Geological Survey of Canada
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EXPLANATORY NOTES.

SUPERFICIAL GEOLOGY

This map relates entirely to fundamental geology. Superficial deposits consist inglargely of resorted glacial material and local drift are of merely limited occurrence At points in the larger valleys, where the conditions have been exceptionally favorable to their preservation, terraces are found consisting of silts, sand, gravel and other resorted glacial material. The majority of these terraces have an elevation of less than 2,500 feet above sea, although they occasionally extend to the 5,000 foot level. Boulder clay was recognized at a few points in the Columbia valley and brick clays in the Columbia and Kootenay valleys.

TERTIARY VOLCANIC AND FRAGMENTAL ROCKS.

The Tertiary rocks of subaerial origin consist largely of andesites, basalts and other varieties of volcanic rocks which occur as heavy flows, together with their corresponding agglomerates and tuffs. Sometimes the lavas are amygdaloidal with chalcedony or zeolites in the vesicles. This series is no doubt identical with the Tertiary volcanic rocks of Miocene age of the Kamloops and Shuswap map-sheets and to the similar rocks of the Okanagan and Boundary Creek districts. Underlying these volcanic rocks, sometimes interbanded with tuffs, are beds of coarse conglomerates with, occasionally, sandstone and shales. The latter in some places, contain plant remains. The medium to coarse-grained reddish-weathering conglomerates of Lake and Sophie Mts., while no longer capped by volcanic flows, are probably remnants of the same series, which have escaped the erosion that has removed a once extensive mantle of these Tertiary rocks. The coarse conglomerate were, in all probability, originally river gravels. Similar conglomerates and sandstones (Coldwater Group), underlying the volcanic rocks of the Kamloops and Shuswap districts are believed to be of Oligocene age.

No ores have been found in the volcanic rocks but the conglomerates of Sophie Mt. have been mineralized along an alkali porphyry dyke. The process of mineralization may be seen, approaching the dyke, in all stages, from unaltered conglomerate to solid ore.

BEAVER MOUNTAIN VOLCANIC GROUP

These rocks consist of beds of andesites, tuffs and ash-rocks, which overlie the surrounding Rossland volcanics. Their age is not definitely known, they appear to be comparatively recent. They lack the underlying conglomerates of the Tertiary volcanics and also differ from them lithologically. The andesites of Record and Old Glory Mts. may be of the same age, though these have not been differentiated from the Rossland volcanics on the map. The Beaver Mountain volcanic rocks are occasionally mineralized to some extent.

ROSLAND VOLCANIC GROUP

This series includes a great number of massive and brecciated volcanic and pyroclastic rocks of different ages. The principal varieties represented are :— Augite-porphyrite augite and hornblende-andesites, fine-grained diabases, augite-porphyrite agglomerates, tuffs and ash-rocks with some bands of slate and limestone.

The augite-porphyrite is often squeezed into a green schistose rock. The agglomerates and tuffs are sometimes squeezed fine-grained dark or green slates or medium-grained greenish rocks, usually indistinctly foliated. Coarse agglomerates occasionally carry large angular fragments of quartzite, slate, limestone, etc. Where the limestone-bearing agglomerate is squeezed, or where dykes of the greenstone cut the limestone and the mass has been subjected to pressure, a pseudo-conglomerate results, due to the balling of the limestone under pressure. Pseudo-conglomerates may also result from the metamorphism of the limestone along reticulating lines. On Sophie Mt., small bands of coral-bearing limestone are associated with the agglomerates. The corals are poorly preserved, but are probably referable to the Carboniferous genus ***Lonsdalia***. These augite-porphyritic agglomerates and tuffs are therefore about Carboniferous in age. All the plutonic rocks described below are intrusive in them.

The andesite masses of Old Glory and Record Mts. and the andesite dykes about Rossland are undoubtedly younger than the augite-porphyrite and tuffs, though older and cut by the Rossland alkali-syenite. They may be of the same age as the Beaver Mt. volcanic group. The Rossland volcanics are often highly mineralized, being the country-rock of many of the mines, particularly in the Rossland and Nelson districts.

SLOCAN SERIES

This series consists of dark carbonaceous argillites, dark limestones (often impure), quartzites and greywackes together with beds of tuffs and ash. Only an obscure fossil has been found in these rocks which are, in all likelihood, Upper Palæozoic, probably Carboniferous. They are mostly thin-bedded and fissile, and where the conditions were favorable seem to have been particularly susceptible to mineralization, forming the country-rock of a large part of the highly productive silver-lead mines of the Slocan district.

CACHE CREEK SERIES

A small area of Cache Creek rocks, consisting of dark argillites, greywackes, quartzites, limestones, with some eruptive material, extends into the northwest corner of the sheet from the Shuswap district. This formation has been determined by fossiliferous evidence in the Shuswap district to be of Carboniferous age and auriferous quartz veins have been found in it. As it is separated from the Slocan series by eruptive rocks, its relationship to the latter could not be determined.

UPPER SELKIRK SERIES

This series consists of a great volume of quartzose micaschists, ranging from quartzites holding a few grains of mica, arranged parallel to the bedding, to well developed micaschists. Crystals of cyanite and andalusite were found in a coarse biotite-micaschist belonging to this series.

LOWER SELKIRK SERIES

This complex set of rocks consists of alternating bands of colored schists, heavily-bedded quartzites, hard conglomerates, dolomites, dolomite-conglomerates or pseudo-conglomerates and massive diabases. They are sometimes mineralized, especially in the northern part of the district. The Selkirk series is thought to be Cambrian.

NISCONLITH SERIES

This series which is supposed to be of lower Cambrian age, consists essentially of dark-colored slates, phyllites, and schists, usually somewhat silicious and frequently showing, on cross-section, numerous fine lines due to the separation of the lamellæ by thin quartz films. They are frequently altered near contacts with intrusive rocks to mica, andalusite and staurolite-schists. Bands of colored schists, quartzites and white crystalline limestones also occur in this series. Some of the limestones are sufficiently pure to yield good lime and the rocks are mineralized in places.

This subdivision into Selkirk and Nisconlith series has been made on purely lithological grounds and upon resemblances to rocks along the main line of the C.P Ry. as worked out by Dawson and McConnell. It is possible that the section in the map-sheet has been reversed and that the chronological sequence of the rocks here called Upper and Lower Selkirk and Nisconlith, is the opposite of that given. The fact that old-looking eruptions were found in the Upper Selkirk series that were not observed in the other two series lends color to such a view. But in the absence of more detailed work to determine this point the above nomenclature and correlation is provisionally adopted.

SHUSWAP SERIES

This series consists of gray gneisses, micaschists, crystalline limestones and dolomites with intercalated crushed and altered granites and diorites. Some of the crystalline schists grouped in the series may prove to be highly metamorphosed members of the Palæozoic formations occuring in this district. They are tentatively classed as Shuswap (Archæan) on account of their associations, position and lithological characters. This series is mineralized in certain localities; and some of the limestones are suitable for use as fluxes and ornamental stones.

All the rocks described above with possible exception of the Tertiary eruptives are frequently cut by dykes or bosses of the plutonic rocks.

ROSSLAND ALKALI-GRANITIC ROCKS

The commonest rock included under this heading is a reddish to pink granitic rock, in which glassy pink and some greyish feldspar are the most conspicuous constituents. The dark constituents, while very noticeable on account of contrast in color, are present in subordinate amount. Its principal constituents are orthoclase, microperthite, albite, perhaps anorthoclase, sometimes quartz, sodalite and probably other felspathoid minerals, biotite, hornblende, diopside, magnetite, apatite, zircon, titanite and orthite. The alkalis form 12% of the rock. The rock shows a number of facies from granititic to probably essexitic types, but an alkali-syenite or pulaskite type is the commonest. Near Lake Mt., Waneta, and on Pend d'Oreille, are bosses of a light aplite-like alkali-granite. These rocks dyke all the other sedimentary and eruptive rocks. Their relationship to the Tertiary volcanics has not been satisfactorily proven but it appears as if they might be closely connected. A genetic relationship exists between them and the Tertiary volcanics of the Boundary Creek district. The dykes from these rocks include granite and syenite-porphyries, granophyres, quartz-porphyries, etc. Younger than these "light" dykes are dark lamprophyric ones including fourchites, camptonites, monchiquites, and mica-lamprophyres. These are probably the complementary basic dykes connected with this eruption. The light dykes often yield gold upon panning or assaying. In a dyke at the head of Deer creek, free gold occurring as an original constituent is visible to the naked eye. Their particular economic interest lies in the fact that it is in the districts which are much dyked by these rocks that the chief mineralization occurs, and that in the districts where no such dykes are found, similar mineralization has not been observed. Most of the light-coloured dykes have been formed immediately prior to the ore while the dark ones cut, and, to some extent, fault the ore-bodies. These rocks are of Tertiary age.

VALHALLA GRANITE

This is a medium-grained, light-colored, very quartzose granite. The felspars are orthochase, microcline and plagioclase (albite to andesite). Micro-granitic intergrowth of quartz and felspar are common. Green biotite and hornblende are the coloured constituents. Apatite, titantite, orthite, zircon, and iron ore are common Near Gladstone Mt. it is a typical granodiorite. Here a column of basic felspar often forms the core of a hornblendic prism. Aplite, pegmatite and odenite dykes accompanied its intrusion. It is older than the Rossland alkali-granitic rocks, but newer than the other plutonics. It has largely escaped mineralization.

MONZONITES

These are medium to coarse-grained, somewhat porphyritic mottled rocks, characterized in hand specimens by dark pyroxene, dark brown mica and white or grey felspar. The rock microscopically resembles a gabbro, into which it often passes. The rock represented as monzonite, south of McRae creek, is very basic and the potash felspar has almost or quite disappeared. This rock may not belong to the Rossland monzonite intrusion. The monzonites are newer than the Rossland volcanic group. Some dykes of monzonite cut the Nelson granite, but the main mass of the latter may be newer.

In the Rossland area, the monzonites are mineralized by gold and copper-bearing pyritic ores.

NELSON GRANITE

The Nelson granite is a fine to very coarse-grained rock of a mottled greenish grey color, though pink shades are occasionally found. It is often coarsely porphyritic. Microcline, microperthite orthoclase, albite, oligoclase, biotite, hornblende and diopside are the principal constituents. The alkali content reaches 9.5%, lime 3.4%, and magnesia 1.1%. The rock holds about the same relationship to the granites that monzonite does to the syenites. At times it becomes almost monzonitic and some facies are rather dioritic. It is often squeezed to an "augen" gneiss or to gneises closely resembling those of the Shuswap series. Where Shuswap-gneisses occur with this granite-gneiss it is impossible to show them separately on the map. Shear-zones are frequent in this rock as bands of lustrous micaschists or fine-grained light and dark gneiss-like bands. Porphyry and pegmatite dykes from this granite cut the older rocks. In age this rock is probably at least Post-Jurassic.

All of the above plutonics are intrusive. Points along their contacts which are rich in inclusions of the older rocks are specially indicated on the map.

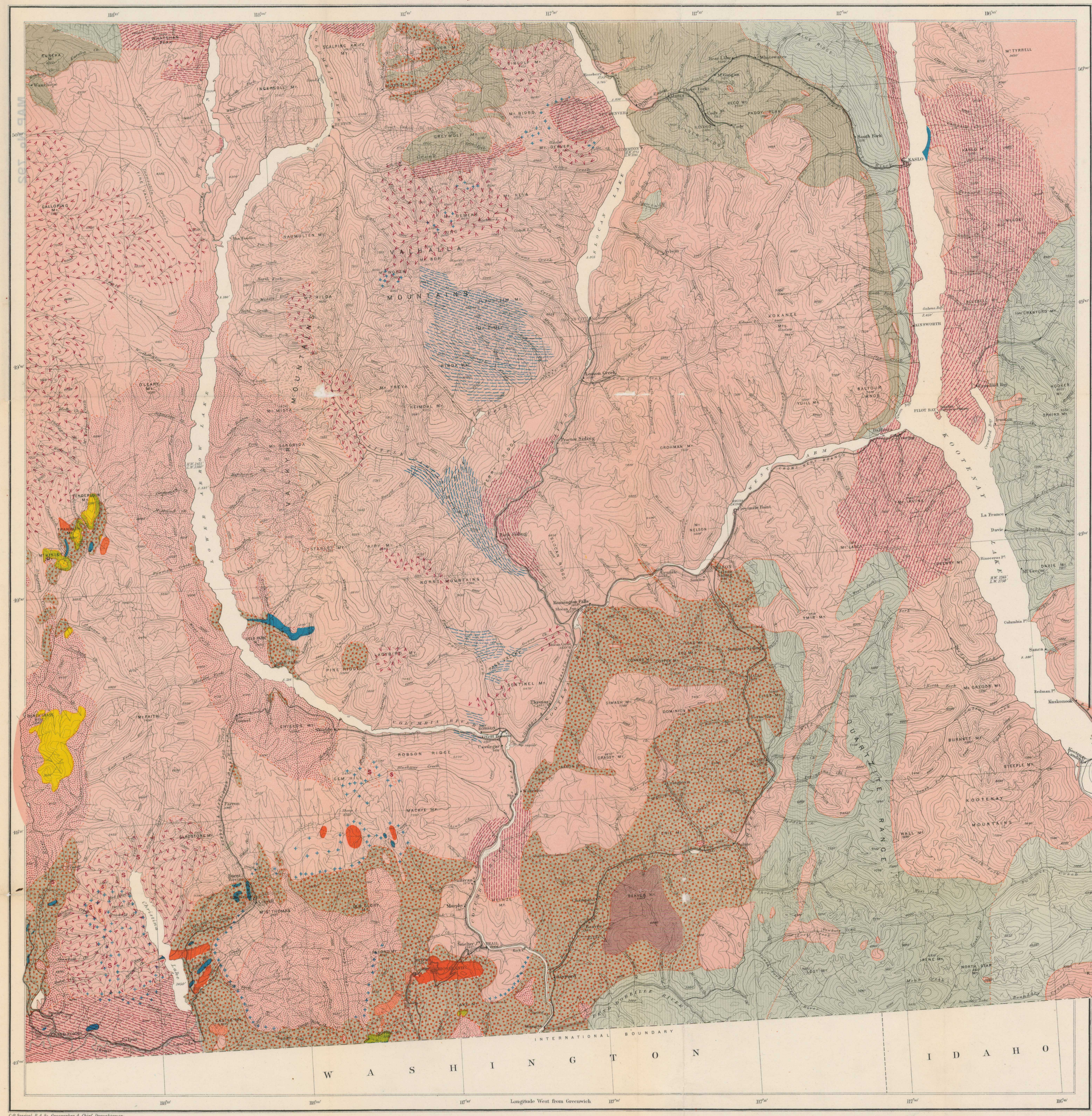
SERPENTINES

The rocks included under this heading are completely serpentinized in places, but over a great part of the area the alteration to serpentine is incomplete, and the parent mass is recognizable as a basic igneous rock. The matrix of the agglomerates in Sophie Mt. and other places, shows partial serpentinization in spots. On Castle Mt. the Serpentine possesses a fine color and is almost solid enough to be used as an ornamental stone. The serpentines are mineralized in places.

The oldest igneous rocks found in the district are the lime-akali-granite and diorite intercalated in the Shuswap rocks, with which they have been mapped. They are usually much squeezed, the granite then forming a gneiss and the diorite an amphibolite-schist. They have not been observed to cut any of the formations younger than those represented as Shuswap.

ORES

From what has been said, it will be seen that all the rocks except the Tertiary volcanics, the Rossland and the Valhalla granites, are more or less mineral-bearing, and that the Rossland granitic rocks are themselves to some extent auriferous: that these older rocks are mineralized in areas of recent vulcanism, manifested by heavy dyking by Tertiary intrusives, the extent of mineralization being influenced more or less by the physical characters of the country-rock. The chemical constitution of the country-rock seems to have had but minor influence in determining the extent of the mineralization, though differences in the degree of solubility of the component minerals have sometimes affected the degree of concentration of the ores. Most of the ores occur in composite shear-zone or replacement veins. These are among the commonest types of fissure veins in Western America. The mineral-bearing solutions followed fissures or zones of fissures, and from these highways, replaced wholly or partially the neighboring country-rock. Often only "commercial" walls are present, but sometimes clear-cut walls appear to exist, though often, in such cases, a parallel ore-body may lie only a short distance away and not infrequently such walls are merely slips later than the ore-bodies. The ore usually occurs in the veins in the form of shoots. In the Rossland district the ores are principally pyrrhotite and chalcopyrite with some pyrite, mispickel and molybdenite. A little galena and blende, gerdorfite and free gold are occasionally met with. The gangue is usually altered country-rock with some quartz and calcite. In the Slocan, the ores are largely argentiferous galena and tetrahedrite sometimes with native silver sulphides. Calcite, quartz, siderite and zincblende are common as gangue minerals. Argentiferous copper ores are found on Toad Mt., and auriferous silver lead ores occur about Ymir. Besides the "wet" ores, "dry" silver and gold ores are mined in the Slocan, frequently in the Nelson granite. These quartz veins are usually narrow and often have definite walls. Auriferous quartz veins, containing some sulphides, also occur near Nelson, on Sheep creek and near Rossland. The mineral occurrences in the different districts are shown on the topographical edition of this sheet.



Explanation of Colours and Signs

Volcanic and Sedimentary

- Volcanic Group. — Tertiary.
- Sedimentary Group. (Coldwater ?) — Tertiary.
- Beaver Mountain Volcanic Group. — Post-Cretaceous.
- Rossland Volcanic Group. — Carboniferous and Post-Carboniferous.
- Cache Creek Series. — Upper or Middle Palæozoic (Carboniferous, in part.)
- Slocan Series. — Upper or Middle Palæozoic (Carboniferous, in part.)
- Selkirk Series Upper? — Cambro-Silurian, Cambrian
- Selkirk Series. Lower. — Cambro-Silurian, Cambrian
- Nisconlith Series. — Lower Cambrian.
- Shuswap Series. — Crystalline Archæan.
- Limestone.

Plutonic

- Rossland Alkali-granite and Syenite. — Tertiary.
- Valhalla Granite. — Post-Cretaceous.
- Monzonites. — Post-Jurassic (?)
- Nelson Granite. — Post-Jurassic (?)
- Nelson Gneiss. — Post-Jurassic (?)
- Serpentine. — Palæozoic.
- Rich in inclusions.
- Geological boundaries.
- ditto Undefined.
- Roads
- Pack-trails
- 6000' Altitudes in feet above sea-level
- s.380' Soundings in feet
- Contours, 500 feet vertical interval

Sources of geological information

The geological boundaries on this map-sheet have been laid down by R.G. McConnell, B.A. and R.W. Brock, M.A.; those in the area between Slocan and Kootenay lakes, in the areas about Nelson, between Beaver creek and the Columbia river, east of Kootenay lake south of Crawford bay, and the district covered by the Trail creek map are principally from Mr. McConnell's work.

The boundaries in the country between Salmon river, Beaver creek and Kootenay lake, and those in the district east of Kootenay lake and north of Crawford bay have been taken from their joint work.

The remainder has been geologically surveyed by Mr. Brock.

The marginal notes have also been written by Mr. Brock.

BRITISH COLUMBIA
WEST KOOTENAY SHEET

GEOLOGICALLY COLOURED BY

R. G. McConnell, B.A.

and

R. W. Brock, M.A.

Scale 4 Statute Miles to 1 Inch = 1/253,440

0 5 10 15

Geographical and topographical data

Railways from plans of surveys fyled at the Department of Railways & Canals, Ottawa, and at the Department of Lands & Works, Victoria. Topographical features in the Nelson district from the topographical map issued by the Department of Lands & Works, Victoria.

Apart from the above sources of information, the geographical and topographical outlines depend upon triangulation, surveys and sketches by J. McEvoy, B.A. Sc., W. W. Leach, B.A. Sc., and H.Y. Russel, B.A. Sc., of the Geological Survey.

Compilation by J. McEvoy and W. W. Leach.

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