File UMOS
Juab Co

Fish Springs SW

PRELIMINARY REPORT

of the

MAGNESITE DEPOSITS OF THE SILVER SHIELD MINING & MILLING COMPANY

FISH SPRINGS DISTRICT, JUAB COUNTY, UTAH

by

Authur L. Crawford and Alfred M. Buranek

May 22, 1942

TABLE OF CONTENTS:

PRELIMINARY REPORT ON THE MAGNESITE DEPOSITS
OF THE SILVER SHIELD MINING & MILLING COMPANY
FISH SPRINGS DISTRICT, JUAB COUNT, UTAH

By

Arthur L. Crawford and Alfred M. Buranek

Introduction:

At the request of Mr. Harry S. Joseph, Hotel Utah, Salt Lake City, Utah, Mr. A. L. Crawford and Mr. A. M. Buranek visited the Fish Springs Mining District on May 8 and May 9, 1942.

This trip, the purpose of which was to examine the Magnesite Deposits of the Silver Shield Mining and Milling Company, was made under the authorization of the Utah State Department of Publicity and Industrial Development.

Location:

The Fish Springs Mining District, Juab County, Utah, is roughly seventeen miles east of Callao, and is situated on the northwestern flank of the Fish Springs Range of mountains. To the west and north of this district lies the southernmost extension of the Great Salt Lake Desert. The magnesite deposits are covered by six full mining claims in the extreme northwestern end of the Fish Springs District. These claims have been surveyed so as to form a parellelogram three claims wide and two claims long (900 feet by 3,000 feet along the ends and sides.) The bearings of the ends and sides, as taken with a Brunton pocket transit, are approximately North 80° W. and, North 5°W., respectively. The road around the north end of the Fish Springs Range passes through the property and withim a few feet of the northwestern trench opened on one of the magnesite veins.

Transportation, Timber, Water, etc.:

The distance from the magnesite claims to Salt Lake City via the Fish Aprings, Simpson Springs, Tooele road is roughly 120 miles. This road is practically impassable during wet weather as are the roads leading west to Gold Hill or south to Eureka. Wherever these roads lead across desert flats, they are composed chiefly of clays and Bonneville marls, which when wet literally bog down any attempted transportation. During dry seasons, these roads are good, except that in some places ruts and sumps occur. Recently the C.C.C. have worked on the Callao-Simpson Springs road, but they failed to complete their project. For permanent use, the sections of road crossing the low areas must be properly drained and graveled.

Culinary water, fuel, and timber for mining would have to be hauled to the property, as none of these items are available at, or near, the Fish Springs District. If necessary, good drinking water can be obtained from the artesian wells at Callao. There is probably ample water for milling purposes that can be obtained at depth wherever the water table of the district is reached. In the Utah Mine, less than 3,000 feet from the southeast corner of the magnesite claims, but approximately 4,500 feet from the best magnesite exposures, water was encountered slightly below the 800-foot level. Examination of several tunnels in the district showed the character of the country rock to be a hard-blue dolomitic limestone, recrystallized into a dense white marble near the magnesite deposits, requiring very little timber in mining, except for ladder ways and stulls.

Geology

Sedimentary and Igneous Rocks:

The northern part of the Fish Springs Range is composed almost entirely of sedimentary rocks, which, according to Butler[1], are Ordovician or Silurian in Age. Those examined by the writers are predominantly fine grained, blue-gray, dolomitic limestones, grading into white marble in the northwestern part of the district where the magnesite is found. A thin section of a typical sample collected from a non-silicified bed near the Galena Mine examined by Crawford showed a uniform texture of dolomite grains averaging 0.2 mm. in diameter. The grains were completely interlocked. Farther to the west in the vicinity of the Black Dragon and Early Harvest claims, and to the northwest in the area covered by the magnesite claims, the dolomites have been largely recrystallized to marbles and the bluish-gray color is bleached out to nearly white. This tends to indicate the probable occurrence at depth of an intrusive, the main mass of which is probably situated north and west of the Fish Springs Mining District, from which the several granite porphry dikes have emanated. The granite intrusive in the Deep Creek Range south and west of Callao and that south and east of Gold Hill originally may have been connected with the dikes of the Fish Springs District. If this be true, the intervening granitic mass, immediately west of the Fish Springs District was probably truncated by erosion, downfaulted, and then covered with Bonneville alluvium.

The visible igneous rocks of the district are confined to a few dikes trending east and west with steep northernly dips. The best exposed of these is roughly 15 to 20 feet in thickness where it crosses the Utah Claim. The western extension of the dike, where it outcrops in the old sea cliffs cut by the waves of Lake Bonneville on what is now the Black Dragon Claim, is considerably thicker, giving the impression that the farther the dike is traced to the west, the wider it becomes, again indicating that a granitic intrusive lies to the west and that the marblized dolomites in this vicinity constitute a part of the contact metamorphic zone. The dike outcrops in many places on the south side of a short ridge trending westerly from the main range for a distance of approximately one mile. It is in this ridge that the larger silver-lead ore deposits of the district have thus far been found. According to Butler[1] south of the main dike a smaller but similar one is reported near the Emma Mine.

Fresh specimens of the dike rock are a light tan-gray color, but much of the weathered material is brownish due to the alteration of the ferro-magnesium minerals. Butler[2] calls the dike a granite porphry, but in the thin section of a specimen collected by us, Crawford found the texture more nearly that of a rhyolite porphyry. The phenocrysts of quartz, orthoclase, and biotite having an average diameter of 0.5 mm. are set in a ground mass of quartz and orthoclase microlites of only 0.01 mm. in size. Apatite is a rather largely abundant accessory mineral, and the specimen examined showed secondary minerals, notably calcite and chlorite replacing biotite, sericite and kaolin replacing orthoclase. Most of the orthoclase, however, is fresh, frequently having rhombic outlines similar to adularia. Some of these orthoclase phenocrysts show peculiar wedge-shaped twinning.

Structure:

5 The structure of the Fish Springs Range on the whole is rather simple. The sedimentary beds strike north-south with a dip to the

1. Butler, B.S., Op. Cit. pg. 467.
2. Ibid.

west. The dip steepens near the western margin, apparently due to the greater rotation of the marginal blocks paralleling the edge of the Great Salt Lake Desert. Northeast of the magnesite claims, near the tip of the range, steeper dips to the northwest and north along the margin of the Desert further indicate extensive downfaulting of the area now covered by alluvium.

The major faults have a north-south direction with the vertical displacement most apparent on the east side of the range, where an extensive thickness of lower Paleozoic limestones and dolomites have been lifted into a great escarpment, now modified by erosion. Lesser north-south faults in the Fish Springs District have horizontally off-set the main rhyolite prophyry dike in several places, notably on the Black Dragon Claim, where it is offset roughly 40 feet. Thus, locally at least, the east-west faulting was older than the north-south faulting. The entire district is cut by numerous east-west fissures and faults that appear to be closely related to the porphyry dikes, and (possibly with the help of master north-south fissures) to have furnished the channels by which the silver-lead ore-bearing solutions entered the sedimentary beds.

Ore Deposits:

Because of the significance of the Joseph Tunnel now being driven by the Silver Shield Mining and Milling Company, which owns the magnesite deposits and because of the probable genetic relationship of the magnesite to the silver-lead deposits to be tapped by the Joseph Tunnel, a few short statements pertaining to the mineralization of several of the larger metal mines located south and east of the magnesite deposits are here included.

All of the metalliferous deposits of the district are similar in composition and mode of occurrence, being silver-lead ores of consistently high silver and low gold content. Very little zinc is present in the ores. Assay returns from the ores actually sent to the smelters usually show from 125 to 150 ounces silver and from 35 to 50 percent lead. One miner, now leasing in the Utah Mine recently shipped a small lot of high-grade ore yielding 250 ounces silver, .01 ounces gold and 50 percent lead.

Most of the ore thus far mined has been south (on the footwall side) of the main porphyry dike that crosses the Utah and Galena properties. Very little ore has been mined from the hanging-wall side of the dike. The ore bodies are replacements in dolomitic limestone and occur as very irregular pipe-like shoots and thin lenticular masses along the main east-west fissures. Between two masses of ore the fissure may show very little mineralization. The usual method of mining is to follow the "ore" fissure even though it appears barren of any values. In many instances these faint showings lead to valuable pockets and occasionally to deposits of considerable size.

As the western extension of the dike is offset to the south in several places, it is apparent that the minor north-south movements were later than the formation of the dike. But, inasmuch as ore is believed to be genetically connected with the dike and is also found in the north-south slips and fractures, it is logical to assume that the formation of the dikes, east-west fissures, north-south fissures, and the entering of the mineralizing solutions into the fractures probably occurred during the same general period.

The examination in the field and the preliminary study in the laboratory of specimens collected by the writers substantiate the descriptions given and the conclusions drawn by Butler,[1] concerning the metalliferous deposits, a detailed account of which can be consulted in his report on the ore deposits of Utah.

Since the organization of the Fish Springs District, March 20, 1891, it is estimated that the silver-lead mines have yielded ores to the gross value of over $2,500,000. The most important production took place during the few years immediately following its discovery. By the end of 1900, gross production had reached $1,212,298--a total which is approximately equivalent to the value of the entire production since that time. Since 1908, production has gradually dwindled to a gross value of only $6,908 for the year 1939, the last year for which figures are available.

Extended bond and leases on the Galena, Black Dragon, Early Harvest group and several other adjacent properties have been acquired by the Silver Shield Mining and Milling Company, and in 1940, work on the Joseph Tunnel was commenced at the base of the western extremity of the spur of the Fish Springs Range, in which are located the chief producers of record. This is a drainage and hallage tunnel projected to tap the lower levels of the Galena and the Utah mines and to explore the mineralized contact zone along the rhyolite porphyrydike which brought in the mineralization. It has reached the Early Harvest shaft, approximately 1,300 feet from the portal of the tunnel, so that good ventilation is assured. Except for a few minor north-south fracture

---

[1] o.p. cit. pp. 468-469

zones crossing the tunnel, the walls consist of dense, hard marble that require no timbering. Thus far no commercial ore veins have been encountered. One small lead has shown occasional pockets which, though small, are quite typical of the ore pockets found in the larger deposits occuring to the east. Adjacent to this lead, the marble is stained reddish and the sample taken near the vein was found to give a qualitative test for manganese. However, a thin section, prepared and studied by Crawford, showed only minor streaks of rhodochrosite cementing a brecciated marblized dolomite so that the amount of rhodocrosite is not sufficiently great to have economic significance.

The following account of the magnesite occurrence is quoted from an unpublished manuscript by Crawford[1], who first reported the discovery of the Fish Springs magnesite before the May 1941 meeting of the Utah Academy of Sciences, Arts, and Letters.

"The Fish Aprings magnesite deposit was first recognized in March, 1941, when a former employee of the Silver Shield Mining and Milling Company brought to the attention of Harry S. Joseph, President and General Manager of the Company, samples of a white procelain-like material which he had collected while in the Fish Springs District and on which he had later secured an analysis by the chemist of the Columbia Steel Company at Ironton, Utah. The analysis showed the material to be relatively pure magnesite, and steps were immediately taken by Mr. Joseph to locate the ground in the name of the Silver Shield Mining and Milling Company. Six claims were staked to cover the entire area in which magnesite was found.

1. Crawford, Arthur L., "Magnesite--A new Economic Mineral for Utah" Proceedings of the Utah Academy of Sciences, Arts, and Letters Vol. XVIII (1941), P. 18.

"Prospecting and development revealed the magnesite to occur in several closely related north-south fissure systems in dense crystalline dolomite. The crushing and metamorphism which the dolomite has undergone has largely obliterated all bedding planes and original structures, so that it is difficult to trace out the exact relationship of the veins to the original beds. The magnesite veins vary greatly in width and continuity; in fact, they consist of a connected series of lenticular bodies, varying from a few inches up to an exposed maximum thickness of several feet. Most of the magnesite is extremely dense and porcelain-like in character, but portions of it often contain angular fragments of included dolomite breccia, which it appears to have replaced. The magnesite vein system crosses obliquely the nose of a foothill spur which projects in a northwesterly direction from the Fish Springs Mountains, just north of the small east-west spur in which are located the metalliferous deposits of the old Fish Springs Mining Camp.

"The 50-foot-wide rhyolite porphyry dike, which is believed to have generated the metalliferous solutions of the Fish Springs District, is also believed to be genetically connected with the mineralization that has been responsible for the deposition of the magnesite.

"The magnesite veins do not appear to have extended south of the rhyolite porphyry dike and the northern extension of the magnesite vein system is believed to have been cut off by a fault-zone at the northwest foot of the Range. This presumed fault-zone is thought to have been responsible for the delineation of this part of the southern rim of the down-faulted basin, which forms the Great Salt Lake Desert. However, it is not certain whether the magnesite deposits are terminated immediately toward the north (valleyward) by this fault-zone; or whether the major fault-zone is some distance out in the valley in which case the magnesite at the end of the mountain spur might be covered merely be desert alluvium.

"A minor fold, forming as assymetrical anticline or modified monoclinal flexture, striking northward from the rhyolite porphyry dike is suggested by such meager evidence as could be gathered during the reconnaissance of the massive crystalline dolomite of Magnesite Hill, and this structure is believed to have had an influence upon the concentration of the solutions that have caused the precipitation of magnesite in the fissures. Thus, following this assumption, the magnesite is postulated to occupy a series of nearly vertical fissure zones developed along the nose of the plunging anticline, having its trend almost at right angles to the rhyolite porphyry dike. The dike appears to dip steeply to the north so that the anticline in which the magnesite forming solutions were concentrated occurred on the hanging-wall side of the dike. Solutions arising from the dike are presumed to have attacked the dolomite, causing the breakdown of the dolomite molecule into its two constituents--calcium carbonate and magnesium carbonate. Hence, the dolomite country rock was in part changed to a marble made up largely of calcite, while the magnesium carbonate thus extracted from the dolomite was concentrated as pure magnesite in the fractured zones along the axis of the anticline.

"The series of reactions by which this concentration of magnesite may have taken place is suggested by the studies of Platzmann[1] from which he devised a process of concentrating magnesia from ordinary dolomite. Reasoning from the findings of Platzmann, it is suggested that the hydrothermal emanations from the igneous dike charged with

---

[1]Platzmann, C. R. Production of Magnesia from Dolomite. Journal Am. Ceram. Soc., Abs. Bull., Vol. 9, No. 1, January 1930, p.64.

$KHCO_3$ or other bicarbonates of the alkali metals may have been instrumental in this concentration of the magnesite from the dolomite. Under intrusive conditions, CO_2 was probably eliminated from the deeper dolomites, and as it slowly escaped upward through the fractures in the impervious dolomite, it, along with the bicarbonates in the solutions, became concentrated, if not permanently entrapped, beneath the nose of the plunging "saddle reef" projecting from the hanging wall of the rhyolite porphyry dike.

"In the presence of CO_2 and $KHCO_3$ the dolomite "calcined" by the heat of the intruding dike would tend to be split into its constituent parts in such a manner that $CaCO_3$ would be precipitated and $MgCO_3$ H_2O enter into solution. However, according to Platzmann when a temperature of 100° C. is reached, (which could easily be exceeded even at considerable distances from the intrusive) the elimination of $4MgO.3CO_2$ $4H_2O$ (Hydromagnesite) set in, and from this ordinary magnesite, $MgCO_3$, would probably result from the elimination of the water of crystallization."

Characteristics of the Magnesite:

The magnesite is extremely dense, being what is generally known as the Grecian type. It is snow-white, has a porcelain-like appearance, is very hard, and has a chonchoidal fracture. Wherever the material of this character is taken free from included dolomite breccia, with which it is frequently intergrown, analyses show the magnesite to be very high grade. The CaO content is often as low as one percent, and the silica, alumina, and iron are in negligible quantities. In fact iron and possibly silica would probably have to be added in order to produce a satisfactory brick. Thin sections of the ore and of the adjacent country rock, examined by Crawford, show the magnesite to be so finegrained that the individual crystals can scarcely be differentiated under high magnifications.

Small veinlets of coarser grained calcite are found in the marginal phases of the dense magnesite, and frequently line vugs in the more porous breccia. Angular fragments of typical dolomitic marble are also common in the marginal phases of the veins. It is evident that the grade of magnesite that can be mined will depend very largely upon the care that can be exercised in cobbing the "ore".

Owing to the irregular thickness of the veins, large-scale production cannot be hoped for if further development is unable to discover larger lenses than have been found of the "ore". The largest lens thus far developed is approximately 8 feet wide, 35 feet long, and has been explored to a depth of 40 feet. The bare nature of the rock exposures makes observation in the magnesite zone relatively easy, and it is not thought likely that larger lenses than the one described are likely to be found to occur in the plane intersected.

Recommendations:

The veins are nearly vertical, and since they are exposed in outcrops from 25 to 200 feet in elevation above the valley floor along the western slope of "Magnesite Hill," it would be relatively easy to explore the extent and thickness of the magnesite veins by diamond drilling. Drill holes put in at approximately right angles to the hillside slope, first near the veins and later, if justified, at progressively greater distances below their outcrop, would block out quite definitely the extent of the magnesite deposits. After such a program of exploration, it would then be possible to plan a system of development more intelligently in conformity with the size and location of the larger magnesite lenses found to exist in the magnesite zone.

It is believed that such a program would block out sufficient magnesite tonnage so that with careful judicious development, a small enterprise could be made to yield profitable returns.

An alternate method of exploration would be to continue the trench begun near the road, at the northern end of the property, cross cutting the magnesite zone until beneath the large lens exposed at the point of "Magnesite Hill", thence turning south drifting along the principal magnesite vein so as to be in a position to stope out, and sink on, and commercial lenses of magnesite encountered. This procedure would have the advantage of putting the property into limited production with the initial investment.

Conclusions:

There is definitely a demand, although it may be considered at present limited, for magnesite brick in the Salt Lake Valley area. The smelters of Salt Lake Valley import a certain amount of magnesite brick and the new steel plant near Provo when completed will undoubtedly use a considerable tonnage of this material. Magnesite bricks are relatively expensive. The cost of the present freight haul is high and the local supply would be a welcome addition to our economic resources.

As a large percentage of the domestic production of magnesite comes from underground workings and as the quality of the magnesite on this property is equal, if not superior to, most magnesite being mined in the United States at present, there should be no question that the magnesite holdings of the Silver Shield Mining and Milling Company have economic value.

It is the belief of the writers that even though conditions exist that definitely will not permit large scale mining operations to function successfully on the magnesite veins as now exposed, a carefully planned and skillfully executed mining program on these deposits should realize the owners of a substantial profit on such ore as can be mined and marketed each year.

Respectfully submitted.

Arthur L. Crawford
Geologist and Mineral Technologist
Utah Engineering Experiment Station
University of Utah
Salt Lake City, Utah

Alfred M. Buranek
Junior Geologist
Dept. Publicity & Industrial Dev.
State of Utah
Salt Lake City, Utah

May 22, 1942