The exotic nature of the Last Peak eclogite in the Teslin zone, south-central Yukon Territory

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ABSTRACT

The history of an eclogite sample and a mica schist sample from the western Teslin zone are discussed in view of garnet zoning profiles. The preliminary metamorphic results support the contention (de Keijzer et al., in press), based on earlier regional and structural arguments, of a structural contact (the "basal thrust" of de Keijzer et al., in press) between the Last Peak eclogite (part of the Anvil assemblage) and metasedimentary rocks of North American affinity to the west of it. Consequently, the eclogite is considered "exotic" with respect to the metasedimentary rocks. The proposed position of the Last Peak eclogite, a few hundred metres above the interpreted basal thrust within the zone of ductile thrusting, explains why it has experienced pervasive amphibolitization (hydration) since fault zones commonly act as conduits for fluid. It is unclear how much of the amphibolite-to-greenschist facies Anvil rocks surrounding the eclogite have experienced earlier high-pressure metamorphism.

RÉSUMÉ

Les histoires métamorphiques d'un échantillon d'éclogite (éclogite de Last Peak) et d'un échantillon de micaschiste de la partie ouest de la zone de Teslin sont discutées à la lumière des profils de zonation des grenats. Les résultats préliminaires appuient la thèse, basée sur des arguments régionaux et structuraux antérieurs, d'une «chevauchement de base» entre l'éclogite de Last Peak et les roches métasédimentaires présentes à l'ouest de celle-ci. En conséquence, l'éclogite est considérée «allochtone» par rapport à ces roches. Il est proposé que l'éclogite de Last Peak se situe au sein des roches de l'assemblage d'Anvil dans le compartiment supérieur près du chevauchement ductile qui sépare ces roches des roches nord-américaines du compartiment inférieur. La position de l'éclogite de Last Peak dans la zone de chevauchement ductile explique pourquoi elles ont subi une profonde amphibolitisation (hydratation) syncinétique puisque les zones faillées servent couramment de conduits pour les fluides.

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INTRODUCTION

Eclogite in the Omineca Belt in the Yukon is restricted to a few isolated occurrences and its structural setting is suspect (e.g., Foster et al., 1994; Erdmer et al., 1998). In this paper we present garnet zoning data from one of the eclogite occurrences, the Last Peak eclogite (cf. Erdmer and Helmstaedt, 1983), and from a mica schist, both from the western Teslin zone in south-central Yukon (Fig. 1). The zoning results provide important constraints on the metamorphic history of the eclogite and its surrounding rocks, and on the structural setting of the eclogite in the Teslin zone.

The Teslin zone was previously called the “Teslin suture zone” (cf. Tempelman-Kluit, 1979) or the “Teslin tectonic zone” (cf. Stevens, 1994). It includes the narrowest portion of the pericratonic Yukon-Tanana Terrane (Wheeler et al., 1991), and is bounded in the Last Peak area (NTS sheet 105E/9), by north-trending post-accretionary faults (Fig. 1), the d’Abbadie fault to the east and the Big Salmon fault to the west. Most of the Teslin zone rocks are assigned either to the Anvil or Yukon-Tanana Nisutlin assemblages (Figs. 1 and 2). Detailed descriptions of the Nisutlin and Anvil assemblages (principally comprising siliceous metasedimentary rocks and marble, and intermediate to ultramafic metavolcanic and metaplutonic rocks, respectively) are provided elsewhere (e.g., Tempelman-Kluit, 1979; Mortensen, 1992; Stevens, 1994; Stevens et al., 1996).

PREVIOUS WORK

The Teslin zone has been described as the fundamental boundary between the ancient continental margin of North America (referred to as North America) to the east and

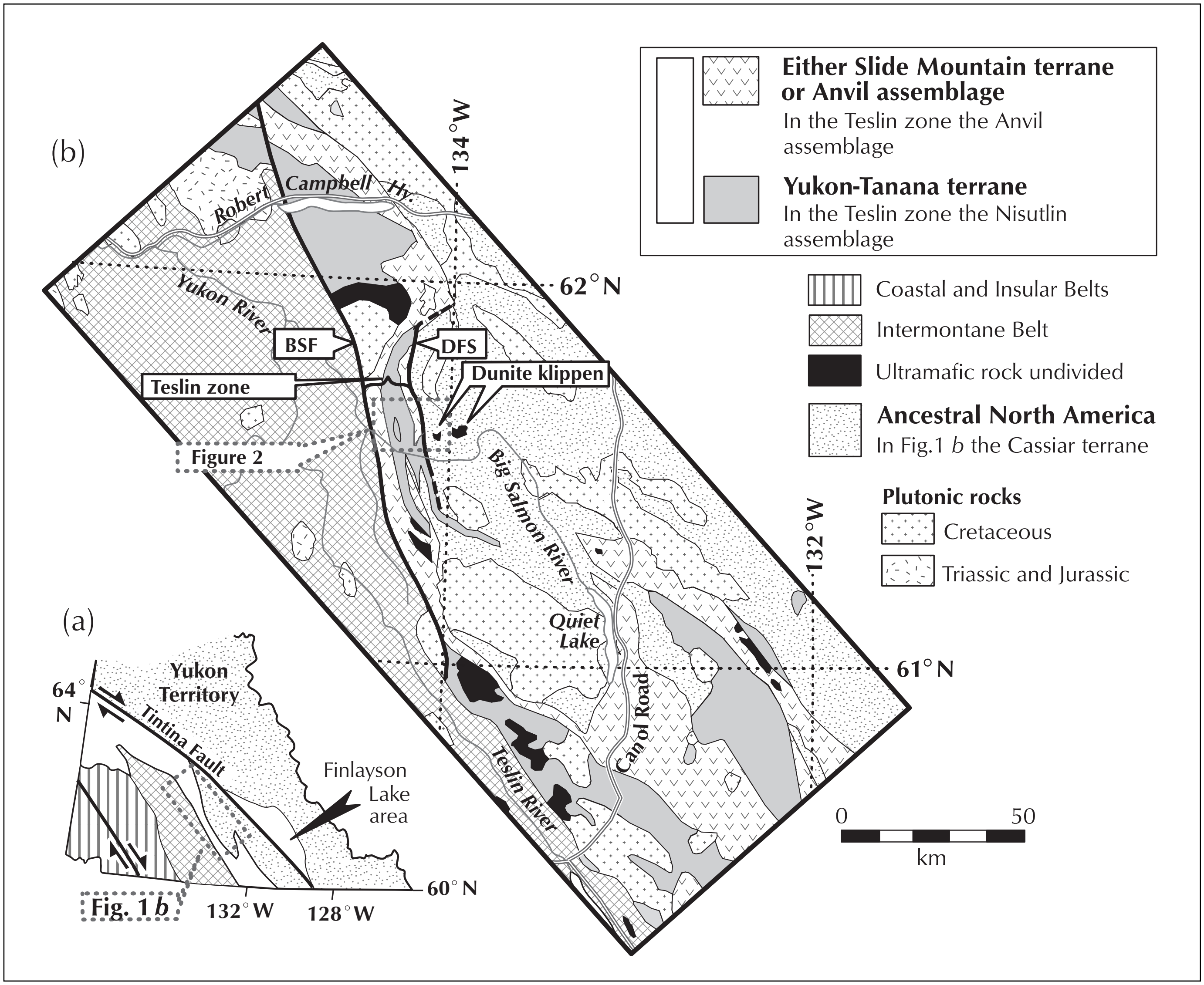

Figure 1. Simplified geological map of south-central Yukon Territory (modified from Wheeler and McFeely, 1991). BSF, Big Salmon fault; DFS, d’Abbadie fault system.

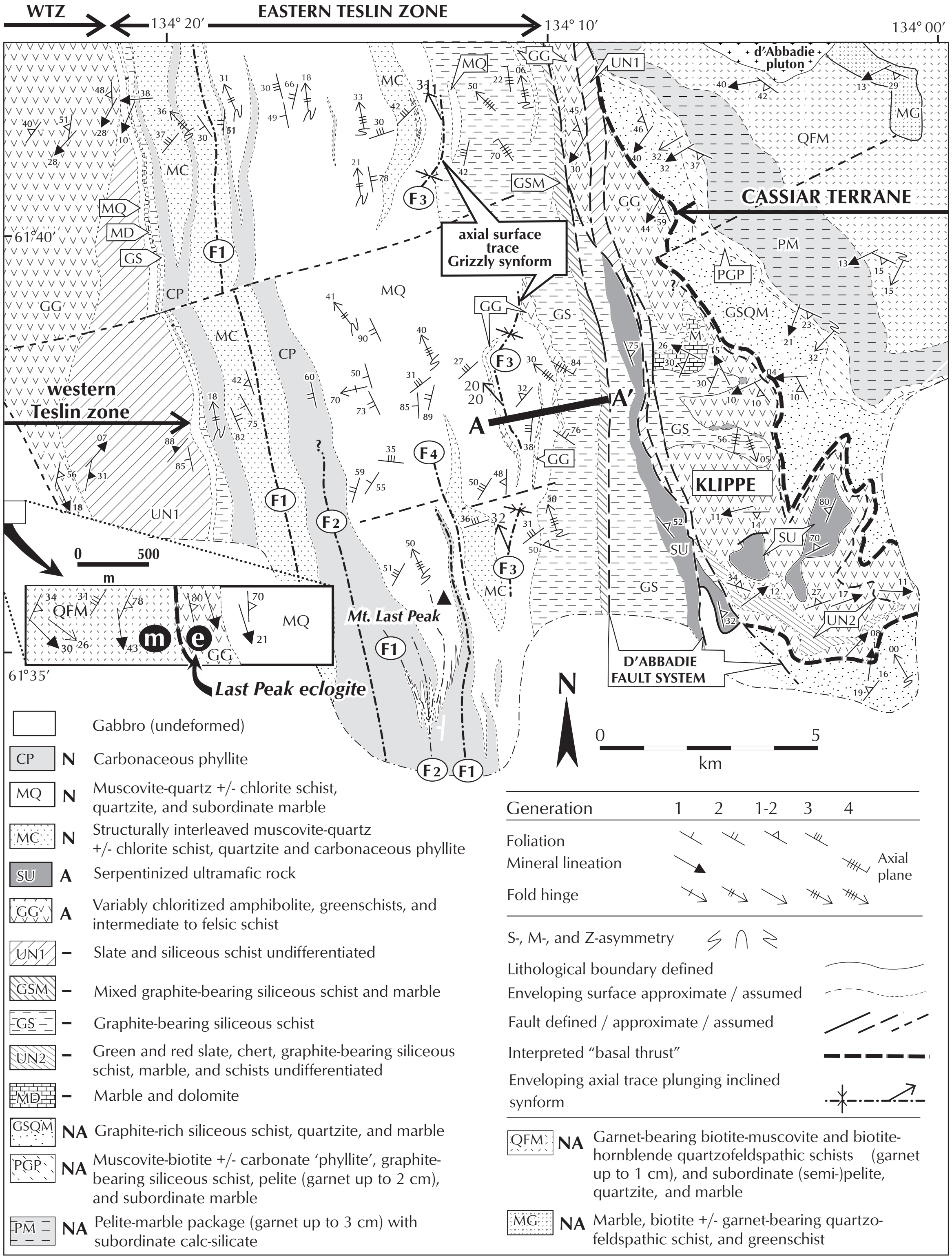

Figure 2. *Geological map modified from de Keijzer et al. (in press) showing the subdivision and distribution of Nisutlin (N), Anvil (A), and North American (NA) rocks in the Last Peak area (NTS sheet 105E/9) (– in the legend implies undetermined affiliation). Shown in the inset map are the location of the two samples (black circles) used for garnet analyses (e = Last Peak eclogite sample; m = mica schist sample). A-A′ corresponds to the vertical section shown in Figure 4.*

allochthonous terranes of the Intermontane Belt (Wheeler et al., 1991) to the west (e.g., Hansen, 1989, 1990). Previous workers described the zone as discrete, with a steep foliation in contrast to more shallowly dipping foliations in adjacent areas (Fig. 3). The steep foliation, together with a single occurrence of eclogite on the eastern side of the zone, was considered evidence for the zone being a subduction-related lithospheric suture (Tempelman-Kluit, 1979; Erdmer and Helmstaedt, 1983; Erdmer, 1985, 1992; Hansen, 1988, 1989, 1990, 1992; Hansen and Dusel-Bacon, 1998; Hansen et al., 1991, Fig. 3a, b). The same evidence has been used in support of it being a crustal-scale transpression zone (Stevens, 1994, Fig. 3c), and this model was modified by Stevens and Erdmer (1996) to include a low-angle detachment separating Teslin zone rocks from underlying North American rocks (Fig. 3d). According to the suture models, the Teslin zone is the root zone of related rocks lying as klippen on North America to the east, and this belief is firmly entrenched in the literature (e.g., Tempelman-Kluit, 1979; Gordey, 1981; Erdmer, 1985, 1992; Hansen, 1989; Stevens, 1994).

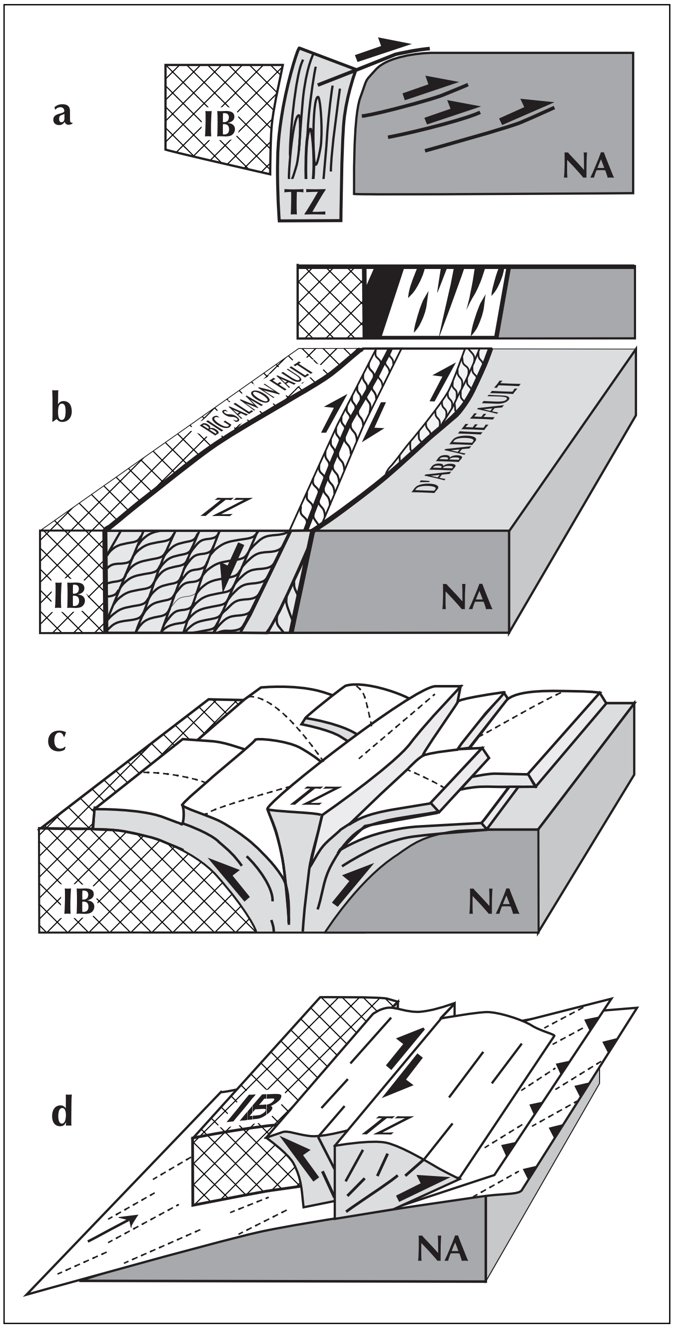

Figure 3. *Simplified crustal geometries proposed for the Teslin zone by **a)** Tempelman-Kluit (1979), **b)** Hansen (1989), **c)** Stevens (1994), **d)** Stevens and Erdmer (1996).*

The field relationships between the Last Peak eclogite and adjacent rocks/rock units are unclear because of (i) relatively poor exposure in the western Teslin zone, and (ii) intense ductile deformation which has affected all rock units and their contacts and obliterated the original nature of these contacts (e.g., Tempelman-Kluit, 1979; Erdmer and Helmstaedt, 1983; Erdmer, 1985; Hansen, 1989). Consequently, the regional structural context of the Last Peak eclogite is ambiguous. The structural framework of the Teslin zone proposed by de Keijzer et al. (in press), briefly described below, is substantially different, at all scales, to earlier interpretations. Although the origin of the eclogite is still ambiguous, the conclusions of de Keijzer et al. (in press) provide the basis for the first coherent interpretation of its structural setting.

SALIENT CONCLUSIONS OF DE KEIJZER ET AL. (in press)

Mapping at scales 1:5 000 to 15 000 revealed that primary layering of Anvil, Nisutlin, and North American rocks, in both the Teslin zone and east of it, has been transposed (see Williams, 1983 and references therein) by two generations of folding (F_1 and F_2). The transposed layering, together with S_1-S_2 axial plane cleavages, defines the transposition foliation S_T. The F_1 and F_2 folds occur at up to km-scale as can be seen, for example, south of Mt. Last Peak (Fig. 2). Figure 4a shows a block diagram of part of the enveloping surface between carbonaceous phyllite (unit CP) and muscovite-quartz schist (unit MQ) in the eastern Teslin zone. The map-scale continuity of this contact contrasts with the structure proposed by previous workers (e.g., Tempelman-Kluit, 1979; Erdmer, 1985) in which the Teslin zone was characterized by the discontinuous nature of lithologic units, and interpreted as representing a mélange. Despite transposition, map-scale continuity has also been observed in other parts of the Teslin zone (Stevens, 1994; Stevens et al., 1996) and in the Cassiar Terrane (the North American rocks east of the d'Abbadie fault system; see Figs. 1 and 2).

The F_1-F_2 folds are refolded by the regional-scale shallowly northwest-plunging F_3 Grizzly synform (Figs. 4b and 5; de Keijzer and Williams, 1997; de Keijzer et al., in press). The generally steep orientation of S_T in the Teslin zone, in contrast to S_T in adjacent rocks to the east, coincides with the steep limb of the Grizzly synform (Fig. 5c) which has a minimum structural thickness of 9 km. This fold has a shallow limb in the easternmost part of the zone (Figs. 4b and 5c) and immediately east of the zone which is cut by the d'Abbadie fault system. Thus, the steep attitude of fabrics in the Teslin zone is not evidence for a steep crustal-scale shear zone, whether it be suture-related or not. If a suture exists between the obducted Anvil and Yukon-Tanana Nisutlin assemblages and ancient North America, it is a shear zone at the base of the obducted rocks which has been folded by the Grizzly synform. However, there is no reason to interpret this obduction boundary as a suture since evidence of high pressure metamorphism during easterly thrusting is lacking (see also below); S_T development, and accommodation of shear by S_T, resulted in amphibolitization of the Last Peak eclogite.

In the suture interpretation, North American rocks are restricted to the east side of the zone, since the zone separates North America from truly allochthonous rocks to the west (Fig. 3). A consequence of the Grizzly synform is that North American rocks pass under the eastern Teslin zone and outcrop west of the Yukon-Tanana Nisutlin assemblage (Fig. 5). Thus, the western limit of North American basement in southern Yukon Territory could well be situated to the west of the Omineca Belt (if not removed by Cretaceous and younger transcurrent faulting; Gabrielse, 1985).

The results of de Keijzer et al. (in press) necessitate a reappraisal of earlier interpretations. The one example described here concerns the distribution of metamorphic grade. The recognition of an inverted metamorphic gradient in the Teslin zone (Tempelman-Kluit, 1979; Hansen, 1988, 1992), with amphibolite facies rocks and rare eclogite in the west, and greenschist facies rocks in the east, was used by proponents of the suture-interpretation to propose a westerly dip of the inferred subduction complex (i.e., Teslin zone). This argument is based on the hypothesis that the direction of increasing metamorphic grade records the polarity of the subduction zone (cf. Ernst, 1971). However, the inverted metamorphic gradient has been established on the overturned limb of the (previously unrecognized) F_3 Grizzly synform which formed post-peak metamorphism (de Keijzer, 1998, unpublished data) and has folded metamorphic isograds. Unfolding of the Grizzly synform positions the higher grade rocks at lower structural levels. Hence, there is no evidence for an inverted metamorphic gradient during the peak of regional metamorphism and no metamorphic argument therefore for the subduction model.

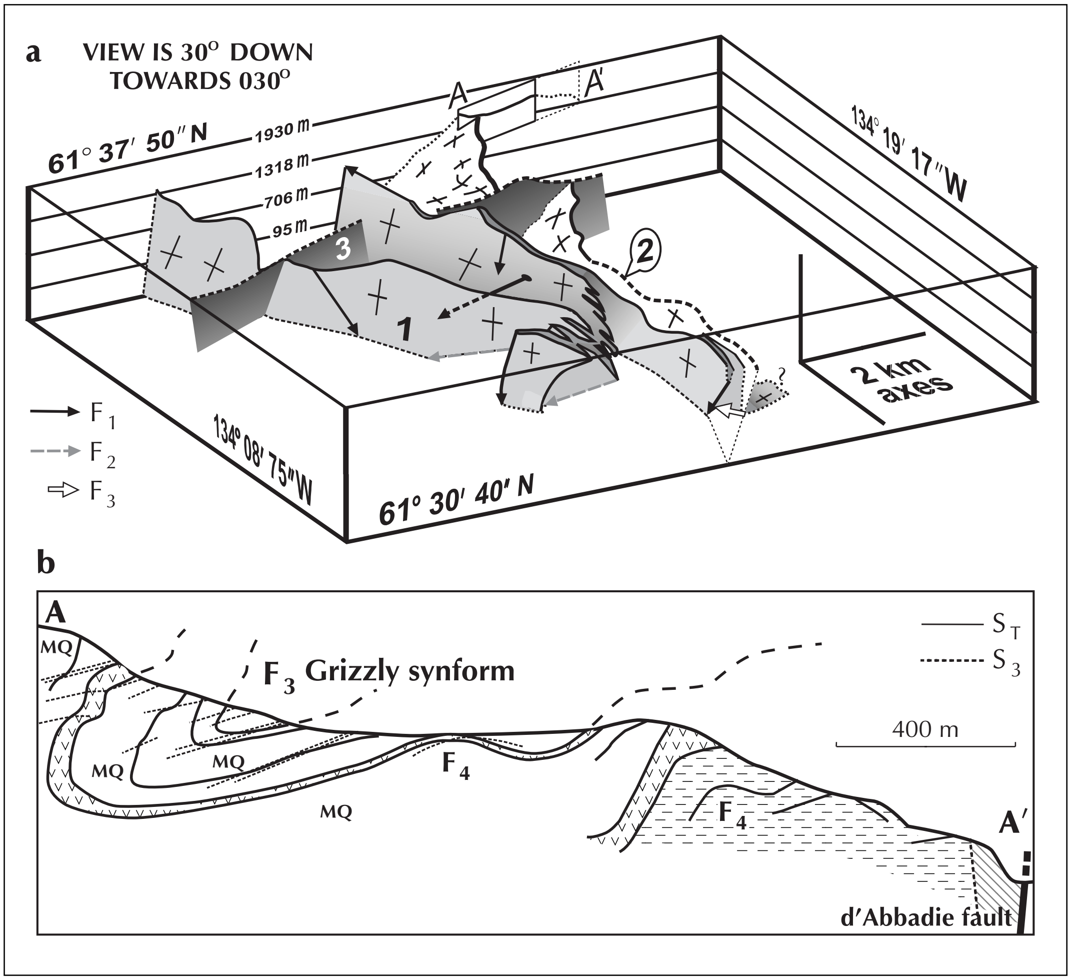

Figure 4. a) *Block diagram in orthographic projection showing (1) part of the contact between carbonaceous phyllite and muscovite-quartz schist in the eastern Teslin zone (top follows topography), (2) the axial plane of the F_3 Grizzly synform, (3) probable brittle normal faults (south-side-down; see de Keijzer et al., in press).* ***b)*** *Simplified vertical section showing the hinge of the Grizzly synform. See Figures 2 and 4a for location. Same legend as Figure 2.*

METAMORPHISM OF THE LAST PEAK ECLOGITE AND SURROUNDING ROCKS

Despite the lack of mineralogical evidence, Hansen (1992) claimed that the rocks in the western Teslin zone experienced "widespread high-pressure metamorphic conditions" (575–750°C and 0.9–1.7 GPa) overlapping with the estimated peak metamorphic conditions of the Last Peak eclogite (Erdmer and Helmstaedt, 1983). However, the vast majority of Teslin zone rocks record metamorphism under greenschist to amphibolite facies conditions (e.g., Tempelman-Kluit, 1979; Stevens, 1994; Hansen, 1989, 1992). Based on structural arguments, some workers (e.g., Tempelman-Kluit, 1979; Erdmer, 1985; Hansen, 1989) proposed an *in-situ* setting for the Last Peak eclogite, whereas others (e.g., Erdmer and Helmstaedt, 1983; de Keijzer and Williams, 1997; de Keijzer et al., in press) argued that the Last Peak eclogite is probably exotic (i.e., tectonically incorporated) with respect to the other Teslin zone rocks. The polyphase metamorphic history of the Last Peak eclogite, recording a profound, younger amphibolite to greenschist facies metamorphic overprint, has been previously documented by Erdmer and Helmstaedt (1983), Erdmer et al. (1998), and by de Keijzer et al. (in press). Besides unambiguous textural disequilibrium, chemical disequilibrium between biotite and amphibole and eclogitic garnet is indicated by garnet-biotite and garnet-hornblende thermometry which yielded geologically unreasonable high temperatures (in excess of 800°C; Erdmer et al., 1998).

In the following section, garnet zoning profiles from a partially amphibolitized eclogite sample (MK-97-3.6.1) and a mica schist sample (MK-97-2.2) from the western Teslin zone are compared. No significant variation in the orientation of S_T and the mineral lineation (L_M) was observed between the two sample locations. Analyses were performed on the JEOL 733 Superprobe at the University of New Brunswick, at an accelerating voltage of 15 kV, a current of 10 nA, a counting time of 40 seconds, and a beam diameter of 1–2 µm. The analyses were corrected using the ZAF method.

SAMPLE DESCRIPTION

The eclogite was collected at 530900E - 6830850N (elevation 760 m/2,500 ft) in unit GG of the Anvil assemblage, approximately 250 m east of the (transposed) contact with quartzofeldspathic and pelitic schists of unit QFM (see inset map Fig. 2). The physiography of this area and petrology of the eclogite were described in detail by Erdmer and Helmstaedt (1983) and Erdmer et al. (1998). Only a brief description of the eclogite sample is presented here. Garnet (Fig. 6a) comprises ~ 40% of the rock and is evenly distributed as small (mostly

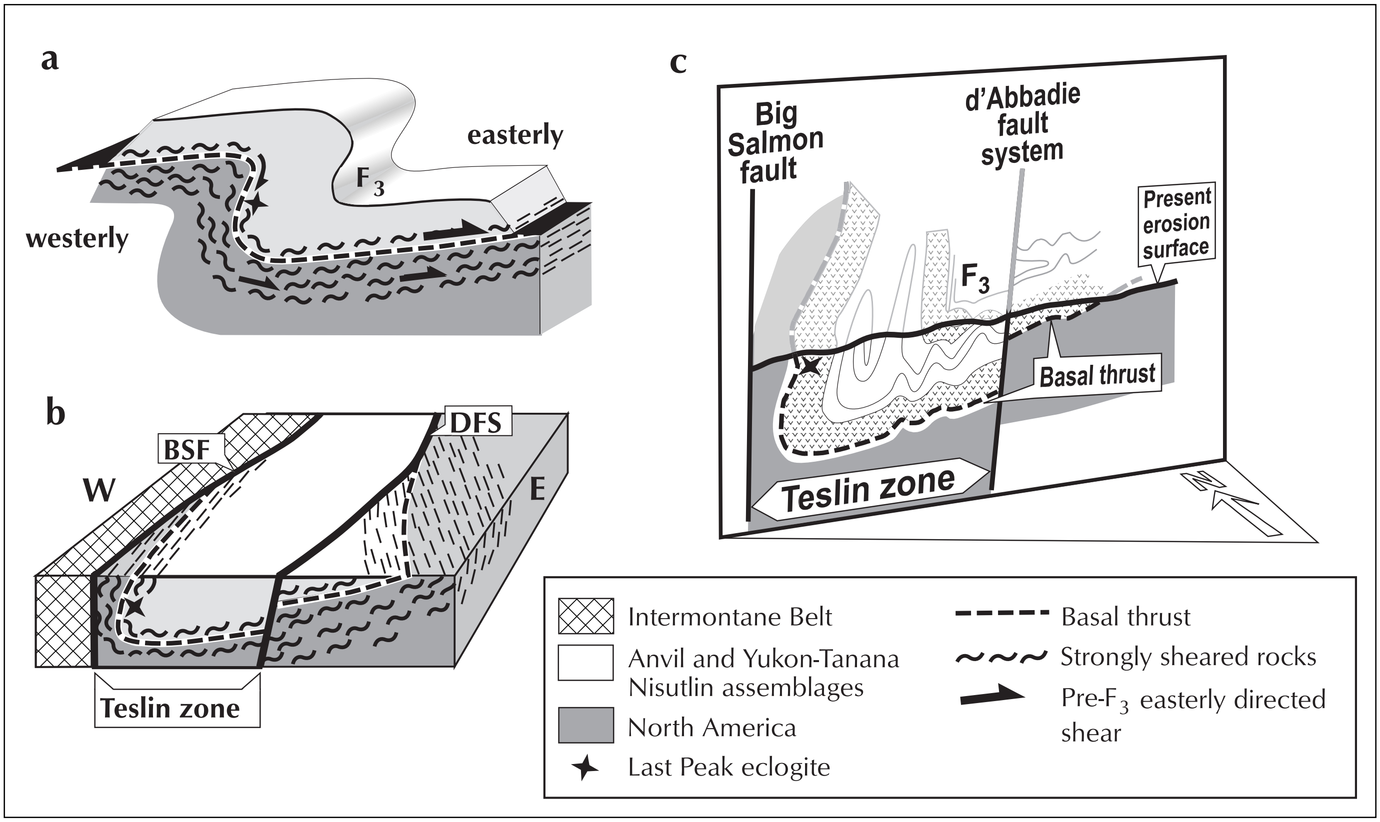

Figure 5. *Illustrations of the crustal geometry proposed by, and modified from, de Keijzer et al. (in press).*

< 1 mm in diameter) sub-idioblastic grains with few inclusions of omphacite, rutile, quartz, epidote/zoisite(?), and albite. The remainder of the rock is comprised of Ca-amphibole (magnesiohornblende; locally forming intergrowths with (clino)zoisite), abundant rutile+/-ilmenite pairs rimmed by sphene, and minor oligoclase, biotite, and a second Ca-amphibole (magnesiohastingsite; rimming garnet, biotite, and the other amphibole). The sample lacks a noticeable foliation. In the rocks directly surrounding the eclogite, clinozoisite, sphene, Ca-amphiboles (magnesiohornblende–tschermakite) and oligoclase grew synkinematically at the expense of garnet and rutile (de Keijzer et al., in press). The (partial) breakdown of garnet and rutile is most profound in the more strongly foliated rocks.

The mica schist (Fig. 6b) was collected at 530550 E - 6830925 N (elevation 750 m/2,460 ft) in unit QFM, structurally a few

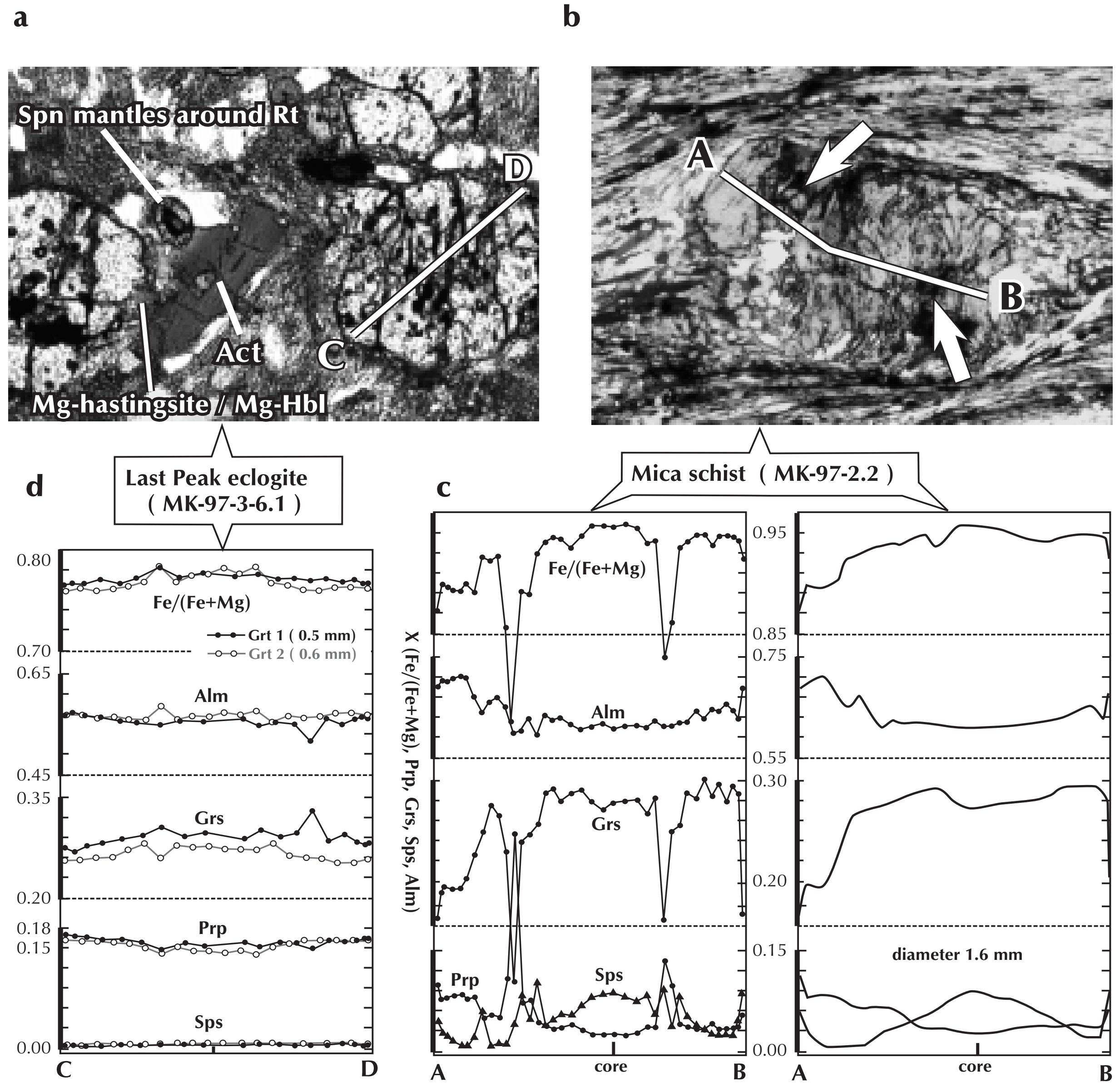

*Figure 6. **a)** Photomicrograph showing one of the eclogitic garnets used for chemical analysis. Note the absence of a foliation in this sample. **b)** Photomicrograph of the garnet grain used for chemical analysis in the mica schist sample. Note the profound resorbed nature of garnet. **c)** Zoning profile of the line A-B in (b). The two pronounced spikes correlate with regions of severe garnet resorption (areas pointed out by the white arrows in b); these have been filtered out in the right-hand portion of the figure. **d)** Zoning profile of the line C-D in (a).*

hundred metres west of the transposed contact with unit GG. S_T is defined by a preferred orientation of statically recrystallized biotite and white mica grains, a quartz and plagioclase shape fabric, strings of fine graphite, and the alignment of rare elongate rutile grains (some of which are rimmed by clinozoisite). S_T invariably bends around strongly resorbed garnet grains ≤ 2 mm in diameter. Some garnet grains show a sigmoidal inclusion pattern defined by quartz grains. Garnet breakdown resulted in the formation of random aggregates of secondary oligoclase–andesine, biotite, white mica, and quartz.

GARNET ZONING DATA

Representative garnet zoning profiles for the two samples are shown in Figs. 6c and d. The line traverses are interpreted as passing through the morphological centre, and therefore as recording the true radial chemical gradient, because the diameter of each of the grains roughly corresponds to that of the largest garnet crystal observed in hand specimen.

Garnet in the mica schist shows significant zoning in all end-member components (Fig. 6c). The asymmetry in zoning trends can be satisfactorily explained by variable amounts of garnet resorption along the rims. The overall outward increase of pyrope and almandine (except in the outer “left” margin), and decrease of Fe/(Fe+Mg) and spessartine, typifies growth zoning under upper greenschist and lower amphibolite facies conditions (e.g., Hollister, 1966; Tracy et al., 1976; Tracy, 1982). The sharp decrease in grossular and increase in spessartine in the outer garnet rim are attributed to modification during garnet consumption; a Mn reversal is generally believed to result from selective removal of Ca, Fe and/or Mg during garnet consumption, causing Mn to diffuse inwards (e.g., Grant and Weiblen, 1971; Yardley, 1977). The decrease in Ca may reflect its selective removal from garnet to provide the nutrients for growth of secondary plagioclase. (Determination of quantitative pressure and temperature estimates is part of work in progress by de Keijzer. Obtaining accurate peak metamorphic conditions, however, is difficult, if not impossible, because of the pronounced retrogression in unit QFM which resulted in, for example, re-equilibration of biotite composition.)

In contrast, none of the garnet end-member components in the eclogite sample are significantly zoned (Fig. 6d). The same observation has been recorded in other eclogite samples (Erdmer and Helmstaedt, 1983). In particular, the flat profile of spessartine ($0.00 < X_{Sps} < 0.02$) is striking.

DISCUSSION

INTERPRETATION OF THE GARNET ZONING RESULTS AND TECTONIC IMPLICATIONS

Dissimilar zoning trends, in particular of spessartine, are normally interpreted as being caused by different metamorphic/thermal histories rather than differences in reaction history and/or bulk rock composition. We propose the same interpretation for the two investigated samples, the strongest argument in favour of dissimilar thermal histories being the probable different degree of diffusional homogenization of garnet in each sample.

The extent of garnet modification by diffusion depends primarily on its size, the duration of heating, and the cooling rate (Spear, 1989; Florence and Spear, 1991). As suggested by these authors, no significant modification of growth zoning pattern is expected for 1–2 mm size garnets that experienced a thermal maximum of ≤ 600°C and slow cooling (of the order of 1–3°C/Ma). This appears appropriate for garnet in the mica schist. However, diffusional homogenization of growth zoning (e.g., Grant and Weiblen, 1971; Tracy et al., 1976; Tracy, 1982; Spear, 1989) of < 1 mm garnets is expected to be significant, if not complete, after the garnets have been subjected to temperatures > 600°C for any geologically significant time (Spear, 1989; Florence and Spear, 1991). The estimated peak temperature of the Last Peak eclogite is ~625°C (Erdmer et al., 1998). We therefore attribute the flat internal profiles in the eclogite primarily to diffusional homogenization at or near the peak temperature, similar to that proposed for eclogitic garnets elsewhere (e.g., Bocchio et al., 1985; Carlson and Schwarze, 1997). The lack of zoning

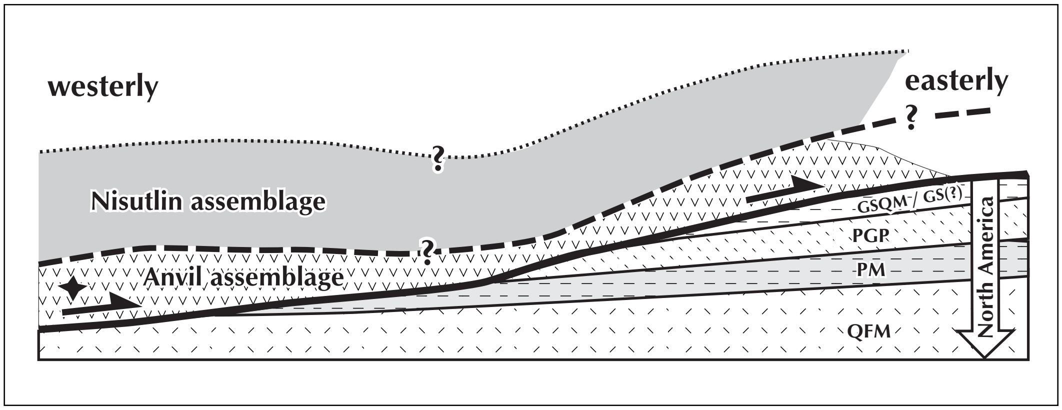

Figure 7. *Idealized diagram showing easterly directed ductile thrusting of the Nisutlin and Anvil assemblages onto North America. The nature of the contact between the Nisutlin and Anvil assemblages is undetermined (see discussion for details).*

in the garnet (comprising about half the rock volume) in the eclogite sample could be explained if eclogite garnet formed in a fraction of the time that it took for garnet to grow in the mica schist. This explanation, however, is considered unrealistic. Nor is the ~0.5 mm difference in garnet radius believed to be capable of explaining the difference in the amount of diffusional homogenization; the eclogite is interpreted as having experienced a higher maximum temperature than the mica schist.

It is considered unlikely that the flat spessartine profile in the eclogite represents a growth phenomenon. A "bell shape" spessartine profile is generally considered a good monitor of garnet growth zoning. It has been interpreted as marking the strong partitioning of Mn into garnet relative to matrix phases such as chlorite and biotite (Hollister, 1966; Tracy, 1982; Spear, 1989), and is therefore expected to occur in both pelitic and mafic bulk rock compositions. This is the case in the Cassiar Terrane. There, garnet in both amphibolite dykes and their micaceous host rocks have "bell shaped" spessartine zoning (de Keijzer, unpublished data,1998). Thus, the fact that the eclogite is the only rock in which spessartine is unzoned, suggests that significant diffusional homogenization has occurred, and that it is restricted to the eclogite.

Given the proximity of the two samples (~500 m apart) and their probable different thermal regimes, the simplest explanation, in agreement with all observations, is that a structural contact exists between the Last Peak eclogite and garnet-bearing quartzofeldspathic schist and pelite of unit QFM, to the west of it. In other words the eclogite is best interpreted as being exotic with respect to the QFM.

THE STRUCTURAL SETTING OF THE LAST PEAK ECLOGITE: REGIONAL CONSIDERATIONS

Based on kinematic observations, de Keijzer et al. (in press) proposed easterly directed thrusting of the Anvil and Nisutlin assemblages onto North America (Fig. 5). According to them, the Last Peak eclogite is situated in the hanging wall, only a few hundred metres above the basal (ductile) thrust/obduction boundary (Fig. 5), and unit QFM is part of the footwall sequence. This interpretation is in good agreement with the metamorphic data described above.

Supporting evidence for the location of, and easterly movement on, the basal thrust is provided by the distribution of rock units in the study area. Mafic and ultramafic rocks (units GG and SU) are found in both the western Teslin zone and east of the d'Abbadie fault (klippe in Fig. 2) which suggests they are the same units on opposite limbs of the Grizzly synform. Similarly, metasedimentary quartzofeldspathic schist and pelite west of the (ultra)mafic rocks in the western Teslin zone lithologically resemble the rocks in the northeastern portion of the Cassiar Terrane (e.g., typically > 40 cm wide quartzofeldspathic layers; similar modal abundances of major constituents; very rare marble layers). These rocks are shown as unit QFM in Fig. 2. In the western Teslin zone, the mafic rocks and unit QFM are in direct contact. East of the d'Abbadie fault, however, unit QFM and the mafic rocks are separated from one another by a succession dominated by garnet-rich pelite, marble, and graphite-bearing siliceous schists (units PM, PGP, and GSQM in Fig. 2) which structurally overlie unit QFM. Therefore, the distribution of rock types within the study area supports the model of easterly directed thrusting, with the basal thrust cutting up-section to the east, carrying the mafic rocks at the base of the hanging wall (Fig. 7). This is consistent with kinematic indicators in the western Teslin zone which record easterly movement of the hanging wall rocks during amphibolite facies regional metamorphism (de Keijzer et al., in press).

Figure 7 also illustrates that, prior to F_3 folding, the first-order distribution of rock packages was, from low to high structural level, North America, Anvil assemblage, and Nisutlin assemblage. Not shown in Fig. 7 are F_1-F_2 transposition folds, which result in a significantly more complicated geometrical framework at the km-scale (and smaller). The first-order sequence contrasts with that proposed by Tempelman-Kluit (1979), Hansen (1988; Anvil assemblage referred to as Slide Mountain Terrane), Hansen (1990; Anvil assemblage referred to as Teslin-Taylor Mountain Terrane), Hansen et al. (1991), and Stevens et al. (1996). These workers position the Anvil assemblage above the Nisutlin assemblage. However, we believe that just as recognition of the Grizzly synform has necessitated reinterpretation of the "inverted metamorphic gradient" it also necessitates re-evaluation of earlier tectonic reconstructions.

AMPHIBOLITIZATION OF THE LAST PEAK ECLOGITE

S_T in the western Teslin zone, in the klippe, and in the Cassiar Terrane, is interpreted by de Keijzer et al. (in press) as having accommodated larger shear strain than S_T in the eastern Teslin zone. This interpretation is based on the marked parallelism of L_M and F_1-F_2 hinges in these areas, a phenomenon not observed in the eastern Teslin zone (see de Keijzer et al., in press, for a more detailed explanation). Importantly, the more strongly sheared rocks are spatially associated with the interpreted basal thrust (Fig. 5a, b).

The Last Peak eclogite occurs within the high strain zone at the base of the hanging wall. It experienced a pervasive syn-kinematic amphibolite facies overprint, common to many eclogites worldwide (e.g., Bocchio et al., 1985; Klápová et al., 1998) and only a few relatively pristine eclogite relicts are preserved in low strain domains. Amphibolitization (hydration) of eclogite requires the introduction of fluids. Hydration of the eclogite is likely to have occurred since shear zones (i.e., the basal ductile thrust) commonly act as conduits for fluid (e.g., Beach, 1976, 1980; Brodie and Rutter, 1985). The fluids were conceivably derived from prograde dehydration reactions in the (dominantly micaceous) footwall rocks during thrusting.

RELATIONSHIPS BETWEEN THE LAST PEAK ECLOGITE AND OTHER HANGING-WALL ROCKS

Given the strong syn-kinematic medium-pressure regional metamorphic overprint (formation of Ca- amphibole + oligoclase + sphene + clinozoisite), it is unclear what portion of unit GG in the study area has experienced an earlier high pressure metamorphism similar to that of the Last Peak eclogite. In other words, the question has to be asked as to whether the eclogite is in-situ with respect to unit GG, and most of the evidence of high-pressure metamorphism has been obliterated, or whether it, and possible other volumetrically insignificant eclogite "blocks," were tectonically incorporated with lower grade rocks of unit GG after high-pressure metamorphism.

Concerning the greenschist facies Yukon-Tanana Nisutlin rocks further east of unit GG in the Teslin zone, no study has produced any evidence for a link between structure and/or metamorphism in the Nisutlin rocks and eclogite facies deformation and metamorphism. This is consistent with other studies (e.g., Erdmer and Helmstaedt, 1983; Mortensen, 1992; Foster et al., 1994; Erdmer et al., 1998) over a large area of the Yukon-Tanana Terrane, none of which have produced evidence of high-pressure metamorphism except in isolated lenses. Moreover, the nature of the contact between the Anvil and Nisutlin assemblages is a topic of continuing debate (see discussions by Mortensen, 1992 and Stevens et al., 1996). Some workers (e.g., Hansen et al., 1991) envisage this contact as a terrane boundary, juxtaposing the Teslin-Taylor Mountain Terrane, correlative with the Anvil assemblage, and the Nisutlin Terrane. Others (e.g., Mortensen and Jilson, 1985; Mortensen, 1992; Murphy, 1998) have interpreted similar rocks in the Finlayson Lake area (see Fig. 1) as part of transposed Yukon-Tanana stratigraphy. Importantly, in the western Teslin zone, the contact between Anvil and Nisutlin rocks is delineated by a narrow zone of graphite-rich schist and marble (Fig. 2). It is believed that these rock types were significantly weaker (easy slip zones) than the predominant rock types in both the Anvil and Nisutlin assemblages (see Fig. 2) during most of the ductile deformation history. The fact that graphite-rich schist throughout the area mostly contains a single pervasive foliation (in contrast to the multiple generations of fabric development preserved in the Nisutlin rocks; de Keijzer et al., in press) can be attributed to transposition being more complete in the weaker rocks. Despite the fact that no regionally significant structural or metamorphic breaks have been observed across the graphite-rich schist and/or marble units (de Keijzer et al., in press; Stevens et al., 1996), it is nevertheless possible that these rocks in the western Teslin zone represent a pre- to early syn-F_1 localized high strain/fault zone. However, because of the intensity of transposition, the nature of the contact between the Anvil and Nisutlin assemblages is obscured and impossible to interpret definitively based on existing field data. In summary, we see no reason to assume a relationship between the Nisutlin assemblage and the Last Peak eclogite and therefore consider the latter exotic with respect to the former.

CONCLUSIONS

Building on earlier structural and regional data of Erdmer and Helmstaedt (1983) and de Keijzer et al. (in press), the contrast in metamorphic grade of the Last Peak eclogite and amphibolite and greenschist facies metasedimentary rocks to the west and east of it, respectively, can be explained in terms of juxtaposition of high-pressure and low- to medium-pressure rocks after eclogite facies metamorphism. This interpretation is supported here by profound differences between garnet zoning profiles in an eclogite sample and a mica schist collected ~500 m west of the eclogite. The proposed exotic nature of the eclogite explains why evidence of high-pressure metamorphism is restricted to one small area in the Teslin zone. Further, the proposition that the eclogite is situated at the base of the obducted Anvil and Nisutlin rocks (cf. de Keijzer et al., in press) satisfactorily explains why only a few relicts of high-pressure rocks have been preserved in the western Teslin zone; it was incorporated in the ductile thrusting process and therefore was prone to amphibolitization during fluid-assisted deformation. It is unclear whether the Last Peak eclogite is exotic with respect to other Anvil rocks or not.

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