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NOTES ON

GEOLOGY AND MINERAL DEPOSITS AT AINSWORTH BRITISH COLUMBIA

(REPORT AND TWO MAPS)

BY

H. M. A. RICE

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INTRODUCTION

Ainsworth settlement is on the highway that follows the west side of Kootenay Lake and lies about 14 miles south of Kaslo. It is also a port of call for lake steamers.

Even before railways crossed the southern interior of British Columbia, Kootenay Lake formed a principal route of travel in, and means of access to, the Kootenays, and became familiar to prospectors at an early date in the history of the province. Ainsworth hot springs, now a tourist attraction, have long been a landmark in the district and, in the early days of mining, formed the site of Hot Springs Camp, later renamed Ainsworth. Numerous mineral discoveries were made between Coffee Creek and Woodbury Creek and that part of the region became known as Ainsworth Mining Camp. Small shipments of sorted ore were made as early as 1888 but the principal period of production from the camp was between the years 1905 and 1920. Since then, occasional shipments have been made by leasers and only a few properties, such as the Spokane and Banker Mines, have been operated systematically even for short periods. At present only the Florence and Spokane Mines are operating.

GENERAL GEOLOGY

The area is underlain by a succession of metamorphosed sedimentary and volcanic formations cut by minor intrusions. These dip to the west and lie roughly parallel to Kootenay Lake and between it and the main mass of the Nelson batholith which outcrops just beyond the western border of the area covered by the accompanying maps. The assemblage is believed to include members of the Lardeau, Milford, Kaslo, and Slocan groups of Windermere, Carboniferous, and Triassic ages, but metamorphism has so changed the rocks that it is difficult, and in many places impossible, to distinguish one group from another and for purposes of this study the attempt has not been made. It is known, however, that the formations are successively younger across the area from east to west, except where folding has locally reversed the order.

The commonest rock type in the area is some variety of quartz-mica schist such as sericite schist, biotite schist, or garnetiferous mica schist. Massive quartzite is not uncommon and all gradations between it and schist can be seen. Some of these rocks are calcareous or dolomitic and grade into almost pure limestone or dolomite.

The dolomite is cream coloured, weathers buff, and occurs near Kootenay Lake as thick beds in formations of the Lardeau group. The limestone is fine grained to coarsely crystalline, is blue-grey and weathers light grey. It occurs in some of the same formations as the dolomite but is also interbedded with volcanic rocks farther from the lake, and forms particularly thick beds above the zone of the volcanic rocks, in what is believed to be the Slocan group.

Thick belts of hornblende schist and, to a lesser extent chlorite schist, occur in a north-south zone that lies roughly up the center of the area. These are believed to be metamorphosed andesitic lavas and volcanic breccias belonging, in part at least, to the Kaslo group. The number and distribution of these belts cannot be determined with certainty, for, like all volcanic formations, they are in part lenticular rather than continuous, are probably repeated in places by folding, and are undoubtedly accompanied by related intrusions that have suffered similar metamorphism and cannot now be distinguished from the extrusive rocks.

Dark grey argillite is common in the formations west of the hornblende schist and is believed to be confined to the Slocan group. Near the base of this group is a thick bed of dark grey schist in which knots of secondary minerals resemble pebbles in a conglomerate.

Bodies of granitic rock occur. Some of these may be truly intrusive bodies but many are in whole or in part the result of granitization of schists or quartzite.

Many dark-coloured dykes and sills can be seen. They are definitely younger than the granitic bodies and vary in composition from diorite to syenite. Some occupy the same fissures as the mineral deposits although they are definitely older. In 1938 the writer collected some evidence to indicate that the dark dykes are probably of Tertiary age and in that case the ore deposits cannot have formed before Tertiary time. The evidence, however, is not considered conclusive.

STRUCTURAL GEOLOGY

The strata in Ainsworth district have a general north-south strike and dip west into the hill at angles of from 30 to 50 degrees. (See maps). They are involved, however, in so many structural complications that a satisfactory interpretation of the nature and history of the structures and their relationships to mineralization could not be made even after careful mapping on scales of 200 and 400 feet to the inch.

The formations have been deflected from their regular trend by a series of complex drag folds that range from an inch to a thousand feet across. In parts of these folds beds of limestone and hornblende schist have been greatly thickened; in other parts they have been thinned out and, locally, may be missing. The difficulty of mapping these folds is further increased by lack of outcrops at critical localities, and by the fact that some of the hornblende schist involved has formed from crosscutting intrusive bodies that serve but to confuse the bedding structures.

No faults of large displacement were observed. There are, however, many small faults or fracture zones that, although they have little structural significance, contain the mineral deposits of the area and are consequently of great economic importance. These will be referred to more fully in the following section of this report.

ECONOMIC GEOLOGY

Types of Mineral Deposits

Silver, lead, and zinc are the principal metals recovered in the district. The two most abundant ore minerals are galena and sphalerite; of these, sphalerite is the more common, but until recent years had been regarded as a detriment rather than an asset in the ores, and as a result only a small amount of it has been produced. Silver is of secondary importance, except in a few mines like the Krao and Silver Hoard, where the native metal and high-grade silver-bearing minerals have afforded rich silver ore. Traces of tin were detected in a number of ores from this camp. Fluorite is reported by Schofield to be a common gangue mineral in some of the deposits, but was not seen by the writer.

Mineralization occurs as fissure veins and replacement bodies, and both types are closely related. The replacement deposits are in limestone and, to a lesser extent, in hornblende schist. Ore-bearing solutions rising along fissures or small faults deposited much of their load by replacing the wall-rocks adjacent to the fractures. Ore so formed is usually high grade but the deposits are irregular in shape and limited to the favourable bed. Fractures may parallel the bedding, but more commonly cross it at a fairly sharp angle. In the latter case the length of the ore-body is limited by the width of the favourable bed. It is not always possible to see the parent fissure; within the ore-body the replacement of the wall-rock by ore commonly destroys the evidence by which it could have been recognized, and in the adjacent schists most faults and fissures pinch out within short distances. Little displacement was observed along any of the faults and efforts to trace them from one limestone bed to another have not been successful. It seems probable that a fissure may develop in schist close to a body of limestone and nearly parallel to it, swing rather abruptly to cross the limestone at a high angle and, on passing into the schist on the other side, swing back into line with the plane of schistosity and die out.

Fissure-vein deposits occur mostly in mica and hornblende schist and quartzite. They occupy the fissure, cementing fault breccia fragments within it, and forming veinlets in the wall-rocks. Replacement is of secondary importance. The normal sequence of events seems to have been as follows: the fissures were first occupied by veins of barren quartz with sometimes a little calcite. This vein-matter was shattered by later movements along the original fissure, and either during or just after this interval of deformation some of the fissures were intruded by the young, dark-coloured dykes referred to earlier in this report. The breccia thus formed, whether it be of earlier quartz, wall-rock, or shattered dyke, was cemented and to some extent replaced by ore to form the present deposits.

It is evident that replacement and fissure-vein deposits are closely related. They probably originated from the same solutions and they follow the same fissure systems. Their differences lie apparently in the nature of the wall-rocks which, if they are limestone, allowed almost complete replacement by ore-bearing solutions.

The key to the location of the ore deposits is clearly related to the occurrence of faults and fissures. Although these form a definite pattern, neither the origin of this pattern nor of the fissures themselves is known. Most of the mineralized fissures at the south end of the area follow the bedding, whereas those at the north end cut across it, this in spite of the fact that rock structures at both ends are, in general, similar. There is little difference in deposits occupying the parallel and the transverse fissures. Most of the parallel fissures can, however, be traced much farther than any of the cross fissures.

Principal Fissure Systems.

The principal mineralized fissure systems will now be described briefly commencing with the most southerly.

The Eden Crescent-Krao system can be traced at intervals for some 7,000 feet. On it are the Eden-Crescent, Last Chance Firebrand, Crow Fledgling, and Krao mines (See map). In general it is parallel to the bedding although in places it splits into two or more components. These components may join again farther along the fissure or swing off to form a related cross fissure. On the Crow Fledgling, for instance, the system is 100 feet or more wide, with well-defined fissures along both walls in which ore-shoots are irregularly distributed. The more easterly fissure continues north to include the Krao deposit, beyond which it dies out. The westerly fissure swings west up Krao Creek and also disappears, although the cross fissure at the United mine is probably a part of the same system.

The next important fissure system to the northeast is that of the Maestro-Spokane mines. This can be traced with reasonable certainty for not less than 6,000 or 7,000 feet and along it lie some half dozen deposits, among them those of the Little Donald, Little Phil, Maestro, Spokane, and Trinket mines. It consists essentially of bedded veins and is as regular as any of the systems in the area, but also splits and throws off cross fractures. South of Spokane mine, for instance, it consists of not less than three parallel veins and at least one small cross vein.

Farther east is the Banker-Townsite system of bedded veins which can be traced with reasonable certainty for 3,000 or 4,000 feet and, perhaps, for over 7,000 feet. The principal deposits in it are those of the Albion, Banker, and Townsite mines but may also include the Danero to the north.

The above-mentioned, as well as other fissure systems such as those of Number 1 and Silver Hoard mines, form the vein pattern in the southern half of the area. Deposits in them, with the exception of the last two mentioned which are replacement deposits in limestone, are principally of the fissure-vein type. Bedded veins are far more abundant, more continuous, and economically more important than those that occur in cross fissures.

Factors commonly controlling the location of ore-shoots in the bedded veins are changes in the nature and direction of the parent fissure. For example, ore-shoots have formed in or close to both vertical and horizontal rolls in the veins at both the Banker and Spokane mines. Dykes and constrictions in the fissures have acted as dams in some instances. A good example was noted at the Banker where an ore-shoot formed under a dyke that crossed the fissure from hanging-wall to foot-wall.

The approximate northern boundary of this group of systems of essentially parallel veins is a few hundred feet south of Cedar Creek. Just north of this boundary is the Highland fissure system that includes, in addition to the several fissures of the Highland mine itself, those of the Jewel, New Jerusalem, Ayesha, and Buckeye mines. These together form a widespread system of short fissure veins that cross the bedding in a northwesterly direction. Ore-shoots occur in mica and hornblende schist and quartzite and their position is controlled, at least in part, by the nature of the beds through which the fissures pass. They are consequently limited to certain locally favourable beds. Thus a shoot in hornblende schist may end abruptly when the fissure passes into quartz-mica-schist; elsewhere the reverse may be true. Few fissures persist from one favourable horizon to the next.

Still farther north is the fissure system of the Florence and adjacent properties whose veins cut more or less directly across the bedding. The position of ore-shoots in the fissures of this system is controlled in a manner similar to those in the Highland system, except that the principal shoots of the Florence and Lakeview mines have formed in limestone by replacement.

Production

Many of the underground workings of the Ainsworth mines are caved or dangerous to enter, and little time was afforded to examine thoroughly the many properties. The reader is, therefore, referred to previous reports by Schofield[1] and the writer[2] for detailed descriptions.

[1] Schofield, S.J.: Geol.Surv., Canada, Ainsworth Mining Camp, Mem.177,1920.

[2] Rice, H.M.A.: Geol.Surv., Canada, Nelson Map Area, East Half, Mem.228,1941.

The following table gives the approximate production of silver and lead from the different mines in Ainsworth Mining Camp up to 1942:

Name	Tons	Silver Ounces	Lead Pounds
Albion	50	944	39,431
Ayesha	10	500	24,000
Banker	3,846	40,214	2,109,657
Crow Fledgling	7	35	835
Danero	6	?	?
Eden-Crescent	342	3,100	202,000
Early Bird	151	1,464	130,045
Firebrand	16	1,832	3,460
Florence (Kootenay Florence)	74,789	129,205	9,762,426
Gallagher	230	17,615	31,863
Glengarry	1	?	?
Hardie	4	215	4,824
Highland	90,861	314,266	18,931,296
Highlander	17	1,590	1,200
Jewel	26	196	14,358
Krao	1,489	122,499	372,996
Libby	12	182	11,895
Little Donald	625	20,112	531,530
Little Mamie	11	550	11,000
Little Phil	267	5,256	262,721
Maestro	2,358	36,542	1,737,827
Mile Point	55	60	370
Neosho	11	411	804
New Jerusalem	19	346	19,296
Number 1	38,683	1,919,102	286,964
Silver Hoard	1,881	106,935	127,377
Skyline	3,027	218,148	4,627
Spokane (Spokane-Trinket)	1,974	38,056	2,257,537
Tariff	181	3,641	154,990
United	837	2,754	163,164

CONCLUSIONS

The work done in the area during the season of 1943 failed to establish a relationship between the structure and the fissure systems that could be used as a guide in prospecting for mineral deposits. Several general facts may, however, be of interest:

(1) The most complicated structures in the area are between Coffee and Woodbury Creeks and there is evidently a relationship between this complexity and the location of the ore deposits. Prospecting to the north of Woodbury Creek and south of Coffee Creek is, therefore, less likely to meet with success than in the area between them.

(2) The most promising veins in the southern half of the area are bedded veins; and, in the northern half, those occupying cross fissures.

(3) Finally, it should be noted that large limestone bodies occur in the drift-covered region west of the area mapped, and between it and the Nelson granite, and that these are more likely to contain large, replacement ore-bodies than the thinner limestone formations nearer the lake. Should the fissure systems of the Highland and Florence mines persist far enough west to intersect these large limestone bodies or should they be involved in other similar systems, important replacement deposits may be expected to be present.