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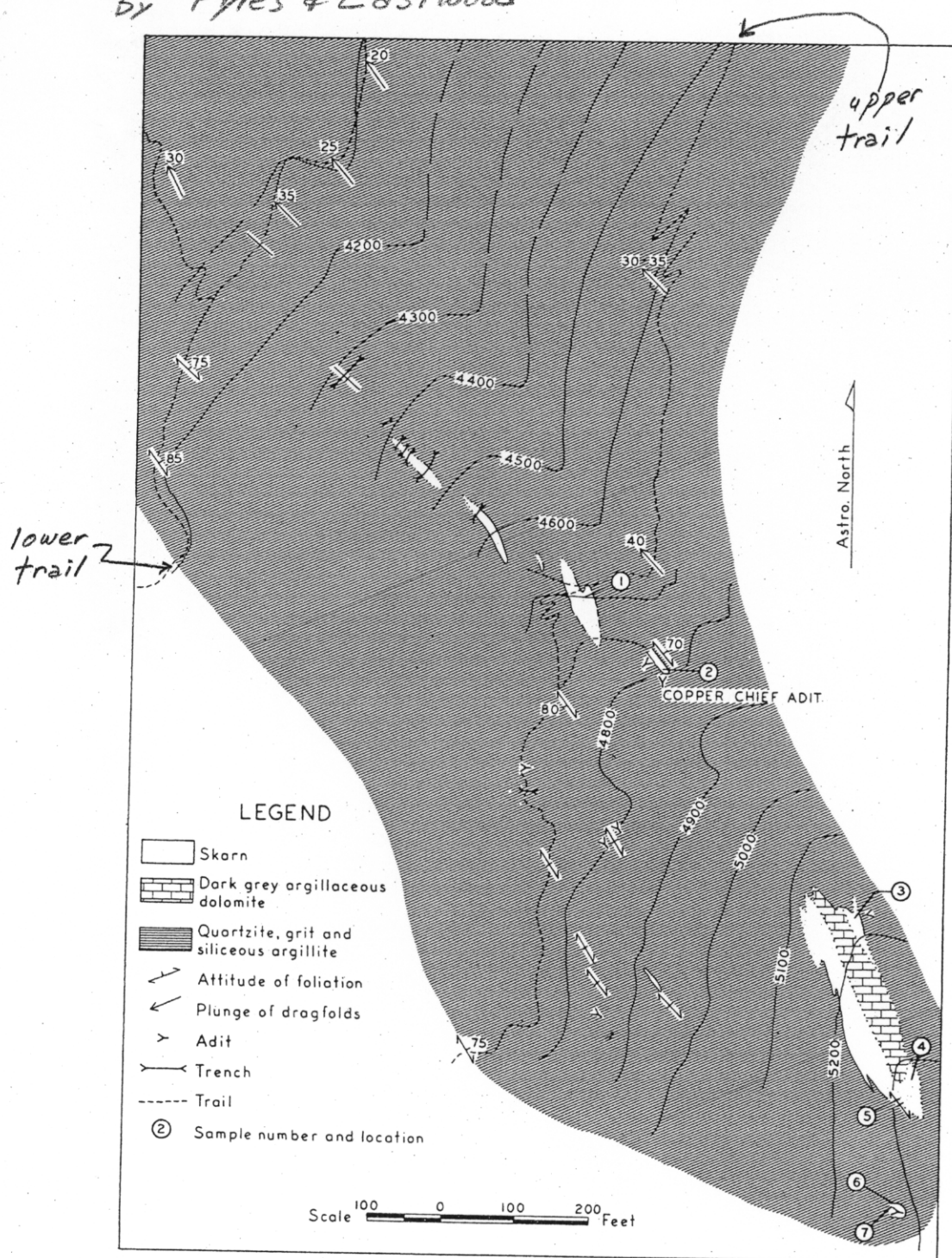


Figure 8. Geological map of the main showings on the Copper Chief property.

Copper Chief and Lucky Boy

The Copper Chief and Lucky Boy properties are on the ridge and steep slope east of Trout Creek between 1 and 2 miles south of the Lardeau Valley. The properties adjoin each other and include a group of seven Crown-granted claims owned by Esther Brandon, of Gerrard, and Alice M. Hillman, of Ottawa, and one located claim owned by Archie Oakey, of Beaton. Several of the Crown-granted claims, including the Lucky Boy, Horseshoe, Copper Chief, Willow Grouse, Ruffled Grouse, and Molybdenum, are briefly mentioned in Annual Reports of the Minister of Mines between 1898 and 1943. They were originally located on narrow, flat-

lying quartz veins, from which small shipments of high-grade silver-lead ore were made. Recorded production is given in the table on page 54.

During 1942 and 1943 the Lucky Boy and adjoining claims attracted some attention because of the occurrence of scheelite in the quartz vein on the Lucky Boy and in skarn bands on the Copper Chief. No scheelite was mined at the Lucky Boy, but in 1942, 23 tons sorted from the old dump and shipped to Ottawa for treatment produced 650 pounds of concentrates assaying 69 per cent tungstic oxide. No further work was done on the properties until they were optioned in 1951 by Major Explorations Limited. This company, in 1952, made a camp at the Lucky Boy mine, built about 3 miles of narrow road from Trout Lake to the camp, and explored showings of scheelite-bearing skarn on the Copper Chief.

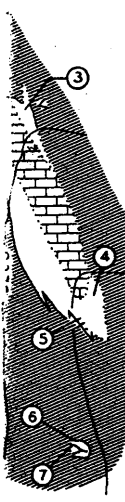
Most of the outcrops on the property are on the steep slope east of Trout Creek; very few are found east of this slope on the relatively gentle slope facing the Lardeau Valley. Geological studies are hampered by the rusty surface of many of the quartzitic rocks, which is produced by weathering of disseminated pyrrhotite and pyrite. Figure 8, based on a compass and tape survey made in September, 1958, shows the main skarn zones and workings on the Copper Chief.

Although detailed geological studies have been made near the showings in addition to regional mapping, the stratigraphy and structure on the property are imperfectly known. Light-grey to white dolomite is exposed near the Lucky Boy mine and is encountered underground. It forms a band a few hundred feet wide which dips steeply to the northeast and is exposed only on the crest of the ridge southeast of Trout Creek. It probably continues to the southeast and pinches out to the northwest a few hundred feet below the mine. The dolomite is correlated with the dolomite member (see p. 34) of the southwestern part of the map-area, which outcrops extensively northwest of Trout Creek. Grey phyllite is exposed in the mine and in scattered outcrops immediately northeast of the dolomite.

To the southwest are quartzites, grits, and siliceous and silicated argillites containing calcareous lenses more or less altered to skarn. They form poorly defined bands several hundred feet wide on the steep Trout Creek slope, extending from the crest of the ridge east of Trout Creek to the level of the creek. The rocks have a poor cleavage, and bedding is rarely visible. Rounded grey quartz grains are seen in some specimens. Argillites containing skarn lie southwest of the quartzites and grits. They are grey to light grey, rusty weathering, and grade into dark-grey argillites with limy interbeds. Probably most of the siliceous argillite and some of the quartzites are formed by bleaching and silicification of grey argillite. The skarn consists of a fine-grained aggregate of quartz, carbonate, epidote or zoisite, diopside, and garnet. It is commonly heavily mineralized with pyrrhotite and locally contains chalcopyrite and scheelite. Skarn rich in diopside and epidote is dark green; that containing a high proportion of garnet and carbonate is brown or cream coloured.

The rocks are complexly folded. Cleavage is vertical or dips steeply to the northeast. Poorly defined lineations and dragfolds plunge 20 to 40 degrees to the northwest essentially parallel to the steep eastern slope of Trout Creek. No major fold or pattern of dragfolds is recognized near the showings. Dragfolds in calcareous skarn southwest of the main Copper Chief showings are N-shaped in section looking down the plunge. Near the main showings calcareous beds have been squeezed into lenses on the crests and troughs of folds which plunge parallel to the slope of the hill. These lenses contain the skarn and scheelite.

Exposures of skarn on the Copper Chief property lie on the southwest side of a steep gully, known as the Copper Chief draw, that extends from the old Copper Chief adit at an elevation of 4,830 feet to the level of Trout Creek more than 1,500 feet below. Light-grey to white dolomite, with lenses of skarn along contacts with



greyish quartzitic rock, occurs in the draw at about 3,500 feet elevation 500 feet northwest of the area of Figure 8. All the other known occurrences of skarn are above about 4,000 feet in elevation southwest of the draw (see Fig. 8). They are mainly lenses of green skarn containing pyrrhotite and disseminated fine-grained scheelite. Because of its fine grain, the scheelite is almost impossible to see with the unaided eye, and use of an ultraviolet light is necessary. Lenses of skarn are discontinuous, and the distribution of scheelite within them is difficult to determine. What appears to be the largest and most continuously mineralized skarn lens is 400 to 600 feet southeast of the Copper Chief adit near the crest of the ridge east of Trout Creek. Most scheelite in this showing is in green skarn which grades into buff to brownish skarn containing little scheelite. The skarn is in a lens of dark-grey dolomite that appears to dip to the southwest, forming a slab parallel to the slope of the hill. Assays of three samples (Nos. 3, 4, and 5) taken in this locality are given in the following table, and the location of the samples is shown on Figure 8. A few hundred feet to the south is a lens of green siliceous skarn rich in pyrrhotite. It appears to lie on the crest of an anticline plunging to the northwest, less steeply than the slope of the hill. Assays of two samples (Nos. 6 and 7) taken in a short adit in the skarn are shown in the table.

At the portal of the Copper Chief adit at 4,840 feet elevation, another skarn body is 2 to 4 feet wide and encloses several lenses of unaltered grey limestone. Both skarn and limestone are mineralized with scheelite, and a sample across 4 feet assayed 1.06 per cent tungstic oxide. Several hundred feet of underground work was done at the Copper Chief adit, which was driven on a narrow quartz vein dipping 10 degrees northeast. Underground the vein is cut off by a strong fault striking north 30 degrees west and dipping 85 degrees northeast, and most of the underground work was in search of the faulted segment of the vein. The fault cuts off the skarn band whose extension on the east side of the fault is not visible. The Copper Chief quartz vein and other narrow, flat-lying veins nearby are rather sparsely mineralized with scheelite. A lens of dark-green skarn between 50 and 100 feet below the adit is well mineralized with pyrrhotite but contains only small amounts of scheelite; an assay of a sample of the highest-grade scheelite-bearing skarn is given in the table (No. 1).

Copper Chief Assays

Sample No.	Width (Ft.)	WO ₃ (Per Cent)
1	8	0.20
2	4	1.06
3	6	0.50
4	4	0.11
5	8	0.04
6	4	1.62
7	4.5	1.02

Between 1,000 and 1,500 feet to the south of the Copper Chief adit, at an elevation of about 4,800 feet, south of the area of Figure 8, are three adits along a gently dipping quartz vein. The vein which ranges from 6 inches to 1 foot thick contains minor amounts of sphalerite and galena and in places is copper stained. Bluffs above the adits are composed of limestone and dolomite interbedded with rusty-grey argillite. The rocks are tightly folded in a series of N-shaped folds plunging to the northwest almost parallel to the slope of the hill. Lenses of skarn, mainly light brown in colour, are found in the calcareous rocks, particularly near limestone-argillite contacts. One or two narrow, gently dipping quartz veins which

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cut the skarn contain scattered grains of scheelite. Some of the darkest-coloured skarns also contain small amounts of scheelite.

The Lucky Boy workings are on the slope facing the Lardeau Valley about 2,000 feet north of the Copper Chief adit. They include an inclined shaft on the Lucky Boy claim near the northeast corner of the Horseshoe claim. This shaft and several short adits and open pits are on a quartz vein which strikes slightly north of east and dips 20 to 30 degrees to the south. The vein is exposed on both the Lucky Boy and Horseshoe claims. Workings on the Horseshoe, which are reported to include two shafts west of the Lucky Boy shaft, were inaccessible in 1958. The vein is in a reverse fault which transects light-grey dolomite of the dolomite member (see p. 34) and has offset the northeastern contact about 20 feet. The vein ranges from 6 inches to 6 feet thick and probably averages 1 to 2 feet. It contains white drusy quartz, galena, tetrahedrite, sphalerite, chalcopyrite, and pyrite. Native silver is reported to be present. Scheelite occurs in the quartz in small grains and masses up to several inches across.

The vein has been traced on surface for about 500 feet by open-cuts and adits, most of which are badly caved. The shaft is inclined at 17 degrees and runs south 20 degrees east a slope distance of 190 feet.

The shaft follows the vein and passes downward through grey phyllite into light-grey dolomite. From the shaft three drifts have been driven on the vein at distances of 65, 85, and 155 feet respectively from the collar of the shaft. They are described by Holland (1943) as follows:—

"The highest, No. 1, level is driven westerly from the shaft and a small stope put in above it. The vein as exposed is narrow and contains little sulphide. There is little or no scheelite in the vein on this level.

"The No. 2 level was driven east and west from the shaft; the east drift, for a distance of 230 feet with several short raises up the dip; the west drift for 120 feet and most of the ground up to No. 1 level was stoped. At 57 feet from the shaft scheelite mineralization is present in the remaining pillars along the drift and extends westerly for about 40 feet. It shows in the backfill in a raise 85 feet west, and on the west side of a second raise 100 feet west of the shaft. The scheelite mineralization makes an attractive display on the west side of this raise from 5 to 14 feet up from the level. Four samples in this section averaged 3.67 per cent tungstic oxide across an average width of 29 inches.

"On the lowest level, No. 3, a drift has been driven east for 130 feet and a raise put through to No. 2 level but most of the vein remains unmined. At the corner of the shaft and the No. 3 level scheelite mineralization extends 23 feet east on both walls of the drift on the No. 3 level and extends 30 feet up the shaft from the bottom level. Six samples from the No. 3 level east of the corner averaged 0.41 per cent tungstic oxide across 33 inches and seven samples up the shaft on the east wall for 30 feet averaged 0.63 per cent tungstic oxide across 35 inches.

"No. 3 level is driven 140 feet west of the shaft and most of the vein up to No. 2 level has been explored or mined. Scheelite occurs in the vein in a raise 70 feet west of the shaft as well as in pillars and unmined vein between No. 2 and No. 3 levels. There is no scheelite in No. 3 level in the west end.

"[West of the Lucky Boy shaft] scheelite also occurs in the same vein on the Horseshoe claim in a surface exposure between the two shafts, also along the wall of the easternmost shaft and for a length of 12 feet in a drift driven east from the same shaft.

"The distribution of the scheelite mineralization falls within the limits of a shoot raking eastward from the surface exposure on the *Horseshoe* through the raise on the west end of No. 2 level to the area between No. 2 and No. 3 levels.

The exposure of scheelite on the east side at the intersection of the shaft and No. 3 level appears to be separated by a barren section suggesting that it is the apex of another shoot. No faulting was observed that would displace the vein were it part of the same shoot.

"There is no development below the No. 3 level. At that depth the vein fracture crosses a limestone bed but its persistence through, and mineralization within the limestone are not proven by the present workings."

The scheelite content of the vein drops off rapidly as the vein passes out of the dolomite. Although locally scheelite occurs with sulphides, scheelite mineralization in general is independent of the sulphides. The sulphides appear to have an erratic distribution not obviously related to the wallrocks.

[References: *B.C. Dept. of Mines*, Bull. No. 10 (Revised, 1943), p. 131; *Geol. Surv., Canada*, Sum. Rept., 1903, Pt. A, pp. 71-72; Gunning, 1929, pp. 83-84; *Minister of Mines, B.C.*, Ann. Repts., 1952, pp. 183-187; 1953, pp. 144-145.]

Index

The Index claim was owned in 1960 by G. C. Short, of Calgary. It is reached by about 1½ miles of jeep-road and trail from Gainer Creek. It is one of a line of Crown-granted mineral claims following the Molly Mac limestone (see p. 21) along the southwest side of Index basin, from Redcliff Peak almost to Gainer Creek. In order from southeast to northwest these claims are the Red Cliff, Index, Royal R., Hidden Treasure, President, and White Quail. The Star Fraction recorded claim lies between the President and White Quail.

Early work on the Index was done before 1914. In 1956 Northern Inland Resources Ltd. had a small crew stripping on the Index and White Quail. A tractor-road was built from the head of the Index basin jeep-road, and some diamond drilling was done that autumn and the following summer.

Workings on the Index claim include a short adit and small inclined shaft driven into opposite sides of a band of the Molly Mac limestone, extensive stripping for 600 feet southeast of the adit, and a caved prospect shaft and two pits 1,200 feet southeast of the adit. On the Hidden Treasure claim a long adit is reported to have been driven in unmineralized rock.

On the Index claim the Molly Mac limestone is in two parallel bands, both dipping steeply southwest. The southwest band forms the core of a small anticline and passes beneath phyllite to the southeast. The northeast band is believed to be a repetition of the limestone on the ascending limb of a dragfold. It is from 50 to 90 feet wide on the Index claim. It is pinched out just southeast of the Index claim, but structural lenses of the limestone occur more or less on strike with it higher in the basin. The limestone is exposed in only two places between the Index and White Quail. Both bands are offset about 50 feet to the left on a fault striking north 75 degrees east and dipping 80 degrees south, 650 feet southeast of the adit. Mineralization has been found only in the northeast band.

The Index showings comprise galena disseminated in siderite which has partly replaced two segments of the northeast band of limestone. One segment extends 1,000 feet from the cross-fault northwest to the end of the outcrop. The second mineralized segment is poorly exposed around the prospect shaft, 400 to 550 feet southeast of the fault. Exposures of limestone immediately southeast of the fault and southeast of the prospect shaft are unaltered and unmineralized. About a foot of galena-bearing quartz has been injected along the fault where it traverses the northeast band. Recent exploration was confined to the larger mineralized segment of the limestone.

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not been found northwest of the basin, but from property descriptions by Emmens it is clear that they are found as far southeast as Brown Creek. Where the rocks are least altered, the massive, medium- to coarse-grained intrusive is readily distinguished from the foliated, fine-grained volcanics and phyllites, but for the most part the volcanics, and to a lesser extent the phyllites, are rather thoroughly replaced by siderite, which is generally massive and coarse grained. The alteration of the intrusive is less than that of the Index rocks, but is sufficient to make the contacts difficult to follow and even in places to mask them entirely. Because of this and because of the talus cover in the Triune basin, the boundary of the intrusives shown on Figure 2 represents the outline of an area in which intrusive rock is found rather than the contact of a single body. The intrusive rocks are medium to dark green in colour where fresh, but are rusty weathering where partly carbonatized. One thin-section consists predominantly of coarse pale-brown pyroxene crystals and of masses of clinozoisite altered from feldspar; a little chlorite and relict feldspar and biotite are present. Another thin-section contains roughly equal amounts of hornblende, feldspar, chlorite, and clinozoisite, with accessory sphene and replacing carbonate. Although alteration precludes precise naming, the rocks are probably diorites.

Along the Tenmile road, 1,400 feet west of Six Mile Creek, a small body of massive dark brownish-grey rock has been intruded along the lower contact of the pyroclastic member of the Broadview formation. The body narrows downward toward Lardeau Creek, and probably pinches out within 200 feet of the road. In the road cut it is 50 feet wide, and it is not exposed to the northwest above the road. The interior is medium grained and massive, but the margins are very fine grained and show banding. In thin-section the rock is a mosaic of albite feldspar, overprinted with isolated thorns and feathery aggregates of biotite; sphene, a black opaque mineral probably magnetite, white mica, chlorite, and quartz are accessory. The rock is a dark syenite.

Acidic intrusive rocks have not been found in the Ferguson area, although dykes and small stocks occur to the northwest on both sides of the Lardeau Valley, and the Kuskanax batholith lies to the southwest. The relative ages of acidic and dark intrusives are not known.

METAMORPHISM AND ALTERATION

Specific studies of metamorphism and alteration have not been made in the present work. Only the most noticeable effects recognized in the field and in a study of representative thin-sections are summarized in the following paragraphs. Although they are strongly deformed and highly sheared, essentially all rocks in the area are in a low grade of regional metamorphism. The non-calcareous rocks contain principally muscovite, chlorite, and quartz. Sedimentary grains are clearly visible in both hand specimen and thin-section. Biotite, apparently related to the composition of the rock rather than to metamorphic grade, is present in tuffaceous rocks of the Jowett formation. Lavas and mafic fragmental rocks in the Jowett and upper part of the Index formation contain epidote, actinolite, chlorite, and minor oligoclase. Pillow structures, amygdules, and breccia fragments are preserved at many places, although these rocks have been completely recrystallized.

On the southeast side of Trout Creek the grade of metamorphism is higher than elsewhere in the map-area. The grade decreases gradually to the north and northwest. Grey grits and quartzitic rocks contain biotite and muscovite in addition to quartz. Disseminated pyrrhotite, partly derived from pyrite, weathers readily and causes many outcrops to be rusty. Calcareous argillites are more or less converted to skarns, the most common of which contain diopside, epidote, and garnet in addi-

tion to quartz and calcite. The dolomite member (see p. 34) is mainly dolomite and does not change noticeably in appearance in passing northwestward out of the zone of relatively high metamorphic grade. The dolomite probably formed by dolomitization of limestone, because irregular masses of apparently unreplaced limestone occur in the dolomite. Whether dolomitization accompanied metamorphism or is related to some other process is uncertain. The volcanic member (see p. 34) between Beaton and Trout Creeks is composed of anhedral epidote and plagioclase and feathered grains of hornblende. Southeast of Trout Creek, on the ridge northwest of Trout Mountain, the volcanic member has the same composition but has been more completely recrystallized; many of the grains are subhedral, and hornblende is in well-formed crystals. Metamorphism southeast of Trout Creek appears to have been dominantly a thermal process involving recrystallization without appreciable deformation. Probably it followed the major period of deformation and may have been associated with intrusion of the Kuskanax batholith. No batholithic rocks are exposed within the map-area, and the main mass of the Kuskanax batholith is several miles to the south.

Silicified rocks and rocks containing vein-like bodies of quartz are found at many places in the map-area. The Badshot limestone on Badshot and Mohican Mountains contains irregular siliceous lenses with a shadowy breccia-like appearance that have probably developed by silicification. Quartz veins are found in limestones in the Milford group and locally in limestones of the Index formation, but replacement of these limestones by silica is uncommon.

Silicification of quartzose rocks is difficult to recognize with assurance. Some beds, notably those in the upper part of the Triune formation, vary in silica content from place to place and may have been partly silicified. Much of the Triune formation is a thin-bedded dark-grey siliceous rock in which detrital quartz grains are distinguishable in thin-section. Near Five Mile Creek and on the eastern side of the Triune basin the formation is a hard, dark bluish-grey rock resembling chert and may have formed in part by silicification. Along some veins, particularly in the Nettie L mine, a form of silicification has taken place. Folia from 1 to 3 inches thick resemble beds of normal grit or argillite on foliation and joint surfaces, but are found to contain lenses of massive grey quartz. Vein-like bodies and masses of white quartz, called formation quartz by prospectors, are common in the Broadview and parts of the Index formations, and are abundant in the Ajax quartzite. Whether this quartz is to be regarded as a product of silicification will depend on how broadly the term is defined. It is thought likely that much of the quartz is derived from the formation in which it occurs, either by recrystallization with expulsion of impurities or in a more mobile form, such as a vein-forming fluid.

Bleaching has affected field recognition of some carbonaceous rocks. Limestones in the Index formation, where highly sheared, as along contacts with phyllitic rocks, are bleached and recrystallized to white marble. Banding in the limestones has probably been accentuated by bleaching during deformation. Variations in the apparent stratigraphy of the Index formation may be caused in part by bleaching of dark-grey phyllites to light-grey or green phyllites.

Siderite has replaced rocks of the Index formation extensively and parts of the Triune and Jowett formations locally. The rusty-weathering characteristic of the siderite makes sideritized rocks show up in the distance and has attracted the attention of prospectors. In the Index formation the uppermost volcanic member has been extensively altered, producing rusty cliffs on the south sides of the Index and Bunker Hill basins. The altered rocks contain principally chlorite and siderite, and primary structures are largely obscured. The Lade Peak limestone contains lenses

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