Garver, 1989); (6) Albian to Cenomanian flora from the Silverquick conglomerate (*see* Garver, 1989).

In addition to the intrinsic scientific value of the blueschists, this area is also important in a regional sense because the rocks are well dated and therefore the timing of structural development is fairly well constrained. This project is an outgrowth of mapping done during the author's Ph.D. research (which focused on the mid-Cretaceous basin development in this area), which was conducted, in part, with the M.D.A.-sponsored Taseko—Bridge River mapping project (Figure 1-7-1; *see* also Glover and Schiarizza, 1987; Glover *et al.*, 1987, 1988a, b; Umhoefer *et al.*, 1988; Schiarizza *et al.*, 1989a, 1989b, 1990; Garver *et al.*, 1989a, b, c).

The structures and their timing bear on the tectonic evolution of the Bridge River and Cadwallader terranes in the immediate area as well as the Intermontane Superterrane to the east and the Insular Superterrane to the west. This structural information also has a bearing on mineral exploration in the area because the earlier structures (*circa* 100 to 80 Ma) outlined in this report are broadly coeval with the Bralorne fault system which hosts well-known mesothermal gold deposits about 20 kilometres to the south; thrusts in the North Cinnabar Creek area are probably a high-level expression of the same contractional event. These contractional structures are cut by a younger dextral fault system that may have experienced several episodes of movement and mineralization. In this area, these brittle high-angle faults host fairly common polymetallic vein mineralization (Minto mine, located on the Castle Pass fault to the southeast of the study area – Schiarizza *et al.*, 1990) and mercury mineralization.

LITHOLOGY

The rocks in the study area belong to two principal units that are cut by intrusive rocks: upper Paleozoic to lower Mesozoic rocks of the Bridge River complex, an oceanic assemblage that includes various imbricated panels of chert, greenstone, clastic rocks, serpentinite and, notably, blueschist; and a mid-Cretaceous sedimentary package that unconformably overlies the deformed Bridge River complex. This sequence includes the middle to upper Albian Taylor Creek Group and the Albian to Cenomanian Silverquick conglomerate (informal; Garver, 1989). Quartz diorite to granodiorite of the Eldorado pluton and related stocks, which are exposed immediately north and west of the map area, intrude both the Bridge River complex and the overlying Cretaceous strata (Figure 1-7-1). The Eldorado pluton has a satellite stock (the Robson stock) with a K-Ar age of 63.7±2.2 Ma on biotite (Leitch *et al.*, 1989); this is taken as the age of the Eldorado pluton. Details concerning the different lithologic units in this area can be found in Garver *et al.* (1989a); Garver (1989); and Schiarizza *et al.* (1989a)

STRUCTURAL GEOLOGY

Our understanding of the structural development in the Bridge River – Taseko area has been been greatly enhanced by MDA-sponsored mapping and thesis research. Recent detailed mapping in the Shulaps Range, slightly to the east of this study area, has revealed some of the intricacies of this deformation. In essence, five deformational events are recognized: (1) lower Mesozoic blueschist deformation (Garver *et al.*, 1989 a, b); (2) southwest-vergent thrusting, which is best displayed in the Shulaps Range and slightly younger thrusts and reverse faults with the same vergence (Calon *et al.*, 1990; Schiarizza *et al.*, 1989a, 1990), both of which were probably contemporaneous with the deposition of a mid-Cretaceous synorogenic clastic wedge (Garver, 1989); (3) northeast-vergent thrusts and folds that probably immediately postdate the earlier thrusting (Schiarizza *et al.*, 1989; Garver *et al.*, 1989; Garver, 1989); (4) northwest-striking dextral strike-slip faulting and extension with significant movement on the Yalakom, Relay Creek and Mission Ridge faults during the Eocene (Glover *et al.*, 1988a and b; Schiarizza *et al.*, 1989a; 1990; Umhoefer, 1989; Coleman, 1989); and (5) north-striking dextral strike-slip faulting that is probably synthetic with the Fraser fault (Schiarizza *et al.*, 1990; Coleman 1989; Umhoefer, 1989; Coleman and Parrish, 1990). The North Cinnabar Creek area is important because it contains well-dated rocks and because structures related to the blueschist deformation, the northeast-vergent thrusting, and the strike-slip faulting are particularly well displayed. Indeed, this area is the one of the few areas in the region where northeast-vergent thrusting can be documented.

Specifically, the area contains internally imbricated panels of rocks within the Bridge River complex that are unconformably overlain by overturned rocks of the Albian Taylor Creek Group (Figure 1-7-2). The orientation and asymmetry of the overturned rocks and small-scale folds suggest that this phase of deformation was caused by northeast-vergent thrusting. These thrust-related structures are cut by a late, brittle, northwest-trending dextral fault system that is apparently plugged by the Eldorado pluton, but internally the pluton has not been mapped in detail. The pluton is cut by faults along its eastern margin. Deformation older than the strike-slip faulting and the northeast-vergent thrusting is present within the Bridge River complex but its nature cannot be resolved. Pre-unconformity deformation must have occurred, however, because the Taylor Creek Group rests above different rock types of the Bridge River complex. The sedimentology and pattern of basin infilling suggest that the Bridge River complex was thrust westward and internally imbricated during the sedimentation (Albian – *circa* 110 to 100 Ma; Garver, 1989). Older, poorly understood deformation is recorded in both units within the Bridge River complex. Notably, the blueschist experienced synkinematic deformation that was approximately contemporaneous with its Permo-Triassic metamorphism.

POST 64 MA STRIKE-SLIP FAULTING

Several of the main strands of the strike-slip faults in the study area can be mapped to the edge of the 64 Ma Eldorado pluton. These faults, which are discussed in detail in the next section, do not extend into the pluton and are therefore presumed to predate it. Although there is certainly a significant rheological contrast between the pluton and the surrounding sediments, deflection of these faults seems unlikely because significant or cumulative offset within the Dash conglomerate of the Taylor Creek Group along the east edge of the pluton is not recognised (Figure 1-7-1; Garver *et al.*, 1989). Recent examination of the central and eastern parts of the pluton suggests that the Castle Pass fault does not cut the pluton where the fault is projected through it. As discussed above, the Castle Pass fault is presumed to have an earlier history of sinistral oblique movement and parts of it had a later history of dextral strike-slip (Schiarizza *et al.*, 1990). It also suggests that the eastern edge of the pluton is faulted. These faults are north-striking, moderately dipping and have horizontal slickenside lineations and down-dip lineations. The nature of this young deformation is incompletely studied but it may have developed at the same time as the north-striking Fraser fault system to the east, or the northwest-striking Yalakom fault which has Eocene movement. The Fraser fault system, some 30 kilometres to the east, characterized by north-trending dextral strike-slip faulting, moved between 46.5 and 35 Ma, according to recent work by Coleman and Parrish (1990). The Yalakom fault is known to have had Eocene movement in this area that was largely transtensional in nature (Schiarizza *et al.*, 1989a; Umhoefer, 1989; Schiarizza *et al.*, 1990; Coleman, 1989). These young episodes of faulting appear to be poorly developed, but they may explain some of the multiple episodes of movement recognized on these brittle faults.

Pre 64 Ma Dextral Strike-slip Faulting

The rocks in the map area are cut by numerous northwest-trending, high-angle faults that are interpreted to have dextral strike-slip movement as suggested by map-scale relationships, small-scale structures and observed offsets. In the following discussion, only faults with known sense of movement are considered. The offset or movement history was determined by: net displacement of piercing points; calcite/quartz fibre mineral growth; or asymmetric fabrics in the faults themselves. Although none of these methods unequivocally gives net displacement, the results show a coherent pattern (Figure 1-7-3). Reverse faults, normal faults and sinistral faults with known net displacement and, generally, only minor movement, are compatible with the strain ellipse for dextral strike-slip faulting. Several small (metre scale) and medium-scale (tens of metres) faults have observable dextral displacement and, where exposed, near-horizontal slickenside striations (Plate 1-7-1), although both vertical and horizontal striations are present on some faults; vertical slickensides record the latest movement, which may be significantly younger, as discussed above. The average strike of faults with known dextral offset is 344° (Figure 1-7-3).

In addition to the dextral faults, many brittle faults indicate north-northeast to south-southwest contraction and nearly east to west extension, and are probably cogenetic with the strike-slip faults. Of all dip-slip faults observed, reverse displacements (indicating NNE-SSW contraction at 025°-225°) are common; faults with normal displacement are rare. Small-scale (<1-2 m) antithetic sinistral faults with an average strike of about 055° are also common, but on a smaller scale, as shown in Plate 1-7-2. Collectively, these late brittle faults with minor displacement fit a strain ellipse for dextral strike-slip faulting with an orientation of about

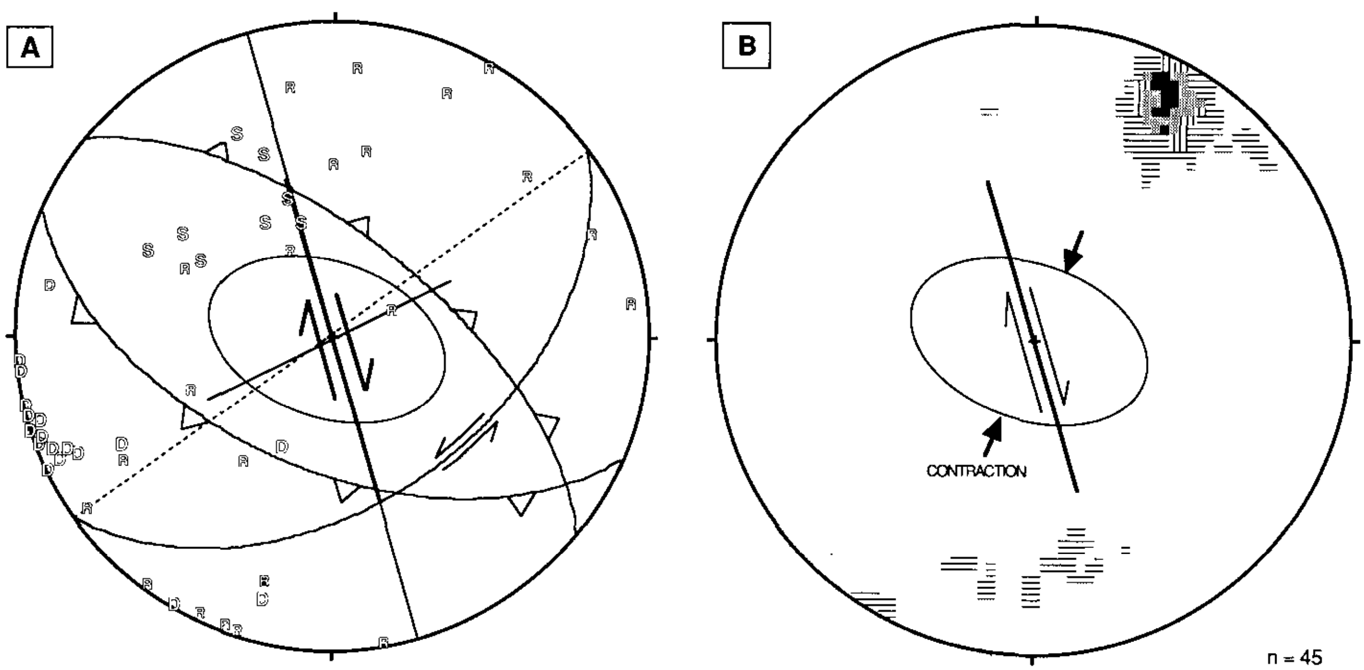

Figure 1-7-3. Small-scale structures related to dextral strike-slip faulting. (A) Poles to faults with known displacement. These faults have metres to tens of metres of known displacement. Most have slickensides that corroborate the inferred sense of movement. Great circles indicate the estimated average of each data set. The strain ellipse for dextral strike-slip faulting overlies the data. (B) Poles to the crenulation cleavage in the blueschist. Asymmetry in the crenulations in both sets indicates reverse movement. Contour intervals are 2.2-5.8%, 5.8-9.3%, 9.3-12.9%, 12.9-16.4%, and 16.4-20.0% per 1% area.

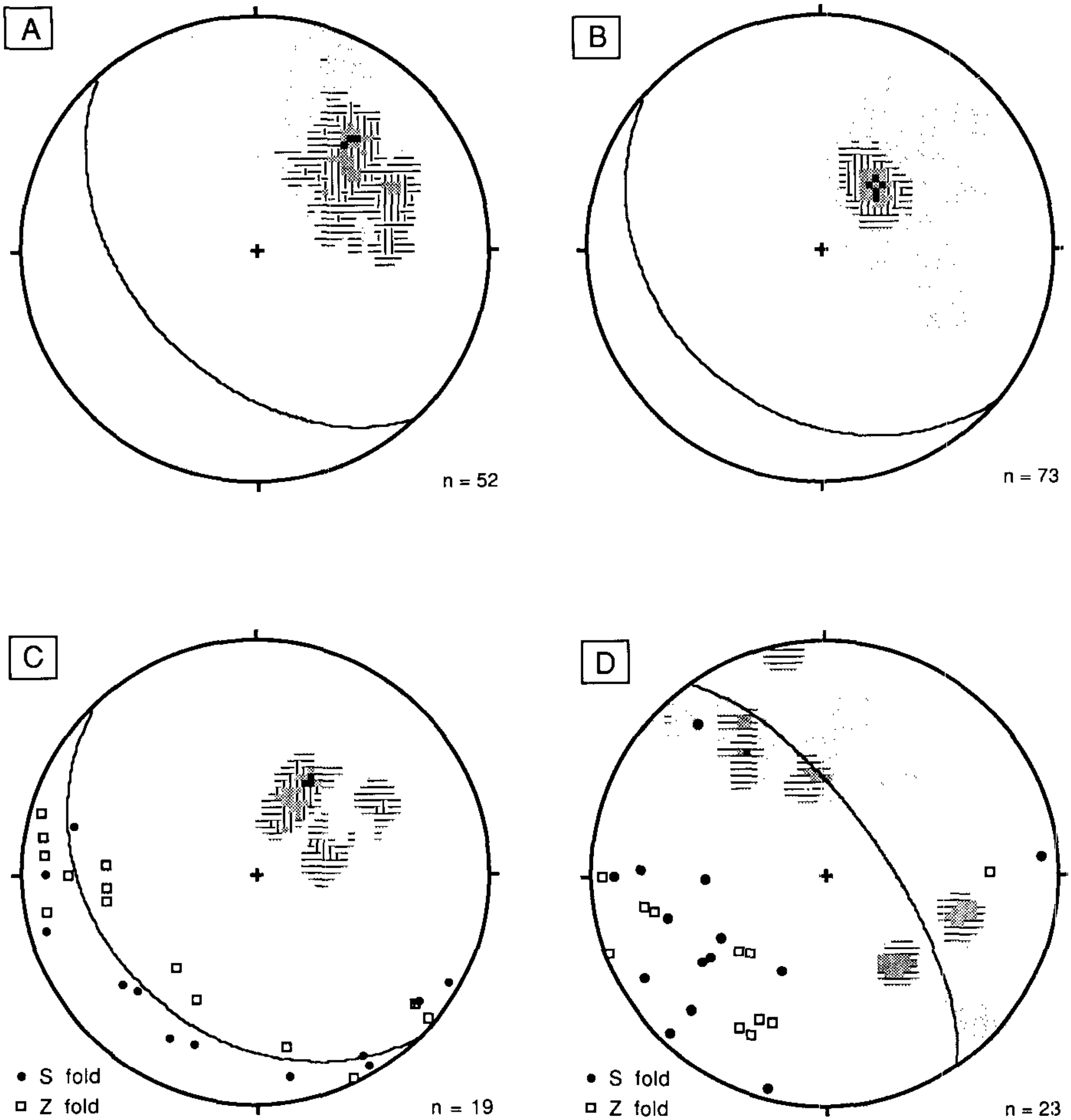

Figure 1-7-4. Stereographic projections of measurements of: (A) poles to foliations within rocks of the Bridge River complex. Contour intervals are 1.9-5.4%, 5.4-8.8%, 8.8-12.3%, 12.3-15.8%, 15.8-19.2% per 1% area. Mean pole to foliation is about 135°/45°; (B) poles to bedding of the Cretaceous sedimentary rocks. Contour intervals are 1.4-10.7%, 10.7-20.0%, 20.0-29.3%, 29.3-38.6%, 38.6-47.9% per 1% area. These data include both upright and overturned attitudes; (C) poles to axial planes (contoured) of fold axes (squares and zeros) from small-scale folds within the Bridge River complex. These data include only those measurements where axial planes are coplaner with the dominant foliation in the Bridge River complex (*see* A above). The mean axial plane (great circle) has an orientation of 135°/30°. The asymmetry of the folds is shown. Contour intervals are 5.3-9.5%, 9.5-13.5%, 13.7-17.9%, 17.9-22.1% 22.1-26.3% per 1% area; D) poles to axial planes (contoured) and the associated fold axes of small-scale folds that do not lie on the dominant foliation plane. These "residuals" almost certainly represent an earlier folding event that was overprinted by structures associated with northeast-vergent thrusting, but refolding of these "older" folds cannot be demonstrated in the field. Contour intervals are 4.3-6.1%, 6.1-9.6%, 9.6-12.2%, 12.2-14.8%, 14.8-17.4% per 1% area.

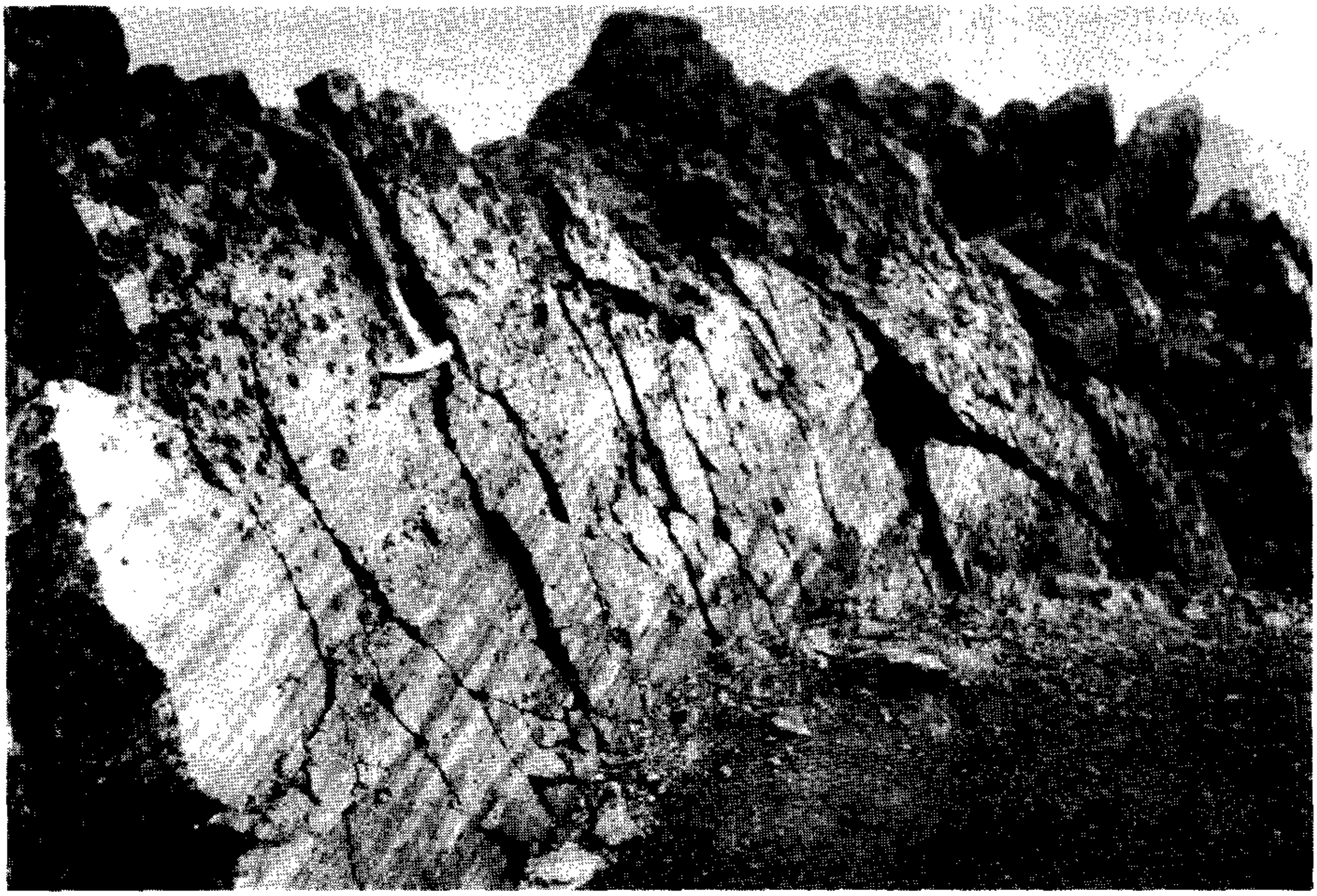

Plate 1-7-1. Northwest-trending high-angle faults with dextral offset. These particular brittle faults, with prominent nearly horizontal slickenside striations, are seen here cutting rocks of the Taylor Creek Group.

Plate 1-7-2. Northwest-striking, high-angle fault with gently plunging slickenside striations that is cut by very small scale northeast-striking sinistral faults. On this fault, the sinistral faults are clearly younger than the strike-slip fault but both are interpreted to have occurred in the same dextral strike-slip fault regime. A white Brunton compass is in the lower right of the photo for scale.

345° (Figure 1-7-3). These minor faults may have been produced during the later phases of movement on the Castle Pass fault in the western part of the map area (Figures 1-7-1 and 2)

Small-scale north-northeast to south-southwest contraction is also indicated by a pronounced crenulation cleavage in the blueschist. The average strike of the cleavage is parallel to the average strike of the relatively common high-angle reverse faults in the area (Figure 1-7-2); both are between 55° and 60° from the orientation of the strike-slip faults, almost exactly what is predicted in a strain ellipse for dextral strike-slip faulting with a strike of 345° (Figure 1-7-3b). Locally, the blueschist contains an earlier crenulation cleavage that is intersected by the late east-trending cleavage, which is dominant. The paucity of observations makes this earlier feature difficult to interpret. Although several faults with apparent normal separation and down-dip slickensides have been recognized, there is a dearth of extensional structures in the map area. The relative lack of extensional structures and abundance of contractional structures may suggest that this area was subject to transpressive dextral strike-slip faulting.

As indicated above, this pervasive system of brittle faults appears not to cut the 64 Ma Eldorado pluton. The north-

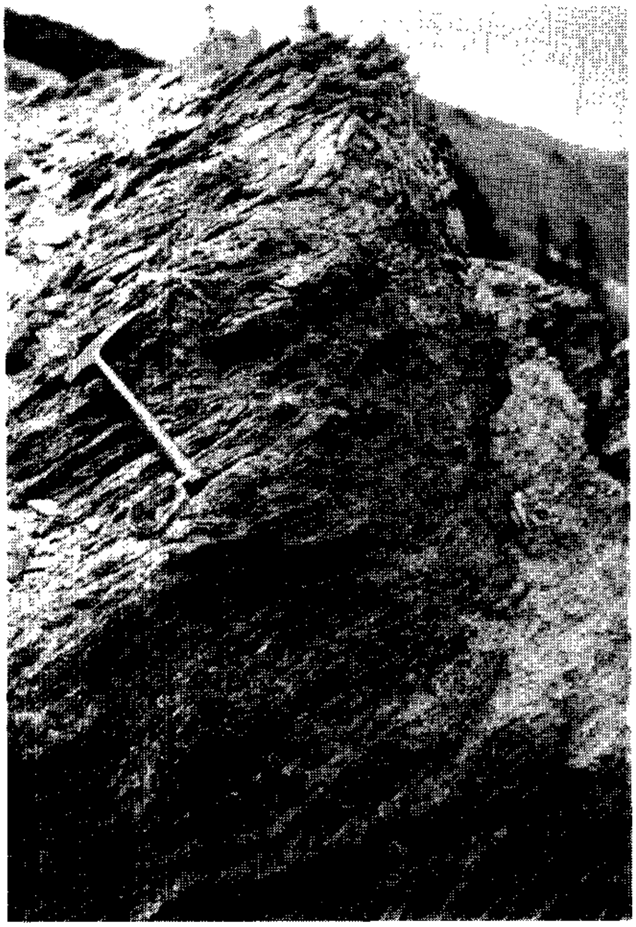

Plate 1-7-3. Thrust fault in metachert of the Bridge River complex. These highly strained rocks are characterised by a penetrative and anastomosing foliation that is defined by strongly attenuated compositional layering. Isolated fold hinges are present and occur as a pronounced streaking lineation on the foliation plane. The streaking lineation (orientated at about 240°/40°), and the dominance of Z-folds in this outcrop, indicate that the tectonic transport was upper plate to the northeast (060°).

striking faults that bound the eastern edge may be related to this movement, or may possibly indicate the latest episode of movement in a protracted event. The system of faults does cut folded and faulted rocks of the Taylor Creek Group and the overlying Silverquick conglomerate. The Taylor Creek Group contains middle to upper Albian fossils (*circa* 105–97 Ma) and the Silverquick conglomerate is undated at this locality, but correlation suggests that it is upper Albian to Cenomanian (*circa* 100–91 Ma; Garver, 1989). Therefore the northwest-trending dextral faulting occurred between about 95 and 64 Ma, during the Late Cretaceous.

NORTHEAST-VERGENT FOLDING AND THRUSTING

The recent mapping indicates that the North Cinnabar area comprises a system of northeast-vergent, imbricate thrust faults with a major (kilometre-scale) overturned fold of mid-Cretaceous rocks in the footwall. The asymmetry of the folds and kinematic indicators in the fault zones indicate that tectonic transport was to the northeast.

FOLDED MID-CRETACEOUS STRATA

A kilometre-scale, overturned, and nearly isoclinal fold occurs in Silverquick conglomerate, the Taylor Creek Group, and presumably in parts of the underlying Bridge River complex. The overturned limb contains the unconformable relationship with the Taylor Creek Group (Dash conglomerate) resting above blueschist and other rock types of the Bridge River complex (Figure 1-7-2). As discussed below, some fault zones in the Bridge River complex were probably produced during this northeast-vergent thrusting; however, any earlier structures must have been overturned or rotated some 150° from the horizontal during this folding event. A plot of poles to bedding (Figure 1-7-4b) shows both upright and overturned bedding attitudes in a relatively tight cluster, with a mean value of about 130°/30°. This asymmetric folding, therefore, has a horizontal fold axis with an orientation of 130° to 310° with a vergence direction to the northeast (040°). Both the scale of this folding and crosscutting relationships suggest that it was a discreet and earlier event from the younger strike-slip faulting. The scale of the folding (a wavelength of 5 kilometres or greater, as some 3 kilometres of strata occur in the overturned limb) is at least an order of magnitude greater than the offset associated with the younger strike-slip faults (metres to tens of metres); folding associated with the strike-slip faulting has not been recognized here. Additionally, numerous synthetic strike-slip faults cut all parts of this nappe-like fold.

BRIDGE RIVER COMPLEX

Within the study area, all units mapped in the Bridge River complex locally contain metre-scale zones of high strain that are characterized by a penetrative foliation (Figures 1-7-2 and 4, Plate 1-7-3). Most of the principal contacts between units are interpreted to be southwest-dipping thrusts (Figure 1-7-2). Where these faults are well exposed, the fabric and the small-scale structures indicate top-to-the-northeast thrusting (Plate 1-7-3). In layered lithologies, such as chert, asymmetric folds are common in these zones and their asymmetry tends to suggest vergence to the northeast. A plot of axial planes to these small-scale folds (centimetre to decimetre scale) is shown in Figure 1-7-4c. Asymmetric folds (both Z and S-folds as viewed down plunge) with axial planes parallel to the dominant foliation suggest that these are developed in northeast-vergent thrusts; however, these data show significant scatter and a slip-line analysis is difficult and speculative. According to the slip-line theory, both S-folds and Z-folds typically form along a common slip plane. The slip line, or direction of tectonic transport, is defined by the area on the slip plane with the least overlap between fold shapes, or the separation arc (Hansen, 1971). These data show most Z-shaped folds plunge gently in the northwest quadrant and most S-shaped folds plot in the southeast quadrant, both reflect northeast vergence but it is not possible to determine a slip-line (Figure 1-7-4c).

The northeast-vergent folds involve the middle to upper Albian Taylor Creek Group and the Albian to Cenomanian(?) Silverquick conglomerate. Recent mapping to the south suggests that these thrusts postdate and cut the 91 to 84 Ma structures in the Bralorne area. (Schiarizza *et al.*, 1990; Schiarizza, personal communication, 1990). The overturned strata of the Taylor Creek Group are also intruded by the 64 Ma Eldorado pluton (Garver *et al.*, 1989a). The timing of this thrusting is probably between 91 to 84 Ma and 64 Ma, or Late Cretaceous.

SOUTHWEST-VERGENT THRUSTING

Regionally, workers have recognised an earlier contractional event that was characterized by southwest-vergent thrusting. The occurrence of southwest-vergent thrusts in the Shulaps Range, which are cut by northeast-vergent thrusts, and the depositional patterns of the Albian Taylor Creek Group and the overlying Albian-Cenomanian Silverquick conglomerate suggest that this initial phase of contraction occurred during Albian to Cenomanian time. Structural evidence for this event in the North Cinnabar area is scant and difficult to interpret due to the profound structural reworking during younger thrusting. It is possible that the folds interpreted to be unrelated to the northeast-vergent thrusting (Figure 1-7-4d) were produced during this earlier event. If these small-scale folds were overturned with the Cretaceous sediments then they must be rotated 150° around a horizontal northwest-trending axis to ascertain their pre-deformational orientation. This rotation takes the originally gently southwest-plunging fold axes, which are dominated by S-folds (Figure 1-7-4d), and restores them to gently northeast-plunging folds with the opposite sense of vergence. Although this restoration is speculative, the restored orientation would be consistent with westerly vergent thrusting. Elsewhere in the Chilcotin Ranges, the nature of this earlier contractional event is difficult to resolve because younger deformation has reoriented or reworked structures related to this older deformation.

The earlier southwest-vergent thrusting and the slightly younger northeast-vergent thrusting are both probably related to the same contractional event that is marked, in this area, by a vergence reversal and the cessation of sedimentation. The timing of southwest-vergent thrusting can be only indirectly determined in the North Cinnabar Creek area. Here, the synorogenic clastic wedge that is interpreted to have been shed westward from active thrusts is middle-late Albian to Cenomanian(?) in age (Garver, 1989). Elsewhere in the basin, however, the clastic wedge is upper lower Albian to Cenomanian (*circa* 110 to 95 Ma) and is presumed to be the best estimate of the timing of southwest-vergent thrusting (Garver, 1989)

SYNKINEMATIC BLUESCHIST-FACIES METAMORPHISM AND DEFORMATION

One of the thrust-bounded packages within the Bridge River complex consists of highly deformed blueschist (Figure

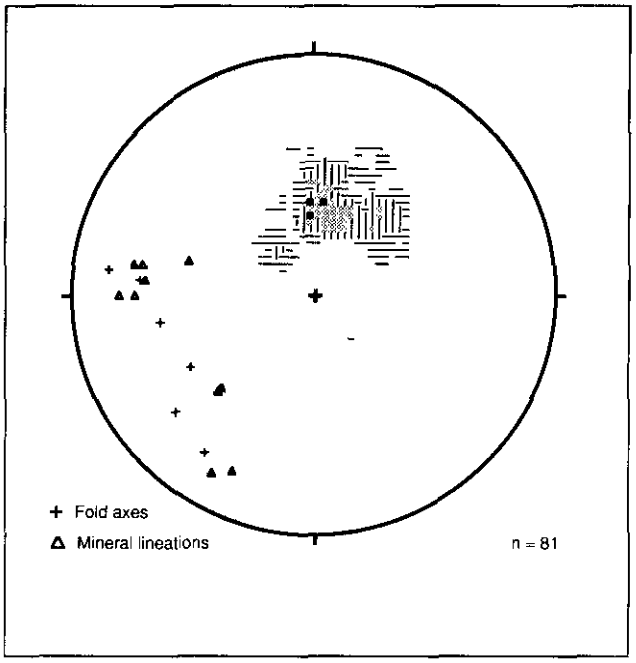

Figure 1-7-5. Stereographic projection of poles to schistosity in the blueschist. Contour intervals are 1.2-3.1%, 3.1-6.7%, 6.7-9.4%, 9.4-12.1%, 12.1-14.8% per 1% area. Also plotted are fold axes from tight to isoclinal folds of compositional layering, and mineral lineations that occur on the schistosity plane.

1-7-2). Brittle high-angle faults and a well-developed crenulation cleavage are present in these schists and are interpreted to represent a relatively young deformation as discussed. These schists have spectacular synkinematic isoclinal folds, a well-developed mineral lineation, and a very well developed schistosity. The schistosity dips moderately to the southwest and both the fold axes and the mineral lineations lie on the schistosity plane and plunge gently to the southwest (Figure 1-7-5). This fabric seems to mimic the foliation planes produced in faults during northeast-vergent thrusting (Figure 1-7-4a); this observation suggests that the blueschist schistosity has been rotated into parallelism with this younger foliation plane, which is common in other rocks of the Bridge River complex. The significance of these structures is unknown because the effects of younger deformation cannot be accurately determined.

The age of the blueschist-facies metamorphism is constrained by K-Ar, Ar-Ar, and Rb-Sr ages on whole-rock samples and white mica separates that range in age between 195 and 250 Ma (Archibald *et al.*, 1990, 1991, this volume; Garuer *et al.*, 1989b). The spread of ages is certainly related to perturbations within the isotopic systems caused by younger deformation. Recently collected $^{40}Ar/^{39}Ar$ data from white mica separates suggest that the blueschist-facies metamorphism and associated deformation was complete by 230 Ma (Archibald *et al.*, 1990, 1991, this volume). Although the significance of these synmetamorphic structures is obscure at best, they are certainly the oldest dated structures in the Bridge River complex.

SUMMARY

- The eastern edge of the 64 Ma Eldorado pluton is cut by north-striking faults with near-horizontal slickenside striations. These faults are parallel to dextral faults that are synthetic to the Fraser fault system and therefore may be related to this episode of strike-slip movement, which is bracketed between 46.5 and 35 Ma some 30 to 40 kilometres to the east (Coleman and Parrish, 1990). These faults could also be related to transtension on the Yalakom fault and related faults that are known to have occurred in this area in the Eocene (Umhoefer, 1989; Coleman, 1989; Schiarizza *et al.*, 1990)
- Northwest-striking dextral strike-slip faulting is pervasive but total distributed movement is minimal (hundreds of metres to perhaps a kilometre). Synthetic dextral, antithetic sinistral, and reverse faults fit the strain ellipse for dextral (transpressive) faulting with an orientation of about 345°. This faulting is post-Cenomanian (*circa* 95 Ma) and probably pre-64 Ma. This deformation may have occurred during a post 91 to 86, to pre-64 Ma interval, as suggested by regional relationships (Garver, 1989).
- Kilometre-scale northeast-vergent thrusting and folding involves rocks as young as Albian-Cenomanian. Folds and thrusts have good kinematic indicators suggesting northeast-vergence. Folds and thrusts are clearly cut by the small-scale dextral fault system and appear to cut structures related to the Bralorne fault system to the south. Regionally, therefore, this deformation is considered to have occurred between 91 to 86 Ma and 64 Ma (Garver, 1989).
- Southwest-vergent thrusting, recognized elsewhere in the region, is difficult to demonstrate in the North Cinnabar Creek area but evidence in the form of overturned small-scale folds may be present in rocks of the Bridge River complex. Other lines of evidence suggest this was an Albian to Cenomanian event (Garver, 1989).
- Isoclinally folded, blueschist experienced deformation and synkinematic metamorphism in the Triassic. This deformation occurred at or before 230 Ma (Archibald *et al.*, 1991, this volume).

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