MAPS IN MAP DRAWER

Ore Reserves at the Navajo Fluorspar Mines near Grants, Valencia County New Mexico

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U.S. GEOLOGICAL SURVEY [Report - Open file series]

For Release April 4, 1944.

FLUORSPAR DEPOSITS OF THE NAVAJO MINES, NEAR GRANTS, VALENCIA COUNTY, NEW MEXICO

A preliminary geologic report, accompanied by mine maps, describing the geology and ore deposits of the Navajo fluorspar mines, located southwest of Grants, Valencia County, N. Mex., has been prepared by A. E. Weissenborn of the Geological Survey, United States Department of the Interior. According to an announcement made today from the office of Survey Director William E. Wrather, copies of the report and accompanying maps have been placed in open files at the offices of the Geological Survey in Washington, D. C., and in Rolla, Mo., where they may be inspected by those directly interested in the development of the deposits.

The Navajo mines, which are now controlled by the Zuni Milling Co., have been in operation for about 2½ years. During the first 2 years about 65,000 tons of acid- and metallurgical-grade fluorspar was produced, mainly from two parallel veins about 1 1/4 miles apart. The minable fluorspar in these veins occurs in ore shoots averaging 2½ to 4 feet in width. Calcite is locally abundant in the veins; quartz and sulfide minerals are relatively scarce. The country rock is a red granite, presumably of pre-Cambrian age.

Other veins, apparently similar to those from which the ore is being mined, occur in the area but have not been explored. This fact, together with the fact that many hundreds of feet along the two productive veins are not adequately tested, supports the expectation that future exploration and development will materially increase the tonnage of fluorspar reserves.

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Abstract

Between August 28 and September 2, 1943 an examination was made of the properties of the Navajo Fluorspar Mines for the purpose of ascertaining if an access road from Grants, New Mexico to the mines is justified. The properties of the Navajo Fluorspar Mines are in Valencia County, New Mexico approximately 22 miles southwest of Grants via State Highway 174. Practically all the production of the property has come from two veins known as the 21 and 27 veins which are found in a pre-Cambrian granite. The ore is hauled from the mine in Euclid diesel trucks which have a rated capacity of 30 tons, but which haul approximately 16 tons per trip. Part of the ore is treated at a jigging mill in Grants, and the rest, together with tailing from the Grants mill, is shipped to a flotation mill at Los Lunas, New Mexico. At present the Grants mill produces about 80 tons of metallurgical spar and the Los Lunas mill about 75 tons of acid spar per day. This production might be increased by providing additional capacity in certain sections of both mills.

It is estimated that the total reserves of the company's mines amount to 112,420 tons of measured, indicated and inferred ore with an average grade of 76.2 percent CaF_2 and 7.7 percent SiO_2. This does not exhaust the ore possibilities of the property controlled by the Navajo Fluorspar Mines for many hundreds of feet along the two productive veins have not been adequately tested, and other veins are known which have not been prospected.

A short section of the road from Highway 174 to the 21 mine probably will require relocation to eliminate steep grades. Aside from a few bad

places, the rest of the road is in fairly good condition and the ore trucks are hauling over it without undue difficulty. However, the road is deteriorating rapidly as a result of the transit of the heavy ore trucks and improvements will be required if traffic is to be maintained during the coming winter.

The New Mexico State Highway Department estimates that $75,000 will be required to recondition the road. It is concluded that the ore reserves and future possibilities of the mines justify this expenditure, but it is urged that consideration be given to a more limited program involving only repair of the bad sections of the road and relocation of the short section from the highway to the 21 mine. It is suggested that a more specific statement of the work intended and the estimated costs be submitted by the Highway Department.

Mr. James H. Mallory, mine superintendent of the Navajo Fluorspar Mines, Mr. Mallory made available mine maps, assay records and other data, and either personally assisted in mapping the underground geology or assigned a man for this purpose. His cooperation was greatly appreciated.

Location

The properties of the Navajo Fluorspar Mines are in Valencia County, New Mexico and are approximately [illegible] west of Grants, New Mexico. [illegible] contain a few hundred feet of the main workings of the 27 vein. The main workings of the 21 vein are approximately

Ore Reserves at the Navajo Fluorspar Mines near Grants, Valencia County, New Mexico

Introduction:

The United States Geological Survey has been requested to prepare an estimate of the ore reserves of the Navajo Fluorspar Mines for the purpose of determining if the construction of an access road to the mines of this company is justified. Mr. H. E. Rothrock, who is in charge of the Geological Survey's fluorspar work in the southwestern United States, would normally have made this examination. Due to the pressure of other work he was unable to do so and requested the writer to act in his place. Approximately five days, from August 28 to September 2, 1943, were spent in the field. Of this time about three and one-half days were spent mapping the underground geology. The rest of the time was spent in studying surface exposures, copying maps, and in discussions with Mr. James H. Mallery, mine superintendent of the Navajo Fluorspar Mines. Mr. Mallery made available mine maps, assay records and other data, and either personally assisted in mapping the underground geology or assigned a man for this purpose. His cooperation was greatly appreciated.

Location

The properties of the Navajo Fluorspar Mines are in Valencia County, New Mexico and are approximately 22 miles by road southwest of Grants, New Mexico. State highway 174 passes within a few hundred feet of the main workings of the 27 vein. The main workings of the 21 vein are approximately

2 miles north of the highway, and are connected with it by a branch road built by the company.

Transportation

After screening at the mine, the ore is hauled to Grants where it is either treated in a jigging plant or sent by rail to a flotation mill at Los Lunas, New Mexico. It is transported from the mine in Euclid diesel trucks which can haul approximately 16 tons per trip. The screenings are hauled in a smaller gasoline truck and are transshipped at Grants and sent by rail to Los Lunas. State Highway 174, which is a graded dirt road, is for the most part in fairly good condition at the present time. However, it is beginning to show the effects of the passage of heavily loaded ore trucks and there are a number of places which are badly in need of repair. It can be expected that the condition of the road will seriously deteriorate if haulage of ore is continued during the coming winter unless steps are taken to improve and maintain it. The branch road to the 21 vein has steep grades in places, and, in general, is in poor condition. Considerable improvement, and probably some realignment to eliminate the steepest grades will be necessary to permit winter transit of ore trucks over this branch road.

History

The ore deposits of the Navajo Fluorspar Mines were first investigated about two and one-half years ago by Mallery, now mine superintendent, who prospected an extensive area southwest of Grants, New Mexico. Early

exploration consisted mostly of trenching, and was financed by Mr. Taylor of Albuquerque, now president of the Navajo Fluorspar Mines. Shipments of hand-sorted ore from shallow open cuts on the outcrops of the veins started about two years ago. At present the Navajo Fluorspar Mines is producing from two veins (the 21 and the 27 veins) both of which have now been developed by extensive underground workings. Two mills are in operation; a jig mill at Grants produces metallurgical grade spar, and a flotation mill at Los Lunas produces acid grade spar. The Grants mill, which antedates the Los Lunas mill was to be dismantled on the completion of the latter, but because of the need for metallurgical spar, the War Production Board has requested that it be maintained in operation. This mill, which has a rated capacity of about 80 tons per day, formerly treated about 165 tons of mine ore a day and produced concentrate which averaged between 81 and 85 percent CaF_2, and tailing which averaged about 45 percent CaF_2. Overloading the mill caused very poor recovery, but this was not considered important because it was planned to retreat the tailing in the flotation mill. The Grants mill now handles from 100 to 115 tons of mine ore daily and produces 80 to 90 tons of concentrate (81 to 85 percent CaF_2). The tailing, which runs between 11 and 15 percent CaF_2, is now discarded. The concentration ratio is approximately $1\frac{1}{4}$ to 1. Routine analyses of the mill head have not been made, but every effort is made to keep the grade of the mill feed above 65 percent CaF_2. The actual grade probably consistently

exceeds this minimum figure.

The Los Lunas flotation mill operates on a mixture of fines screened from the mine ore, tailing from the Grant mill stockpile, and enough mine ore to make a total of 225 tons per day. From this, 75 to 80 tons of concentrate with a minimum grade of 97 percent CaF_2 is produced daily. It is planned to increase the mine production to 300 or 350 tons per day. This will require increased capacity at either or both mills. It is stated that the capacity of the Los Lunas mill is limited by the amount of concentrate which can be handled by the existing filters. Mr. Mallery states [1] that the total production of the mine to date amounts to about 65,000 tons. Approximately 12,000 tons of 45 percent tailing is stockpiled at Grants. There are 8000 tons of mine ore stockpiled at Grants and 2000 tons at Los Lunas.

1/ Verbal communication

Mr. Mallery informs the writer that most of the holdings of the regular Navajo Fluorspar Mines are on land belonging to the Santa Fe railroad. Mineral rights have been leased from the railroad.

Geology

Practically the entire production has thus far come from the 21 and 27 veins. These veins are nearly parallel and approximately 1 1/4 miles apart (see fig. 1). They strike from N 40° to 60° E. and dip 70° to the southeast.

Other veins are known, but have not been explored except for a few shallow pits. In the 21 vein the ore shoots average about 2½ feet in width (see fig. 2); in the 27 vein they average about 4 feet in width (see fig. 4), but the grade of the ore in the 21 vein is higher. In both veins the width of the ore varies greatly from place to place. The mineralogic and physical character of the two veins is nearly identical. Except at one place where the 21 vein crosses a narrow light-colored dike, both veins are entirely enclosed in a red granite which, according to Darton 2/ is pre-Cambrian in age.

2/ Darton, N. H. Geologic Map of New Mexico. U.S. Geological Survey (1928)

A strong gouge is almost everywhere present on the foot wall of both veins. Gouge is also found on the hanging wall of both veins, but there are many places where this gouge is poorly developed or missing. Extreme brecciation of the wall rock is common along both veins but is more characteristic of the 27 than the 21 vein.

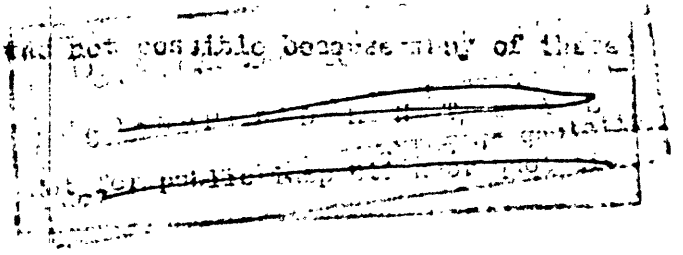
Fluorspar occurs as fissure fillings, as lenticular pods, as irregular masses in brecciated granite, as narrow stringers separated by fractured granite, and as ground-up fragments in gouge. The gangue consists chiefly of gouge and included horses of wall rock, although locally calcite is abundant. Quartz is extremely rare. Sulphide minerals have been observed at only one place in the 21 vein.

Mapping shows that there a number of sub-parallel fractures, and that the mineralization tends to jump from one fracture to another without apparent reason. Where this occurs the ore usually branches into the wall as a narrow stringer. The footwall gouge usually continues as strong as before but is either completely unmineralized or is accompanied by only a narrow seam of fluorspar. In other places stringers of fluorspar make off into the wall but rejoing the main vein in a short distance. Fairly The veins are cut by a number of cross faults but the displacement the on these never exceeds a few feet (usually the displacement is only a few inches). Because of their relative unimportance, not all of these minor faults have been shown on the geologic maps. ch vein ... e known, with

As already stated, a strong gouge usually is found on the footwall of the vein, and commonly is found on the hanging wall also, although not in everywhere so well developed. The presence of ground-up fragments of ly fluorspar in the gouge, the brecciation of the ore, and the fact that in a number of places this gouge cuts through cross faults which themselves offset fluorspar stringers are evidence that at least part of the movement which formed the gouge is post-mineral. The lenticular nature of many of the ore shoots probably results from this post-mineral movement.

Ore Reserves ... ... (Figs. 2, 4, 6 and 7)

Due to the extensive underground development it was out of the question to sample the workings thoroughly, and it was not believed that a few check ... to record the widths of ore exposed in the various developments and ... oration raises but this was not possible because many of these



samples would be of much value. Consequently reliance had to be placed on samples taken by the Navajo Fluorspar Mines. However, the mineralogy of the veins is simple and it is not difficult to distinguish between barren gouge and brecciated wall rock on the one hand, and fluorspar on the other, and with a little practice it is even possible to make a fairly close estimate of the grade of the ore. For this reason it is believed that the company samples, in so far as they go, can be relied upon. Fairly complete sampling was done in the early stages of the work, but, due to the ease with which the grade can be estimated, few samples have been taken since then. However, careful inspection of the ore and comparison with samples where available indicates that in each vein the ore lenses, with some readily distinguishable exceptions, are remarkably uniform in grade. In other words, it is easy to tell if the vein at any given place will run ore or waste. In ore, one part of the same vein will not differ greatly in grade from another, although there is a consistent difference between the grade of the 21 and 27 veins. Therefore, although in places the information is meager and uncertainties exist, it is believed that by the use of such samples as are available it is possible to arrive at a fair approximation of the grade.

On the underground maps of the various workings (figs. 2, 4, 6 and 7) the width of the vein has been recorded at numerous points and therefore the width of the various ore shoots is accurately known. It would have been desirable to record the widths of ore exposed in the various development and exploration raises but this was not possible because many of these

raises are timbered. However, inspection of the stopes indicates that the ore shoots are fairly continuous although there are many pinches and swells.

In estimating the ore reserves, 12 cubic feet per ton is the factor used to convert cubic feet to short tons.

21 Vein

Figure 3 is map showing the underground workings and stoped areas along that part of the 21 vein which has been developed by the 21-1 and 21-2 tunnels. For want of a better name, it has been termed a "Profile Section". It differs from a longitudinal vertical projection in that horizontal distances have been shown in their true length, as though bends in the vein had been straightened out. This map has been adapted with some modifications from one drawn by Mr. Mallery. On it there have been indicated in a distinctive color those parts of the vein which have mineable widths and grade of ore, as determined by the geologic mapping of the underground working. In Plotting these ore shoots, the minimum mining width has been taken as 18 inches, but minor pinches in the vein have been included as ore. The average widths of the vein are also shown. From this information the various ore blocks have been drawn, as indicated on the profile-section (fig. 3). It is not expected that the several unproductive parts of the vein will necessarily correlate from level to level exactly as shown, but it is believed that the length of vein mapped as ore in the drifts will be a measure of the proportion of ore to be expected in any given area of the vein.

		35.7	7.1
	2,000	35.0	6.0
	24,300	85.5	6.3
Total Ore	49,610	85.9	6.1

Northeast of the 21 shaft sampling on the 100 foot level is fairly complete. A few samples have been taken off the 200 foot level, but the assays could not be obtained. For most of the blocks above the 200 level, the grade can be estimated with some confidence from the weighted average of samples included within each block, although, in a few cases, it was necessary to assign a grade based on the average of nearby blocks. Below the 200 foot level (Blocks 30 and 31) the grade of the block immediately above has been accepted as indicative of the grade of the block.

Southwest of the 21 shaft the grade of Block 21 was estimated from the weighted average of the drift samples above that block, and Block 29, directly underneath Block 21, was assigned the same grade. All other blocks southwest of the shaft have been assigned a grade which is the average of all samples from southwest of the shaft. This is necessary because very few samples have been taken southwest of Block 21. Because in Block 18 both the 100 and 200 foot levels were stopped in low grade parts of the vein, only 75 percent of the block has been considered as ore. In the 21 vein there are a few areas where the stope maps are not up to date. These have been indicated by a distinctive symbol. Although some ore may remain in these areas, none has been included in the ore reserve estimate.

On the above assumptions the following ore reserves have been calculated for the 21 vein.

	Short Tons	% CaF_2	% SiO_2
Measured Ore	22,320	85.7	7.1
Indicated Ore	2,990	85.0	6.0
Inferred Ore	24,300	85.5	6.8
Total Ore	49,610	85.6	6.9

The 21 vein has been traced approximately 1000 feet southwest of the 21-1 Portal, and a small tonnage of ore is now being produced from shallow open cuts at various places along the outcrop. No allowance has been made for additional ore from this part of the vein, although it is very probable that future exploration will find considerable quantities of mineable ore.

27 Vein

27-3 Tunnel

Most of the production from the 27 vein has come from the workings connected with the 27-3 tunnel. Figure 5 is a profile-section showing workings, stoped areas, ore blocks, widths of ore, etc. and is comparable in all respects to the profile section of the 21 vein which has already been described. Fewer samples than in the 21 vein have been taken so that greater assumptions were made in estimating the grade of the ore, but the grades and tonnages of the various ore blocks have been estimated using methods similar to those used for the estimate of the 21 vein. The following points, however, are worthy of mention. In the drift which separates Block 10 and 11 three small ore shoots have been found which occupy about 45 percent of the total length of the block. The total volumes of Blocks 10 and 11 were computed, but only 45 percent of the volume was considered to be ore. In the stope in Block 9 the ore shoot can be observed raking to the northeast, and for this reason not all the area above the stope is shown as ore.

It is estimated that the following tonnage of ore remains in the workings of the 27-3 tunnel.

	Short Tons	%CaF_2	%SiO_2
Measured Ore	12,920	72.8	10.2
Indicated Ore	4,450	78.0	10.0
Inferred Ore	35,940	67.2	8.5
Total Ore	53,310	69.5	9.0

The 27 vein has been traced southwest of the portal of the 27-3 Tunnel, and likewise can be traced to the northeast to the portal of the 27-2 tunnel. Future prospecting may develop ore in either or both of these sections of the vein but none has been included in this ore estimate.

27-2 Tunnel

Stoping has been continuous above the 27-2 Tunnel from the portal to Station 204, a distance of 250 feet. (see fig. 6) Beyond this point the vein consists mostly of gouge and is too low grade to be mined. Two strong stringers of fluorspar make off into the hanging wall and have been found in the cross cut at Station 207. At the very end of the main drift the mineralization strengthens. It is very probable that further ahead the two stringers may join the main vein and form a workable ore shoot; in fact, surface trenching confirms this idea.

An incline has just been started on the vein from near the portal of the tunnel. It is planned to sink this incline 100 feet vertically below the old stope. Assuming an average width of 4 feet and considering only two thirds of the length of the vein under the stope as productive, 5200 tons of ore are indicated to the bottom of the proposed incline. The

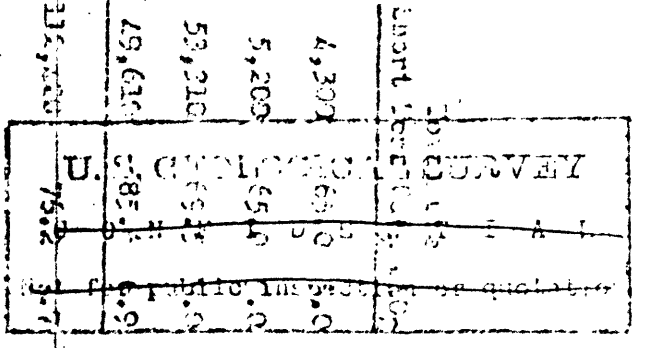
grade of the ore has been arbitrarily assumed as 65 percent CaF_2 and 5 percent SiO_2. No allowance is made for ore which might be developed ahead of the present workings.

27-1 Tunnel

In the 27-1 Tunnel the vein is low grade and spotty from the portal to Station 12. At this point the vein splits, and a drift which has followed the hanging-wall split has developed approximately 150 feet of fair looking ore. If this stretch of the vein is assumed to have a width of 2 feet, and if two-thirds of it is assumed to be mineable, approximately 4300 tons of ore can be inferred. The grade has been assumed as 65 percent CaF_2 and 5 percent SiO_2. Surface trenching indicates that the ore shoot may extend for 600 feet beyond the present face of the drift, but no allowance has been made for this. Neither has any allowance been made for ore which may be mined from the portal to Station 12, although lesees have already mined a small tonnage of ore from this part of the vein and doubtless will recover an additional small quantity.

Total Ore Reserves

The following is a recapitulation of the estimated tonnage and grade of ore which can be mined within the near future from the properties of the Navajo Fluorspar Mines. It is believed that this is a conservative estimate.



Working Place	Measured Ore			Indicated Ore			Inferred Ore			Total Ore		
	Short Tons	CaF_2	SiO_2	Short Tons	CaF_2	SiO_2	Short Tons	CaF_2	SiO_2	Short Tons	CaF_2	SiO_2
27-1 tunnel							4,300	65.0	5.0	4,300	65.0	5.0
27-2 tunnel				5,200	65.0	5.0				5,200	65.0	5.0
27-3 tunnel	12,920	72.8	10.2	4,450	78.0	10.0	35,940	67.2	8.5	53,310	69.5	9.0
21-vein	22,320	85.7	7.1	2,990	85.0	6.0	24,300	85.5	6.8	49,610	85.6	6.9
Total	35,240	81.0	8.2	12,640	74.3	7.0	64,540	73.9	7.6	112,420	76.2	7.7

Included in the appendix to this report is a list, showing the grade and tonnage of the individual blocks.

<u>Recommendations and Conclusions</u>

It is obvious that a sufficient tonnage of mineable fluorspar ore is reasonably assured to justify a very considerable expenditure for road improvement. The New Mexico State Highway Department estimates that $75,000 will be required for this improvement. In view of the fact that most of the road is not in really bad condition, and that at present the ore trucks are hauling over it without undue difficulty, this proposed expenditure seems rather high, although it is quite true that the road is apt to deteriorate rapidly during the coming winter unless steps are taken to improve and maintain it. If the proposed expenditure is deemed necessary by those more competent to judge than the writer, the ore reserves and future possibilities of the mine appear to be sufficient to justify it.

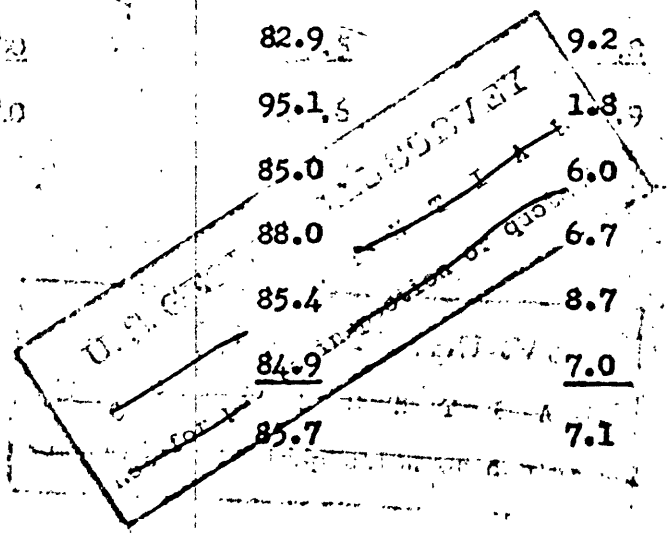
			6.6
11 and pillar	340	86.7	4.3
12	140	57.9	24.2
13	600	88.3	6.1
14	1,[illegible]	88.6	5.6
15	1,[illegible]	88.9	5.9
16	7[illegible]	8[illegible].9	9.[illegible]
17	[illegible]	[illegible]	1.3
20	[illegible]	[illegible]	6.9
21	[illegible]	[illegible]	6.7
22	[illegible]	85.4	8.7
23	[illegible]	84.9	7.0
	[illegible],320	85.7	7.1

Appendix

Recapitulation of Ore Reserves

21 Tunnel

Measured Ore Block	Short Tons	% CaF_2	% SiO_2
1	950	85.0	6.0
2	290	85.0	6.0
3	150	85.0	6.0
4	1,810	85.0	6.0
5	270	81.5	11.0
6	330	81.5	11.0
7 and pillar	980	90.0	6.2
8 and pillar	1,380	81.1	9.9
9	210	83.8	8.2
10 and pillar	740	86.4	6.6
11 and pillar	340	86.7	4.3
12	140	57.9	24.2
13	600	88.3	6.1
14	1,390	88.6	5.6
15	1,280	88.9	5.0
16	780	82.9	9.2
17	150	95.1	1.8
20	1,810	85.0	6.0
21	2,320	88.0	6.7
22	2,830	85.4	8.7
23	3,570	84.9	7.0
	22,320	85.7	7.1



Indicated Ore Block	Short Tons	% CaF_2	% SiO_2
19	2,990	85.0	6.0
Inferred Ore			
18	4,310	85.0	6.0
24	230	57.9	24.2
25	5,050	86.6	6.4
26	400	92.2	0.4
27	1,860	85.0	6.0
28	2,130	85.0	6.0
29	2,380	88.0	6.7
30	3,030	85.4	8.7
31	4,910	89.9	7.0
	24,300	85.5	6.8
Measured Ore	22,320	85.7	7.1
Indicated Ore	2,990	85.0	6.0
Inferred Ore	24,300	85.5	6.8
All Ore	49,610	85.6	6.9
	4,710	74	12
	35,2[illegible]	87.2	3.5
Total all ore	53,[illegible]	[illegible]	2.0

Recapitulation of Ore Reserves in 27-3 Tunnel

Measured Ore Block	Short Tons	% CaF_2	% SiO_2
1	920	71	9
2	3,510	79	11
3	940	74	13
4	1,720	74	13
5	1,550	74	13
6	500	67	7
7	590	67	7
8	2,620	67	7
Floor Pillars	570	67	7
Total Measured	12,920	72.8	10.2
Indicated Ore			
9	4,450	78	10
Inferred Ore			
10	7,460	58	7
11	6,420	58	7
12	8,940	78	10
13	8,410	67	7
14	4,710	74	13
	35,940	67.2	8.5
Total all ore	53,310	69.5	9.0

Recapitulation of Ore Reserves

27-2 Tunnel	Short Tons	% CaF_2	% SiO_2
Indicated Ore	5,200	65.0	5.0
27-1 Tunnel			
Inferred Ore	4,300	65.0	5.0

Summary of All Workings

Measured Ore

Working	Short Tons	% CaF_2	% SiO_2
21 Vein	22,320	85.7	7.1
27-3 tunnel	12,920	72.8	10.2
	35,240	81.0	8.2

Indicated Ore

21 vein	2,990	85.0	6.0
27-2 tunnel	5,200	65.0	5.0
27-3	4,450	78.0	10.0
	12,640	74.3	7.0

Inferred Ore

21 vein	24,300	85.5	6.8
27-1	4,300	65.0	5.0
27-3	35,940	67.2	8.5
	64,540	73.9	7.6
Grand total all ore	112,420	76.2	7.7