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2003-A2

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2003

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ISSN 1701-4387

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Physiography and Tertiary base levels in the southern Interior Plateau and adjacent areas, southwestern British Columbia

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Tribe, S., 2003: Physiography and Tertiary base levels in the southern Interior Plateau and adjacent areas, southwestern British Columbia; Geological Survey of Canada, Current Research 2003-A2, 11 p.

Abstract: Geomorphology, valley-fill geology, and drainage anomalies indicate that a suite of early Tertiary and older valleys occurs in the study area. Eocene relief and base level of the North Thompson River valley were the same as today, 1000 m and 400 m respectively. The valley predates the middle Eocene. The Thompson River from Kamloops to Martel follows the trend of a broad Eocene valley and is inset 125 to 350 m below the sub-Eocene unconformity. The Thompson River valley from Martel to Lytton and the Nicola, Nahatlatch, and Stein river valleys define a branching, north-flowing drainage pattern that postdates the Eocene Fraser Fault. The Nicola Lake valley is probably Paleocene to Eocene. A former drainage divide existed along the Fraser River valley between Anderson River and Hell's Gate. Base level was about 500 m higher in the Miocene than in the Eocene.

Résumé : La géomorphologie, la géologie du remblayage des vallées et des anomalies hydrographiques indiquent qu'il existe une suite de vallées remontant au Tertiaire précoce et à des temps plus anciens dans la région à l'étude. Dans la vallée de la rivière Thompson Nord, la dénivelée était la même à l'Éocène qu'aujourd'hui, soit de 1 000 m, et le niveau de base est demeuré inchangé à 400 m. La formation de la vallée précède l'Éocène moyen. Entre Kamloops et Martel, la rivière Thompson suit l'axe d'une large vallée éocène et s'écoule à un niveau compris entre 125 et 350 m sous la discordance marquant la base de l'Éocène. La vallée de la rivière Thompson, de Martel à Lytton, et les vallées des rivières Nicola, Nahatlatch et Stein définissent un réseau hydrographique ramifié à écoulement dirigé vers le nord, dont l'origine est postérieure à la formation de la faille du Fraser de l'Éocène. La vallée du lac Nicola remonte probablement au Paléocène et à l'Éocène. Une ancienne ligne de partage des eaux s'étirait le long de la vallée du fleuve Fraser, entre la rivière Anderson et le canyon Hell=s Gate. Le niveau de base au Miocène était d'environ 500 m plus élevé qu'il ne l'était à l'Éocène.

INTRODUCTION

An intricate network of valleys is carved into the landscape of the southern Interior Plateau, British Columbia. Many valleys are poorly drained by underfit streams and lakes and contain a stratigraphic record of fluvial and lacustrine conditions during the Tertiary. Many Fraser River tributaries have gentle upper reaches that change to steep, narrow canyons before joining the main stream. This is the opposite of an equilibrium longitudinal profile and suggests that base level has changed in the past. This paper describes the physiography of the area and examines geomorphic evidence of former base levels. Ages are assigned to some larger valleys on the basis of geological and structural relationships.

PREVIOUS WORK

Previous work on paleodrainage in the study area is limited and consisted mostly of short sections in bedrock and Quaternary geology reports. Uglow (1922) described Eocene fluvial sediments on the floor of the North Thompson River valley below Clearwater and concluded that the valley must be Eocene or older. Rice (1947) concluded that the modern drainage system in the Princeton area developed in the late Pliocene or early Pleistocene and that drainage rearrangement in this area was the result of glaciation. Trettin (1961) mapped an elevated floodplain near Pavilion that might be a former valley of the Miocene Fraser River. Campbell and Tipper (1971) suggested that the North Thompson–Clearwater River valley and other major drainage systems in southwestern British Columbia were established before Eocene time. Fulton (1975) suggested that the valleys of the Nicola and Thompson rivers are antecedent and date back to the early Tertiary or possibly the Cretaceous. He interpreted the Nicola Lake valley as a Tertiary feature that was exhumed during the late Tertiary and Quaternary. Bevier (1983) thought that the Fraser and Chilcotin rivers established their modern courses in late Miocene time, whereas Mathews (1989) thought that the modern Fraser River was established possibly as recently as the late Pleistocene. Read (1988) mapped a Miocene drainage network near the Bonaparte and Deadman rivers that flowed north and west. Tribe (2002) described an eastward-flowing paleodrainage network in the southern Coast Mountains that predates Eocene strike-slip faulting along the Fraser Fault.

DATA SOURCES

Hillshades, slope maps, topographic profiles, and elevations were produced from 1:250 000 scale, 25 m gridded DEM available from British Columbia's Base Mapping and Geomatic Services, using ArcView® and ArcInfo^{SM} software on a personal computer. Airphoto interpretation of the Fraser, Thompson, and North Thompson river valleys was done with 1:50 000 scale airphotos. Stream and other geographic names are from 1:50 000 and 1:250 000 scale topographic maps. Geological information is from Journeay and Monger (1998) and Journeay and Williams (1995).

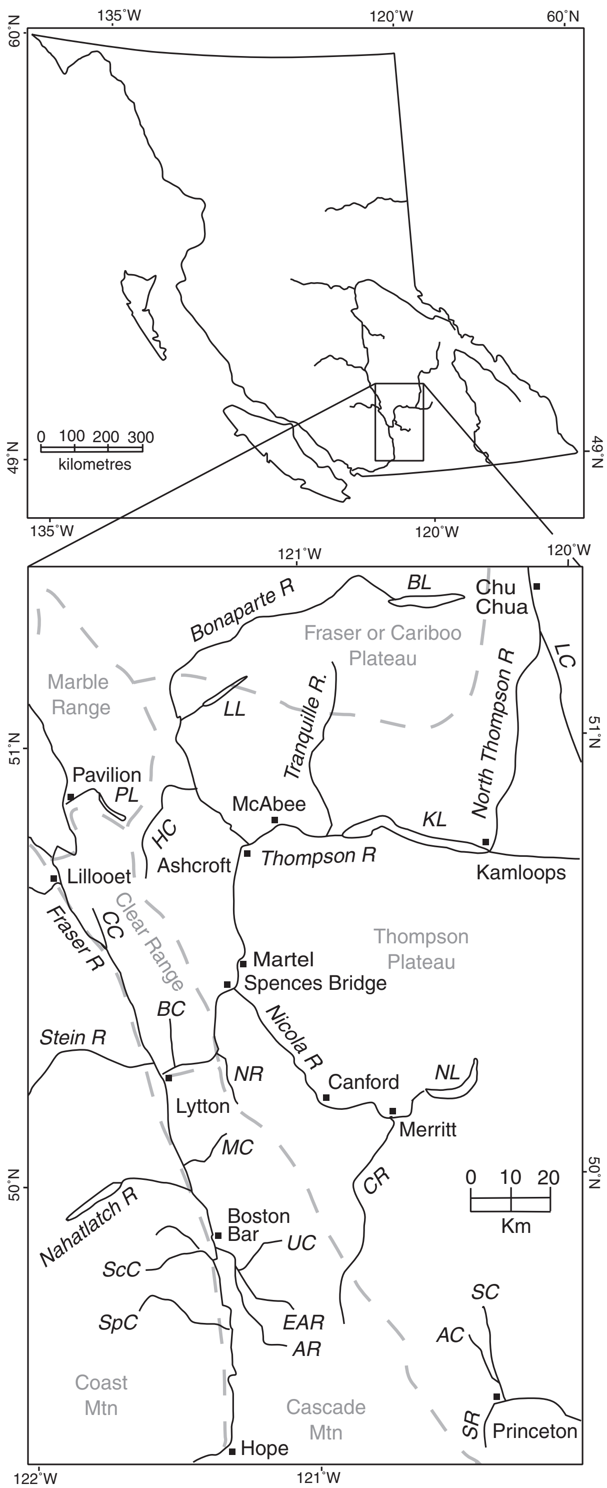

Figure 1. *Map of the study area showing towns, streams, lakes and physiographic provinces. AC, Allison Creek; AR, Anderson River; BC, Botanie Creek; BL, Bonaparte Lake; CC, Cinquefoil Creek; CR, Coldwater River; EAR, East Anderson River; HC, Hat Creek; KL, Kamloops Lake; LL, Loon Lake; LC, Louis Creek; MC, Mowhokam Creek; NL, Nicola Lake; NR, Nicoamen River; PL, Pavilion Lake; SC, Summers Creek; ScC, Scuzzy Creek; SpC, Spuzzum Creek; SR, Similkameen River; UC, Uztlius Creek*

STUDY AREA

The study area extends from latitude 49°15′N to latitude 51°30′N and from longitude 120°W to longitude 122°W; it is drained mostly by the Fraser River and its tributaries (Fig. 1). The longitudinal profile of the Fraser River (Fig. 2) has a fairly smooth, gentle gradient downstream to Leon Creek, which is just outside the northwest corner of the study area and marks the first major step or knickpoint in the profile. Downstream from Leon Creek, and within the study area, the profile has a series of steps with steep gradients. The longitudinal profile of the Thompson River has a gentle gradient from Kamloops to Bonaparte River (Fig. 3). Downstream from there, the profile is stepped with knickpoints and steep gradients. The southeastern part of the study area drains via the Similkameen River toward the southeast.

GEOLOGY AND STRUCTURE

East of the Fraser River, bedrock consists of north- and northwest-striking, Paleozoic to Jurassic rocks of the Quesnellia, Cache Creek, Tyaughton–Methow, and Bridge River terranes. West of the Fraser River, bedrock is dominated by Jurassic to late Cretaceous intrusions of the Coast Plutonic Complex. Submarine deposition last occurred in the Jurassic and since then, the area has been the site of restricted sedimentary deposition and widespread volcanism. Cretaceous Spence Bridge Group volcanic rocks crop out in a northwest-trending belt that overlaps Quesnellia and Cache Creek terranes. Paleozoic and Mesozoic rocks constitute the bedrock into which the valleys are incised and are described in detail by Monger (1989), Journeay and Monger (1994), and others.

Small outcrops of Tertiary sedimentary strata that record fluvial and lacustrine environments are scattered throughout the area (Fig. 4, Table 1). They are locally overlain by volcanic flows and breccia of the Eocene Kamloops Group. Miocene fluvial sediments were deposited in valleys up to 500 m deep (Read, 1988) in the upper Bonaparte River area. Horizontal Miocene–Pliocene Chilcotin basalt crops out in the northern study area and is dated at 9 to 15 Ma (Mathews, 1989). Repeated glaciation (Clague, 1989) and minor basaltic volcanism occurred during the Quaternary.

Major faults include the northwest-trending Hozameen Fault, which was offset by the northwest-trending Fraser Fault. The Fraser Fault had an estimated 80 to 120 km of dextral strike-slip displacement between 53 Ma to 47 Ma (Monger and Journeay, 1994). North-northwest-trending faults in the Thompson Plateau are related to strike-slip faulting (Monger, 1985).

PHYSIOGRAPHY

The physiography of the area was first described by Bostock (1948) as the southern plateau and mountain area. Holland (1976) delineated the Coast Mountain, Cascade Mountain,

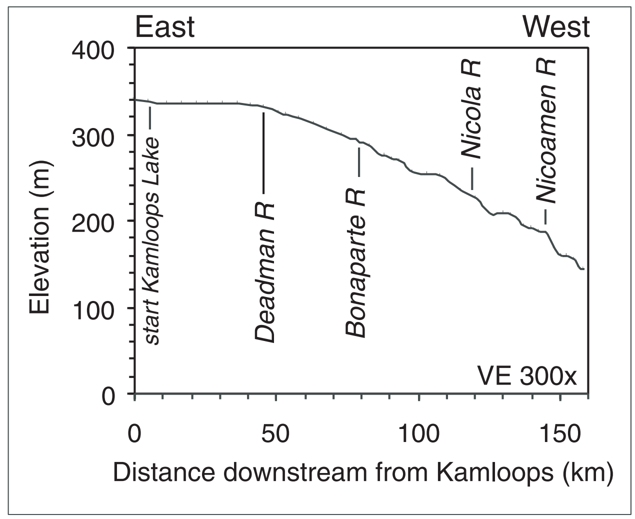

Figure 3. Longitudinal profile of the Thompson River from Kamloops to Lytton.

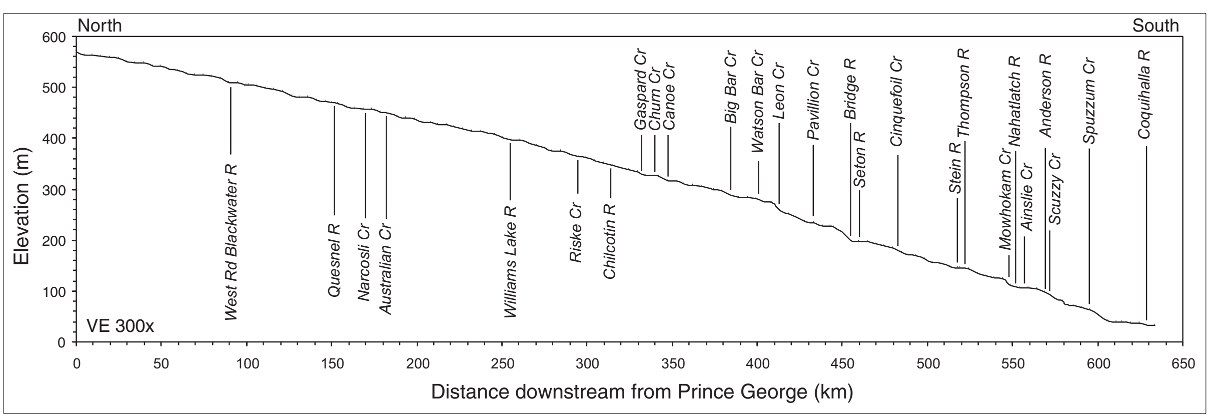

***Figure 2.** Longitudinal profile of the Fraser River from Prince George to Hope. The reach from Pavilion Creek (km 430) to Coquihalla River (km 630) is in the study area.*

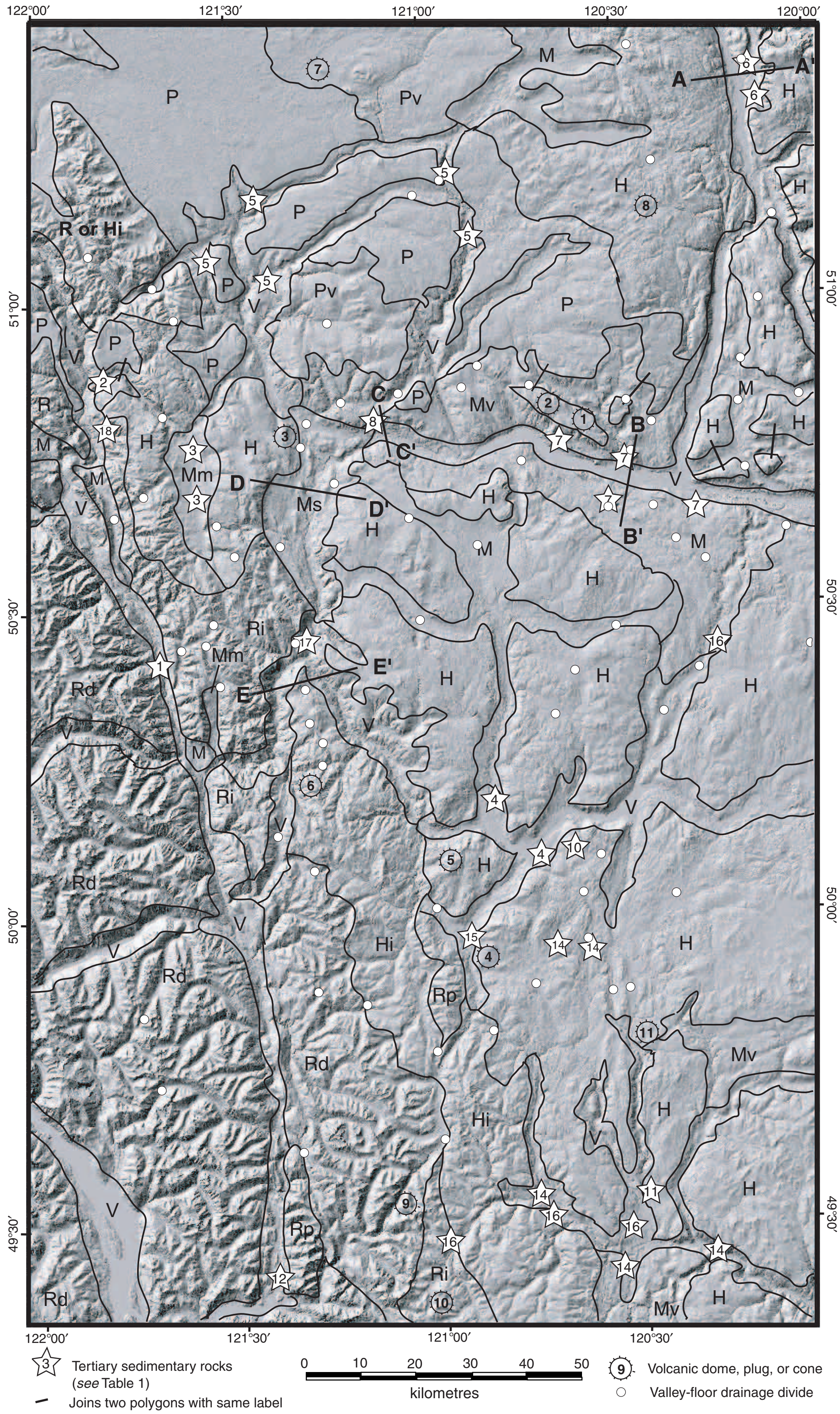

Figure 4. *Physiographic map of the study area showing locations of Tertiary sedimentary rocks (Table 1), valley-floor drainage divides, and volcanic forms. R, mountains; H, highlands; P, plateaus; M, midlands; V, valleys; d, deeply incised drainage; i, incised drainage; m, smooth topography; p, parallel drainage; s, strath; v, valleys*

Table 1. Tertiary sedimentary strata in the study area (*see* numbered stars on Fig. 4).

No.	Age, Formation	Location	Description	Reference
3	Eocene; Hat Creek beds	Hat Creek	Basal Coldwater beds are1300 m of fluvial conglomerate and sandstone. Overlying Hat Creek Coal Fm is 300 m of coal, claystone, sandstone, conglomerate, and ash deposited in marsh and lacustrine settings. Medicine Creek Fm is 600 m of siltstone and claystone. Hat Creek basin is a fault-bounded graben. Elevation from 860 to1207 m.	Church, 1975
4	Eocene; Coldwater beds	Nicola valley	Up to 230 m of basal conglomerate, breccia, sandstone, shale, and coal. Elevation from 616 to 850 m.	Cockfield, 1961
7	Mid-Eocene; Tranquille Fm	Kamloops Lake	Up to 500 m of tuffaceous sandstone, siltstone, and minor conglomerate. Bedding dips 0° to 35°. Lacustrine paleoenvironment. Elevation from 376 to 567 m.	Graham and Long, 1979; Ewing, 1981
8	Eocene; McAbee beds	McAbee – Savona	Mudflows, flow breccia, and130 m of lacustrine deposits. Elevation from 500 to 800 m	Ewing, 1981
11	Mid-Eocene; Princeton Gp.	Princeton	Sandstone, siltstone, coal seams, and minor conglomerate. Elevation from 640 to 1094 m.	Preto, 1979
12	Eocene; Allenby beds	Hope	Nonmarine cobble conglomerate and minor sandstone deposited in a graben along Fraser Fault. Strata are folded with subvertical dips, bounded to the west by the Hope Fault, to the east by a vertical unconformity on gneiss. Elevation from 185 to 582 m.	Monger, 1969
1	Middle Eocene	Siwhe Creek	Comprises 1000 m of fault-bounded basal breccia, conglomerate, sandstone, shale. Fluvial paleoenvironment. Strata tilted and faulted by Fraser Fault. Elevation from 294 to 942 m.	Duffell and McTaggart, 1952
14	Eocene; Princeton Gp.	Princeton	Up to 300 m of conglomerate, sandstone, shale, and coal. Strata are horizontal with local steep dips. Elevation from 640 to 1094 m.	Rice, 1947
15	Eocene	Kingsvale	Up to 2000 m of conglomerate and sandstone deposited by north-flowing braided streams in the Fig Lake graben. Strata dip 25° to 40°. Elevation from 761 to 1211 m.	Thorkelson, 1989
16	Eocene; Allenby beds	Princeton; Trapp Lake	No description available.	Journeay and Monger, 1994
6	Mid-Eocene; Chu Chua Fm	Chu Chua	Up to 50 m basal conglomerate and 800 m of sandstone, shale, and coal. Fluvial and lacustrine paleoenvironment. Elevation from 410 to 570 m.	Uglow, 1922; Campbell and Tipper, 1971
17	(?)Eocene	Spences Bridge	Small exposure of lithic sandstone, argillite, and coal. Coal seam is 2 m thick. Age control poor, but thought to be Eocene. Location of this outcrop is uncertain.	Duffell and McTaggart, 1952
18	(?)Eocene	Keatley Creek	Isolated exposure of well indurated cobble conglomerate containing clasts of Cache Creek Group, Spences Bridge Group, and Coast intrusions.	Duffell and McTaggart, 1952
5	Miocene; Deadman River Fm.	Deadman, Bonaparte rivers	Comprises 350 m of ash, sandstone, siltstone, shale and diatomite. Fluvial paleoenvironment in deeply incised, north- and west-trending valleys. Elevation of base from 690 to 1020 m.	Read, 1988; Campbell and Tipper, 1971
2	Mio-Pliocene	Pavilion	Up to 60 m of horizontal or gently dipping lithic sandstone, conglomerate, and carbonaceous shale. Fluvial floodplain paleoenvironment. Elevation from 970 to 1212 m.	Trettin, 1961

and Interior Plateau physiographic provinces, and subdivided the latter into the Thompson Plateau, the Fraser Plateau, the Clear Range, and the Marble Range (Fig. 1). Mathews (1986) renamed the Fraser Plateau the Cariboo Plateau and grouped the Clear and Marble ranges into the Pavilion Range. These classifications are presented at 1:2 000 000 scale or smaller, with the exception of Fulton (1975) who classified the Nicola–Vernon area into uplands, midlands, and valleys at a map scale of 1:500 000.

The physiographic map (Fig. 4) delineates areas of similar geomorphology, relief, slope, and drainage identified on 1:500 000 scale shaded-relief maps. At the broadest scale, the landscape is classified into mountains, highlands, plateaus, midlands, or valleys, designated by upper-case letters. These categories are adapted from Fulton (1975) and correspond to the tertiary level of classification of Bostock (1948). Further subdivision is made on the basis of surface texture or pattern and degree of drainage development, and is designated by one or more lower-case letters. Major landform types are described below.

Mountains (R) are regions of high to moderate relief with steep slopes, a rugged profile, and a restricted area at or near the summit elevation. Highlands (H) are elevated regions of moderate relief with moderate to gentle slopes, a rounded outline, and a large area at or near the summit elevation. Highlands have a sparser stream network than mountains, but may contain broad valleys or canyons. Plateaus (P) are extensive, elevated regions of low relief with most of their area at or near the summit elevation. Drainage is commonly poorly developed, but canyons or deep valleys may be found locally. Midlands (M) are areas of moderate to low relief elevated above local base level, but below adjacent mountain or highland summits. They represent elevated former valley floors (Fulton, 1975) and may contain canyons, valleys, rock benches, or terraces. Valleys (V) are elongate, relatively narrow depressions bounded by rock slopes. They generally contain a stream with an outlet, but may contain multiple streams or lakes. Only the largest valleys are delineated in Figure 4.

Mountains predominate in the western and southwestern parts of the study area and correspond closely to the Coast Mountain physiographic province of Holland (1976). His Cascade Mountain physiographic province is subdivided in Figure 4 into a western belt of deeply incised mountains (Rd) and an eastern belt of less incised mountains (Ri) and incised highlands (Hi). His Clear Range is subdivided into a southern mountain region (Ri) and a northeastern highland region (H). The highlands continue across Pavilion Lake into the southern Marble Range. Remnants of a peneplain observed in the field in the northern Marble Range may represent a northward extension of highlands. Midlands fringe the largest valleys in the region and are inset into the highlands and plateaus.

The terrain around Ashcroft (Ms) consists of an unusually wide, rock-floored valley interpreted to be a strath. A strath is a terrace-like remnant of a broad valley floor that formed by lateral stream erosion and has undergone subsequent incision following uplift (Bates and Jackson, 1987). Hat Creek valley (Mm) consists of fairly flat, smooth terrain with no stream incision surrounded by highlands to the east and west.

GEOMORPHIC EVIDENCE OF FORMER BASE LEVELS

Many valleys in the study area are drained by two underfit streams flowing in opposite directions from a low divide on the valley floor (Fig. 4). Elevations of the valley-floor divides range from 400 m to 1500 m, with maxima around 650 m, 800 m, and 1050 to 1150 m (Fig. 5, 6). Eocene sedimentary strata crop out from about 400 m to 800 m elevation. The average elevation of the base of the Miocene strata is about 900 m.

Topographic profiles across the Thompson River valley show a broad rock bench in Triassic and older bedrock on which Eocene sediments and volcanic material were deposited. At Kamloops, the bench has a minimum elevation of about 450 m on the south shore of Kamloops Lake and rises to about 750 m to the south (Fig. 7, B-B'). The bench is at least 150 m above the level of Kamloops Lake, which is up to 150 m deep (Fulton, 1975). At McAbee, the bench is at 480 to 515 m elevation and 125 m above the river (Fig. 7, C-C'). Downstream, the rock bench widens and merges with the Ashcroft strath.

The floor of the Ashcroft strath is at 900 m elevation in the west and slopes gently to 650 m elevation at the river (Fig. 7, D-D'). East of the river, the strath floor is at an elevation of 480 to 680 m. Above the strath and to the east, the sub-Eocene

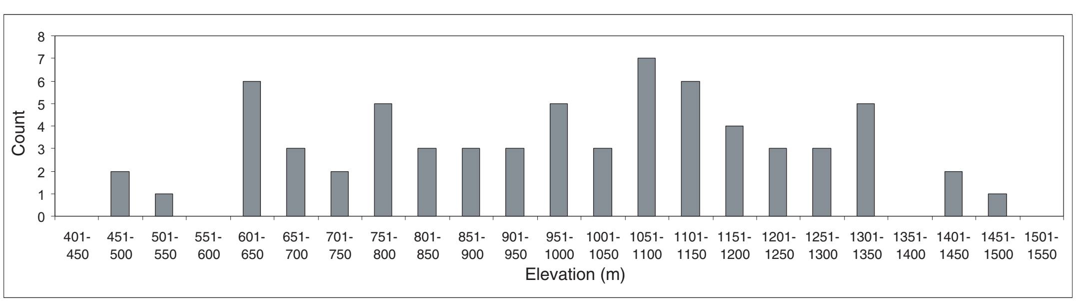

Figure 5. *Histogram of elevations of valley-floor divides (n = 74). Divide locations are shown in Figure 4.*

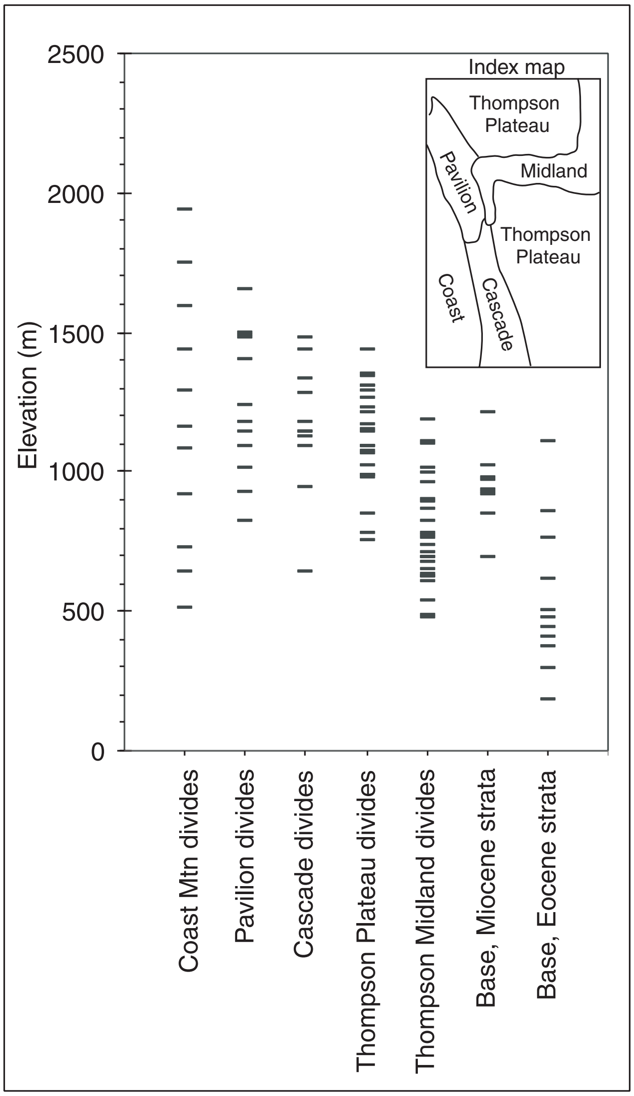

Figure 6. Scatter plot of elevations of valley-floor divides and base of documented Eocene and Miocene sedimentary strata. Divides are grouped by region shown in inset map. Valley-floor divides from the southern Coast Mountains outside of the study area are also included.

unconformity rises steeply to 1300 m in the highlands. The strath floor is 200 to 350 m above the river level. The sub-Eocene unconformity has 800 m of relief in this area.

The rock bench is not seen in the North Thompson River valley (Fig. 7, A-A'). Here, Eocene sediments are exposed between 410 and 570 m elevation, close to the modern river level. The strata are 600 m below the west valley wall and 1100 m below the east valley wall. The sub-Eocene unconformity has 1000 m of relief in this area.

Many tributary streams flow in relatively wide, gently sloping valleys that become narrow, steep rock canyons near their junction with the Fraser River (Fig. 8). The valleys are unusual because they are graded in their upper and middle reaches and not in their lower reaches, which is the typical equilibrium long profile of a stream. Graded valleys are widespread west of the river. The minimum elevations of graded reaches along the east and west walls of the Fraser River valley are shown in Figure 9. West of the river, low-order tributaries between Seton River and Nahatlatch River are at an elevation of 1300 to 1500 m. South of the Nahatlatch River, the elevation of the low-order graded reaches decreases to about 500 to 900 m. East of the river, graded valleys are scarce north of the Thompson River junction. South of this junction, graded valleys are more common and range in elevation from 800 to 1200 m.

DISCUSSION

The base level of erosion is the lowest level below which streams cannot erode their beds (Bates and Jackson, 1987). It is a hypothetical surface that matches sea level along the coast, where it is called the 'ultimate base level', and rises inland along principal streams and their tributaries. In aggrading areas, local base level is the depositional surface. A graded stream is one that has adjusted its bed to a local base level and has no rapids or waterfalls along its course. Valley-floor divide elevations may approximate former base levels.

The grey dashed line in Figure 9 joins the downstream limits of graded valleys and approximates a former base level. Principal streams will tend to have a lower elevation than first- or second-order streams because of their larger drainage area and capacity to erode their bed. The extent of graded valleys in Figure 8 closely matches the extent of the Miocene drainage network described by Tribe (2002).

The floor of the Ashcroft strath is interpreted to represent an old base-level stillstand. The displacement of the Thompson River to the east of the strath valley axis may indicate relative uplift in the west. The change in elevation of the sub-Eocene surface from 400 m at Chu Chua and 450 m downstream at Kamloops and McAbee, to 600 m in the Ashcroft strath may also reflect relative uplift in the Hat Creek area west of the strath. The Ashcroft strath has an orientation, size, and shape similar to those of the nearby Hat Creek valley. Another strath is found farther west in the Coast Mountains near Gold Bridge; it contains Gun Lake (Tribe, 2002).

The smooth topography of the floor of the Hat Creek valley is interpreted as the surface expression of a filled depositional basin. The Hat Creek valley contains over 1000 m of coal-bearing lacustrine and fluvial sedimentary rocks that were deposited in a graben whose base level was controlled by a spillway (Church, 1975). Four candidate spillways are shown in Figure 4 by drainage divides in the highlands bordering the valley. The divides have different elevations and probably served as spillways at different times. The valley containing Pavilion Lake and Pavilion Creek was probably the main spillway in the Miocene, as suggested by Miocene fluvial strata near Pavilion. Base-level indicators in the structurally controlled Hat Creek valley do not necessarily relate to base levels elsewhere. This is also true in the Fraser River valley where most Tertiary strata are fault bounded.

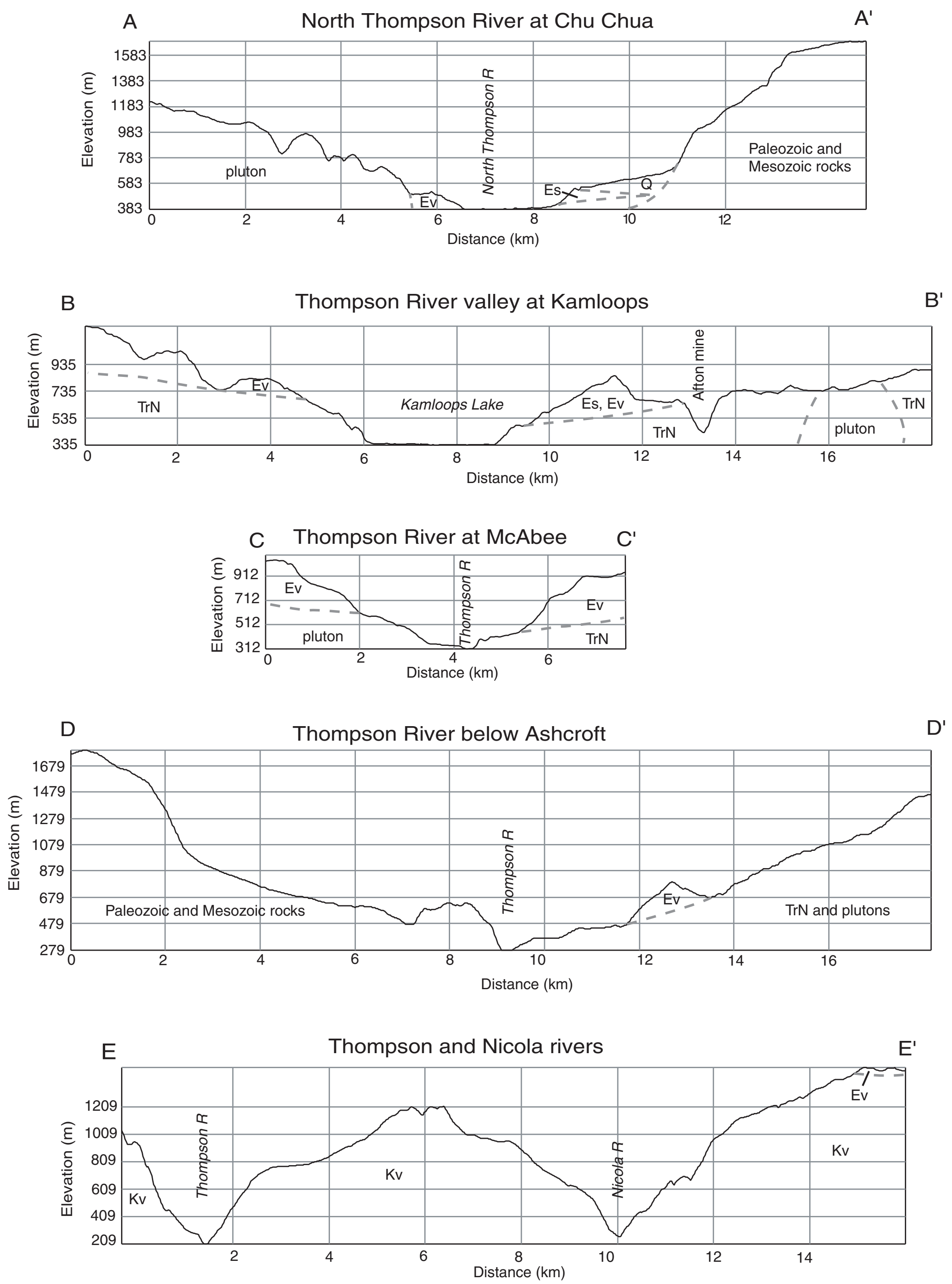

Figure 7. *Topographic profiles of the North Thompson and Thompson river valleys showing schematic geology. Profile locations are shown in Figure 4. Es, Eocene sedimentary rocks; Ev, Eocene volcanic rocks; Kv, Kamloops Group volcanic rocks; Q, Quaternary glacial deposits; TrN, Triassic Nicola Group. Vertical exaggeration = 3.4.*

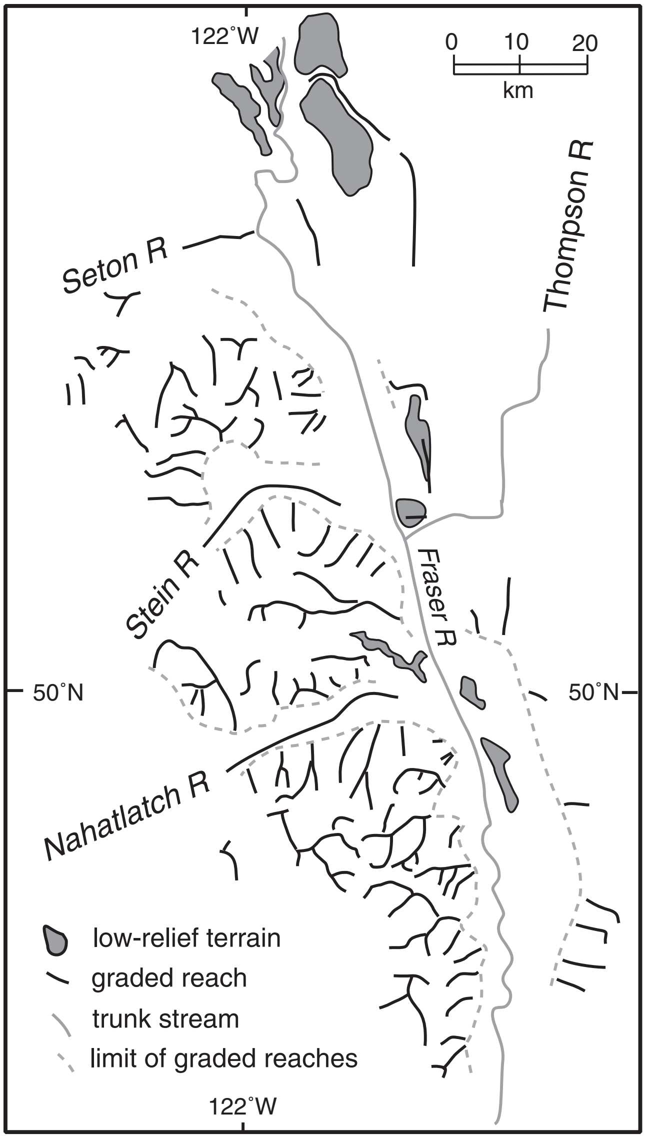

Figure 8. *Map showing the extent of graded-valley reaches along tributaries of the Fraser River south of Lillooet.*

The apparent alignment of the Nahatlatch River with the Mowhokam Creek valley and of the Stein River with the lower Thompson River is intriguing. Figure 9 shows the graded floor of the Stein River to be at an elevation of about 500 m, the same as the rock bench at Botanie Creek, which is used as a proxy for the graded floor of the Thompson River. The upper reach of Mowhokam Creek is a broad, graded valley with a valley-floor divide from which the Nicoamen River flows northward along gentle gradients, then forms a 200 m waterfall before joining the Thompson River. Figure 9 shows that the graded floor of the Nahatlatch River is at about 325 m elevation, whereas the graded limit of Mowhokam Creek is at 1000 m and the Mowhokam divide, at 1280 m. The difference in elevation between the graded limit of the Mowhokam and Nahatlatch valleys may reflect 700 m of uplift of the land east of the Fraser River and south of the Thompson River. Alternatively, it may reflect the ability of the east-flowing Nahatlatch River to incise its bed in concert with base-level lowering along the Fraser River, whereas the beheaded stream that flowed along the Mowhokam–Nicoamen valley was unable to incise its bed and remained stranded at high elevation.

Glacial erosion may be partly responsible for the development of graded valley reaches along tributaries west of the Fraser River, and for the valleys in the deeply incised mountains (Rd) north and east of Hope (Fig. 4). Many of these valleys have a fairly constant downstream width, which suggests that alpine glaciers have truncated spurs and straightened the valleys.

Estimates of valley age and Tertiary base levels

The North Thompson River valley incises Mesozoic and older rocks and contains a record of middle Eocene lacustrine and fluvial deposition. It follows the trace of faults dating from the early Jurassic to the Eocene (Journeay and Monger, 1994). The valley was 1000 m deep in the middle Eocene and may have formed several million years earlier. The local base level in the middle Eocene was similar to what it is today, about 400 m elevation. An ancestral stream probably flowed northwest or southeast along the Louis Creek Fault. It was captured at a point 25 km south of Chu Chua by an ancestral stream flowing south along the lower North Thompson River valley. Today, the North Thompson River valley is filling with postglacial deposits.

The Thompson River from Kamloops to Martel incises Mesozoic and older bedrock and is filled with Eocene lacustrine, fluvial, and volcanic deposits. The sub-Eocene unconformity is expressed as a broad depression coincident with the trend of the river. Kamloops Lake and the river are inset into the floor of this depression. The modern river has eroded through the Quaternary fill and flows near the underlying bedrock surface. Cumulative post-Eocene incision is estimated to be 125 to 350 m. The broad profile of the sub-Eocene unconformity suggests that the valley predates the Eocene.

From Martel to Lytton, the Thompson River flows through Cretaceous Spences Bridge Group volcanic rocks. In places, it is fault controlled. No midlands developed in this valley, which has single-slope walls from river level to the ridge tops (Fig. 7, E-E’). The valley does not appear overly wide for the modern Thompson River. It must be younger than the upstream segment, which includes the Ashcroft strath, because of its smaller size and the absence of a rock bench. Today, the Thompson River has cut through Quaternary fill and is carving a narrow notch in the underlying bedrock. The Nicola, Nahatlatch, and Stein river valleys have the same dimensions as this segment of the Thompson River valley. If they are of the same age, they define a north-flowing drainage pattern that postdates the Eocene Fraser Fault, as they have not been offset across it.

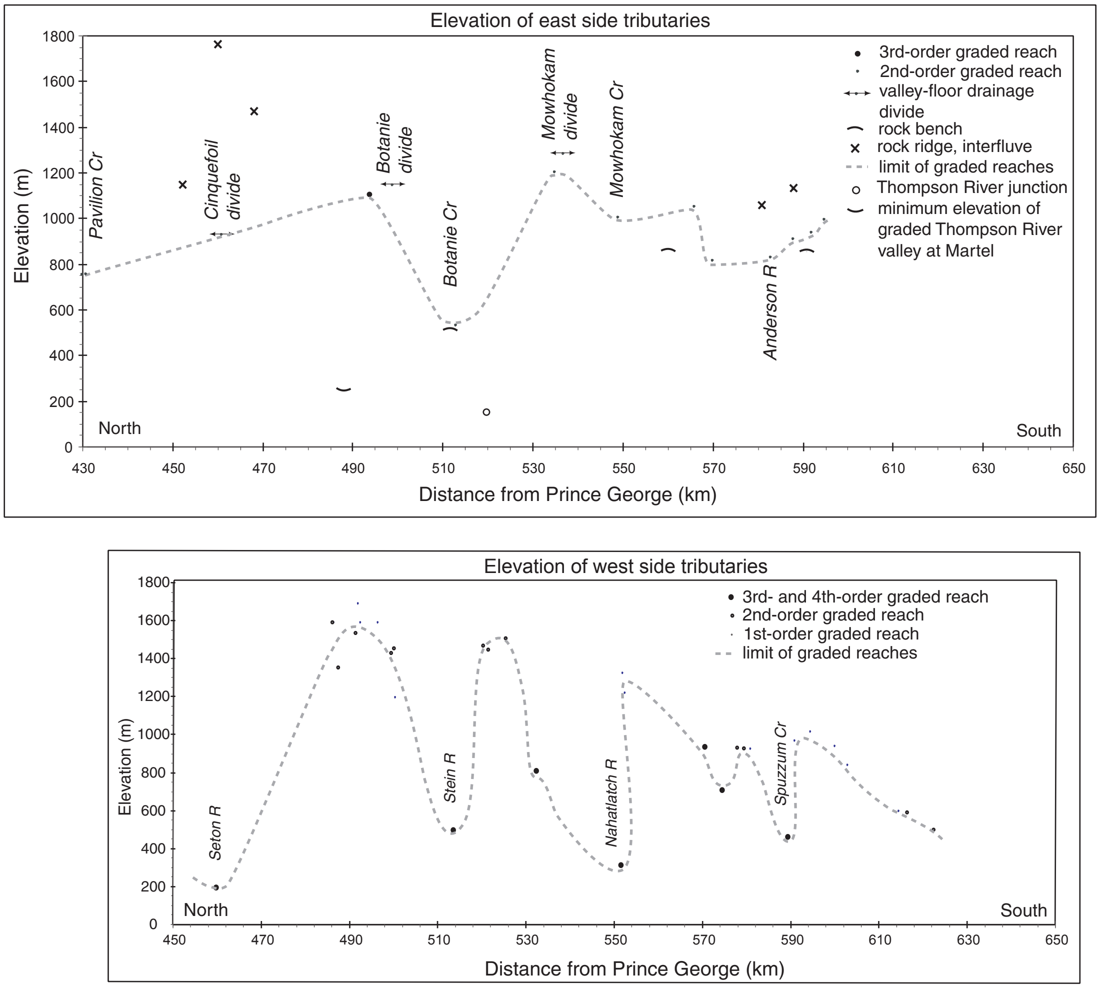

__Figure 9.__ Profiles of the east and west walls of the Fraser River showing the minimum elevation of graded-valley reaches mapped in Figure 8.

The Paleocene Nicola horst forms the northern wall of Nicola Lake. Other parts of the valley are in older rocks. Eocene fluvial and lacustrine sedimentary rocks occur within the valley. The Nicola Lake valley is probably Paleocene to Eocene and is today being filled with postglacial deposits.

The Nicola River valley from Canford to Spences Bridge is incised into Cretaceous volcanic rocks. It appears to be related to the north-trending Lomex Fault (Journeay et al., 2000) that extends along longitude 121°W. The fault marks the place where the wide Nicola Lake valley changes to the narrower Nicola River valley, and where the broad valley located at latitude 50°N and longitude 121°W is truncated to the west (Fig. 4). The change in character of the valleys across the fault suggests east-side-down displacement; however, Journeay et al. (2000) showed this fault as having west-side-down displacement. The Nicola River valley must postdate the Lomex Fault.

Near Lillooet, the Fraser River valley reaches its greatest width of 5 km. The river formerly flowed along the Cinquefoil valley when it was at an elevation of about 900 m. The Fraser River valley is narrowest — less than 500 m wide — in the region from Anderson River to 12 km downstream, past the Hell's Gate fish ladder. Graded tributary valleys on the east side of the river near Hell's Gate show a branching stream network made up of the Anderson and East Anderson rivers and Uztlius Creek. The lower north-northeast-trending reach of the Anderson River follows the trace of the Hozameen Fault. This area may be an old drainage divide and the youngest segment of the Fraser River valley. The modern Fraser River has cut through the Quaternary and Tertiary fill and is eroding a rock notch in the bottom of the valley.

CONCLUSIONS

Geomorphology, valley-fill geology, and drainage anomalies indicate that a suite of early Tertiary and possibly older valleys occurs in the study area. Drainage anomalies such as valley-floor divides, underfit streams, and graded-valley segments point to former base levels stranded in the landscape. The valleys of the North Thompson River and the Thompson River from Kamloops to Martel are possibly Paleocene or late Mesozoic. The Hat Creek and Nicola Lake valleys are Eocene. The Lower Thompson River, the Nahatlatch River, the Stein River, and Mowhokam Creek postdate the Eocene. Doctoral research continues into the drainage development of southern and central British Columbia.

ACKNOWLEDGMENTS

Base Mapping and Geomatic Services provided the digital elevation data. John Clague (Simon Fraser University) and Robert Turner (GSC) reviewed the manuscript. This work was supported by an NSERC scholarship, an NRCan Earth Sciences Sector supplement, and Clague's NSERC Research Grant.

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