

GEOLOGY OF TRAIL

Summary Report of the Dominion Geological Survey.

GABBROS AND ORE BODIES

McCConnell's Views as to the Relation of the Rocks to Ore Bearing Veins—Replacement Veins Equally Permanent With True Fissures.

During the past year very notable progress has been made in the development of the mineral resources of Canada, both in the way of actual work and in attracting the attention and interest of capital. British Columbia has begun to evidence its value as a permanent producer of the precious metals, in a manner long foreseen by those who have paid attention to its geological structure and position. In Ontario, wherever the Huronian system is developed and has been examined, valuable mines—more particularly those of gold—are being discovered and opened up. In Nova Scotia renewed interest has been shown in gold mining, and with improved machinery and methods the output is likely soon to be greatly increased. Other mineral industries throughout the country, whether already established or in course of development, share in general appreciation.

In British Columbia the supplementary work necessary to complete the topographical and geological information for the Shuswap map-sheet was completed. A small, rugged, mountainous country in the northeast corner of this sheet was left unexplored, as it was thought to be more important for Mr. McElroy to join Mr. McConnell in the mapping of the West Kootenay. Mr. G. McConnell geologically investigated a tract of country to the south of Sloan and Alouette, including the Treadwell, Toad Mountain, Kossland, and Trail mining centres. As already stated, the region generally is divided between the granitic and gabbroic rocks, largely of volcanic origin, and granitic rocks, largely of plutonic origin. Fossils, believed to be of Carboniferous age, were found in some parts of the stratified series. The gabbros occur in association with an eruptive mass of gabbro, about four miles long by one in width, and the definition of its importance, as the principal ore bodies appear on or about its periphery. It is proposed to prepare, as soon as possible, a preliminary geological map of that part of the West Kootenay district which has already been covered.

McCConnell's Report.

The following are extracts from the report of R. G. McConnell:

"The region examined forms part of the southern continuation of the Selkirk range, and is everywhere a rugged and mountainous character. It is traversed by several large and deep valleys running in different directions, the principal ones being those of the Columbia river, the Stikine, the Slokan, the Beaver and the Salmon. Draining into these are numberless small streams, usually of no great length, which rise in the higher peaks and summits and descend through the country in a westerly or southwesterly direction. The present rough condition of the country is mainly due to the slow but persistent wearing action of their present courses, on rocks of differing hardness, the processes having continued long enough to obliterate all traces of the earlier configuration. "The most prominent range south of the Kootenay mountains is the Selkirk range, which extends westward from the head of the Columbia river, an apparently endless succession of deep branching valleys and lofty ridges crowned at intervals with sharp peaks and crests, are everywhere met with. "The whole country, or rather has been, covered with heavy forests, for since mining operations began, destructive fires have razed away summer after summer large areas, principally coniferous, but is relieved by a few broad-leaved trees.

Geology of the District.

"The most notable feature in the geology of the district examined, is the marked predominance of rocks of igneous origin. Two great series are represented, of which the older consists mostly of porphyries, diabases, gabbros, tuffs and agglomerates, and the younger of granites. "The granites belong to the same mass so largely developed in the country north of Kootenay and outlined in my summary last year. The normal type is a medium-grained, pinkish granite, consisting mostly of biotite, hornblende, quartz, orthoclase and plagioclase; but great variations in both texture and composition are frequent. In places and over considerable areas the development of a typical augen-granite, with variations in the proportion of its constituents the granite passes into hornblende-granite, granodiorite and mica-syenite. The latter, cut by dykes from the more acidic varieties occurs largely along the Kootenay river west of Nelson.

"The granites, except for some small outliers of schists, are found in their various phases all along the Kootenay river, from the Columbia to near the mouth of Bear creek. The southern part of the area crosses the Columbia and extends south for some distance along Lookout mountain ridge, and thence westward from Lookout mountain north to China creek, the granites occur in a band from one to two miles in width, following the river and extending occasionally spurs to the west, one of which partly encircles the Kootenay-Columbia and another extends westward beyond the edge of the latter stream in a narrow area of gabbro and granite extending in an irregular-shaped mass from three to ten miles in width northward to Hall creek. Besides the main granitic area, numerous bosses and reefs of granite, evidently of the same age, break through the older rocks throughout the district. The largest of these crosses the Nelson & Fort Sheppard railway near Salmon siding and extends eastward into the still unknown country between the Salmon and Kootenay rivers.

Porphyries and Associated Rocks.

"The older system of predominantly porphyritic rocks, through which the gray granitic breaks, occurs under so many forms and in such different degrees of preservation that it is highly probable that the rocks of the series is a greenish augite porphyry often passing into a porphyrite. The ground mass of this rock is usually diabasic, and in many places the augite crystals of the porphyry disappear and it passes into a fine-grained diabase. The porphyrites, while often massive and uniform in texture and appearance, usually show a more or less brecciated structure on weathered surfaces. The embedded fragments and the groundmass, except for slight differences in coloration, appear microscopically almost identical. Besides the augite porphyrites and diabases, massive eruptive rocks are also represented by gabbros, small areas of which are to be seen on the north fork of the Salmon, and by the grayish porphyrites with plagioclase phenocrysts of Toad Mountain and Spokane mountains. Fragmental volcanic rocks, consisting of tuffs and agglomerates occur on the ridges south of Spokane mountains and also on the ridges south of Lake and Bald mountains and in other places in the district. The agglomerates are calcareous in places and are interbedded occasionally with bands of fossiliferous limestone. The fossils, collected are imperfectly preserved, but are probably Carboniferous in age.

"Slates and Dykes. "The eruptive series of rocks include bands and patches of dark fissile slates, which appear in most cases to be residual portions of the formations and which the igneous rocks were erupted from. The slates, which are a few feet or more in thickness, can be traced for any distance along the strike. Slates holding small

limestone bands occur on Hall creek, on the north fork of the Salmon, on Trail creek and in other places. "The granites and other rocks of the district are cut by numerous dykes and bosses, most of which belong to about the same period, but showing extreme variations in texture and composition. Specimens showing a range of colors, from a dark basic one, and from a microcrystalline to a coarse granitic condition. "The distribution of the various members of the eruptive series is extremely irregular, and owing to the large proportion of the surface being covered by drift and forests, and the limited time at our disposal, it was found impossible in many cases to trace out junctions except in an approximate manner. A brief statement of the distribution and character of this group so far as known will, however, be given, so far as economic interest, inasmuch as it contains the gold-bearing porphyritic ores which have made the district famous. The principal rocks of the series are now being examined microscopically by Mr. Ferrier, and some of the names given may be altered when his investigation is completed.

Distribution of Gabbros.

"At Rossland, the central member of the group is a fine to coarse-grained gabbro, apparently passing in a couple of places into a uraltic granite. The gabbros occupy an irregular-shaped area with a length of about four miles and a width of one mile. They extend from Deer Park mountain eastward to the westward base of Lookout mountain and bordering porphyrites, commencing at the northwest corner of the area, runs south through the Cliff, War Eagle, and Koi claims, then turning to the west, circles around a spur from the main area which covers the base of Deer Park mountain and extends eastward in a sinuous line, passing about a quarter of a mile north of the Crown Point and the foot of the west slope of Lookout mountain. The northern edge of the area runs from the Cliff mine eastward to the Spokane mountains, then bends more to the south, skirting the southern base of the Kootenay-Columbia mountains. "The gabbros are a southerly direction towards Lookout mountain. The eastern edge of the area has not been precisely defined owing to the absence of surface exposures. The gabbros are fringed with a varying width of augite and albite porphyrites, and fine-grained diabases. The passage from the porphyrites to the gabbros is nowhere sharply defined and the two rocks are apparently derived from the same magma, but have cooled under different conditions.

Relation to Ore Bodies.

"The gabbros and bordering porphyrites are important from an economic standpoint, as most of the ore bodies at present being worked are situated either on or close to their line of junction. In passing outwards from the gabbro area, a section taken at almost any point, shows a bordering zone of highly altered porphyrites, and beyond which comes an alternating series of porphyrites, tuffs and agglomerates, associated in places with fossiliferous limestone, make their appearance. The gabbros occur with the porphyrites on Red Mountain, on Kootenay-Columbia mountain and south of the gabbro area, and also on the Spokane mountains and the ridges running south from them. Agglomerates make up the main mass of Spokane mountain and occur in slates, tuffs and porphyrites on Granite, Spokane, Grouse and Lookout mountains, and on the ridge immediately east of Bear creek.

Volcanic Origin of Rocks.

"The roughly concentric arrangement of the Trail creek rocks, and the gradual passage outwards from a holocrystalline central area through semi-crystalline rocks to bedded volcanic fragments, suggest an ancient (though now deeply eroded) volcanic cone situated near the present site of Rossland, from which lavas and ashes deluged the surrounding district. The presence of small basins of the Columbia river, the stones with the agglomerates and tuffs, also make it probable that a shallow sea existed at the time of the eruption, and that the eruptions were intermittent and continued during a lengthened period. "The porphyrites on Lookout mountain and on Toad Mountain and Lake mountain are much fresher looking than those on Red Mountain, and may belong to a later period. An area of uraltic and wholly argillaceous rocks occurs on Sheep Creek between the western base of Deer Park mountain and O. K. mountain. "From Rossland, porphyrites and associated rocks, often crystalline, and some of them replaced by granites and argillaceous rocks, were traced northward across Rock and Murphy creeks to China creek, where they are cut off by the gray granites.

East of the Columbia.

"East of the Columbia river, porphyrites and other igneous rocks similar to those at Rossland have a wide distribution. They are found along the Columbia river from the boundary north to near the mouth of Bear creek, where they are replaced by granites, and thence were followed in a northerly direction along the line of the Nelson & Fort Sheppard railway to within a couple of miles of the Kootenay river. The width of the band was not ascertained, as the country east of the Nelson & Fort Sheppard railway was not examined except at a couple of points. From the railway west to the granitic area, a wide range of land, dependent on the sinuities of the latter, the country is altogether occupied by these rocks. They were found on the head of Bear creek and Champion creek and along the lower part of the north fork of the Salmon. Near the mouth of the latter stream is a small area of gabbro indistinguishable in appearance from that at Rossland, while farther north the porphyrites are the order, and are accompanied by diabases and slates, make their appearance. The series here, as over most of the district, is traversed in all directions by porphyrites and other dykes of a later age. "The eruptive series extends from the base of a spur of the granite mass near the head of Hall creek, and extends eastward across Toad mountain as a broad band penetrating the granites, the porphyrites, and then continues in a more southerly direction to near Waterloo on the Columbia river. The rocks, as on Toad mountain, the porphyrites and other igneous rocks have been crushed and altered into fine-grained argillaceous rocks, and the schists usually corresponds with the edge of the bordering granite. The derivation of the argillaceous rocks from the massive eruptives, as already noted by Dr. Dawson (Annual Report, N. S., vol. IV, p. 30) admits of little doubt, as indicated from one to the other are frequent, and in many places the crushed and flattened fragments of the porphyrites are still apparent. On Rover creek and southward towards Waterloo, where they disappear, the narrow bands of porphyrites and associated volcanic and argillaceous rocks are broken up by numerous granitic intrusions, and assume a more schistose character, although the alteration is nowhere so complete as on Toad mountain. "No systematic examination of the mines in the district treated of was made during the past season, as Mr. Carlyle, recently appointed Inspector of British Columbia, was devoting his time to this particular work, and it was thought best, in consequence, to give all possible attention to the geological structure of the country. A bulletin descriptive of the Trail Creek mines has already been published by Mr. Carlyle, and another, which will embrace those of the Slokan, Toad mountain, and other parts of the district, is in course of preparation. A large number of mines and prospects in different parts of the district were, however, examined in connection with the geological work, and with a view to the elucidation of their character and the classes to which they may be referred. The results of these examinations are given below.

Distribution of Ore Bodies.

"The auriferous iron and copper sulphide ores of Trail Creek occur almost exclusively in the massive members of the eruptive series, and most of the important ore bodies which have so far proved productive are situated either on or close to the line of contact between the gabbros and surrounding porphyrites and diabases. The Le Roi, War Eagle, Cliff, and a number of other leads west of Centre Star pulch, cut through the line of junction almost at right angles, while the Cozy is situated a short distance to the left of it, in the porphyrites, and the Centre Star workings almost immediately east of it, in the gabbro. The Monte Cristo and Deer Park claims occur close to the same line, the Kootenay-Columbia, a few hundred feet to the north of it, in a band of porphyrites, and the Crown Point, Homestake, Gopher, and other leads in the south belt, a short distance to the south of it, in the diabases and porphyrites. The ore bodies are, however, not altogether confined to the neighbourhood of the central gabbro area, but are also found in the bands of massive porphyrites, which alternate with the surrounding igneous rocks and argillaceous rocks. The Jumbo is situated on one of these belts, as is also the Cozy, the Giant, and the Eagle are all situated in a massive condition, ranging in texture from a fine to a medium grain, but it is also disseminated through the country rock. The massive variety usually holds blebs of quartz, and grains and irregular patches of other sulphides, and is replaced by a later date. "The pyrrhotite contains gold and silver in varying quantities, a small percentage of nickel and traces of cobalt. An especially notable example analysed in the laboratory of the survey gave 0.24 per cent. of nickel, and one from the Monte Cristo, 0.13 per cent. The gold contents are exceedingly irregular, ranging from traces up to several ounces to the ton, and the silver from traces to four or five ounces to the ton. "The pyrrhotite is usually accompanied by a variety of chalcophyllic or copper pyrrhotite, intimately commingled with it. The copper pyrrhotite is extremely irregular in its distribution, some places constituting a considerable proportion of the ore body and in others occurring only as isolated and occasional grains in large masses. It was nowhere present in large masses, it is auriferous and holds apparently about the same percentage of gold as the pyrrhotite. "Mispickel or sulph-arsenide of iron, is found associated with the pyrrhotite in a number of the mines, and in places occurs in considerable quantities. It is auriferous, and at the Evening Star mine and possibly at other places, a portion of the iron is replaced by cobalt and it passes into cobaltiferous mispickel or diamite. Dr. Hoffmann gives the following note on this mineral: "The specimen consists of a fine to coarse crystalline variety carrying a cobaltiferous mispickel, most probably the variety known as diamite. It is coated in parts with ferric hydrate and iron carbonate. The cobaltiferous mispickel (earthy cobalt bloom a variety of erythrite) resulting from the decomposition of the diamite and other parts of the iron is replaced by cobalt and it passes into cobaltiferous mispickel or diamite. A portion of the mineral having been entered upon. "Molybdenite or sulphide of molybdenum, occurs in small quantities, notably at the Cozy and Deer Park. At the latter mine it is stated to be highly auriferous. "Besides the above minerals, galena and blende occur at the Lily May and other locations in the south belt and also at the Evening Star and other parts of the north of the main mineral area, but are not found, so far as I am aware, in the Red Mountain mines. Ordinary iron pyrites is met with in greater or less quantities nearly everywhere. "The ores are usually oxidized on the surface, but the alteration seldom extends downwards more than a few feet, and in some cases a single shot brings the unchanged sulphides into view. "Ores of Other Camps. "The ores in the schistose eruptive rocks differ markedly from those in the massive eruptives. In the well known Silver King mine, the pyrrhotite contains a large amount of argentiferous pyrrhotite, with some copper and iron pyrites, tetrahedrite, argentic, blende, galena and stromeyerite. A fine variety of pyrrhotite, which has only recently been detected, was handed to me for determination by the late Mr. R. W. Wood, and is a variety of pyrrhotite, a sulphide of copper and iron, composed of a grayish felspathic rock. An approximate determination of the silver in this variety of pyrrhotite, after separation of all gangue etc., gave 5.9 per cent. of silver. The best of all the minerals I shall shortly be taken in hand. "In the Dandy, a claim adjoining the Silver King mine, the pyrrhotite is associated with galena, and associated with it in more or less abundance are tetrahedrite, argentic, blende, borate and copper and iron pyrites. "Classification of Ore Bodies. "The classification of the Trail Creek ore bodies and the substitution of the general name of igneous rocks of the district is a difficult problem, and one which has given rise to considerable differences of opinion. They may be original segregations from a holocrystalline central area, or they may be pyrrhotite ores, secondary segregations from the basic rocks which include them, replacement veins, or they may be a variety of the latter. I am inclined to believe, true as the latter view may be, that the pyrrhotite deposits as a whole, the theory which fits in best with the prevailing conditions is undoubtedly the third. The blunt irregular outlines of some of the ore bodies and their fissure-like regularity in others, the presence in most cases of a single wall which is often meaningless as a confining line, and the occurrence of any wall of the rock and the presence of the latter as the principal gangue in all cases, all these facts, in my opinion, point to the ore from ascending heated waters, which have eaten away portions of the country rock along lines of fracturing and replaced it by the minerals held in solution. The definite and apparently parallel arrangement of the pyrrhotite veins, and the fact that the pyrrhotite veins, the siliceous character of many of the ores and the presence of calcareous and irregular rocks, tell against the theory of original segregation, which has of late years been applied to somewhat similar deposits in different parts of the world, while the ordinary marks of fissure veins, as usually understood, are seldom observable. "Permanency of Ore Bodies. "The miners of the district are generally prejudiced in favor of fissure veins, under the belief that they are the only ones which are apt to be continuous in depth. There is no reason, however, why replacement veins following lines of fracturing, and fissure veins, in a wide variety of localities, should not be equally permanent. "Auriferous Gabbros and Pyrrhotite. "Besides the pyrrhotite and associated sulphide ores characteristic of the basic volcanics, an important system of siliceous ore-bearing fissure veins has a wide distribution in the district. The quartz leads are not of fracturing and are not continuous in all directions. The O. K. occurs in an altered and partly sericitized host volcanic rock. It is a massive porphyrite, the Foraman, Maud S. and Clearwater in granite, the Ketchikan, and the Gold Hill and Helen in eruptive rocks later than the granite. The quartz leads vary greatly in size, but seldom exceed eight feet in width, and usually average less. They contain free gold, auriferous basic chalcophyllic and galena. Stamp mills have been erected at the Foraman, O. K., and Fern, and a number of the other leads are being prospectively worked. "Mineralized Belts. "A third class of gold leads includes the Starlight, Golden King and others in the vicinity of Toad mountain, and consists of pyrrhotite belts, a hundred feet or more in width, traversing the schistose eruptives. These are simply more or less mineralized portions of the schistose eruptives, carrying occasional ribs and stringers of quartz. They are low grade, the Starlight, Golden King and others, are a valuable exception. They are not of great value, but by Mr. Francis for an English company, averaging about 2 1/2 in gold per ton, but owing to the practically unlimited amount of material available, they may possibly in some instances be profitably worked. "Development of Mining. "Mining has made satisfactory advances on all sides in West Kootenay during the past season. Prospectors, the pioneers of the industry, swarmed over the country making locations everywhere, and in a fair percentage of cases, of previous years on which development work has been done, primary and secondary signs of older mineralization were no longer to be developed. Several new camps, notably Waterloo, Champion creek, the North Fork of the Salmon, and the Springer creek district, have come into prominence, while the older ones have developed and recognized mining centres. The output of ore has largely increased and the capacity of the mill has been more than doubled in order to meet the demand. Favorable reports from competent men have been received in regard to a number of outlying districts which have not yet been examined, and it is altogether probable that, with the advent of easy communication, the success of Trail Creek and the Slokan will be repeated in East Kootenay. Boundary creek, the Lardo, the Big Bend and other places. Capital has flowed freely into the district during the past season, but it is to be feared that a undue portion of it has found its way into the hands of speculators rather than into legitimate mining. "Development in Rossland. "In Rossland and vicinity, although there has been a good deal of scarcely warranted speculation, much conscientious development and prospecting work is being carried on, the result of some time yet, as the hard eruptive rocks of the district, in a large measure, are still in a primitive operation. Compressor plants have, however, been erected at the Le Roi, the Cozy, and the Eagle, and the principal results are rapidly supplanting hand smelting charges are imperative, and will doubtless be made in the near future. A considerable shipments at irregular intervals, from the Le Roi, the Cozy, the Eagle, the Evening Star, Crown Point, and others, and it is highly probable that the typical iron pyrites development work now in progress, the output from these will be largely increased, the amount of high grade, and a large proportion of those in sight cannot be profitably worked under present conditions. The cost of freight of the ore, as given by Mr. Carlyle at \$10 to \$14 per ton, is a very high one, and if it is added to this it will be evident that ores carrying less values than \$15 per ton would not be worth shipping, and in fact, if all, in order to utilize the material, reductions in both freight and smelting charges are imperative, and will doubtless be made as the treatment of the ore becomes better understood, and competing lines of transportation are opened up. Should the railway now projected through the Crow's Nest Pass be built, and the mines connected with the extensive coal-fields known to exist in the Rocky

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The Red Eagle Gold Mining Co.'s Properties CONSIST OF THE Red Eagle and Red Pole Mineral Claims, Composed of about 75 acres.

The Red Eagle. The Red Eagle mineral claim is situated on the east slope of Deer Park mountain, between the Mayflower and Curlew claims. There are three known ledges crossing this property. These veins are known as the South vein, the Curlew vein and the Mayflower vein. The South vein, which has produced some of the richest surface ore ever discovered in the district, is six to eight feet wide with a 24 inch pay streak, assays from which gave returns of \$18 to \$285. This vein was recently discovered by workmen grading for a tramway across the claim for the sawmill company, and is generally regarded as the most important of recent discoveries in the south belt. This vein is traceable across the entire width of the claim a distance of over 1400 feet. On the Curlew ledge an open cut has been made exposing a vein of ore four feet wide, from which assays of from \$14 to \$161 per ton have been secured. This vein has been exposed by a number of shallow pits and crosscuts for several hundred feet. The Mayflower ledge, from which this well known mine is now shipping such high grade ore, crosses the Red Eagle claim for a distance of 300 feet.

The Red Pole. The Red Pole is situated one-half mile south of the Red Eagle and east of the Silver Bell mine. The Silver Bell ledge crosses the Red Pole mineral claim. Assays from this vein have shown over \$100 per ton of gold and silver.

Treasury Shares. The company have secured the survey and are applying for the Crown grant, and will continue developing the property all winter, and fully expect to be able to find pay ore to cover the development almost from the surface. But to prepare for all mining emergencies and to fully equip the property with machinery we have placed 500,000 shares in the treasury, a limited amount of which we offer to the public at the rate of 10 cents, and when the p id limit is reached the company will close their books and reopen in the course of ten days at an advanced rate for further stock.

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