

LEGEND

- CENOZOIC**
- TERTIARY**
MIOCENE(?)
11 Basalt, olivine basalt
- PALEOCENE OR EOCENE**
PHOENIX VOLCANIC GROUP
10 Andesite, trachyte, minor basalt; locally, interbedded tuff, shale, and/or siltstone
9 KETTLE RIVER FORMATION: rhyolite and dacite tuff; locally, conglomerate, sandstone, and shale; minor rhyolite flows and intrusive porphyritic rhyolite
- PALEOCENE(?)**
8 CORYELL INTRUSIONS: syenite, monzonite, shonkinite and granite
- MESOZOIC**
- CRETACEOUS(?)**
LOWER CRETACEOUS(?)
7 VALHALLA INTRUSIONS: granite, porphyritic granite
6 NELSON INTRUSIONS: granodiorite, porphyritic granite; diorite, monzonite, quartz monzonite
5 Ultrabasic intrusions, serpentinite
- JURASSIC**
ROSSLAND GROUP
4 Andesite, latite; agglomerate and flow breccia; minor greywacke
- PALAEZOIC**
- PERMIAN(?)**
ANARCHIST GROUP
3 Greenstone, greywacke, limestone; paragneiss
- PENNSYLVANIAN AND/OR PERMIAN**
2 MOUNT ROBERTS FORMATION: greywacke, greenstone, limestone; paragneiss
- PROTEROZOIC (?)**
1 MONASHEE AND GRAND FORKS GROUPS
Paragneiss; minor crystalline limestone and pegmatite

Drift-covered area
Geological boundary (defined approximate)
Bedding (inclined, overturned)
Bedding (inclined, vertical; tops unknown)
Gneissosity (inclined, vertical)
Fault (defined, approximate, assumed)
Fossil locality
Mineral property

INDEX TO MINERAL PROPERTIES

1. Waterloo (Paycheck Mining and Development Company Limited)
2. Mountain Chief (Renata Copper Company, Limited)
3. W. S. (Cascade Lode Mines, Limited)
4. Ore Denoro (Noranda Exploration Company, Limited)
5. Snowshoe and Old Ironsides (Phoenix Copper, Limited)
6. Stenwinder (Columbia Copperfield Mines, Limited)
7. Providence (W. Madden)
8. Gold Bug and D. A. (E. Ruzicka)
9. Greyhound (Salamat Mines Limited)
10. Mother Lode (Woodgreen Copper Limited)
11. Copper Queen (Aztec Exploration Limited)

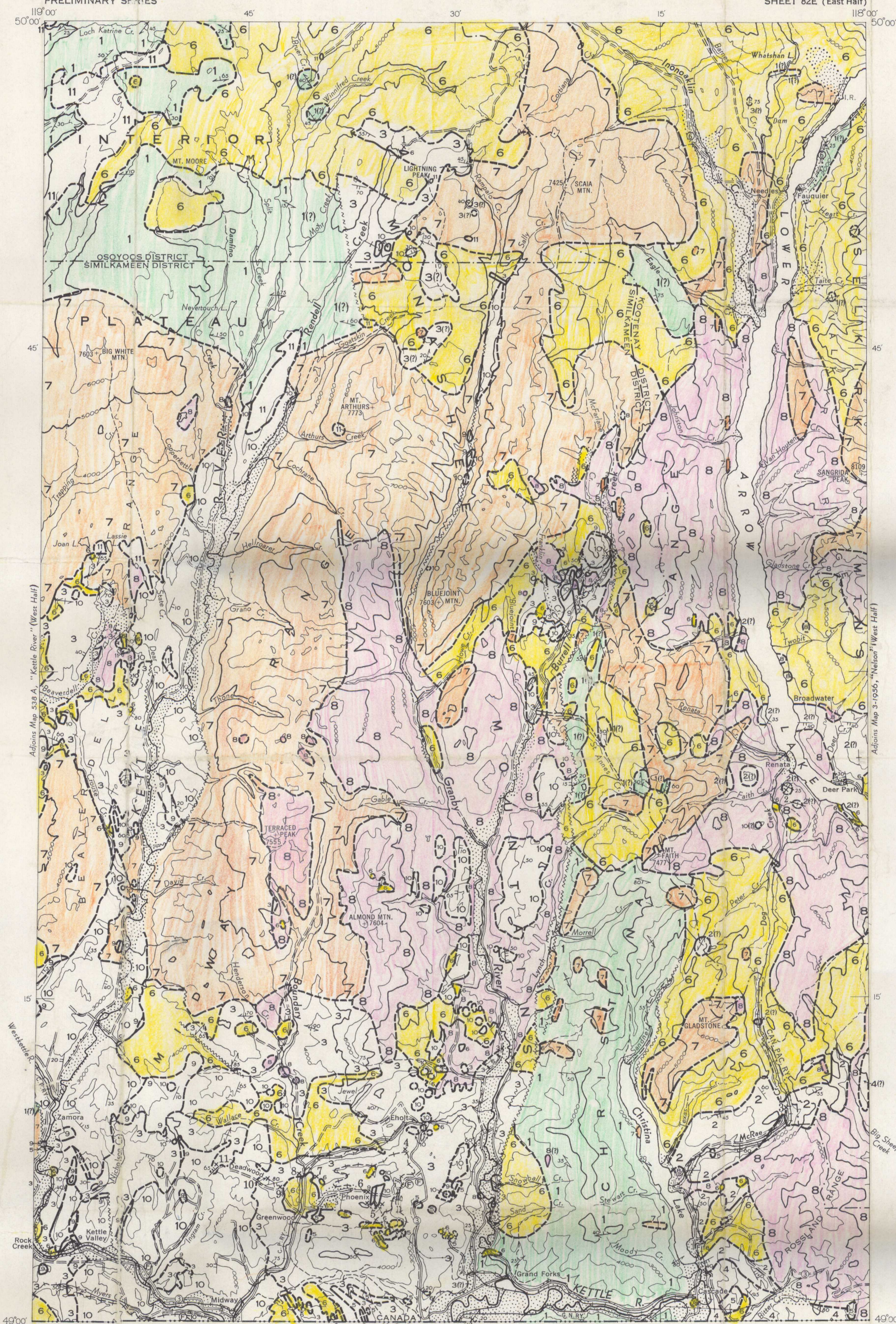
Geology by H. W. Little, 1953-1956

Cartography by the Geological Cartography Unit, 1957

Approximate magnetic declination, 22° 30' East

In response to public demand for earlier publication, Preliminary Series maps are now being issued in this simplified form, thereby effecting a substantial saving in time. There is no loss of information, but the maps will be clearer to read if all or some of the map-units are hand-coloured.

Air photographs covering this area may be obtained through the National Air Photographic Library, Topographical Survey, Ottawa, Ontario



DESCRIPTIVE NOTES

The oldest rocks within the map-area, the Monashee and Grand Forks groups (1), occur in the northwest and south-central parts, and may include some roof pendants of gneiss in other parts. They comprise paragneisses of pre-Pennsylvanian, presumably Precambrian age. Although their relationship to the younger strata is not seen within the area, to the north they underlie Permian rocks unconformably.

Rocks of the Mount Roberts formation (2) may occur in the east-central part of the map-area as well as where shown in the southeast. Fossils, probably Pennsylvanian age, were found in them at Puterson, to the east of the map-area, but south of the International Boundary similar rocks are classed as Permian. The Anarchist group (3), restricted mainly to the west part of the map-area, is probably, at least in part, equivalent to the Mount Roberts formation (2), and near Phoenix contains fossils believed to be Permian. A few miles south of the International Boundary, however, a collection of Triassic fossils has been reported, and beds of this age may be included with those mapped as Anarchist group (3).

Volcanic rocks of the Rossland group (4), mainly or entirely of Jurassic age, occur along the International Boundary southeast of Christina Lake, and may be intimately mixed with rocks of the Mount Roberts formation (2) in McRae Creek Valley. Rocks exposed on the ridge east of Big Sheep Creek are tentatively assigned to the Rossland group (4).

Serpentinized ultrabasic bodies (5) intrude the rocks of Late Paleozoic to Jurassic age, and are in turn cut by granodiorite and related rocks of the Nelson intrusions (6). Non-porphyrific granodiorite is the dominant phase of the Nelson intrusions (6), but a porphyritic granite phase is common in the northeast part of the map-area and near Mount Gladstone. In those localities Valhalla granite (7) is mainly gradational into the Nelson intrusions (6), but elsewhere cuts them. Except in the western part of the area where it commonly contains large phenocrysts of microperthite, the Valhalla granite (7) is non-porphyrific. It may be distinguished from the Nelson by the presence of smoky quartz, the rarity of hornblende, and an allotropic texture, in contrast to the Nelson which is usually hypidiomorphic. The age of the Nelson and Valhalla intrusions is between latest Jurassic and middle Cretaceous.

Batholiths, of reddish to pale buff Coryell syenite (8) that grades locally into granite or shonkinite, are widespread. Some of the smaller bodies of Coryell intrusions (8) are composed of augite monzonite and one is of olivine syenite. The Coryell intrusions (8) cut all the above rocks as well as a conglomerate of Upper Cretaceous or later age that occurs to the east of the map-area.

The Kettle River formation (9) consists of acidic tuff, and local basins of conglomerate and sandstone. In the conglomerate the roundstones consist for the most part of rocks of the underlying formations exposed in the vicinity. In Franklin camp a little rhyolite is interbedded with acidic tuff and sandstone. In the southwest part of the map-area small plugs of porphyritic rhyolite with quartz phenocrysts apparently mark the vents from which some of the acidic tuff was emitted.

The Phoenix volcanic group (10) overlies the Kettle River formation with apparent unconformity, for in many places it lies directly upon older formations. It consists mainly of andesitic and trachytic lavas, but locally contains interbedded sediments. A few miles east of the mouth of Burrill Creek siltstones occur in the group, and along Kettle River Valley west of Midway tuffs and shales are well exposed in road- and railway-cuts. From the latter localities fossil plants of Paleocene or Eocene age were collected.

In the northwest part of the map-area extensive flat-lying flows of basalt and olivine basalt (11), commonly with columnar structure, rest upon all older formations. These basic lavas are correlated with those of Columbia Plateau, and are probably of Miocene age.

The drift consists of fluvial clay, sand, and gravel of Pleistocene and later age, and Pleistocene till that extends to great elevations. Glacial striae were observed as high as 6,000 feet above sea-level, but some of the higher peaks appear to have escaped continental glaciation. The ice movement was in general southerly.

All formations except the Miocene (?) have been folded, the Proterozoic (?) having experienced the most intense deformation. The main north-south valleys, those of Dog and upper McRae Creeks, Sandner Creek and Christina Lake, lower Granby River and Burrill Creek, upper Granby River, and Kettle River northward from Rock Creek, contain strong shear zones that were initiated after the intrusion of the Nelson batholith. Subsequent movement on these faults has sheared rocks of the Phoenix volcanic group. The most clearly defined faults occur in the Christina Lake-Sandner Creek and lower Granby River-Burrill Creek valleys. Between these major faults a large block of Proterozoic (?) gneiss has been uplifted relative to the younger rocks.

Mining activity reached its peak during the early part of the present century when some 22 million tons of copper ore containing gold and silver were mined in the Phoenix and Deadwood camps. This ore supplied smelters at Grand Forks, Greenwood, and Boundary Falls. Current activity is mainly centred about the old productive copper properties, but none had reached a stage of continuous production in 1956.

These copper deposits (Ore Denoro, Snowshoe, Old Ironsides, Stenwinder, Greyhound, Mother Lode, and others) are large, irregular replacement bodies containing chalcocopyrite, pyrite, and magnetite in skarn formed by the metamorphism of limestone of the Anarchist group. This limestone is known locally as the Brooklyn formation. The Copper Queen copper deposit, on the other hand, consists of a vein (or veins) that occurs in an oxidized shear zone in crystalline limestone. Cupiferous sulphides have been oxidized to azurite and malachite, with limonite.

Gold and silver are the chief products of the Gold Bug property. Recent exploration has been devoted to the search for the continuation of the south vein beyond a dyke, against which it terminated. The Providence mine, which has operated intermittently since 1893, produces mainly silver and gold. The vein, which has been extensively explored, lies in altered argillaceous and volcanic rocks and in granodiorite. Ore minerals are gold, silver, proustite, tetrahedrite (?), sphalerite, and galena, with some pyrite and chalcocopyrite.

The W. S. is primarily a silver-lead mine. The deposit consists of a main vein, with branch veins, that occurs in crystalline limestone of the Mount Roberts formation (2). The Mountain Chief copper deposit is in limestone within a huge roof pendant surrounded by Coryell syenite (8). Within the silicified limestone, chalcocopyrite and pyrite occur, with malachite, azurite, and chalcocite (?).

The Waterloo vein is in a shear zone mainly in crystalline limestone. The vein varies in width along the strike for about 800 feet, and averages about 4 feet wide. It consists of quartz and carbonate with silver, argente, ruby silver, stephanite, tetrahedrite, galena, and sphalerite.

MAP 6-1957

KETTLE RIVER
(EAST HALF)
SIMILKAMEEN, KOOTENAY
AND OSOYOOS DISTRICTS
BRITISH COLUMBIA

Scale: One Inch to Four Miles = $\frac{1}{253,440}$

0 2 4 8 12 Miles

LEGEND

- Main highway
Other roads
Trail
Abandoned railway
International boundary
District boundary
Power transmission line
Intermittent stream
Contours (interval 1000 feet)
Height in feet above mean sea-level

MAP 6-1957
KETTLE RIVER
BRITISH COLUMBIA
SHEET 82E (East Half)



REC'D SEP 3 - 1957