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N E V A D A   M O L Y B D E N U M
R E P O R T

By Edward W. Brooks,
Consulting Engineer.

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Los Angeles, California,
June 10th, 1938.

On April 9th, 1936, the writer submitted to Mr, R, D, Clarke, of Los Angeles, California, now deceased, a preliminary report on what appeared to be a very extensive deposit of ore carrying molybdenum. This deposit is situated in Esmeralda County, Nevada. Several weeks had been spent on the ground studying the geology, surface-showing and the physical conditions as related to possible mining operations to be later undertaken. The following primary considerations were taken up in the order named below:

1. The character and extent of the mineralization exposed at the surface as indicative of what might reasonably be expected to be developed underground.

2. The development required to prove or disprove the value of the deposit for mining.

3. If the proposed development disclosed ore of sufficient quantity and quality to warrant mining operations, could such operations be carried out successfully. The answer to this question involved the following indispensable factors:

(a) Water in sufficient quantity and of suitable quality to supply a flotation plant having a daily capacity of not less than 1,000 tons of ore, or more if required.

(b) An available millsite to which the ore could be cheaply delivered, and from which concentrates could be shipped to market, with adequate spreading ground for tailings-disposal.

(c) An available supply of miners and mine-labor at reasonable wages.

(d) Low cost power.

(e) Mining supplies and materials at nominal cost.

A careful and painstaking survey convinced the writer that all of the foregoing questions could be safely answered in the affirmative, and he advised that the exploratory development be undertaken. This was accordingly done, and the preliminary work begun June 1st, 1936, and continued with occasional forced interruptions until November 27th, 1937, when work was discontinued for lack of funds. In what follows, the writer summarizes his conclusions, as embodied in his report to Mr, Clarke, dated April 9th, 1936. He follows this with a more extended discussion of the geology, structure and character of the orebody, and his conclusions in the light of the disclosures made in the course of the development which has thus far been accomplished.

It will require at least 3,000 feet of adit and crosscuts, to determine whether or not further operations are warranted. (At this writing 474 feet of the Adit Have been completed.).

A. An abundant supply of water is available at and in the vicinity of Sand Springs. This water according to tests made is suitable for the flotation process of recovery, and is so located that it can be delivered to a suitable millsite at a reasonable cost.

B. An excellent millsite, with ample spreading ground for tailings, exists some three and one-half to four miles below the property at the mouth of Alum Gulch, at an elevation of about 4,500 feet above sea-level. This is about 1,800 feet below the working level at the mine, which is about 6,300 feet above sea-level.

C. Ore from the mine to the mill, and supplies to the mine can be delivered either by aerial tramway, or by surface tramway using electric haulage. The concentrates from the mill can be delivered by truck to either Goldfield, or Beatty, both about equally distant, ~~and thence either by rail~~ or truck to San Francisco or San Pedro, thence by water to the Atlantic seaboard, or other markets as desired. Trucking the concentrates to tidewater appears likely to be the cheaper, since both Goldfield and Beatty are connected with the Coast points mentioned by excellent, wide and graded highways which are paved throughout. The road from the mine to Goldfield is about fifty-five miles in length, unpaved, and some inexpensive road-construction will be necessary to make it serviceable for trucking. This also applies with equal force to the road to Beatty.

D. Experienced mine-labor is available at the pay-scale customary at Goldfield, Tonopah and neighboring mining centers.

E. Power for development must be supplied initially by gasoline driven engines, or better by Diesel installations. Later it may be obtained from the California-Nevada Power Company, by connecting with their transmission line about 25 miles distant, or what is more probable and to be preferred, by connecting with the proposed line to transmit electric power from Boulder Dam. If the latter becomes available as appears probable, the power cost would be very low.

F. Mining supplies and materials of all kinds are available at reasonable cost.

G. Climatic conditions favor continuous operations throughout the year.

In conclusion the writer believes the property here being considered to be one of unusual merit, warranting the necessary outlay to prove it up for subsequent mining operations, which if undertaken, promises to place it in the very front rank among important present-day producers of molybdenum, possibly rivalling that at Climax, Colorado, the largest now known.

Respectfully,

Consulting Mining Engineer,
Formeraly Chairman Southern Branch,
California Mining Association.

Molybdenum Deposit
Esmeralda County, Nevada.

This great deposit of molybdenum-bearing ore is situated in Esmeralda County, State of Nevada, about forty-five miles southwesterly, as the crow flies, from Goldfield, an important mining town on a branch of the Southern Pacific Railway joining the main San Francisco-Salt Lake City line at Fallon, Nevada. From Goldfield one may also drive to Los Angeles or San Francisco over a wide paved highway all the way, the distance being about the same to both cities, or approximately four hundred miles. Automobiles cover this entire distance easily in from eight to ten hours, and loaded trucks make the completed trip in less than a day and a night. The property is connected with Goldfield by a passable desert road over a distance of about fifty-five miles, fifteen miles of which is paved.

Topography.

The general region within which this property is situated is one of sharp relief. Rugged mountain masses with steep, or at times precipitous sides are separated by deeply incised canyons, or gulches, the whole constituting what is termed a young topography. This is particularly emphasized immediately surrounding the deposit under consideration. The elevation ranges up to eight thousand feet above sealevel, but falls off rapidly on the south into Death Valley, which sinks below sealevel in its deeper portions.

Climate and Vegetation.

The climate is that common to the region of the Great Basin in this latitude, being hot during the summer months in the lower reaches, but much cooler in the higher elevations. During the winter months the low lands are comparatively warm, while the higher elevations are cold with occasional snow and hard, freezing weather.

The entire region is arid and water is scarce, as a rule especially in the low, desert areas, but more abundant in the higher elevations where the snows fall and rain is more frequent. Here springs and water-holes are to be found, some of which flow throughout the year with an occasional small perennial stream flowing down some of the gulches to be lost and disappear beneath the surface in the sandy waste of the desert below. It is an interesting fact that in this great state of Nevada, only two small, inconsequential streams deliver their waters outside the state boundaries. The water falling as rain or snow remains almost in entirety within the state lines, except such as escapes through evaporation. The net result of this is that the waters drain off into the numerous basins, or low depressions and sinking into the ground remain, impounded usually at no great depth below the surface. Much of this is highly charged with alkali and is unfit for use.

Vegetation is scarce and mainly of the scrubby desert variety except in the higher reaches which support considerable growths of nut-pine and low branching cedars. The winter rains and snows are almost wholly confined to the high elevations, as stated, and are moderate in intensity causing little or no damage. The summer rains are very local and commonly of the cloud-burst type. They often cause destructive, torrential floods in the canyons and gulches which carry the runoff. They must be taken into careful account in planning mining operations to protect against serious damage. On the whole, however, the climatic conditions in the locality here considered are favorable for operations continuing throughout the year.

Geology.

The general formation of the locality in which this deposit is situated is granitic. An intrusive body of coarsely crystalline granite of bathylithic proportions has here been thrust up under a covering of paleozoic sedimentaries, only remnants of which now remain in the form of occasional roof-pendants tilted at varying angles and resting on the underlying granite. Limestone and shales, with occasional quartzite members are chiefly represented in these roof-pendants. After this large granitic magma came to rest it crystallized and congealed against the cold walls of its enclosing rocks. The result was to form a chilled shell of solid granite of indeterminate thickness along the contacts marginal to the body of the granite as a whole and enclosing within it the still highly heated mass of molten granite below, or within the body of the parent magma. Later the outer chilled shell of this granite intrusive was ruptured, and the great fissure formed was immediately filled by the still molten parent magma forced into it from below. This becoming solidified formed a huge dike having a length of more than ten thousand feet, and a width of upwards of three hundred feet. It strikes North-20 degrees West approximately and dips North-east at about 70 degrees. The dike-rock itself is porphyrytic granite with texture and composition very similar to that of the granite forming the walls of the fissure, differing from the latter only in the presence of quite large, intratelluric crystals of orthoclase, which are frequently twinned and generally idiomorphic. This fissure was again opened and a second intrusion of porphyrytic granite was formed on the hangingwall side of the first intrusive. This second porphyry intrusion solidified with a somewhat finer texture than the first, but carries the same idiomorphic crystals of orthoclase which give it its porphyrytic character. It also appears to be more silicious. Its width is about twice that of the first formed dike, the two together measuring a thousand feet more or less between walls.

A third movement again reopened this same fissure, but broke through the original porphyry filling about midway between the two walls to which it conforms in strike and dip. At the surface this third fissure was filled with a highly silicious magma, giving rise to an almost pure white quartz dike having in places a width of from one to two hundred feet, and a visible outcrop extending over a distance of several hundred feet. It will undoubtedly change gradationally into a more or less fine-grained, highly silicious porphyry with depth. It represents the end-phase in the crystallization and consolidation of the parent granite magma which gave it birth.

This centrally located quartz dike within the much larger main dike formed by the two first mentioned porphyry intrusions was apparently the source and active agent in the mineralization of the porphyry forming its walls. Its first effect was to crush and shatter the adjacent rocks making them permeable to mineralizing agents. Into the cracks, seams and fissures so formed, the silicious magma responsible for the quartz dike itself, would be forced, and accompanying mineralization braught about in the rocks affected. Also a more or less highly heated circulation of the groundwaters would be set up following the intrusion of the quartz dike, and this continued over a considerable period of time, would bring about more or less decomposition of the original primary minerals in the porphyry, with a corresponding development of new mineral combinations and secondary derivatives, as they now appear.

If the disturbance and shattering of the adjacent rocks, and their subsequent mineralization accompanied and followed the intrusion of the quartz dike, proceeding in fact from it, then it follows that the effects of this disturbance, and intensity of mineralization would be expected to become progressively less from the contact with the quartz dike outward into the enclosing porphyry. At the Nevada Deposit, this is precisely what occurs, and in this respect a strong analogy is afforded with the conditions at Climax, Colorado, as described by Butler, in(U.S.G.S. Bull.846-C.). At Climax the mineralization is stated to have been brought about by the intrusion into the granite and gneiss, which forms the country rock, of a large central body of quartz. The enclosing rocks were crushed and shattered as at the Nevada Deposit, and the mineralization extends outward in everydirection from the central quartz core into the surrounding granite and gneiss, gradually decreasing in intensity as the distance from the quartzecore increases. A point is finally reached where the values become too low for profitable mining, though mineralization still continues beyond. At Climax the central quartz core itself is too low grade to be worth mining. The same may be said with regard to the big quartz dike at the Nevada Deposit, as far as it has been explored.

Viewed at the surface the great dike which forms the Nevada Deppsit, like a homogenicous, bleached yellowish mass of altered and softened porphyry, forms a striking contrast with the enclosing granite with its much darker color tones. It forms a conspicuous feature of the landscape when viewd from a distance of many miles.

That this dike when formed, or subsequently, afforded the channel for the escape of imprisioned volcanic forces is evident. At least three distinct, though small volcanic cones occur at intervals along its course. From one of them, evidently the older, rhyolite and andesite was extruded. The remaining two are basaltic in type and much younger; are in fact comparatively recent.

The porphyry composing the dike-rock has been greatly altered from its original composition and texture. The entire mass, except the centrally located quartz dike, has been softened, decomposed and bleached. It weathers rapidly in contrast to the granite forming the walls of the great dike, and due to this erosion has scored deep into the outcrop. Certainly much of the original upper portion of the dike itself has thus been removed, and as seen today, the effects of this erosion are striking. As a result sections of the porphyry filling the dike-fissure have become exposed through a vertical range of as much as a thousand feet or more in one instance.

Fault movements have occurred both along the strike and across it. The cross faults have broken the dike into blocks which have usually, if not always, been tilted towards the south. The cross-faults are normal in type, and dip at about 70 degrees to the north. The lines of fault displacements control the drainage here, as generally throughout the region of the Great Basin. It is not believed that the faults in the Nevada Deposit will prove a serious obstacle to mining.

The faults are all post-mineral, and the slip-faces are slickensided. The latter appear over a considerable width usually, the porphyry on either side being crushed and altered to a tough,plastic clayey mass in the case of the strike-faults.

The rocks forming the walls of the great dike are altered and bleached for some distance out from the contact. This is is especially noticeable where sedimentary roof-pendants form the walls. Where granite forms the walls,which is generally the case alteration and bleaching is less conspicuous.

Erosion has cut deeply into the footwall side of the dike to a depth of a thousand feet or more below its outcrop on the hangingwall side. This has scored out a deep gulch, with steeply inclined sides. This follows closely the footwall of the big dike for a distance of several thousand feet; it then diverges from the dike and granite forms both walls of the gulch generally to its mouth. In the bottom of this gulch a small stream of alum-water constantly flows. This water issues from the porphyry dike at its northerly end and is known and mapped as "Poison Spring" on the U.S.G.S. topographic sheet. This water is,of course, unfit for use. Before it reaches the mouth of the gulch it sinks below the surface and disappears.

Character and extent
<u>of the mineralization.</u>

That this great porphyry dike in its entirely is heavily mineralized is at once apparent to the trained observer. The surface exposures of the dike-rock throughout show the characteristic colors of the oxidized salts of molybdenum, molybdite and molybdic ochre, the former being straw yellow and the latter a redish-yellow due to the presence of some iron salts. In places where the slopes are very steep, erosion has overtaken oxidation, in limited areas. These show primary molybdenite with much accessory marcasite, the latter in crystals of varying size. The molybdenite is always accompanied by more or less marcasite, but the marcasite, which is much the more abundant sulphide, often occurs with little or no molybdenite accompanying it. In the large quartz dike previously mentioned as cutting the porphyry in a course parallel to and close to the center line of the big dike, a short tunnel about fifty feet in length discloses several vughs in the quartz mass, all of which were filled with almost pure marcasite. These vughs range in size from a few inches across to as much as three and one-half to four feet in greatest diameter. Rich concentrations of molybdenite sometimes occur on the contact between the marcasite and the enclosing quartz, but does not appear in the body of the marcasite mass itself. This would suggest that marcasite was deposited first, and the molybdenite later. The quarts composing the mass of the quarts dike, is d dense and cryptocrystalline in character, much of it even amorphous and strongly suggestive of having been consolidated from an original silica gel, a common and characteristic end-product in the consolidation of granitic magmas. A finely crystalline, or amorphous coating of molybdenite commonly occurs along the fracture faces in the quartz, but does not appear to penetrate into the body of the quartz itself. This fact together with the ~~molybdenite occurring~~ in the marcasite vughs referred to above, supports the belief that the molybdenite was deposited from a hydrothermal circulation set up by and following the intrusion of the quartz dike, but that the marcasite was segregated from the silicious magma, or gel during the period of its cooling and consolidation, and was therefore formed before the molybdenite was deposited.

No copper or other accessory minerals have been found except for a trace of zinc of rare occurrence. In the sections of the porphyry which have been strongly silicified, a little gold is found, ranging in value as high as 60¢ per ton at the present price.

In all cases both the molybdenite and the marcasite are intimately associated with quartz, or strongly silicified rocks. The molybdenite is definitely not disseminated through the body of the porphyry, but always occurs in and along the margins of quartz veinlets, stringers or seams, or local segregations of quartz in the body of the dike-rock, and is almost invariably accompanied by more or less marcasite. The grade of the ore is thus determined by the frequency with which these quartz veinlets, stringers or seams and segregations occur in the rock affected. Where these are close together the values in molybdenum are higher than where they are widely separated. Here again there is a marked analogy with the ores at Climax where this same condition rules,-(See Butler, U,S,G,S, Bull, 846--C.).

In examining the surface exposures on this great porphyry dike, the mineralization appears to be distinctly stronger on the hanging-wall side than on the foot-wall side of the dike. That is to say, an adit driven to crosscut the entire width of the porphyry dike, starting in from the foot-wall side, would encounter the large, prominentquartz dike about midway between the two walls of the porphyry dike in a distance of approximately 500 feet. After passing through the quartz dike it would pass through 500 feet or more of porphyry to reach the hanging-wall of the big porphyry dike. All present indications point to the conclusion that this last 500 feet to the hanging-wall of the main dike should be the richer ground.

At the time of the writer's first visit to this property, no development of any consequence had been done anywhere on the property. What there was consisted of assessment holes, and short tunnels, none of which penetrated below the zone of surface oxidation. Examination was confined to surface exposures alone. These as has been stated showed unmistakable signs of wide-spread mineralization with oxides of molybdenum such as molybdite and molybdic ochre. The question to be decided at the time was whether or not this surface showing warranted the expenditure necessary to determine the quality and grade of the ore in the body of the porphyry below the zone of oxidation. What surface sampling had been done gave returns too low to justify mining, and unless a satisfactory grade could be developed with depth, the property was of no commercial value.

Litlestudy by competent engineers had ever been given to the origin and manner of occurrence of molybdenum deposits, for the very practical reason that only very recently had its importance as an alloy-metal become recognized, and the demand for it created. What little technical information was available embodied the conclusion, quite generally accepted, that the molybdite and molybdic ochre occurring in the upper, oxidized zone of any molybdenum deposit, being relatively insoluble, did not leach out, as for example in copper deposits, but remained where formed; that accordingly if sampling did not show the surface ground to be of profitable mining grade, no better values could be expected in the unoxidized or sulphide zone below. After a careful study of the surface exposures the writer became convinced that the conclusion quoted above had been too hastily reached; that under certain conditions such as those shown in the ground under consideration, leaching and removal of some at least of the molybdenum minerals in the oxidized zone, not only was possible, but had occurred. The reason for this conclusion follows:

On one of the exposed and very steeply inclined faces in the porphyry, an area approximately 200 feet high, and equally wide was found to be completely coated over with a thin crust of the water-soluble sulphate of molybdenum, Ilesmanite. The surface covered was moist, and in places wet, and back of the deep blue Ilesmanite crustation, molybdenite and marcasite showed plainly at the surface. Close inspection disclosed that the molybdenum sulphate had been derived directly from primary molybdenite accompanied by marcasite by oxidation in the presence of water. Further investigation also showed that this mineral, Ilesmanite, was to be found in many widely separated places in the porphyry exposures; that in fact it was a development common to the deposit as a whole. As the characteristic blue color of this mineral shows only where it is wet or moist, but bleaches almost white when perfectly dry, its presence could be easily overlooked where the latter condition prevailed, which in the hot,arid locality of the deposit, was very general. Until its importance became fully recognized, the writer passed over many such exposures without recognizing them for what they were. Again in certain protected situations, such as crevices and small cavities in the porphyry, finely formed crystals of impure molybdite, small but unmistakable, were found, which it appeared could only have been formed by crystallizing out from solution. Inasmuch as the molybdenum was found to exist in the form of its soluble salts, in the zone of oxidation, that these salts could be and in fact had been leached out to some extent at least at and close to the surface, appeared certain. If this was, as it appeared, true, then surface sampling could not be taken as representative of the orebody in its entirety, but better values were reasonably to be expected below the leached zone. Subsequent exploratory development, while not yet conclusive, strongly supports this conclusion as stated above. While the porphyry at and near the surface in the deposit here considered has undoubtedly lost some, if not a very considerable part, of its originally contained molybdenum through leaching and weathering, no clear evidence of secondary enrichment of the primary ores in the sulphide zone with molybdenum in soluble form working down from the oxidized zone above has thus far been observed. Some of the crystals of marcasite in the sulphide zone are coated over with what may be a very thin film of molybdenite, which may be of secondary origin, but this is not as yet proved.

The porphyry composing the great dike has suffered very considerable change in the character of the minerals originally formed. The feldspar has been largely altered to kaolin, and sericite has been extensively developed over wide areas. Accompanying this sericitization molybdenite usually occurs distributed through it, but always in close association with quartz, the latter generally in the form of small veinlets or stringers. The ferromagnesian minerals originally present have become converted into chloritic and talcose derivatives, with a little epidote occasionally appearing. Much of the original potash in the feldspar has been recombined to form alum, or alunite and jarosite. This is perhaps the most universal and important change which has occurred in the dike-porphyry. The silica set free in the process has been added to that originally present as quartz, or as silicious replacements of the original minerals present, while much of the potash and alumina has been leached out in the form of soluble sulphates, alum etc. This is, of course, especially pronounced in the oxidized zone, and the net result of all this has been to render the residual, leached rocks more highly silicious than in their original state. Below the level of the permanent ground-water, these decomposition products will probably be less conspicuous, or disappear altogether. It is note-worthy that the areas of more intense seritization are the richer in molybdenite, a fact that can be made useful in the search for ore.

Present Development.

For the purpose of determining the character and grade of the ore in the porphyry dike below the zone of oxidation, it was decided that an adit should be driven to crosscut the entire width of the great dike at the lowest accessible point. The point selected was the only one available when considered from the standpoint of accessibility, location of a campsite, water-supply and delivery of necessary supplies and materials at reasonable cost. Moreover, if the grade of the ore shown in the proposed adit was such as towarrant commercial operations, the ore could be delivered to an excellent millsite situated from three and one half to four miles below the camp at the mouth of Alum Gulch, either by aerial tramway, or surface haulage, as circumstances dictated, and water from the only available supply in quantity and character suitable for big tonnage operations, could also be delivered to the mill at a reasonable cost for pumping.

An adit started at the point selected would start an the footwall side of the dike, and should reach the hanging-wall in a distance of approximately 1,000 to 1,200 feet, more or less. From this adit laterals could be driven into the orebody on both sides at intervals, and from these raises could be made to block out tonnage. It was believed that approximately 3,000 feet of under-ground work would technically block out sufficient ore to warrant the construction of a mill of not less than 1,000 tons daily capacity, which could be increased as circumstances warranted. It was clearly recognized that the money going into this exploratory work was a risk which had to be taken, and that if the results of its expenditure were negative, would be lost.

Surface indications also indicated that the first two, and possibly three hundred feet of the adit would have to pass through a more or less barren section of the big dike, before ore of sufficiently high grade could be expected to be encountered, but that when once found, it should continue to the hanging-wall, interrupted only by the centrally located quartz dike through which the adit would pass. Commencing at the portal, the adit would gain progressively increasing depth below the surface as it advanced. The face of the adit when it reached the hanging-wall of the porphyry dike would be close to 1,000 feet below the surface.

Before the adit could be started it was necessary to build a road about nine miles long over which machinery,materials and supplies could be delivered, and a camp constructed with buildings for housing men and machinery. Water had to be developed and brought in for domestic and mining purposes, after which the mine equipment could be installed and actual exploratory development begun. Completion of all this consumed several months time, and a very considerable outlay in money. By July, 1937, everything was in readiness, and work on the adit begun. This continued without interruption until November 27th, 1937, when all work ceased for lack of funds.

For the first hundred and fifty feet in, the adit was carridd seven feet high and five feet wide inside the timbers. The width was then narrowed to four feet and so continued to its present face located 474 feet from the portal. Much of the adit required timbering, and occasional stretches of heavy ground were encountered which necessitated the use of head-boards and spiling. Water also appeared before the adit had advanced very far and this increased as the work progressed until a steady stream of alum water flowed out into the gulch below the portal. The ground broke well as a rule, but showed a tendency to become loose and run at times requiring to be quickly caught up and the timbers reinforced. The timbers used were 6" x 6", and 8" x 8" sawed pine, with 2" x 12" sawed lagging. The native timber was unsuitable for the purpose.

Every foot of the adit as far as it has been driven showed some molybdenum, mainly in the form of the sulphide,molybdenite. For the first 220 feet in from the portal,the average of all the samples taken carried less than one-tenth of one percent of molybdenum. The succeeding 111 feet, averaged -0.41% MoS_2, and following this the adit penetrated a more or less completely barren rib or horse of granite for a distance of fifty feet or more, after passing which the ore came in apparently better than before and continued to the present face which is in the best ore yet encountered, judging from its appearance. Owing to the sudden and unexpected stoppage of work, a section of the adit for a distance of about 100 feet, measured from the present face back, has not been properly sampled, and no definite figures relating to its grade are at present available. However, the rock broken in this unsampled section of the adit carries easily recognizable molybdenite in greater quantity than that shown in any previously encountered in the adit judging from its appearance. This is particularly true in the face of the adit and for a few feet back. As the adit was approaching the quartz dike responsible for the mineralization of the porphyry on either side, this increase in the showing of molybdenite was anticipated, and should continue to and after passing through the quartz dike referred to. In fact, judging from surface indications, the porphyry after passing through the quartz dike, should carry an even better grade in molybdenum,than that encountered before reaching the quartz dike.

It had been originally planned to make a careful, systematic and thorough sampling of the ground passed through after completion of the adit. Such sampling as has been done was for the purpose of gaining sufficient advance information as to the values shown, as could be used in justification of continued exploratory development, rather than to establish the average grade of the ore. The unexpected illness and passing of Mr. Clarke, who originally sponsored the undertaking, defeated the original program. Enough has, however, been learned to make it reasonably certain that the adit has entered an orebody of commercial grade, which there is strong ground for believing will improve as the adit is advanced.

Potential Ore.

No present estimate of the possible tonnage of profitable ore contained in this great deposit can be justified. All that can be safely said on this point is that it gives promise of running into high figures representing many millions of tons. There exists in this deposit a strongly mineralized body of porphyry more than ten thousand feet in length and upwards of a thousand feet in width. It contains a vertical exposure of approximately a thousand feet. This porphyry everywhere shows more or less molybdenum in the form of its oxide, and also the sulphide at the surface, the latter in steep faces where erosion has overtaken oxidation. The sulphide is predominant below the zone of oxidation, as clearly shown in the adit, and is evidently of primary origin. The water-soluble sulphate, Ilesmanite also shows in many places, testifying to the susceptability of the deposit to leaching out of its original molybdenum content more or less at and for a varying distance below the surface. As an example of samples taken at the surface the following by an accredited engineer of standing, Mr. C. E. Hill, is offered:

Mr. Hill sampled a total of 941 feet of cuts representing an orebody 3000 feet long, 300 feet wide, and an assumed 150 feet in depth. These samples were assayed by Abbot A. Hanks, of San Francisco, a chemist of high standing. The average of all the samples taken and computed on the weight basis, gave 0.525% MoS_2. On the figures given above, the tonnage represented was nine millions. Of this Mr. Hill says in explanation:

"No definite tonnage is assured, but the surface indicates a body of ore totalling 9,000,000 tons, assaying 0.52% MoS_2."
This block of ground assayed by Mr. Hill, is but a small fraction of the deposit as a whole.

An analysis of an unidentified sample of the surface ores, made by M. Eisenhauer, a reputable chemist is as follows:

No Arsenic. No Antimony. No Copper. No Lead.

MoO_3-(Molybdite in surface sample.)	1.48%
Fe_2O_3,	4.01
Al_2O_3,	16.99
CaO,	1.34
MgO,	Trace.
ZnO,	0.41
SO_3, (Sulphuric Anhydride.)	2.13

CO_2, (Carbonic Anhydride.)	1.04%
SiO_2,	72.30
Total Water,	1.68
	101.38

The MoO_3 shown at 1.48% in the foregoing analysis, is much too high to be representative, and as such should be disregarded.

Factors involved in
Mine-operation.

The working level at the portal of the adit is close to 6,300 feet above sea-level. The apex of the deposit attains an extreme elevation of close to 8,000 feet.

The portal of the adit is about 20 feet above the bottom of Alum Gulch immediately below. Alum Gulch drains into the extreme northerly end of Death Valley about four and one-half miles distant in a southerly direction. It is through this gulch that the road leading into the camp was built. The camp is situated on a wide,protected bench along Alum Gulch, about a quarter of a mile below the portal of the adit, with which it is connected by a graded road. The average grade of the road through Alum Gulch is seven percent. Excellent water for camp purposes is obtained from springs issuing from the granite in a small gulch which branches off from Alum Gulch on its western side a short distance below the camp.

A good millsite comprising 160 acres of ground has been filed upon just below the mouth of Alum Gulch. There is ample spreading ground for tailings disposal, and the topography is favorable for mill-construction. This millsite is also conveniently situated for the delivery of ore from the mine, and bringing in water for mill use. A passable road connects the millsite with Goldfield in a distance of approximately fifty-two miles, eighteen of which is paved. Goldfield is connected with San Francisco, and also with Eastern Markets by rail. The Port of San Pedro can also be reached in about the same distance, by routing through the town of Beatty, the distance from the latter to the millsite being a little longer than that to Goldfield. The haul from the millsite to either San Francisco or San Pedro is about 400 miles, and from both places water-transportation to Eastern Markets, or to foreign ports is available. Transportation of concentrates out and supplies in can be made from the two places mentioned by rail, or truck haulage as desired, and at all times throughout the year.

Water for milling purposes can be obtained in any desired amount, from the vicinity of Sand Springs. These Springs have been withdrawn from entry by the Government, but the writer was assured by the U,S, Deputy Water-commissioner, that water could be obtained from them by any bona fide operating company upon proper application. But considering this, the writer carefully investigated the possibility of obtaining water entirely outside of the withdrawn area, and reached the firm conclusion that such water was available, and at even less cost than if brought from the springs themselves. This conclusion is based upon the following:

Over an extensive catchment area in the high mountains overlooking the northern end of Deah Valley, rain and snow fallXs during the winter months, and brief, torrential rains are common in the summer. The natural drainage channels, --canyons, gulches, and ravines deliver this water into Death Valley at its northern extremity where it promptly sinks out of sight in the valley-fill. An extensive lake formerly existed here in which a considerable thickness of sediments accumulated now recognizable in the form of a series of clay-beds which covered the bottom of the lake. At a later period a fault movement took place across the upper end of the valley. The effect of this movement was to up-tilt the clay-beds across the line of drainage, and in such a way as to effectually dam back the underground flowage of the accumulated waters towards the lower region to the south, so that the waters entering the valley from the mountains to the north, are caught and impounded by this relatively impervious clay barrier. Capillarity and surface evaporation keep the surface dry, but below the surface and at no great depth there exists a vast reservoir of water standing at the level of Sand Springs which lie along the fault referred to, and from which the water flows out on the surface of the valley. These springs represent the spill-over from this underground reservoir, at its underground level. Wells drilled almost anywhere in the valley above, or north of this fault should encounter an abundance of water at comparatively shallow depth. Tests have shownthis water to be suitable for use in flotation concentration. The elevation at Sand Springs is a little over three thousand feet; that at the millsite is about one thousand, eight hundred feet below the adit-level, and thus about fifteen hundred feet higher than Sand Springs. The water would, of course, have to be pumped from the wells to the mill, over a distance of three miles or less. After use in the mill much of this water would be returned into the same reservoir from which it originally was pumped. That such a method of obtaining water for large milling operations is entirely feasible is attested by its having been so obtained at some of the large porphyry copper mines in Arizona, notably the Inspiration Mine in Gila County, Arizona. The great Climax Mill in Colorado, brings its water over a distance of six miles, and delivers it at an elevation close to eleven thousand feet above sea-level.

The power used at the mine during its development stage must be obtained by the use of internal combustion engines, preferably of the Diesel type. For commercial operations on a large scale it can be obtained from the California-Nevada branch of the Southern Sierras Hydroelectric Power Company, by building a connecting transmission line about 25 miles long, or what is more probable, by connecting with a proposed transmission line from Boulder Dam. When this becomes available, it would afford power in any amount and at very low rates.

Costs.

A recent annual report to its stockholders by the Climax Company in Colorado, shows an over-all cost per ton for mining, milling and marketing its molybdenum, of a fraction under $2.00 per ton. This cost also covers insurance, state and federal taxes. Taking this cost per ton as the basis, and assuming that it can be duplicated on a comparative basis of daily output, the following figures are instructive:

(1) Assume the ore to carry 1% MoS_2, (Molybdenite.) per ton, 90% recovery, and the current price as of this date at 45¢ per pound MoS_2., price f,o,b, Pittsburg,Pa.

I ton ore @ 1% contains 20 lbs, MoS_2.

90% of 2o lbs, is 18 lbs, net per ton recovered.

18 lbs, @ 45¢, is $8.10, or the value in 1 ton of ore.

$8.10 less over-all cost of $2.00 per ton, gives $6.10 as the net value of 1 ton of ore as mined, and milled.

1000 tons ore mined and milled per day, on the above figures will yield a net operating profit of $6,100.00 per day.

$6,100.00 x 300 -(Assumed working days in a year.)- gives $1,830,000.00 per year net operating profit, or 10% on an investment of $18,300,000.00.

(2) Assume the ore to carry an average of 0.5% MoS_2, or 10 lbs, per ton of ore as mined and milled. Then on the same basis of recovery and selling price of the metal as shown above in example (1), we have the following:

1 ton of ore has a gross value of $4.05.

$4.05 less over-all cost per ton, $2.00 gives a net operating profit per ton of $2.05.

The net operating profit on 1000 tons per day mined and milled will be $2,050.00, and this gives a total per year of 300 working days of $615,000.00, or 10% on an investment of $6,150,000.00.

From the foregoing it appears that the Climax Company can show a substantial operating profit on ores running less than one-half of one percent per ton of crude ore.

As the conditions governing mining, milling and marketing costs at the Nevada deposit, will compare favorably with those at Climax, and are perhaps even better, there appears no sound reason to believe that the figures given above will not apply to the Nevada deposit, all based, of course, on a corresponding scale of production, if and when attained, and at the present market price for the metal.

It will be recognized that the enterprise here offered is one of great magnitude, and will entail a correspondingly large initial outlay to bring it to a successful issue. The requirements for preliminary development will be comparatively small, and should result in guaranteeing the safety of the larger investment to follow.

Respectfully,

Consulting Engineer.

Los Angeles, California.
October 16, 1937.

The following is a true and complete record of each and every Certificate of Assay received by Edward W. Brooks, Trustee, Nevada-Moly property from samples submitted by him to W.S.McRea, Assayer, of 747 South Hill St., Los Angeles, and Abbot A. Hanks, Inc., Assayers, 624 Sacramento St., San Francisco, California. All samples were general samples, broken, rolled, coned and quartered. None were hand picked.

ASSAYS FROM
W.S.McREA.

Office Number	Owners Mark	Date of Certificate	Per cent Molybdenum Mo	Percentage Molybdenum Sulphide
83614	Grabl # 1	7/20-37	0.07	
83670	Grab from muck pile (General) 23' in from portal set. Face generally oxidized and decomposed.	7/31-37	0.03	
83671	#3- 26'	7/31-37	0.03	
83672	#4 Drillings from 3 2' Lifters 26' depth	7/31-37	0.04	
83689	#5 Cuttings from 6 2' drill holes lower part of face 29' depth (Copper none)	8/5-37	0.05	
83693	#6 Cuttings from 8 2' holes in face	8/6-37	0.02	
83716	#7 Aug 2,37 8-2' holes	8/9-37	0.02	
83732	#8 Drillings from 10 holes	8/12-37	0.03	
83737	#9 6- 2' holes	8/13-37	0.02	
83841	#10 6- 2' top	8/31-37	0.03	
83842	#11 Cutting from 6 2'6" holes 42' in from face	8/31-37	0.04	
83843	#12	8/31-37	0.03	
83844	#13	8/31-37	0.02	
83845	#14	8/31-37	0.02	
83898	#16 75' In	9/7-37	0.02	
83899	#18 89' In	9/7-37	0.02	
83900	#19 95' In	9/7-37	0.01	
83901	#81 (Should be #17) 81' In	9/7-37	0.02	
83931	#20 103'	9/11-37	0.03	
83932	#21 110½'	9/11-37	0.02	
83933	#22 117'	9/11-37	0.03	
83934	#23 126'	9/11-37	0.03	
83964	#25 139'	9/17-37	0.02	
83965	#26 146'	9/17-37	0.02	
83966	#28 9-10-37	9/17-37	0.01	
83967	#29 157'	9/17-37	0.02	
83968	#30 164'	9/17-37	0.03	
84031	#34 197'	9/27-37	0.02	
84032	#35 203½'	9/27-37	0.01	
84033	#36 209'	9/27-37	0.02	
84034	#37 215½'	9/27-37	0.02	

ASSAYS FROM ABBOT A. HANKS, Inc.

Labty No.	Owners Mark	Date of Certificate		MoS_2
73806	#22	9/18-37		0.21
74289	#31 173'	9/28-37		0.07
90	#32 180½'	9/28-37		0.63
91	#33 188'	9/28-37		0.31
74790	#39 234½'	10/9-37		0.04
91	#40 Face 239'	10/9-37		0.07
74626	#38 222 ft	10/12-37		0.15
75010	#41 Face 248'	18/12-37		0.25
11	#42 Face 256 ft	10/12-37		0.31
75163	#43 Face 264	10/14-37		0.35
64	#44 Face 271	10/14-37		0.47

N.B. This list is incomplete, as the Adit is in 474 feet, but is fairly representative of the whole. Last 100 ft or so of the Adit, shows somewhat better.

Merrill Nibley
1430 Chapman Building,
Los Angeles, California
Phone Tucker 4674

R E P O R T O N T H E

R. B. S O R E N S E N M O L Y B D E N U M P R O P E R T Y

(Esmeralda County, Nevada)

----oooOooo----

SULPHUR COMPANY QUITS WORK AT ALUM GULCH

GOLDFIELD, Nev., April 6 (Special)—The Freeport Sulphur Company, which has been conducting extensive exploration operations on the Nevada Moly, a molybdenum property in Alum Gulch, fifty-seven miles south of Goldfield, abruptly suspended operations this week and laid off practically the entire force of men.

This may mean that the option will be surrendered. The Freeport Sulphur took this option August 5, 1939, from the owners of the Sorenson and Roper groups of claims for a total sum of $425,000, with payments extending over a period of five years, the first heavy payment, $20,000, being due April 5 of 1940.

The company has been driving a tunnel from the bottom of the hill into the Roper group and also running the diamond drills from the top of the hill, employing altogether a force of seventeen men. The tunnel has reached a distance of over seven hundred feet into the Roper ground. This unlooked for action is a great disappointment to Esmerald County, as it was understood that results so far had been satisfactory.

COPY

CERTIFICATE OF ASSAY

ABBOT A. HANKS, INC.
ASSAYERS, CHEMISTS, ENGINEERS
624 Sacramento Street

SAN FRANCISCO

SAMPLE OF O R E DEPOSITED BY I. P. Carpenter.

Labty. No.	Mark	GOLD, per ton of 2,000 lbs. Troy Ounces	GOLD, per ton of 2,000 lbs. Value @ $20.67 oz.	SILVER, per ton of 2,000 lbs. Troy Ounces	SILVER, per ton of 2,000 lbs. Value @ ¢. oz.	PERCENTAGES
77848	No. 1		$		$	Molybdenum - 0.47%
49	2					" 0.47
50	3					" 0.62
51	4					" 0.67
52	5					" 0.30

5/25/32 50

ABBOT A. HANKS, INC.

/s/ Abbot A. Hanks.

(SEAL)
JD

REPORT ON THE SORENSEN MOLYBDENUM PROPERTY
ESMERALDA COUNTY, NEVADA

LOCATION:

Approximately forth-five miles southwesterly of Goldfield, Esmeralda County, Nevada, or two miles from the Nevada-California boundary line. (Good road all the way to property, six miles off of main highway)

PROPERTY:

The Molybdenum group of claims consists of ~~nine~~ Eleven mining locations.

GEOLOGY:

The molybdenite formation strikes north 45 degrees west; it being almost free from overburden for the entire length of the formation, and pitches north 15 degrees east. The greatest width of this formation is 2,200 feet, while the narrowest is in excess of 400 feet.

The country rock one side of this vast formation is a granite and on the other side of this formation it is a mixture of grano-diorite, lime and porphyry.

The gangue minerals are quartz, and altered feldspar, muscovite and boitite mica, containing molybdenite, pyrites, small amounts of calcite and other minerals of the grano-diorite rocks.

The molybdeite is disseminated throughout the mass and is intimately associated with quartz and pyrites. However, it is much richer when it occurs in the vugs or crevices where the brecciated zones of the grano-diorite occur.

The main body containing the valuable minerals is of such a physical character that it readily breaks down, therefor the cost of mining and preparing the ore for extraction is brought down to minimum.

See copy letter from Pan-American Engineering Company, who have made a floatation test; also analysis by Ed. Eisenhauer, Metallurgist.

ESTIMATE OF ORE:

In estimating one block of ore (the southeast face) which would be on the claims arbitrarily numbered 1-2-3-4, (carrying the best of molybdenum ore) which block stands at an angle of 50°, I find that I have ore in the amount as follows;

> 2,200 feet of width; 850 feet of vertical depth by a definitely known length of 75 feet; the cubic area of which is 2,200 x 850 x 75, or 140,250,000 cubic feet. Taking 15 cubic feet as the basis of one ton, I have 140,250,000 cubic feet divided by 15 cubic feet equalling 9,350,000 tons in one block of ore.

SAMPLING:

A channel was cut about five pounds to the foot over a distance of one hundred fifty feet and quartered down to five pounds, which gave an assay return of 1.54 molybdenum sulphide.

At another place on the deposit (the north west end) a channel was cut five pounds to the foot over a distance of two hundred feet in width and three hundred feet in height, giving an assay return of 1.68 molybdenum sulphide.

Another assay was made from a composite sample cut by channels over five hundred feet in width and five hundred feet in heighth; in the center of the 2,200 foot face, giving an assay return of 0.91% molybdenum sulphide. I will use the result of the composite sample is calculating the MO S2 content of the block of ore.

The above sampling was done at points where especially high grade material could not be expected. Other samples which were chosen with special care appear to carry from 3% to 7% molybdenum sulphide. No assays have been made from such samples, however, as it has not yet been ascertained how great a proportion of the ore body contains this high grade molybdenite.

I do not hesitate to say that you will be able to mine, without selectivity, ore that will run in excess of 1 percent MO.S2.

Taking 9,350,000 tons x 18.2 pounds (0.91% MOS2 equals 18,2 pounds) we have in the block of ore 170,170,000 pounds of MO S2.

The run-of-mine ore has a ten percent moisture content.

NOTE: The market price of molybdenum sulphide concentrates is quoted in the various mining journals at from 42 to 45 cents per pound, f.o.b. Atlandtic Seaboard points but you will find on further investigation that the real price is approximately 30 cents.

METHOD OF MINING:

It is my suggestion that this deposit be worked by the GLORY HOLE method. From a careful study of this body of ore, taken in addition to a study of the ore assays, I do not hesitate to now vouchsafe the opinion that the ore which is made available from this deposit will average from 1% to 2.5% molybdenum sulphide, and without selective mining methods. The 50 cents in Gold must not be overlooked as the Gold is free.

The ore is readily crushed and with ease put to 100 mesh. Floatation is the proper method of separating the concentrate, and any standard floatation unit will do the work; Kraut, Groch or Callow. See Kraut letter.

The run-of-mine ore would not exceed 8 inches to 10 inches maxium size and I feel that 75% would readily pass through a grissly with one and one-half inch space.

COST OF MERCHANDISING:

It is hard to realize the magnitude of this property, but a study of the photo (Photo No.) will show that it is more vast than anything yet known to the mining world, in the way of Molybdenum.

However, I have set an arbitrary figure of 10% of gross receipts as the cost of merchandising can be accomplished for and it affords a large margin of safety.

I figure the production cost per ton of ore as follows:

Mining	$ .50	
Milling	.25	
Classifying, floating, filtering, drying, and sacking	1.00	
Supplies	.15	
Assaying	.10	$2.00
Reagents	.10	
Sacks @ 14¢ ea.	.07	
Fuel for drying	.02	
Incidentals	.15	.40
Power 200 HP Diesel	.25	.25
Incurance	.03	
Superintendence	.05	
Overhead	.02	.10
TOTAL COST PRODUCTION PER TON ORE		$2.75

A copy of an analysis of ore from this property follows. These are made by Ed Eisenhauer, Jr. Assayer-Metallurgist-Assayer, 535 Phillips Building, 224 South Spring Street, Los Angeles, California.

Subject: Analysis of sample of ore.

Arsenic Pentoxide - - -	As 2 0 5 - - -	none
Antimony " - - -	Sb 2 0 5 - - -	none
Copper Oxide - - - - -	Cu 0 - - - - - -	none
Lead 0 xide - - - - -	Pb 0 - - - -	none
Molybdenum Trioxide - -	Mo 0 3 - - - -	1.48%
Ferric Oxide - - - - -	Fe 2 0 3 - - -	4.01%

Aluminum Oxide	- - - -	Al_2O_3 - - -	16.99%
Calcium Oxide	- - - -	Ca O - - -	1.34%
Magnesium Oxide	- - -	Mg O - - -	trace
Zinc Oxide	- - - - - -	Zn O - - -	0.41%
Sulphuric Anhydride	- -	S O 3 - - -	2.13%
Carbonic Anhydride	- -	C O 2 - - -	1.04%
Silica	- - - - - - - - -	Si O 2 - - -	72.30%
Total Water	- - - - - - - - - - -	- -	1.68%
	Total	- - - - - -	101.38%
	Less Oxygen for Sulphur	- - -	1.35%
			100.03%

Platium	None	Osmium	none
Palladium	None	Silver	trace
Iridium	None	Gold - - - - - - - - - -	.025 oz.$.50

Respectfully submitted

Signed - Ed Eisenhauer, Jr.

Subject: Sample of ore.

Molybdenum --------------------------------.99%

Equivalent to:

Molybdenum Sulphide (Mo S 3) 1.98%

Respectfully submitted

Signed - Ed. Eisenhauer, Jr.

Subject: Sample of ore.

Molybdenum ------------------------------1.01%

Equivalent to:

Molybdenum Sulphide (Mo S 2) 1.68%

Respectfully submitted

Signed - Ed. Eisenhauer, Jr.

Subject: Sample of ore.

Molybdenum Sulphide (Mo S 2) -----------0.91%

Signed - John Herman.

Note: The latter assay by John Herman, Los Angles - Assayer

ELEVATION:

The average elevation of the property varies from seven thousand feet at the camp site to sixty-one hundred feet at the floor of the canyon, and from the property a view of Death Valley for one hundred miles can be had.

TITLE:

Title to all of the molybdenum locations has been perfected in accordance with the United States Mining Statute and the mining laws and customs of Nevada ; the "NOTICES O F LOCATIONS" of which are duly recorded in the Mining Records of the Recorder's Office of Esmeralda County, Nevada.

WATER:

The owner has filed title to spring water for domestic purposes, which is three thousand feet away from the property. There is also water on the property for milling purposes.

NATURAL RESOURCES AVAILABLE FOR
EXPLOITATION OF THE MINING PROPERTY:

The land all about the mining locations is wooded with juniper and pines, which can be used for stulls, and which will save thousands of dollars on lumber bills a nd drayage. This is also available for camp use.