

Property File 020388
O'Connor River Gypsum

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114 P/10E

ADDITIONAL PRELIMINARY REPORT

on

O'CONNOR RIVER GYPSUM DEPOSITS

BRITISH COLUMBIA

1959

JAS. J. McDOUGALL, GEOLOGIST

Vancouver, B. C.
November 30th, 1959

ADDITIONAL PRELIMINARY REPORT

on

O'CONNOR RIVER GYPSUM DEPOSITS

Jas. J. McDougall - 1959

P R E F A C E

The following is a short report resulting from work done on the O'Connor Gypsum Deposits towards the end of the 1959 field season. More detailed descriptions appear in our 1958 report on the property, which should be used in conjunction with this one.

SUMMARY AND CONCLUSIONS:

Late in the 1958 field season an occurrence of good grade gypsum was discovered near the Haines Highway in Northwestern British Columbia. The discovery, which was staked, resulted from helicopter ground checking of a zone previously outlined by Super-Cub reconnaissance.

This past season the required assessment work was done on the claims, and preliminary mapping done on the showings.

The deposits as presently outlined should contain about 11,000,000 tons of gypsum, a large percentage of which could be mined from the surface. About half of this tonnage consists of unusually pure white material which is probably the result of low temperature thermal metamorphism.

1 9 5 9 INVESTIGATION AND RESULTS

Between the 10th and 15th of September a limited amount of packsack diamond drilling was done on the gypsum for assessment work purposes. This consisted of 5 short holes totaling 225 feet - plus a few blast holes. At this time of year most side creeks were dried up, and as the packsack pumps were unable to lift water more than a few feet, drill holes could not be placed advantageously. Due to near surface solution cavities and the softness of the gypsum, recovery was very poor.

All holes were stopped while still in white gypsum. The core from two holes collared in proximity to a basaltic dyke or sill(?) along the hangingwall on the only accessible portion of the Aunt Jemima east zone show scattered pyrite grains.

The occasional narrow band of anhydrite, only partially altered to gypsum, was noted in several of the drill holes. As the much harder, compact and granular textured anhydrite is totally recoverable in drilling, the amount present in the core in relation to that actually present in the deposit is greatly exaggerated.

Several of the drill holes were later blasted to obtain several hundred pounds of relatively fresh bulk samples.

Two days were spent mapping the two mineral zones with transit and stadia. As time was limited only the gyp-

sum contacts received any degree of attention.

Several small lumps of anhydrite the size and shape of footballs were found on surface in a gypsiferous zone north of the main Aunt Jamima Extension. The rims of these had been completely altered to gypsum with gradation inward. Two similar "kernals" were encountered near surface in one of the drill holes yet gypsum similar to that on the surface was evident to the bottom of the drill hole. Surface indications and inference from the drilling point to the deposits having been formed by alteration of an anhydrite body. However, unless that anhydrite presently found on the surface in proximity to gypsum has some special or unique resistive characteristic, the process of conversion was not that of simple surface weathering but more likely hydrothermal alteration associated with the nearby granitic and/or dyke-like intrusives. If this is true, the joints and bedding planes probably served as arterial channelways for such a process. The O'Connor gypsum then would not necessarily be expected to change into anhydrite at shallow depth as did the similarly high-grade Falkland Deposits in Southern British Columbia. The one 15' wide massive anhydrite band well exposed on the Aunt Jamima is not visibly altered to gypsum to any degree, although analysis show it to contain a small percentage of gypsum.

As can be seen by noting the relation of the various wall rocks on the map, the structural environment is not simple. A number of small(?) faults cut the area and there is evidence of close folding within the deposits themselves. The

bulging-out of the Aunt Jemima zone suggests that the sulphate bodies acted as a plastic under pressure. *(space rock - conversion anhydrite to gypsum ??)*

The better quality gypsum occurs as massive continuous bands (probably beds) up to thirty feet wide. These are snow-white and contain no visible impurity, although traces of anhydrite may be present. Some of the smaller bands are separated by small gray streaks of slightly less pure gypsum.

A brown or buff colored gypsum or gypsum-carbonate mixture is occasionally present near the edges of the white material and is best developed near the hangingwall of the Aunt Jemima Extension west of the river.

A gray to black, soft, highly altered rock quite common to all localities, although untested, is believed to be gypsiferous. In some places this rock, probably a gypsiferous shale, separates outlying gypsum bands from the main deposit.

Although of environmental interest because of their world-wide association with gypsum, especially in the Permian, the overlying(?) "purple beds" were not mapped. They consist of brick-red to light purple limestone breccias, sharpstone conglomerates(?) and carbonate beds. These are siliceous in part.

White limestone is the most common rock in this sulphate basin and has been almost completely converted to marble. Unrecognized anhydrite beds, which closely resemble those of marble, may be present within the area mapped. A fine-grained evenly textured black limestone which is best exposed on the mountainside above the Aunt Jemima Extension, contains

silicified forms resembling poorly preserved Fusilina fossils. These have yet to be examined by a paleontologist. However, the fact that we did collect well preserved crinoids, corals, and other fusilinids(?) several miles north along the Parton in similarly close proximity to granite lends support to the former as a legitimate fossil occurrence. All were common in the Carboniferous period.

Strontium Sulphate and/or Strontium Carbonate has been found in the limestones between the two main gypsum zones but the occurrence has not been seriously investigated.

Radiating clusters of a soft, white mineral resembling tremolite except for hardness are common in the limey rocks west of the river. These are often fibrous and in part are suggestive of mountain leather, an amphibole asbestos.

On the west bank of the river and on the corner across from the well-developed anhydrite band on the Aunt Jemima a small, several hundred foot wide, sill-like intrusive of a granitic rock of probable dioritic composition is well exposed. Because of the gravel river flats obscuring it along the strike, and offset by faulting, the extent of this member is uncertain. The sediments bordering this granitic rock have been silicified and otherwise metamorphosed. Within 100 feet of the contact pyrite and epidote are common. The fibrous amphibole(?) previously described was almost certainly formed as a result of this intrusive.

Only one intrusive has been recognized with cer-

tainty in the gypsum sequence itself. This is an 8 to 15' wide highly altered basaltic dyke which cuts across the Aunt Jemima deposit just above river level. Some of the now highly altered bordering rocks may be of igneous origin. A small poorly exposed granitic dyke-like body was seen near the lower exposures of gypsum on the Kim zone. This could be float. It is felt that the intrusives have in some way helped in upping the grade of gypsum although in certain local areas they have unfortunately contributed pyrite as an impurity.

ASSAYS AND RESERVES:

For the purposes of calculating grade and tonnage on the basis of present exposures the property has been divided into the following parts:

- (1) Aunt Jemima Zone (east of the river)
- (2) Aunt Jemima Extension (west of the river)
- (3) Kim Zone (about 3000' south of (1) and (2) and west of the river).

A factor of 13 cu. feet to the ton is used.

A. Aunt Jemima Zone:

Gypsum is exposed along a strike length of 1300' and varies in width from 70' to 250'. The minimum vertical extent, using the results of DDH #3, is about 580'. Probable tonnage to river level, if surface structure persists, is approximately 4.5 million tons.

B. Aunt Jemima Extension:

West of the river the mineral zone as exposed is 400 feet long with widths between 200 and 300 feet. Exposed vertical range is about 350 feet. To river level this deposit should contain 3,000,000 tons of good grade gypsum.

C. Kim Zone:

Exposures on the Kim Zone show a strike length of 1800 feet. Vertical extent is 480'. If surface dimensions persist to the 3250 ft. level this deposit should contain about 4,000,000 tons.

Thus a total of 11,500,000 tons of gypsum can be used as a reasonable minimum figure for reserves. Another 1,000,000 or 2,000,000 tons of low grade could be added to this. These figures make no allowance for possible but unlikely extensive underground leaching or for the small but important anhydrite content. It is thought that selective mining could eliminate much of the anhydrite. Also we are not absolutely certain that the anhydrite content will not increase with depth although our drilling showed no appreciable change to 63 feet.

Of the above, approximately half should be snow-white, impurity-free gypsum with only a small anhydrite content. In most cases this could be selectively mined as it tends to occur as massive, continuous bands near the center of the deposits. The remainder might contain minor gray bedding impurities although this would not seriously effect the overall good color quality when ground. Pyrite, even in

small amounts would be a dangerous impurity and sections containing it should be carefully noted.

Possibly two-thirds of the tonnage described could be mined by surface stripping or open-cut methods.

Total possible ore could be many times that indicated. Sink holes in overburdened areas along strike suggest that the Aunt Jemima deposits are continuous across the river and have a total length of at least 4800'. There is nothing to suggest that an average conservative width of about 100' should not hold throughout the overburdened areas. This zone then could have a tonnage factor of about 55,000 tons per vertical foot at river level. Depth expectancy is unknown. If the deposits prove more tabular than lens-like, there is no reason they should bottom at depths less than 500'. The Kim Zone does appear to bottom at the 3250' level but a 30' square gypsum outcrop is present along strike 2000' to the east of the last outcrop and is at elevation 2680'.

CONCLUSIONS AND RECOMMENDATIONS:

Our short hole diamond drilling has proven that there is no appreciable change in the gypsum at least to depths of 63 feet. Impurities appear limited to definite horizons and a large tonnage of good grade material is present.

Without our spending considerable money on a regular diamond drilling program nothing more of advantage can be done by us on the O'Connor Gypsum.

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Any gypsum company interested in this deposit can examine and test our drill core and bulk samples.

Following a rapid examination and survey, six of the previously located claims were allowed to lapse. 26 remain in good standing with three years assessment work recorded on the key Aunt Jemima claims and two years on all others which are known to contain gypsum.

*Quick analysis
Subtotal content 2690 cu
12 of 14 samples
100%*

Vancouver, B. C.

November 25th, 1959

Jas. J. McDougall, Geologist.

DIAMOND DRILL RECORD

SECTION FROM TO

DEPT # 1

LOCATION: LAT..... Aunt Jamina Extension.....
 DEP.....
 ELEVATION OF COLLAR 2850 ±
 DATUM.....
 DIRECTION AT START: BEARING..... Northerly.....
 DIP..... -40°.....

STARTED..... September 9th, 1959.....
 COMPLETED..... September 11th, 1959.....
 ULTIMATE DEPTH..... 63 ft.....
 PROPOSED DEPTH.....

DEPTH FEET	FORMATION	FROM	TO	WIDTH OF SAMPLE	% Recovery	AVERAGE IRON	S.	P.
0 - 10	Fine-grained white gypsum. 15% shows grey bedding lines @ 40°; possibly 5% anhydrite as band 6" in width			10 ft	60%			
10 - 20	Snow-white gypsum as above. 1% grey bedded			10 ft	75%			
20 - 34	15% of total core contains about 50% light grey anhydrite in single band. Remainder white gypsum			14 ft.	50%			
34 - 39	White gypsum. 1% slightly buff coloured (Co ₃ ??). Several inches of anhydrite.			5 ft.	75%			
39 - 63	Core ground. No worthwhile recovery. White gypsum in bottom of hole when abandoned due to caving.			24 ft.	5%			

DIAMOND DRILL RECORD

SECTION FROM TO

5

LOCATION: LAT. 80 ft. S.W. of DDH #1
 DEP. _____
 ELEVATION OF COLLAR 2910 ±
 DATUM _____
 DIRECTION AT START: BEARING Westerly
 DIP -70°

STARTED September 13th, 1959
 COMPLETED September 14th, 1959
 ULTIMATE DEPTH 58 ft.
 PROPOSED DEPTH _____

DEPTH FEET	FORMATION	FROM	TO	WIDTH OF SAMPLE	Recovery IRON	AVERAGE IRON	S.	P.
0 - 15	Snow-white gypsum - several inches of anhydrite in band at 14 feet			15 ft.	95%			
15 - 30	15-17 bluish-tinged translucent anhydrite - fine crystalline texture - shows distinct gradation to gypsum. 17-30 - Snow-white gypsum			15 ft.	40%			
30 - 41	White gypsum. 8 inches of anhydrite in band only partially altered to gypsum. One thin grey band at right angles to core.			11 ft.	25%			
41 - 58	Recovery very poor - core ground - white gypsum in bottom of hole			17 ft.	1%			
	S.B./B.D.							

DIAMOND DRILL RECORD

SECTION FROM '0.....

LOCATION: LAT. Northern edge of Hunt
 DEP. Jomina deposit
 ELEVATION OF COLLAR 3110 ±
 DATUM
 DIRECTION AT START: BEARING
 DIP Vertical

STARTED September 12, 1959
 COMPLETED September 14, 1959
 ULTIMATE DEPTH 63 ft.
 PROPOSED DEPTH

DEPTH FEET	FORMATION	FROM	TO	WIDTH OF SAMPLE	% IRON	AVERAGE IRON	S.	P.
0 - 10	75% white gypsum 25% micaceous, buff Co ₃ . Pebbles, etc.			10 ft	40%			
10 - 30	25% white gypsum 35% gypsiferous buff Co ₃ , etc. 20% gypsum with grey streaks (bedding?). Remainder buff pebbles, etc. Several distinct flakes of biotite(?) developed in some of the gypsum. Also occasional speck of pyrite plus another grey metallic mineral			20 ft	10%			
30 - 40	70% white gypsum, 20% grey anhydrite and buff dolomite. Grey bedding bands parallel to core.			10 ft	50%			
40 - 58	White gypsum - 10% slightly grey, 5% anhydrite in part			18 ft	25%			
58 - 63	Core ground - no recovery. Gypsum in bottom			5 ft				

NORTHERN MINER PRESS LIMITED, TORONTO

G.D./E.D.

Hole closely paralleled, single bed containing pyritic low grade material. Possible proximity to dyke or fault.

DIAMOND DRILL RECORD

LOCATION: LAT. North edge of Aunt Jemima
 DEP. deposit at base of hill.
 ELEVATION OF COLLAR 2720 ±
 DATUM _____
 DIRECTION AT START: BEARING Easterly
 DIP -30°

STARTED September 14th, 1959
 COMPLETED September 15th, 1959
 ULTIMATE DEPTH 50 ft.
 PROPOSED DEPTH _____

DEPTH FEET	FORMATION	FROM	TO	WIDTH OF SAMPLE	Recovery IRON	AVERAGE IRON	S.	P.
0 - 25	Casing drilled. White gypsum with occasional speck of pyrite caused by proximity to overlying basic dyke.			25 ft.	20%			
25 - 50	Core ground, but bottom in gypsum				1%			
<p>Note: Since logging of core additional "overflow" samples have been discovered, which, although not affecting the overall picture, will add about 20% core recovery to all holes except # 5</p> <p style="text-align: right;">J. H. / Dec 59</p> <p>G.D./R.D.</p>								

Property File
114P005
O'Connor River Gypsum

MEMORANDUM

TO: O'Connor River Joint Venture Management Committee
FROM: K. Galovich and D. D. Sharp, Queenstake Resources Ltd. (J.V. Operator)
DATE: 86-08-19
RE: O'Connor Gypsum Deposit Update

SUMMARY

During the months of July and August of 1986, Caron Diamond Drilling has completed the core drilling program of 2,265 feet (690 m) on the East Zone of the gypsum property located on the east bank of the O'Connor River canyon, some 11 kilometers west of Kusawak Lake in northwestern British Columbia.

The purpose of the program was to establish geological reserves in the East Zone, interpret the orebody, analyze the quality of gypsum ore, establish gypsum content and the gypsum-anhydrite contact in the deposit.

Altogether, 8 diamond drill holes of BQ and NQ core diameter were drilled at different elevations to various depths, probing for lateral and vertical extent of the orebody.

A tent camp, housing 10 persons was established at the drilling site some 0.8 km away from the gypsum outcrop. Drilling was carried out on a steep hillside with slopes of up to 35°. Access ramps and drill pads were cut out by a D8 CAT bulldozer on varying elevations from 1074m to 1192m above sea level.

The holes were drilled at an angle of 45° to 60° to depths of 70 - 108 metres. One vertical hole was drilled through the orebody to a depth of 148 metres.

The core was split on site and crushed in Queenstake's Warehouse in Whitehorse. Crushed samples were sent for analysis to Can Test Ltd's Laboratory in Vancouver for testing as prescribed by the ASTM standards for gypsum.

RESULTS

The drilling results indicated an orebody of 100 m in thickness, dipping at about 70° to the vertical, bounded by a fault on the hanging wall side and amphibolite/quartz-feldspar-porphyry rock on the footwall side. The sinkholes and small surface-ground-depressions that abound over the area indicate karst features of the orebody.

The gypsum ore is pure white and very clean through the sections from surface outcrop to 60 m in drilling depth. Below that depth the gypsum contains some impurities and the clean white color becomes grey and rusty. At drilling depths of 64 metres to 76 metres, a crude field test for gypsum-anhydrite contact has indicated the occurrence of anhydrite. This has yet to be confirmed by laboratory analysis.

Preliminary (field) geological interpretation of the East Zone drilling, sampling and mapping shows a true orebody thickness of approximately 100 metres in the upper section, narrowing towards the bottom, and vertical depth of some 60 metres, yielding geologically proven reserves of 3.0 million tonnes and probable reserves of up to 5.0 million tonnes.

The first results from the laboratory are encouraging, showing only a small percentage (0.03%) of sodium chloride (NaCl) from 98 samples through holes No. 1 and 2.

The orebody is amenable to surface mining methods (hillside contour mining). Some overburden stripping to a depth of 3-5 metres in depth is estimated to be required during the preparation and development stage. The waste rock removal to ore mining is expected to be in the order of 1:1 or more, depending on the final pit limits.

The sinkholes which are filled with barren detrital material will dilute the gypsum quality around them as will faults on the contact zones and pronounced lenses or tubular type impurities imbedded in the lower part of the orebody.

Rough estimates of mining capital and operating costs on the basis of needed equipment, maintenance and manpower have been calculated together with road access and land and marine transportation costs. These figures indicate that further engineering studies and planning will be warranted if the geologic interpretation and laboratory analysis delineate enough reserves of acceptable quality.

Drill hole cores as logged show the following:

Drill hole No. 1

Total depth 334' (102 m)

Dip: -60°

0 - 10.7 m gypsum

10.7 - 13.5 m sinkhole

13.5 - 60.6 m gypsum

60.6 - 71.3 m amphibolite sill

71.3 - 92.6 m gypsum with impurities

92.6 - 101.8 m quartz-feldspar-porphyry

Drill Hole No. 2

Total depth 230' (70 m)
Dip: -60°

0 - 2.4 Overburden
2.4 - 9.1 gypsum
9.1 - 11.8 sinkhole
11.8 - 29.9 impure gypsum
29.9 - 63 gypsum
63 - 70.1 quartz-feldspar-porphyry

Drill Hole No. 3

Total depth 345' (105 m)
Dip: -45°

0 - 3.2 gypsum
32.2 - 40.5 sinkhole
40.5 - 64.9 gypsum
64.9 - 68.8 amphibolite sill
68.8 - 74.6 gypsum
74.6 - 76.5 amphibolite
76.5 - 105 impure gypsum

Drill Hole No. 4

Total depth 90' (27.4 m)
Dip: -45°

0 - 18.3 limestone breccia
18.3 - 24.7 amphibolite
24.7 - 27.1 limestone
27.1 - 27.5 gypsum (hanging wall contact)

Drill Hole No. 5

Total depth 355' (108.2 m)
Dip: -60°

0 - 15.1 amphibolite
15.1 - 26.1 limestone breccia
26.1 - 32.3 gypsum
32.3 - 34.6 amphibolite
34.6 - 105.0 impure gypsum

Drill Hole No.6

Total depth 487' (148.4 m)

Dip: -90°

0 - 4.5 overburden

4.5 - 25.5 gypsum

25.5 - 46.9 impure gypsum

46.9 - 54.3 amphibolite

54.3 - 148.4 impure gypsum

Drill Hole No. 7

Total depth 220' (67.0 m)

Dip: -60°

0 - 23.2 amphibolite

23.2 - 29.9 limestone

29.9 - 48.5 faulted limestone, breccia

48.5 - 53.8 gypsum

53.8 - 67.0 faulted limestone, breccia

Drill Hole No. 8

Total depth 204' (62.0 m)

Dip: -60°

0 - 11.5 amphibolite

11.5 - 14.0 limestone, breccia

14.0 - 40.5 gypsum

40.5 - 62.0 amphibolite

WORK IN PROGRESS

A detailed geological report is now being completed. It will interpret the orebody geology, reserves and the quality of gypsum ore in the east zone of the O'Connor Gypsum Deposit.

The laboratory work is in progress on samples from holes 3 to 8 with some 300 samples to be analyzed for sodium chloride (NaCl), surface moisture, combined water, insoluble matter, iron and aluminum, calcium (CaO), sulfur trioxide (SO₃) and magnesium content.

A mining plan with costs incorporating engineering estimates and design for the mine equipment, crushing and screening equipment, and operating costs is being prepared in conjunction with geological interpretation.

The mining plan will include the proposed access road alignment and construction cost to the site from the Alaska highway turn off at the Kusawak Lake and the loading dock facility at the Port of Haines, Alaska.

An in-house study on marine transportation using barges and tugboats is presently ongoing. It will address the cost of barging including labour, insurance, customs, loading, off-loading, fuel, wharfage, dockage, storage, demurrage, barge sizes, backhauls, barging season etc.

A proposal for the access road to the site with baseline engineering including, terrain mapping, road alignment, road building specifications, drainage control and construction costs is being put together in-house for future discussions with qualified road builders and the government regarding possible subsidies.

SCHEDULE

The following shedule for the Phase I study is as follows:

	<u>Completion Date</u>
- Geological Report	September 1st, 1986
- Access Road Proposal	September 1st, 1986
- Mining Report	September 15th, 1986
- Marine Transport Study Report	September 15th, 1986

FUTURE WORK

It is recommended that if the preliminary engineering/feasibility study yields a positive recommendation for investment and development then the following work should be carried out:

- Market study (base line data can be collected by in-house staff).
- Discussion with the B.C. Government regarding grants/subsidies for the access road.
- Discussions with the town council of Haines, Alaska regarding dock facility and real estate needed for development by Queenstake.
- Discussion with appropriate B.C. Government departments regarding mine permitting, environmental concerns and mitigative measures, base line studies needed for mine approval such as fish, wildlife and water quality studies, reclamation etc.
- Pin down land transportation and marine transportation costs through competitive bids.

RECOMMENDATIONS

It is recommended that we concentrate the study efforts on the East Zone only, since the West Zone and the Kim Zone are not accessible to mining at present.

The West Zone itself requires a bridge over the O'Connor River Canyon and a costly road construction approach. The orebody would be difficult to mine because of very steep terrain and a slide area above. The West and Kim Zones are not considered in any near term feasibility but only as additional reserves for long term expansion of the project.

/sa
GYP prop