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A CRITICAL REVIEW OF THE GRUM PROJECT 1975 - 1976

by

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PREFACE

The following report is submitted at the request of Mr. J.K. Carrington, Project Supervisor, in the hope that future Kerr exploration and development projects can benefit from our experience on Grum. It is written from the point of view of the geologists on the site and so is admittedly biased. It is also written with the benefit of hindsight.

The writer has been directly associated with the project since June 1975 to October 1976 as a senior geologist on the site and, since October 1976, as an office geologist in Vancouver.

The report is arranged in a chronological manner covering the prospecting phase 1973 - 1974, the development phase 1974 - 1976 and the preparation of the mineral inventory report at the end of 1976.

As with any pioneering venture, the people associated with the project made their share of mistakes, and at times were guilty of short-sightedness and wishful thinking. In the following pages I will try and point out ways I think things could have been done better or easier, but I do not mean to imply personal criticism of anyone. I believe no one involved need feel ashamed of their role in the Grum project, and that, on the whole, it has been brought to its present stage in a competent and sensible manner.

THE PROSPECTING PHASE

I consider the work done on the property prior to the end of the 1974 field season as the prospecting phase. This phase accomplished the following:-

1. Enough ore grade drill intersections were made to prove beyond a reasonable doubt that a major orebody existed.

2. It established that continuity down plunge was good, but that continuity in cross-section was unusually poor.

3. The gross limits of the orebody were established.

4. The main rock types and ore types were drilled and examined.

5. A good idea of drilling conditions and core recoveries had been obtained.

Fortunately the project had inherited a reliable surface grid of chained cut lines. Also, all drill holes had conscientiously been marked with painted poles. Thus the layout of new holes could be done quickly and accurately at any time. Another big plus was the building of a core shack at Vangorda Camp to house the new core.

On the west end of the zone, ore grade sulphides had been found below 300m. At this depth acid tests showed hole deviations in the order of 15^{o} to 20^{o}.

These deep holes had to be subsequently re-entered in order to make accurate deviation surveys and to cement them to prevent water entering any future underground workings. The sooner the decision could have been made to leave casings in these holes, the less the cost and problems of re-entry would have been.

During the winter of 1974 - 1975 the decision was made to go ahead with a full scale development programme in the spring, comprising an underground decline, underground drilling and continued surface drilling. As soon as this decision was made, certain steps could have been taken. These steps were subsequently taken, but the delay in taking them caused confusion and wasted effort. Most of the delay was due to a shortage of geologists on the site in the first months of the programme. In my view, the steps which could have been taken earlier were as follows:-

1. A well thought out, mutually exclusive series of geologic descriptions of the main rock and ore types could have been written out, backed up by reference sections from the core in storage. This would have been of great help to new geologists on the job in logging core.

2. At least some of the criteria for stopping drill holes in the area should have been discussed, decided on and written out for the benefit of new geologists on the job.

3. As soon as the decision was taken to make hole deviation surveys, the procedure for computing and drafting deviating drill holes should have been set up.

4. The drafting system should have been standardized sooner. Part of the problem here was the conversion to metric in July, right in the "busy season".

In the prospecting phase of a programme there are relatively few drill holes and so relatively few plans and sections. The drawings can and should be made in a size and scale which best displays the data. However, once the development phase is reached, and production is a distinct possibility, it is imperative that standard size drawings and a three dimensional block system be set up because, instead of a few dozen drawings, there are soon going to be hundreds.

THE DEVELOPMENT PLAN

Early in 1975 a development plan for the surface and underground drilling and underground decline was proposed by Canadian Mine Services Ltd. and was accepted. The major item in the plan was the underground decline which was to spiral down to the mid-section of the ore zone and then follow the ore on plunge for 600m with two headings. It was obvious from the start that the decline would have to be mapped geologically and that this might entail delaying or obstructing the mining operation to a certain degree, but no mention of this was made in the C.M.S. proposal. At the start of the job I personally had no experience on an underground trackless diesel mining operation and held the mistaken belief that detailed mapping could be done when opportunity allowed, or even, if need be, after all mining had been completed, so long as pipes and headers were available. The true situation was that the fresh rock surfaces were soon obscured by diesel fume and oil deposits that could not be washed off and if the ground was weak, it soon had to be shotcreted. Thus, if mapping were not done within a week or so, it could never be done.

I believe that the contract could have been set up so that time was provided to do the necessary geological mapping on a planned basis. If the geological crew could have had the unobstructed use of the heading for one shift every tenth round, a marked improvement in the geological maps would have resulted. One shift every tenth round would also have given the surveyors a better opportunity to set survey stations without being rushed.

THE DEVELOPMENT PHASE

Surface Drilling - This was done with BQ wireline using mud. The overburden was tri-coned to bedrock. A good deal of information regarding overburden characteristics, artesian water flows, loss of water, that subsequently would have been very useful in the search for a camp water supply, and for backfill sand and gravel deposits, was not collected. It had been collected by the geologists in the exploration phase of drilling but was later neglected. An effort should have been made to have the drilling crew record this information.

Underground Drilling - Most of the underground drilling was done with C.M.S. "Superdrills". They gave very good results when in good ground and with operators who understood them. In bad ground or where artesian water was encountered, problems arose. The head of the machine was not big enough to run an NQ rod string so there was no convenient way to ream down with NQ and reduce to BQ. Also, we found that to get good core recovery on holes over 200m, we had to use mud and the head of the Superdrill did not allow a proper "T" casing to be used to re-circulate the mud.

Underground Mapping - Two types of underground mapping were done at the Grum; "Face Mapping" and "Detail Mapping." Face mapping consisted of a geologist going to the face at least once per day at the end of the mucking cycle and making a quick three dimensional sketch of the last round in a field book. No attempt was made to wash down. Detail mapping consisted of washing down 30m or so of drift behind the rock bolt jumbo during the rock bolt cycle, taping and marking it, and mapping both walls in detail. The back usually could not be mapped since the vent tube was in the way. In the office the wall mapping was used to synthesize a breast height drift plan. This plan was often erroneous since it was not based on direct observation of the back. Time usually did not permit a thorough washing of both walls and back even when not obstructed.

The reason for the two types of mapping was that in weak ground shotcreting had to be started immediately and there could be no detail mapping. Also the faces presented a wealth of geological information in the cross-section plane that otherwise would be lost.

The main defect with the face mapping system was locating the faces. Survey stations were often unreadable because of their height (4.5m), or were obscured by the vent tube and the machines at the face made taping difficult in any case. The system we tried to use was to match the date of the face sketch with the surveyor's measurement to the face for the same date, but this often led to errors when the mining cycle was irregular. Also, the faces were mapped on day shift only, so faces occurring on afternoon or graveyard were missed. If the manpower were available on a project such as this, it might be worthwhile to schedule face mapping on all shifts.

The main problems with the detail mapping were in getting time and facilities to wash and map and the inability to map the back effectively. The first problem could be solved by getting unobstructed use of the heading one shift every ten rounds as mentioned previously. The second problem is more difficult. Possibly mounting a stepladder on a jeep would give access to the back.

During the 1975 - 1976 underground programme, some experimenting was done with photographing the walls. I believe it would be possible and worthwhile to make a complete photo record of the walls and back of all the workings with the use of a wide-angle camera. Even if it cost $5.00 per meter of drift, it would be worthwhile.

Drill Hole Deviation Surveys - At the start of the 1975 surface drilling, deviation was measured with a Tropari compass. This instrument was found to have two main drawbacks, (1) It produced no permanent record, and (2) It was designed for standard rods. Thus, in its protective case it would not go through a BQ bit, so that testing a hole entailed pulling the rods, putting on a shoe, reaming to bottom and then starting to test.

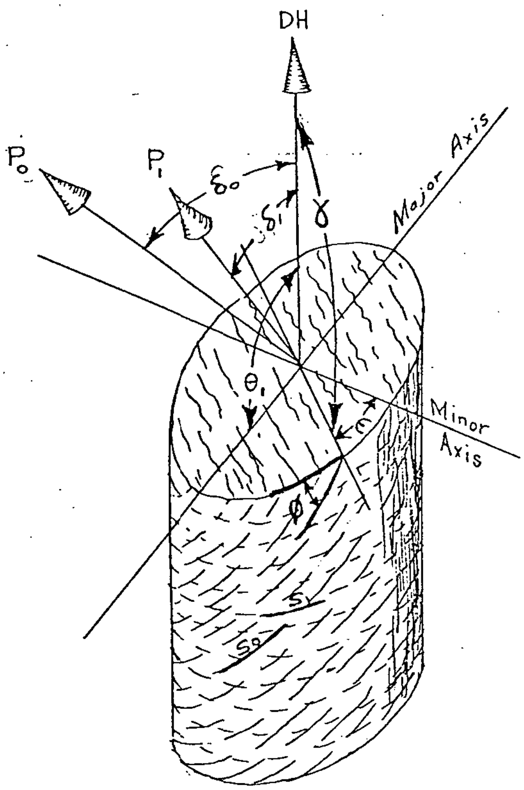
The Tropari was soon replaced with a Sperry Sun single shot instrument which would go through a BQ bit and which produced a permanent photo record. It performed very satisfactorily throughout the job. Poor results were always due to the operator not understanding the instrument.

The main problem in deviation surveys was not with the instrument, but in training people to calculate the declination and to plot the hole correctly. Finally a graphic system was devised whereby the hole was plotted in plan and the offsets to the cross and longitudinal section planes scaled off.

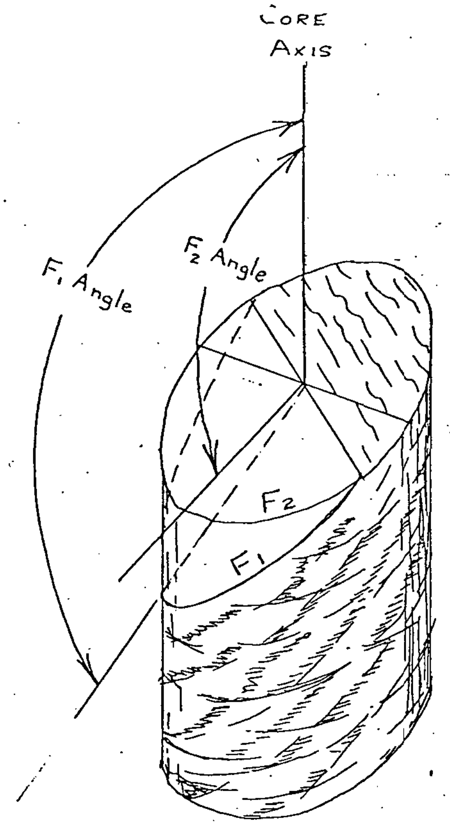
Drill Core Storage - Facilities for logging and storing core at Grum were very good and one of the plus factors on the job. The racks were the standard type using 2 x 6 framing and 3/8 inch rebar for rods. The only problem was that some of the rods were short and not anchored properly so when the rack was loaded, they sagged and jammed the core below. Also the carpenter who built the building put several large windows in the core storage portion which were unnecessary. Several small windows or skylights would have let in enough light. Big windows just invite bears and human vandals, the two main enemies of stored core.

Drill Core Logging - The symbol system and legend set up in 1974, and expanded somewhat in 1976, was used in logging most of the core. It proved to be a great time saver. All core was logged for rock type, sulphide type and amount, and the angles to the core axis of the banding (F_1) and the foliation (F_2). Also, all fault zones and contacts were recorded.

The main criticism of the core logging was that all the angular relationships were not defined rigorously and measured. The F_1 and F_2 angles were measured to the core axis but these angles were ambiguous if the angle between F_1 and F_2 were not also noted. Also, the angle between the core axis and the lineation produced on the F_2 cleavage faces by the F_1 were never recorded. The reader is referred to a recent paper by W.P. Laing, Structural Interpretation of Drill Core from Folded and Cleaved Rocks, Economic Geology, Vol. 72, 1977, pp 671 - 685. The following diagram shows these relationships:-



LAING NOMENCLATURE



GRUM NOMENCLATURE

So	-	bedding (Grum F_1)
S1	-	foliation (Grum F_2)
Po	-	pole to So
P1	-	pole to S1
DH	-	Core axis
δo	-	Angle between core axis and Po
δ1	-	Angle between core axis and P1
θo	-	Angle between core axis and So = Grum F_1 angle
θ1	-	Angle between core axis and S1 = Grum F_2 angle
Ø	-	Angle between So and S1
L1	-	Lineation caused by intersection of So and S1
γ	-	Angle between lineation and drill core axis
ε	-	Angle between lineation and the minor axis of the cleaveage ellipse

These angles are important, since, if carefully recorded and analysed, they can be used to determine the position of major fold noses and axial planes. At Grum we were fortunate in having the general attitude of the F_2 foliation plane from regional surface mapping and from the underground workings to supplement the core angle data in our geologic interpretation. If we had not had these we would have had to depend entirely on core angle data.

Drill Core Sampling

The drill core was sampled by marking it up with yellow chalk and writing up duplicate tags in the conventional manner. The tag that was to go with the sample was folded up and tucked into the core box close to the end of each marked sample run. This system worked very well and we had a minimum of errors.

The rules for sampling were a compromise between various views. Sample intervals based strictly on geologic boundaries, on estimated grade boundaries, at 1.5m intervals, at 3.0m intervals and at variable intervals each had their advocates at various times. In practice it was left up to the logging geologists' discretion.

Drill Core Splitting

The Grum core was often very difficult to split accurately, which made this job unusually tedious. The splitting was done with Longyear "Wheel" type splitters set up so the operator could sit at his work. A mechanical, hydraulic operated splitter was tried out but was beset by mechanical problems. If the mechanical problems could have been overcome, I believe it would have greatly improved the efficiency on the job and greatly helped morale.

Our major problems with core splitting were personnel problems, which I believe could only have been solved by giving the core splitters more prestige and more money.

Chip Sampling

Chip sampling was done on drift walls at various times in preparation for taking bulk samples. Sample coverage was not satisfactory until a platform was built on the jeep which allowed samples to be taken up to the height of the back.

Most of this sampling was done after the mining was completed. Generally 2 by 3 meter panels were marked out on the wall and approximately 2 kg. of chips were taken within the panel with a rock hammer and moil. This system worked well and gave results accurate enough for the purpose. The use of a pneumatic chipper was contemplated but was not tried because of the set up time it would require.

Drill Hole Plotting and Drafting - After several false starts, the following drafting system was evolved in 1975, when the conversion to metric made most previous drawings obsolete. The surface drill holes were plotted on cross-section showing deviation. The section was then covered with a plastic overlay on which the underground drilling was planned in pencil. As the underground holes were drilled, they were plotted in ink on the overlay and a structural interpretation made. An inclined plan in the plane of the underground workings was also kept up showing the drift geology as it was mapped. This plan and the sections were the tools used in planning the underground drilling from day to day. An attempt was made at producing a set of longitudinal sections along the same lines but never got completed.

This system worked well but was restricted in that most of the interpretation was done in two dimensions on the cross-sections. If we had known then that we would have to make 9 meter geological bench plans, and if we had had the manpower to do the drafting involved, it would have been worthwhile keeping up a series of bench plans in 1975 to guide the underground drilling. Perhaps we could have avoided some of the interpretation problems we had later.

Personnel Relations - Most of the personnel on the Grum site were employed by C.M.S., but half a dozen people comprising the geology crew and the project supervisor were employed by Kerr Addison. There was a good deal of discontent and turnover caused in the geology crew by the lack of integration of wage and furlough rates between Kerr and C.M.S. A core splitter working for Kerr was paid approximately a third less than a dishwasher or bullcook working for C.M.S.. C.M.S. employees got two weeks furlough every two months, while Kerr employees got one weeks furlough every six weeks. This made it difficult to develop a contented Kerr crew. An equitable northern allowance and some type of job completion bonus would have helped a great deal. Also, if rules on overtime work, on the use of company vehicles, on the supply of protective clothing, had been in place at the start of the job, it would have prevented the conflicts that later developed regarding these matters.

At the start of the programme in 1975 a bare minimum of geological crew were on the site to service the drills. After drilling started in April, two more geologists were hired but quit soon after. By June, the backlog of work was reaching crisis proportions. More geologists were hired and slowly the backlog was brought under control, but the result was that many things which should have been done at this time did not get done. Any money saved by hiring a minimal crew at the start of the programme was later lost several times over by the extra expense this policy incurred. The total cost of geological services to the project was less than 2%, yet for the project to attain its objective, competent and thorough geological control was vital.

The Structural Interpretation - As the drilling progressed at the Grum site a rough geological interpretation was done in two dimensions on the cross sections. Later, in the Vancouver office, longitudinal sections and plans were constructed plus isometric sketches and, after much toil, an interpretation was made of the whole ore zone which satisfied most of the observed facts. At various times the building of a mine model was considered, but the writer felt that it would consume too much time and the proper tools and equipment were not available. At the time, C.M.S. were in the process of constructing an ore outline model and it is regrettable that at this time, they did not also build a geologic model. In retrospect, I believe it would have been a good deal of help in the geologic interpretation and would have shortened this phase of the work.

The Mineral Inventory Report - The work done on the Grum up to the end of 1976 was summarized in the Mineral Inventory Report. This report had to meet a deadline and so was completed under a good deal of pressure. One of the major bottlenecks which developed was the reproduction of the ore and geology sections in colour. This was done by reducing the standard sections to letter size, colouring them and then reproducing them by colour photography. This reduction made most of the lettering on the sections too small to be readable. If more foresight had been used when setting up the lettering sizes for the sections, at least the drill hole numbers and co-ordinates could have been made larger so that they would have been easily read in the reduced form in the report.

This concludes my report. There are several topics I have not discussed, such as the setting up of the grid system, the conversion to metric, the ore calculations and the bulk sampling. These were omitted since I felt I had no insights to offer or no improvements to suggest.

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