GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES

LEGEND

CARIBOO, MONASHEE, AND SELKIRK MOUNTAINS

CENOZOIC

QUATERNARY
RECENT

- **14** Basaltic cinder cone and blocky olivine basalt flows

PLEISTOCENE AND RECENT

- **13** Alluvium and glacial deposits; gravel, sand, silt, till; few if any bedrock exposures

TERTIARY OR QUATERNARY
PLEISTOCENE OR OLDER

- **12** Basaltic volcanic cone, flows, and breccia

TERTIARY
MIOCENE OR PLIOCENE

- **11** Olivine basalt flows

MESOZOIC

CRETACEOUS OR TERTIARY

- **10** Muscovite-biotite granite and quartz monzonite; minor pegmatite

JURASSIC (?)

- **9** Biotite granodiorite, minor hornblende-biotite granodiorite, quartz diorite, and diorite

PALAEOZOIC

CAMBRIAN (?)
MIDDLE CAMBRIAN (?)

- **8** Marble and micaceous marble; minor quartz-mica schist (may be equivalent to 7)

CAMBRIAN
LOWER CAMBRIAN
CARIBOO GROUP (3, 4, and 6)

- **6** YANKEE BELLE FORMATION: green and grey shale and siltstone; minor quartzite and limestone

CAMBRIAN OR WINDERMERE
LOWER CAMBRIAN OR WINDERMERE

- **4** CUNNINGHAM LIMESTONE: grey limestone; minor shale and siltstone
- **3** ISAAC FORMATION: dark phyllite, limy phyllite, slate and argillite; minor quartzite and limestone

PROTEROZOIC

WINDERMERE

- **2** KAZA GROUP (Cariboo and Monashee Mountains)
HORSETHIEF CREEK GROUP (Selkirk Mountains)
Gritty feldspathic quartzite, phyllite, quartz-mica schist, garnet, staurolite, and kyanite-quartz-mica schist, biotitic and/or hornblendic quartzo-feldspathic gneiss; minor marble and amphibolite, minor pegmatite with staurolite-kyanite schist; 2a, marble; 2b, amphibolite; (thin layers of 2a shown in solid black and of 2b in dashed black)
- **2A** SHUSWAP METAMORPHIC COMPLEX: biotitic and/or hornblendic quartzo-feldspathic gneiss, sillimanite-garnet-quartz-mica schist and gneiss, amphibolite, pegmatite, foliated granitic rocks, minor augen gneiss and marble; 2Aa, grey marble; 2Ab, marble and rusty schist; 2Ac, amphibolite; (thin layers of 2Aa, and 2Ab, shown in solid black, and of 2Ac in dashed black)

AGE UNKNOWN

- **1** Hornblendic and/or biotitic quartzo-feldspathic gneiss, feldspar augen gneiss, amphibolite, quartz-mica schist, and quartzite

ROCKY MOUNTAINS

CENOZOIC

QUATERNARY
PLEISTOCENE AND RECENT

- **13** Alluvium and glacial deposits; gravel, sand, silt, till; few if any bedrock exposures

PALAEOZOIC

CAMBRIAN
MIDDLE CAMBRIAN

- **7** Limestone, shale, phyllite, marble, micaceous and garnetiferous marble, quartz-mica schist (locally garnetiferous)

LOWER CAMBRIAN
GOG GROUP

- **5** Quartzite; minor shale, phyllite, quartz-mica schist (locally garnetiferous)

PROTEROZOIC

WINDERMERE
MIETTE GROUP

- **2B** 2Ba, gritty feldspathic quartzite, phyllite, slate, argillite, quartz-mica schist; minor conglomerate and limestone; 2Bb, conglomerate (folds in 2Ba and 2Bb relatively open); 2Bc, gritty feldspathic quartzite, phyllite, quartz-mica schist, garnet, staurolite, and kyanite quartz-mica schist; minor conglomerate, marble, limestone, and biotitic quartzo-feldspathic gneiss (folds tight, commonly isoclinal)

AGE UNKNOWN

- **1** Hornblendic and/or biotitic quartzo-feldspathic gneiss, granitic orthogneiss, feldspar augen gneiss, amphibolite, quartz-mica schist (locally with sillimanite), minor quartzite

Glacier
Small outcrop
Geological boundary (defined, approximate or assumed)
Limit of geological mapping
Bedding (inclined, vertical)
Foliation; cleavage, schistosity, gneissosity (inclined, vertical)
Lineation (inclined, horizontal)
Fault (defined, approximate or assumed)
Thrust fault
Anticlinal axis (fold upright, overturned, arrow indicates plunge)
Synclinal axis (fold upright, overturned, arrow indicates plunge)
Antiformal axis (fold upright, overturned)
Synformal axis (fold upright, overturned, arrow indicates plunge)
Fan axis
Garnet isograd (approximate, assumed or inferred)
Staurolite-kyanite isograd (approximate, assumed or inferred)
Sillimanite isograd (approximate, assumed or inferred)
Mineral property . . . Au ×

MINERALS

Gold	Au	Uranium	U
Mica	mi	Vermiculite	vm
Silver	Ag		

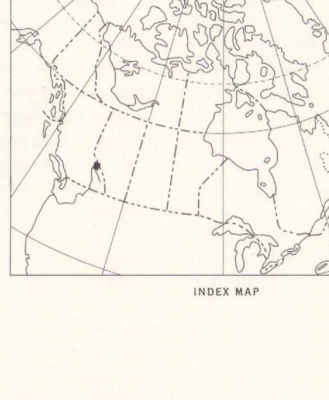
Geology by R. B. Campbell, 1963, 1964, and 1965

Geological cartography by the Geological Survey of Canada, 1967

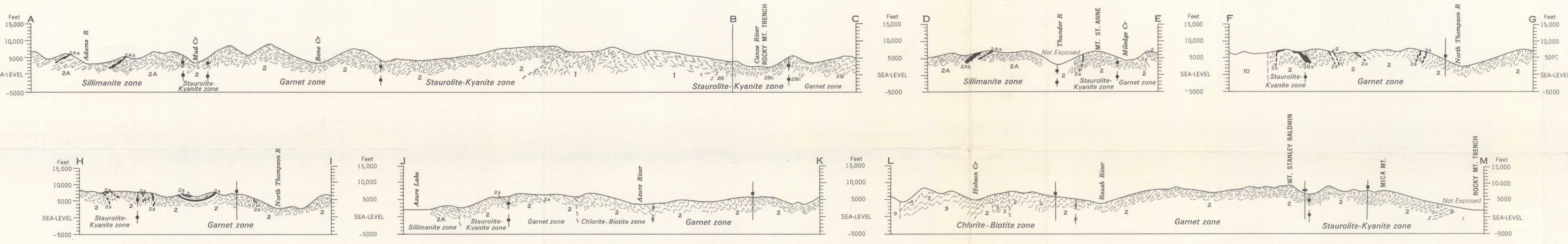
Base-map compiled and drawn by the Surveys and Mapping Branch 1958-61

Magnetic declination 1968 varies from 23° 47' easterly at centre of east edge to 24° 04' easterly at centre of west edge. Mean annual change decreasing 3.6

Elevations in feet above Mean Sea Level



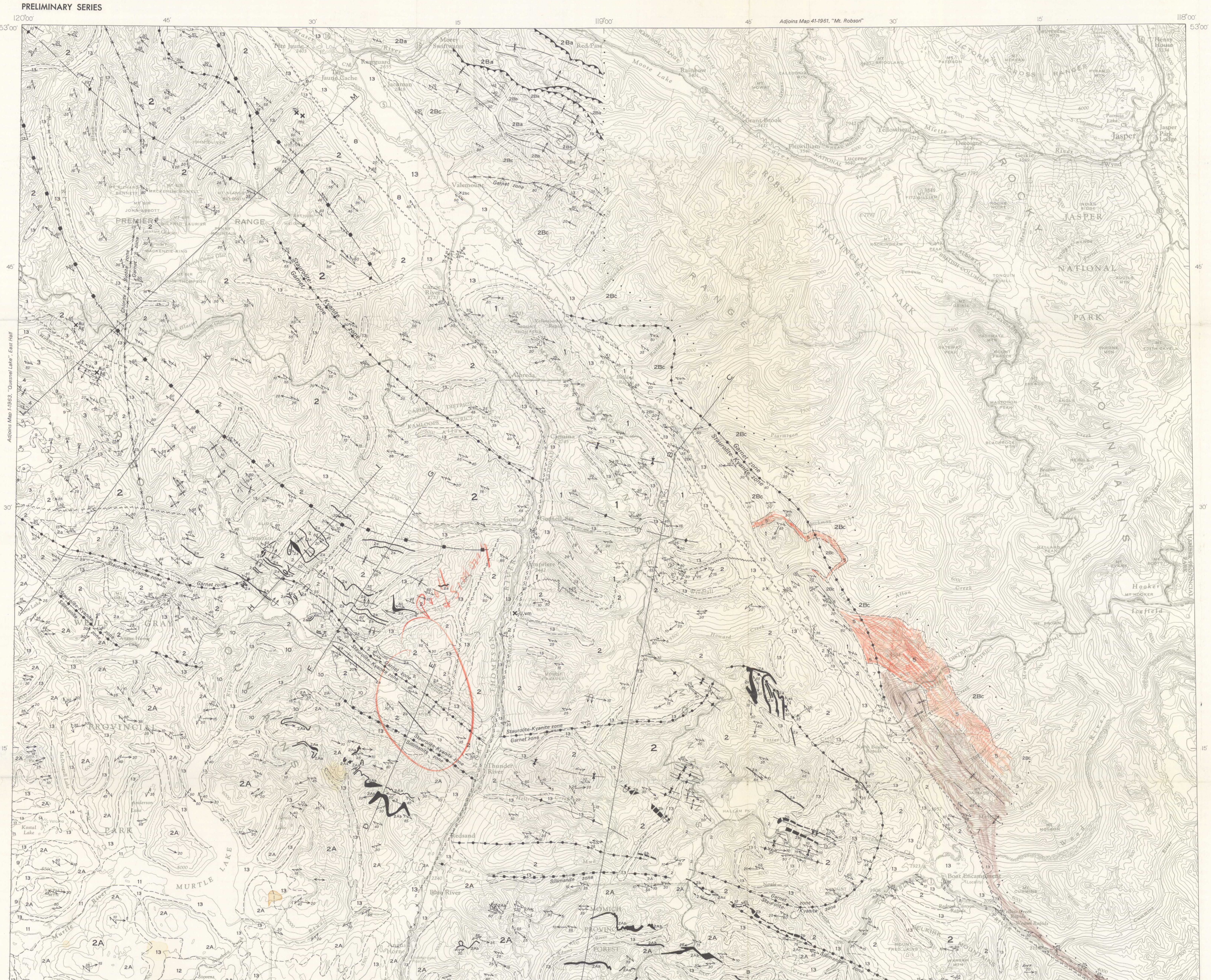
INDEX MAP



Cross sections along lines A-B-C, D-E, H-I, J-K, and L-M

Except where outlined by mappable units folds are diagrammatic but illustrative of fold style

PRELIMINARY SERIES



Published, 1968
Copies of this map may be obtained from the Director, Geological Survey of Canada, Ottawa

Printed by the Surveys and Mapping Branch

MAP 15-1967

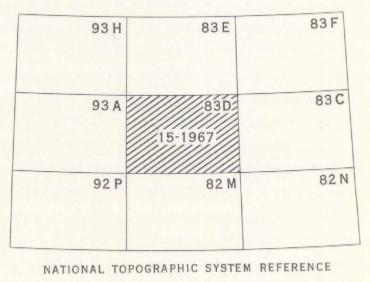
GEOLOGY

CANOE RIVER

BRITISH COLUMBIA

Scale 1:253,440
1 inch to 4 miles

Miles 4 0 4 8 12 Miles
Kilometres 6 0 6 12 18 Kilometres



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE

DESCRIPTIVE NOTES

Field work by the writer was confined to the Cariboo, Monashee, and Selkirk Mountains and to a narrow strip of the Rocky Mountains bordering the Rocky Mountain Trench. The geology of the Rocky Mountains in the west half of the map-area was mapped by E. W. Mountjoy in 1964 and that of the remainder of Rocky Mountains, in the east half, including mapping of the Gog Group and Middle Cambrian strata, was undertaken by R. A. Price [1,2] and E. W. Mountjoy in 1965 and 1966. The contacts of the gneiss (map-unit 1) and of some of the associated Gog Group (map-unit 5) in Rocky Mountains were mapped by C. A. Giovanella in 1966 and 1967.

Access to the area is provided by Highways 5 and 16, by the main line of Canadian National Railways, and by the Big Bend Highway on Columbia River. A logging road extends from near Valemount down Canoe River Valley to within a few miles of Columbia River.

Precipitation is moderate to heavy, and summers generally cool and moist. Below timber-line, at about 6,200 feet above sea-level, the slopes are covered by dense vegetation.

Steep faults evidently form the boundary of the metamorphic rocks of unknown age (map-unit 1) in the valleys of Camp Creek and Albreda and North Thompson Rivers, though exposures of the contact have not been observed. In Monashee Mountains the southern contact is a gently to moderately south-dipping fault that separates the underlying gneiss from metamorphosed strata of the Kaza Group above. Foliation in both units is generally parallel with the fault but near the head of Windfall Creek that of the gneiss is truncated.

Previously the writer stated [3,4,5] that the gneiss of map-unit 1 was thrust eastward over rocks of the Miette and Gog Groups and Middle Cambrian strata in Rocky Mountains. This opinion was also expressed by Price and Mountjoy, [1] but subsequently Price [2] suggested that the gneiss is the metamorphic equivalent of Miette and Gog Group rocks in situ. Evidence obtained by Giovanella (in preparation) supports the earlier view. The gneiss (map-unit 1) is compositionally distinct and locally exhibits discordant relationships at its contacts. The speculation is warranted that the gneiss is a segment or slice of crystalline Precambrian rocks that has been carried upward 20,000 to 30,000 feet or more though definite proof of this may not be forthcoming.

The similarity of lithology and stratigraphic position of the Kaza, Horsethief Creek, and Miette Groups has long been recognized. Kaza Group strata can be traced from Cariboo through Monashee into Selkirk Mountains where they are continuous with Horsethief Creek Group rocks traced from the south by Wheeler [6,7]. The rocks of both groups are strikingly similar to those of the Miette Group. Work by the writer in McBride map-area [8] indicates the equivalence of the Kaza to part of the Miette Group and suggests that the Isaac Formation and Cunningham Limestone correspond to the upper part of the Miette Group, and that the Yankee Belle Formation is a shaly facies of part of the lower Gog Group. This is at variance with earlier concepts of the stratigraphy of the Cariboo Mountains [9,10,11].

Carbonate-bearing rocks, forming a wide belt extending easterly from north of Azure Lake to North Thompson River, were originally thought to be metamorphosed equivalents of the Isaac Formation and Cunningham Limestone [3,4], but further work [5] showed that structures in this sequence plunge with apparent conformity beneath typical Kaza Group strata near Slide Mountain. Thus the carbonate-bearing rocks must be part of the Kaza Group and are apparently separated by a fault from the upper Kaza Group and Isaac Formation in the region north of Azure Lake.

The low density of observations and the rather erratic occurrence of critical minerals precludes the precise delineation of isograds; those shown are approximate but are locally well controlled. South of the map-area Wheeler [6] and the writer [12] have traced complexly deformed metamorphic rocks continuously to the region where the Shuswap Metamorphic Complex was originally studied [13,14,15]. Within the map-area the Shuswap Metamorphic Complex is formed mainly, if not entirely, from rocks of Windermere age. The latter merge with and become indistinguishable from those of the metamorphic complex. The boundary of the complex is taken as the sillimanite isograd within which the gneissose rocks, with much associated pegmatite, are typical of the complex to the south. Lower grade rocks beyond the sillimanite isograd are less complexly deformed, have little or no associated pegmatite, and are schistose rather than gneissose.

Rocks of the Rocky Mountains are discussed by Price and Mountjoy [1,2] and those of the Cariboo Group by Sutherland Brown [9,10] and the writer [8,11].

Biotite granodiorite (map-unit 9) cuts across and locally warps structures in the stratified rocks, and thus was intruded subsequent to the original deformation. A K-Ar age for biotite of 143 ± 14 m.y. [16] from the granodiorite indicates that the deformation took place at about the Jurassic-Cretaceous boundary or earlier.

Muscovite-biotite granite (map-unit 10) also distinctly transects structures of the surrounding rocks. K-Ar ages for biotite and muscovite [17] are 51 ± 6 m.y. and 54 ± 6 m.y. respectively.

Tertiary basaltic flows (map-unit 11) occupy much of the valley of Clearwater River [11,12,18] and extend up Murtle River Valley to Murtle Lake. No glacial deposits are known to underlie these flows though their surface is glaciated. They are believed to correspond to the plateau lavas of the Interior Plateau farther west which they resemble in many respects. A second group of basaltic effusives (map-unit 12) form lava and cinder cones, flows, and breccia deposits that rise above and lie on the surface of the earlier flows (map-unit 11). These are modified by glacial erosion and hence are Pleistocene or older. The youngest volcanic rocks are post-glacial, and comprise basaltic cinder cones and blocky lava flows (map-unit 14).

Three huge structural units underlie Cariboo and Monashee Mountains; two northwesterly trending anticlinoria flank a central synclinorium. The synclinorial axis extends from near Boat Encampment to the outcrop of the Cunningham Limestone, and continues with a more northerly trend through Quesnel Lake [11] and into McBride map-area where it lies just east of Isaac Lake [10]. In the latter areas the axial zone is underlain by unmetamorphosed, weakly deformed, relatively young stratigraphic units which, though structurally simple, are cut by many strike faults that complicate the form of the synclinorium. The plunge is generally northwesterly but the structure displays broad depressions and culminations, particularly in Quesnel Lake and McBride map-areas. Toward the southeast the synclinorium becomes more and more structurally complex and difficult to define. In Monashee Mountains its configuration is lost but its existence may be inferred from the outline of the staurolite-kyanite isograd. Only in the higher grade and intensely deformed rocks is there clear evidence of two stages of folding. First folds within the synclinorium are characterized by strong axial plane foliation. The second folds are erratic in distribution and form, varying from isoclinal to open warps, and are mainly nearly coaxial with the first.

Northeast of the synclinorium, in Cariboo Mountains, Kaza Group rocks form a complicated anticlinorium well exposed in Premier Range. The equivalent zone in Monashee Mountains is occupied mainly by the gneiss of map-unit 1. In Cariboo Mountains the southwest boundary of the anticlinorium is marked approximately by the arcuate fan axis near North Thompson and Raush Rivers. This axis cannot be traced into Monashee Mountains. In Premier Range the rocks apparently yielded by flowage and are deformed into a bewildering array of isoclinal folds which are themselves arched across an antiformal axis and through a fan axis (section L-M). The anticlinorium plunges gently northwestward into McBride map-area [8] where, at a structurally higher level, Kaza Group strata are deformed into a series of large, similar shear folds. At the highest structural level the anticlinorium is expressed as an arch outlined by unmetamorphosed strata of the Cariboo Group [8]. The latter rocks were deformed mainly by brittle fracture expressed by a series of tilted fault blocks, and by minor concentric folding.

The highly metamorphosed rocks of the Shuswap Metamorphic Complex (map-unit 2A) apparently form a complex antiformal structure that extends westerly into the Quesnel Lake map-area and southeasterly along the southwest side of the Trench in Big Bend [6] and Rogers Pass [7] map-areas. The form of this structure is nowhere clearly outlined and its margins are locally complicated by faulting. First folds within this complex were apparently produced by flowage and have been redeformed by at least one stage of later folds; the latter are erratic in distribution and form but in general are nearly coaxial with the former.

The northern two of these regional structures, together with the broad zones of metamorphism and deformation associated with them, appear to be cut off by a fault or faults subparallel to the Rocky Mountain Trench. In the Rocky Mountains northeast of the inferred fault there is a belt of metamorphosed rocks featured by tight shear folding that over relatively short distances passes into a zone of gently folded, unmetamorphosed, and faulted rocks typical of much of the Rocky Mountains.

To date no exploitable mineral deposits have been discovered within the map-area. The best possibility lies in the discovery of lead-zinc deposits associated with one of the carbonate units. Muscovite deposits have created interest in Premier Range and though pegmatites are rare in those mountains, more may be found. Uranium-bearing minerals associated with marble near Lempriere offer another exploration target.

[1] Price, R. A. and Mountjoy, E. W.: Operation Bow-Athabasca, Alberta and British Columbia; in Rept. of Activities, Geol. Surv. Can., Paper 66-1, pp. 116-121 (1966).
[2] Price, R. A.: Operation Bow-Athabasca, Alberta and British Columbia; in Rept. of Activities, Geol. Surv. Can., Paper 67-1 Pt. A, pp. 106-112 (1967).
[3] Campbell, R. B.: Canoe River west half map-area; in Rept. of Activities, Geol. Surv. Can., Paper 65-1, pp. 43-46 (1965).
[4] Campbell, R. B.: Canoe River west half map-area; in Rept. of Activities, Geol. Surv. Can., Paper 65-2, pp. 47-50 (1965).
[5] Campbell, R. B.: Canoe River map-area; in Rept. of Activities; Geol. Surv. Can., Paper 66-1, pp. 51-52 (1966).
[6] Wheeler, J. O.: Big Bend, British Columbia; Geol. Surv. Can., Paper 64-32 (1965).
[7] Wheeler, J. O.: Rogers Pass, British Columbia-Alberta; Geol. Surv. Can., Paper 62-32 (1963).
[8] Campbell, R. B.: McBride map-area; in Rept. of Activities, Geol. Surv. Can., Paper 67-1 Pt. A, pp. 53-55 (1967).
[9] Sutherland Brown, A.: Geology of the Antler Creek area, British Columbia; B. C. Dept. Mines, Bull. 38 (1957).
[10] Sutherland Brown, A.: Geology of the Cariboo River area, British Columbia; B. C. Dept. Mines, Bull. 47 (1963).
[11] Campbell, R. B.: Quesnel Lake, east half, British Columbia; Geol. Surv. Can., Map 1-1963 (1963).
[12] Campbell, R. B.: Adams Lake, British Columbia; Geol. Surv. Can., Map 48-1963 (1964).
[13] Dawson, G. M.: Shuswap Sheet, British Columbia; Geol. Surv. Can., Map 604 (1898).
[14] Daly, R. A.: A Geological Reconnaissance between Golden and Kamloops, British Columbia; Geol. Surv. Can., Mem. 68 (1915).
[15] Jones, A. G.: Vernon map-area, British Columbia; Geol. Surv. Can., Mem. 296 (1959).
[16] Wanless, R. K. et al: Age Determinations and Geological Studies, Geol. Surv. Can., Paper 64-17 (Part 1) p. 15 (1965).
[17] Wanless, R. K. et al: Age Determinations and Geological Studies, Geol. Surv. Can., Paper 65-17, p. 15 (1966).
[18] Campbell, R. B., and Tipper, H. W.: Bonaparte River, British Columbia; Geol. Surv. Can., Map 3-1966 (1966)

CANOE RIVER
BRITISH COLUMBIA