

FARO DEPOSIT

ZONE 3

REVIEW

016168

By:

J. G. Simpson

D. S. Jennings

G. A. Jilson

T. J. Adamson

May, 1983

TABLE OF CONTENTS

SUMMARY

DEPOSIT MODELLING, OVERVIEW AND CRITIQUE

INTRODUCTION

APPROACH

LIMITATIONS OF THE APPROACH AND RESULTANT GEOLOGICAL MODEL

DOWNSTREAM RECOMMENDATIONS

TONNAGE AND GRADE MODELS, THE GRADE/FACIES APPROACH

ASSAY SECTIONS AND RECALCULATED RESERVES

Assay Sections

Ore Reserve Calculations

Conclusions

ZONE 3 GEOLOGICAL SYNOPSIS

INTRODUCTION

LOCAL STRATIGRAPHY

LITHOLOGY

Unit 1D

Units 1E and 3E Graphitic Schist/Phyllite

Unit 1C

Unit 1CD

Unit 3D - Calc Silicates

Unit 3A

Units 3B and 1H Chloritic Schist

Unit 3C/1F Metabasite - Amphibolite

TABLE OF CONTENTS - (Cont'd)

Unit 3F/1G Marble

Intrusive Rocks

Breccia Cap

FARO DEPOSIT

Form

Ore Types

Unit 2A

Unit 2B

Unit 2C and 2D

Unit 2E

Unit 2F

Unit 2G

Unit 2H

Unit 2J

Unit 2K

Units 2L and 1D4

Structure

Folds

Faults

Big Indian Faults

Big Mac Fault

Big Gulp Fault

McChicken Fault

Quarterpounder

Big Bird

McRib Fault

The Problem of the Missing Ore in DDH 81-09

Notes on Individual Sections

Sections 14+00, 14+125, 16+00

Section 17+00

Section 18+00

Section 19+00

Section 19+94

Sections 20+26 and 21+00

Section 22+00

Section 24+00

Section 124+22

Section 125+00

Section 126+23

Section 127+09

Section 128+20

Section 129+00

Section 130+00

Section 131+22

LIST OF ILLUSTRATIONS

Figures

- 1 New Cross and Long Sectional Grid for Zone 3.
- 2 Map of Subareas Showing Variable Degrees of Agreement Between Long and Cross Sections.
- 3 Uncertainty Analysis for a Data Point in an Unsurveyed Drillhole.
- 4 Schematic Stratigraphic Section Through Zone 3.
- 5 Metamorphic Overprint on Original Stratigraphy.
- 6 Simplified Form of Faro Deposit.
- 7 Plan Map of Zone 3 Showing F_4 Trace.
- 8 Interpreted Zone 3 Fault Pattern.
- 9 Possible Interplay of Big Mac and McChicken Faults.
- 10 Possible Relation of Big Bird to Big Indian Fault System.
- 11 Drill Grid Showing Fault Truncated Sulfide Intersections.
- 12 Alternative Interpretations of Big Indian Fault System.
- 13 Drill Grid Showing Upper Horizon.
- 14 Alternative Interpretations of Upper Ore Horizon.

Tables

- 1 Zone 3 Long and Cross Section Designations.
- 2 Comparison of Revised Model F_3 and Exploration Department April 1983 in Situ Reserve Estimates.
- 3 Comparison of Pounds Metal: Exploration vs. Mintec Models.
- 4 Main Deposit Area Lithostratigraphic Code.
- 5 Rock Type Equivalences.

Appendices

- I Logs for DDH's 456-75-12 and 13, and 71 DS 01.

SUMMARY

This report summarizes the Exploration Department's involvement in the 1982-1983 geological remodelling exercise of a portion of Zone 3 of the Faro deposit. It is divided into three sections. The first is an overview and critique of the modelling effort documenting our approach, the limitations of this approach and recommendations to improve on-going modelling of the deposit.

The second part deals with reconnaissance tonnage and grade estimates from cross sectional data alone, as a comparison to the F3 Model. A major feature of this exercise was to better describe the facies and grade distribution in the deposit, outlining areas for selective extraction of higher grade, metallurgically desirable ores, thereby improving the overall economics of the deposit.

The final section capsulizes the geology of the subject portion of the deposit detailing its stratigraphy, structure, faulting, form and descriptive lithologies. This section is not intended as a definitive treatise on the geology of the deposit, rather an introduction to this topic to aid present and future workers formulate relevant questions to ask of the rocks.

DEPOSIT MODELLING

OVERVIEW AND CRITIQUE

D. S. Jennings

INTRODUCTION

In late 1982, the Exploration Department began to assist the Anvil District Geological Department in geological remodelling of Faro Deposit, Zone 3 between Sections 124W-135W and 14N-25N inclusive (13 cross sections, 13 long sections, 30 bench plans). The intent was to produce a revised geological model of this portion of the deposit by the end of May, 1983, incorporating recent (1980, 1981, 1982) drilling data and a more realistic portrayal of the geometry of the deposit. It was hoped this re-evaluation would provide:

- 1) an improvement on the earlier models of Clark et al (1977) and Nakai (1981) by resolving some of their geological inconsistencies, and
- 2) provide an on-going basis for computer mine modelling.

The degree to which these objectives have been met is the subject of this review.

APPROACH

Following historical precedent, time was of the essence in this venture, resulting in necessary short cuts. The first of these was the partial re-logging of all diamond drill holes in the subject volume. Since little practical use has or can be made of detailed information in the hanging wall Vangorda Formation calc-silicate rocks, the approximate base of the Vangorda was estimated from existing logs. Core was pulled from the racks from this point to the end of the hole and logged in good lithologic detail

with particular emphasis on the sulfide facies. As a result of this "short cut", Vangorda calc-silicates are "lumped" into two general units 3A and 3D, with varying levels of consistency and confidence. This problem is treated in more detail later.

As a further time concession, detailed symmetry analysis was suspended with in favor of more rapid symmetry domain logging techniques. At all times in structural logging, good attention was paid to fault zones, structural style and degree of development of F_4 folds. While an exacting portrayal of fold geometries is thus not possible, major F_4 's will be located and modelled adequately for this exercise. Logging of 103 drillholes in this portion of Zone 3 was completed by mid-November, 1982, mainly by R. Tolbert and J. Keir.

All logging data was edited and entered into the HP 3000 DDH data base. New cross and long sections were defined by an "eyeballed" best fit of section traces in plan to surveyed borehole collars (Figure 1). These new designations are summarized in Table 1. Five southeasterly sections (130+00, 131+22, 132+52, 133+00, 134+47) were plotted by normal projection of individual drillholes to their plane of section, manually compiled in cross-sectional format, drafted and interpreted. These sections, along with their assay data counterparts, were completed and submitted on 30 January, 1983 for preliminary evaluation. Concurrently, a reconnaissance 1" = 100' compilation of the incompletely mapped Zone 3 pit was completed by R. Tolbert and J. Keir.

By this time, we had developed the capability to plot entire cross and long sectional arrays of boreholes with the option to "correct" the location of a hole on section for trend fold and plunge. Inspection of old long

T A B L E 1

ZONE 3 CROSS AND LONG SECTION DESIGNATIONS

<u>Long Sections</u>		<u>Cross Sections</u>	
1.	14+ 00	1.	124+ 22
2.	14+125	2.	125+ 00
3.	16+ 00	3.	126+ 23
4.	17+ 00	4.	127+ 09
5.	18+ 00	5.	128+ 20
6.	19+ 00	6.	129+ 00
7.	19+ 94	7.	130+ 00
8.	20+ 26	8.	131+ 22
9.	21+ 00	9.	132+ 52
10.	22+ 00	10.	133+ 00
11.	23+ 00	11.	134+ 47
12.	24+ 00	12.	135+ 54
13.	25+ 00	13.	135+122

sections revealed an apparent deposit plunge of 22° NW parallel to the long sections (315°). As a plunge correction would significantly alter the vertical position of sulfide intersections on cross section, a decision had to be made whether to apply such corrections. A positive decision was taken with a 22° correction applied to all drillholes on cross sections 127+09W, 128+20W, 129+00W, 130+00W, 131+22W, 132+52W and 133+00W. Implicit in this decision was the assumption the deposit was not broken into relatively flat lying, fault-bounded panels giving the appearance of uniform plunge as shown on the old long sections. No plunge or dip correction was applied to the balance of the cross and long sections.

Co-operative interpretation of the 13 cross sections leading to a simplified acetate model of the deposit was completed by the end of February. At this point, insufficient time remained to complete long sectional interpretations from drilling data on section. To minimize conflict of cross and long sections, idealized long sections were constructed by transferring the interpreted stratigraphy at cross and long section intersections back onto the idealized long sections. Comparison of the actual drilled geological relationships to the idealized relationships was undertaken and appropriate modifications made. Coherent long sectional interpretations were then made from this idealized cross sectional data. Extensive smoothing and modelling of fault systems in long section was subsequently completed and modelled on plexiglas in late April.

It was apparent at this point that the fault array shown in the "idealized" long sectional model differed from that in the cross-sectional model. Concerted attempts were made to rationalize the differences. It rapidly

became clear an independent fault model was required to resolve the problem since equally compelling, but partially incompatible, cross and long section models flow from this approach to the drill data alone. The only independent "ground truth" that can be brought to bear on this problem is an exhaustive, correct and on-going pit mapping exercise which is simply not in hand. A further exacerbation of this fault dilemma was the lack of time available and the questionable worth of completing a "second iteration" of the cross and long sections to achieve a simple "best fit" to a preconceived (though not necessarily correct) fault model. By way of compromise, we have shown on cross and long section the most compelling faults as dictated by logged major gouges, truncated ore intersections and ore elevation differences that are consistent with the preliminary pit data. The faults do not agree in all cases between long and cross sections. This is simply a fact of life until a unique fault solution from pit remapping is integrated with the drilling information.

The "best fit" cross and long sections have been coded and digitized entirely or in part to produce a set of lithologic ticks on pre-established bench plan elevations. These plans will be geologically interpreted to produce approximately thirty bench maps which will form the basis for block coding and entry into the Mintec mine model. Tetrad completed the digitizing as a time-saving step over manual methods.

LIMITATIONS OF THE APPROACH AND RESULTANT GEOLOGICAL MODEL

The principal limitation on our ability to adequately model this portion of Zone 3 is the lack of independent control on faults. Using our "best fit" model as discussed above, the practical ramifications are summarized

in Figure 2. Subarea A, covering aurally and volumetrically the largest portion of the deposit, shows best agreement between the long and cross sections. In this area (volume), all cross and long sectional data will be used in the construction of bench plans. Not coincidentally, this subarea has the densest and most regular drilling coverage and the least apparent disruption by faulting, thereby allowing the best overall fit. In subarea B, there is virtually no hard drilling data except on Section 130+00W. Comparison of the fit between early cross and long sectional interpretations of this area (volume) was appalling. In retrospect, these early interpretations were scrapped, except for Section 130+00W. Because of the near total absence of drilling control in B, we have elected to produce no bench plan interpretation in this subarea on the premise you can't model what you don't have drilled. Data from Section 130+00 will be included on the bench plans however. The near parallelism of the cross sections in subarea C to the present interpretation of the "horsetailed" Big Indian fault system translates to a horror show in terms of agreement between long and cross sections in this domain (see two interpretations of Section 133+00W as an example). As a result of these widely divergent interpretations, we have elected to use the "idealized" long section data only in the development of bench plans for subarea C. While this treatment is not ideal, it will yield bench plans which are internally consistent and reflect the degree of certainty of the original geological data. The important point to be emphasized is that the overwhelming volume of the deposit will be properly treated with this approach.

From an engineering and mine modelling point of view, one of the most severe limitations of the entire Faro deposit drillhole data base is the irreparable fact that about 50% of all boreholes in Zone 3 have no downhole

survey data. In order to show the most probable trajectory of the unsurveyed holes, we have arbitrarily assigned x, y, z coordinates in the R subfile for each hole in accordance with limited numbers of nearby surveyed holes. The details of each "applied" or "faked" trajectory are recorded in the R subfile on page 2 of the drillhole logs. All pre-1976 borehole logs were inspected for acid dip test data and included in the Zone 3 R subfiles where reasonable. It should be clearly understood that this alternative was our only remaining option since the boreholes simply cannot be re-entered and surveyed. Additionally, this alternative is better than treating the holes as vertical since there are literally hundreds of surveyed holes in the Faro and other district deposits which categorically demonstrate deflection into crude perpendicularity with S_2 is the norm.

The practical ramifications of this problem are shown in Figure 3 where the "faked" trajectory of an unsurveyed drillhole is drawn with a "guesstimated" error cone, i.e. the location of the borehole can only be estimated at best to lie within the uncertainty envelope. Thus any given point, such as an assay interval, may be shifted from one ore block to another as a result of this uncertainty. The application of plunge vs. normal projections of a data point further compounds this uncertainty viz: the application of a geologically reasonable 22° plunge correction to a point on a drillhole projected 50 feet "off section" shifts this point by twenty feet from the normal (perpendicular) projection of the same point. Thus, the application of a plunge correction may also shift a data point from one ore block to another, particularly for holes lying far off-section. In general, the plunge corrections are estimated to shift data point locations more like \pm ten feet. Taken together, these uncertainties guarantee that data points in unsurveyed boreholes simply cannot be assigned to a unique

SW

NE

DDH 78-007

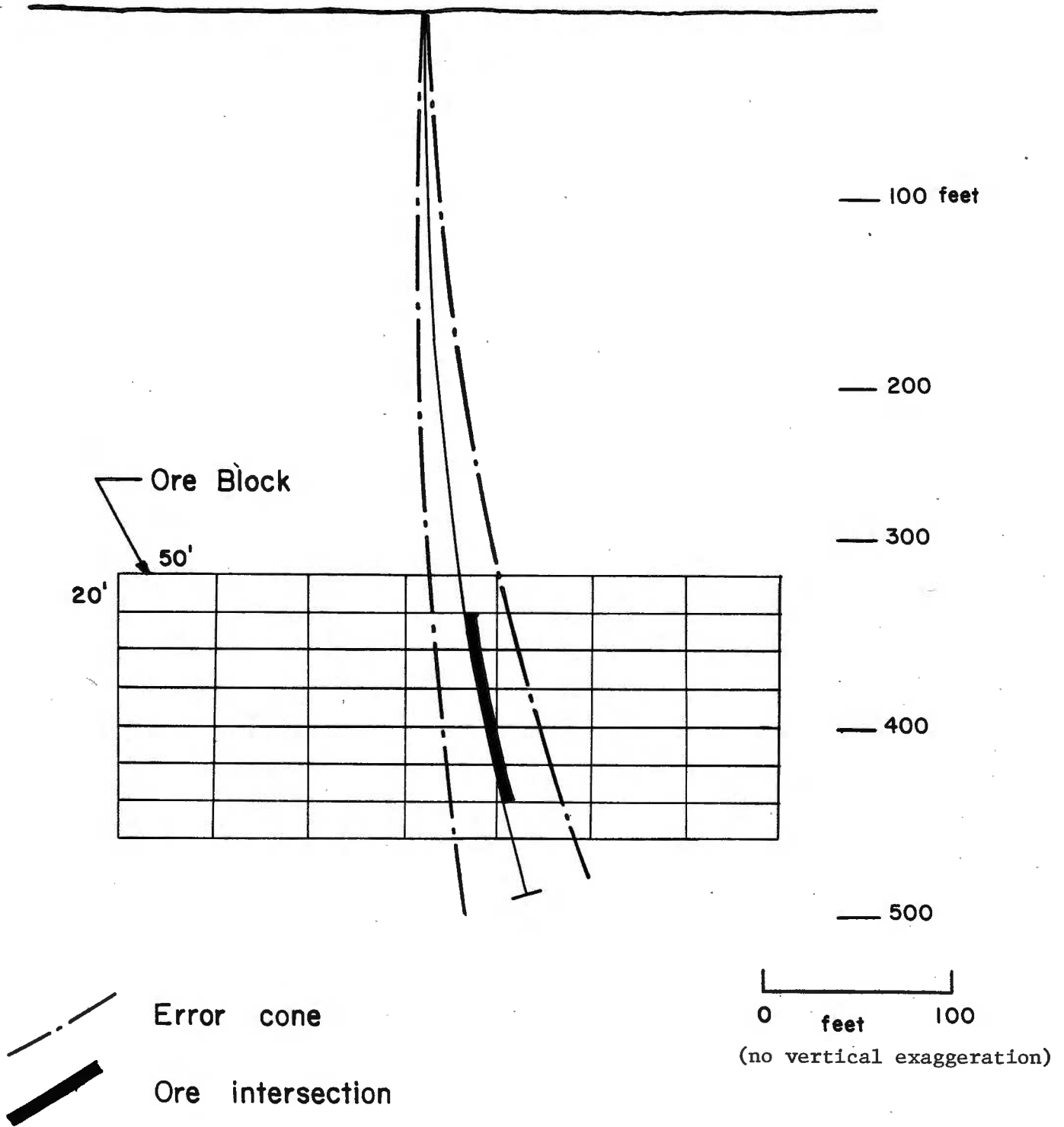


Fig. 3: Uncertainty Analysis for a data point on an unsurveyed drill hole. The uncertainty is as large as the model block size especially if large projections to plane of section are involved.

ore block (20' x 50' x 50'). In the case of surveyed boreholes, the composite error cone surrounding the plotted trajectory is approximately 5° , thus the shift of data points from one block to another will still occur, but be less likely. The above comments on plunge corrections apply equally to surveyed holes.

The fundamental implication of these primary data location uncertainties is that we simply cannot model the Faro deposit any closer than \pm one ore block (20' x 50' x 50'). The corollary of this is that since mining follows twenty foot high benches (at least in ore) on a month to month basis, we cannot use the geological model to confidently predict mining results on a month to month basis. The geological model should afford reasonable predictability on a longer range basis within the tiered hierarchy of limitations discussed above. Month to month predictability is the domain of the ore control geologist using logged, blasthole information, assays, pit mapping and the general framework the overall model provides. The short term limitations of the model underscore the necessity of on-going geological control in the extraction of all Anvil District ores.

DOWNSTREAM RECOMMENDATIONS

From our discussions to this point, it should be clear the 1983 geological model of Faro Zone 3 is but one more step toward an ultimate model. The major contributions of the current effort are:

- 1) to focus on the limitations of the data base and geological models past and present;
- 2) to provide a model which is geometrically and stratigraphically consistent with the rocks themselves;

- 3) to postulate a fault model affecting the deposit on a basis for ongoing study and revision, and
- 4) to provide a historical perspective into ways some of the problems of Faro deposit geology may be resolved.

The latter point is the subject of this section.

Uncertainty on the location of drillholes in space is a fact of life. The problems that spring from these uncertainties have been dealt with to every extent possible. Nonetheless, they have a profound impact on the day to day application of the model. We again caution users, the model cannot be confidently used to predict month to month operating results - the data won't let us get there from here. As a consequence, it is imperative that future drillholes be downhole surveyed for azimuth and inclination without fail.

Perhaps the largest lesson learned from this modelling exercise is our collective inability to decipher the faulting history of the deposit from drill core data alone. It is difficult, if not impossible, to derive a unique faulting model (and therefore a unique shape for the deposit) from the plethora of imperfectly preserved and/or observed and recorded brittle failure data in core. An independent faulting model must be derived from "hands-on" mapping to which the drillcore data can be related. In the current model, we have assumed relatively continuous, normal faulting. The key word here is "assumed". It may be that the bulk of the deposit has not failed into discrete fault bounded panels as drawn; rather a complex network of discontinuous faults and fractures may better describe its brittle behavior. Only ground truth mapping can resolve this.

Here again, for the n-hundredth time, we harp on the value of continuous, professional, correct pit mapping. This attempt to model Zone 3 has shown in spades not only the value but the necessity of fanatically accurate pit mapping! There is absolutely no point in going back to the logged data in cross and long section now to resolve the faulting problem and improve the model as we've passed the point of diminishing returns. Rather, we suggest a concerted effort be made during the 1983 field season to plane table map the pit with particular attention to the fault model. As a minimum concession to a more accurate product, many more permanent survey monuments should be established to locate outcrop data on maps as closely as possible. Once a coherent fault model is defined (or at least approached) in the field, the iterative process of fitting this model back to the logged, drillhole data can be done paving the way for an improvement on the current model. It is stressed that similar modelling problems will be (or have been) encountered in other deposits of the district where insufficient attention has been paid to geological mapping (e.g. DY).

Once a "ground truthed" fault model has been established, fill-in drilling of subarea B should be considered to complete modelling of the southeastern two thirds of Zone 3. This drilling could logically be combined with that needed to fill-in Sections 117W to 123W. It seems more important at this stage to refine the existing model rather than simply collect more data.

From an uninitiated point of view, it seems considerable thought should be given to ways of rapidly modifying the geological and mine models as changes or data additions accrue. It seems almost counterproductive to have to perform complete iterations of all sectional and bench data at each

step in the model's evolution. This approaches wholesale manual handling of the data base. At this point, we have no solution to this problem, only concerns.

Provision should be made in future to have competent, technical "back-stopping" for staff personnel, particularly for structural problems in the Anvil terrane. It cannot be emphasized strongly enough that, since the geometric problems of the Anvil deposits are structural problems, structural geologists should address them. Consultants like P. B. Read, K. R. McClay and others would be possibilities. One of our lingering unknowns is the rationalization of the bulk structural behavior of a deposit during deformation as seen in terms of its resultant mesoscopic structures. Since geologists who model these deposits will ultimately have to draw this rationalization, it is a problem worth bearing in mind.

TONNAGE AND GRADE MODELS

THE GRADE/FACIES APPROACH

J. G. Simpson and T. J. Adamson

ASSAY SECTIONS AND RECALCULATED ORE RESERVES

Current low metal prices, combined with shortfalls in stripping on the Faro deposit, serve to highlight the limitations of the existing mine model and mining methods. The Faro No. 3 orebody has a highly variable distribution of facies and ore grades and a complex internal structure. To optimise the mining operation, it is essential to have a flexible mining model and method based on the anatomy of the deposit. Previous partial comparisons of some recalculated mine phase reserves with the revised F3 model indicated that the F3 model includes large amounts of sub-grade and marginal grade material and is not sufficiently discriminating to flow through to a flexible mining model. A mine plan based on facies-grade distribution, with stockpiling of lower-grade material, would provide a mechanism for better grade control in response to price fluctuations, while reducing costs and maintaining metal output.

Assay Sections

To achieve the best understanding of grade-facies distribution, a series of assay cross sections was compiled (Sections 124-134 inclusive). Grade facies composite assays were selected by observation from all available downhole assay data and entered into the computer. These were plotted on corrected borehole projection sections showing Pb, Zn, Ag values over intercept. Like grade-facies composites were interpolated, using the revised geological base as an underlay, to provide grade-facies panels on the cross

section. The panels were color coded for 2% increases in combined lead-zinc grade, i.e. less than 2%, 2-4%, 4-6%, etc., with a facies code overprint (e.g. 2E4, etc.). The resulting sections show the 2-4% element to be significant in terms of relationship to facies. Almost all graphitic 2A and siliceous 2C elements are below or within the 2-4% range and are marginally economic. Removal of the minus 4% material from the model reduces overall volume but enhances grade considerably.

Ore Reserve Calculations

The following procedures were used to calculate reserves from the assay cross sections:

1. Working on each vertical cross section assay plot (for Sections 124+22 through 133+00), each assay/facies block was assigned an identification number.
2. The planimetered area (in square meters) for each assay block was measured.
3. The weighted average assay for lead, zinc and silver was calculated for each assay block.
4. The weighted average S.G. for each block was calculated. For this purpose, the pulp S.G.'s reported on the assay computer printouts were reduced by 5%.
5. For each section, a tabulation was made of assay block number, weighted average assay for lead, zinc and silver, weighted average S.G., combined lead plus zinc weighted average assay, and the facies designation.
6. Blocks with combined lead and zinc assays of 5% plus were designated as ore, 3-5% blocks as stockpile material, and with less than 3% as waste.
7. Ultimate pit limits for each mining phase (NA, OA, PA, UB, WA, YA) were drafted on to each assay/facies cross section.
8. For each section and for each mining phase, the in-situ tonnage and grade ore reserves were calculated, using one-half the distance to adjacent sections as the applicable strike length. Reserves were calculated using two mining cut-off grades of 3% and 5% combined lead plus zinc.

9. Total reserves for each mining phase within the limits of Sections 124+22 through 133+00 were calculated and tabulated.
10. For mining phases entirely within the limits of Sections 124+22 through 133+00 (i.e. phases NA, OA and PA), tonnage and grade results were tabulated in comparison with revised Faro Model F3 tonnage and grades, as provided by R. S. Tolbert by memo of April 22, 1983. Percentage variances with revised Model F3 were calculated.

Conclusions

From the reserve calculation comparisons and direct observation of the assay sections, the sub-grade and marginal grade material is clearly defined in sufficiently large blocks to be selectively mined, without jeopardizing costs. An indicated mine/mill cost reduction of 10-20% should be achievable with no decrease in metal output, using more selective mining methods based on a revised grade-facies model.

T A B L E 2

FARO ORE RESERVES

Comparison of Revised Model F3 and
Exploration Department April/83 In Situ Reserve Estimates

	<u>3% CUT-OFF</u>			<u>5% CUT-OFF</u>		
	<u>Revised Model F3</u>	<u>Expl. Apr./83</u>	<u>% Variance Ex.vs.F3</u>	<u>Revised Model F3</u>	<u>Expl. Apr./83</u>	<u>% Variance Ex.vs.F3</u>
<u>NA</u>						
Tonnes (000's)	1,827	1,308	-28	1,306	1,253	- 4
Pb - %	2.45	3.11	+27	2.84	3.18	+12
Zn - %	3.81	5.02	+32	4.35	5.11	+18
Ag - G/MT	37	48	+30	40	49	+22
<u>OA</u>						
Tonnes (000's)	1,330	1,087	-18	900	938	+ 4
Pb - %	2.35	3.01	+28	2.59	3.26	+26
Zn - %	3.40	4.68	+38	3.98	4.97	+25
Ag - G/MT	32	39	+24	33	42	+27
<u>PA</u>						
Tonnes (000's)	1,320	887	-33	966	737	-24
Pb - %	2.60	3.78	+45	2.98	4.17	+40
Zn - %	4.22	6.31	+49	4.88	7.11	+46
Ag - G/MT	32	44	+37	35	47	+34

T A B L E 3

FARO ORE RESERVES

Comparison of Pounds Metal, Exploration Model and Mintec Model

	<u>Tonnes</u>	<u>% Pb</u>	<u>Tonnes Pb</u>	<u>% Zn</u>	<u>Tonnes Zn</u>	<u>Ag-G/MT</u>	<u>Gms-Ag</u>
<u>3% CUT-OFF</u>							
NA - Mintec	1,827	2.45	44.8	3.81	69.6	37	67,599
Expln.	1,308	3.11	40.7	5.02	65.7	48	62,784
Variance (%)	-28	+27	- 9	+32	- 6	+30	- 7
OA - Mintec	1,330	2.35	31.2	3.40	45.2	32	42,560
Expln.	1,087	3.01	32.7	4.68	50.9	39	42,393
Variance (%)	-18	+28	+ 5	+38	+13	+24	Nil
PA - Mintec	1,320	2.60	34.3	4.22	55.7	32	42,240
Expln.	887	3.78	33.5	6.31	54.1	44	39,028
Variance (%)	-33	+45	- 2	+49	- 3	+37	- 8
<u>5% CUT-OFF</u>							
NA - Mintec	1,306	2.84	37.1	4.35	56.8	40	52,240
Expln.	1,253	3.18	39.8	5.11	64.0	49	61,397
Variance (%)	- 4	+12	+ 7	+18	+13	+22	+18
OA - Mintec	900	2.59	23.3	3.98	35.8	33	29,700
Expln.	938	3.26	30.6	4.97	46.6	42	39,396
Variance (%)	+ 4	+26	+31	+25	+30	+27	+33
PA - Mintec	966	2.98	28.8	4.88	47.1	35	33,810
Expln.	737	4.17	30.7	7.11	52.4	47	34,639
Variance (%)	-24	+40	+ 7	+46	+11	+34	+ 2
<u>3% CUT-OFF OA, PA, NA PHASES</u>							
Total Mintec	4,477	2.46	110.3	3.81	170.5	34	152,399
Total Expln.	3,282	3.26	106.9	5.20	170.7	44	144,205
Variance (%)	-27	+33	- 3	+36	Nil	+29	- 5
<u>5% CUT-OFF OA, PA, NA PHASES</u>							
Total Mintec	3,172	2.81	89.2	4.40	139.7	36	115,750
Total Expln.	2,928	3.45	101.1	5.57	163.0	46	135,432
Variance (%)	- 8	+23	+13	+27	+17	+28	+17

ZONE 3 GEOLOGICAL SYNOPSIS

G. A. Jilson

INTRODUCTION

This report is intended to provide a brief summary of the geology of the Faro deposit between cross sections 124+22 and 134+45 and long sections 14 and 25. Emphasis is on the lithologic types encountered on these sections, as well as structural features relevant to this portion of the deposit. Early descriptions of the Faro deposit and its environs can be found in Jennings (1971).

The Faro deposit is a large, elongate, assymmetric lens of Pb-Zn-Ag⁺-Ba bearing massive sulfide grading into disseminated sulfide-bearing quartzites. The deposit is prominently layered with respect to ore types and, consequently, grade.

The deposit is hosted by late Precambrian to early Paleozoic pelitic sedimentary rocks with a lesser mafic volcanic component. The host rocks and ores have been subjected to an intense polyphase deformational and metamorphic history resulting in recrystallization and folding of the ore lens at amphibolite conditions, then weaker refolding at lower grade. The post metamorphic history of the deposit includes faulting, intrusion of dikes and formation of a large body of explosion breccia, the breccia cap. These post metamorphic effects on the shape of the orebody create complex and presently unpredictable structures which add considerable uncertainty to the exact outline of the deposit.

LOCAL STRATIGRAPHY

The Faro deposit is hosted by the upper part of the Mt. Mye formation, a thick sequence of non-calcareous quartz mica schists and phyllites of generally pelitic to psammopelitic composition (shale to silty shale and fine sandstone). The Mt. Mye formation is overlain by the Vangorda formation which, in the mine area, is represented by calc silicate schists (derived from shale and variably dolomitic and calcareous siltstone). Figure 4 is a schematic stratigraphic section through the area of the deposit showing formation assignment of various lithologic types.

Regional mapping and comparison with dated stratigraphic sequences shows that the Mt. Mye formation is equivalent to the late Hadrynian to Lower Cambrian siltstone/shale sequence within and overlying the Upper Grit unit. The Vangorda formation likewise corresponds to the Cambrian and Ordovician Rabbitkettle formation but is less calcareous. The transitional contact zone between Mt. Mye and Vangorda formations is characteristically more carbonaceous and variably dolomitic; this probably corresponds to the shale equivalents of the lower Cambrian Sekwi formation (map unit 8A of Blusson, 1966).

In the district, ore occurs as one or more lenses near and generally below the contact of the Mt. Mye and Vangorda formations. Both Grum and Dy deposits include ore lenses in the Vangorda formation. Faro appears to equate approximately to the lowest of the Grum and Dy ore lenses.

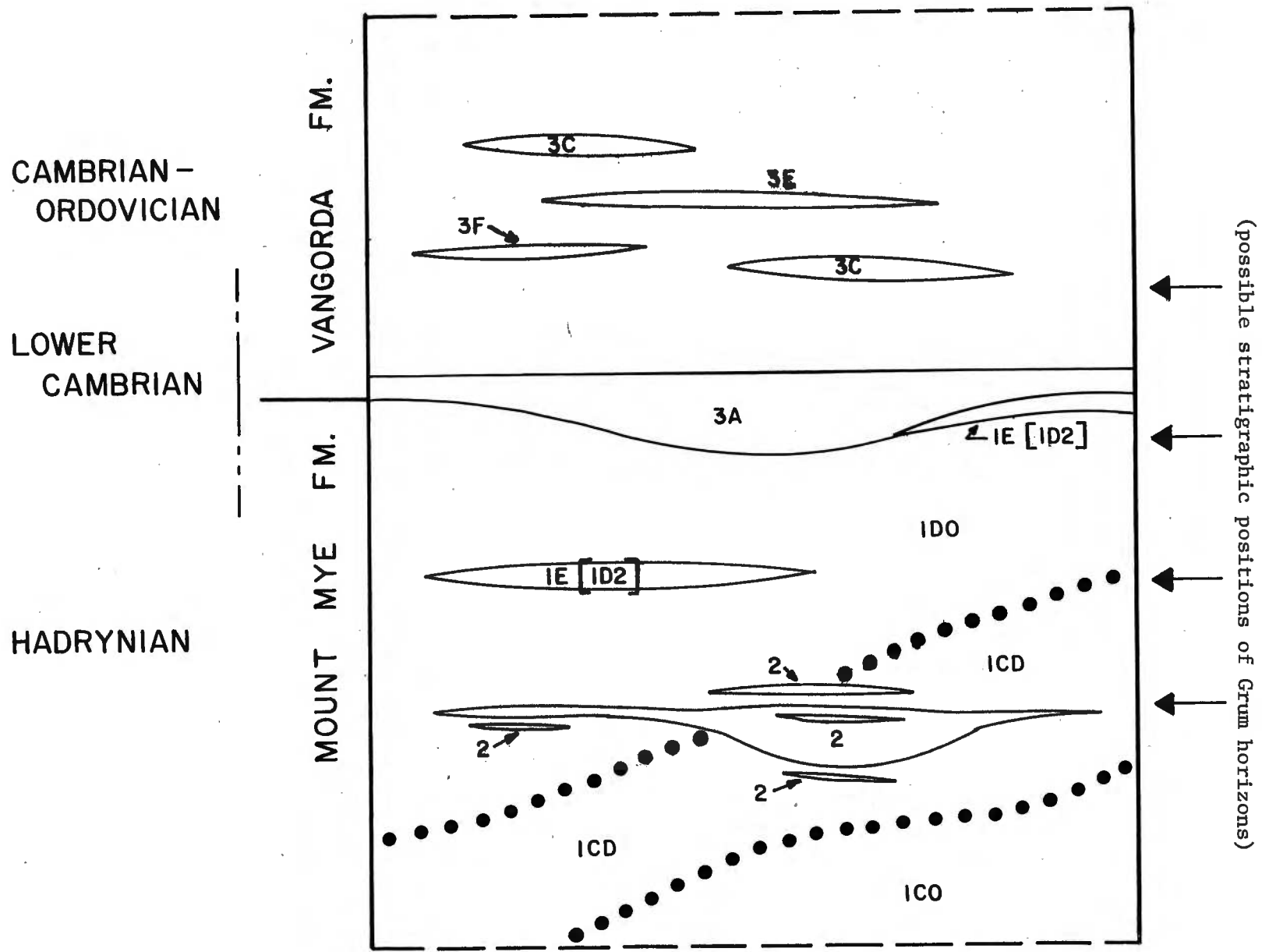


Fig. 4. Schematic stratigraphic section through zone 3

LITHOLOGY

The present lithologic code (based on maps units 1-5 with alphanumeric compositional modifiers - see Table 2) stems from work done in the early 1970's. Since that time, several changes have occurred in stratigraphic nomenclature which render the code somewhat confusing, since unit numbers do not correspond exactly to formation boundaries. This lamentable situation has been allowed to continue to avoid outdated hundreds of coded drill logs and maps. The confusion is caused by the amphibolitic facies metamorphic overprint at the Faro Deposit as opposed to the less intense metamorphism on the Vangorda Plateau. The result is two sets of rock units for each of the major formations. The Mt. Mye formation is called 1C, 1CD and 1D (schists) at Faro but 3G (phyllites) in areas that have suffered less metamorphism. The dominant lithology of the Vangorda formation is called 3D (calc silicate schists) at Faro but 5B (calcareous phyllite) elsewhere. Figure 5 shows this effect superimposed on the stratigraphic sequence while Table 3 gives an equivalence for rock types formed at different conditions and in different formations.

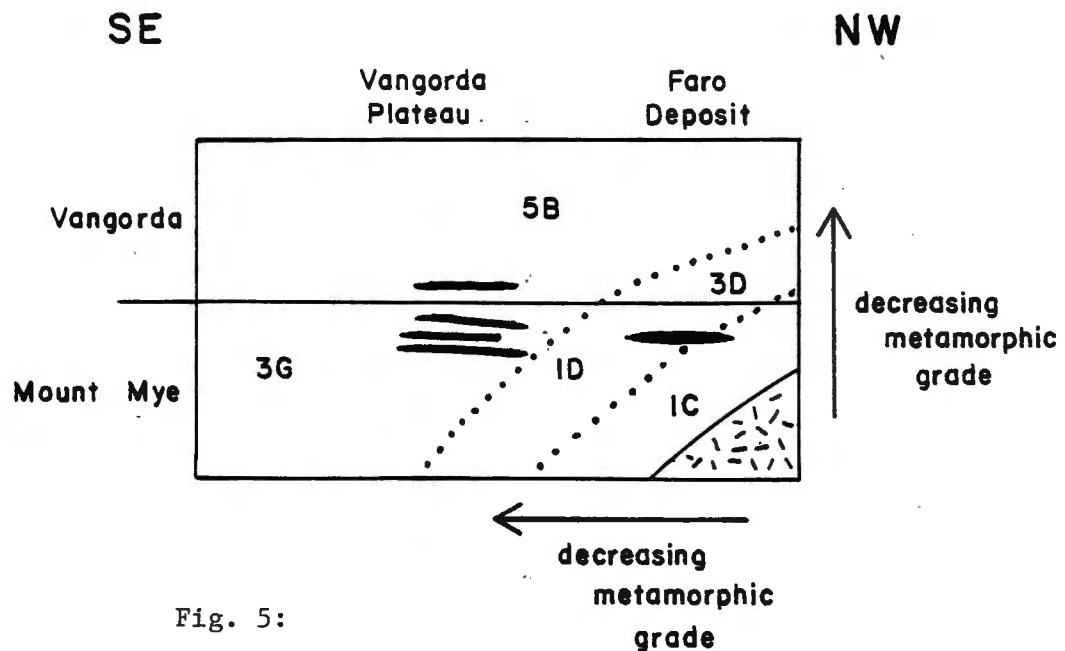


Fig. 5:
Metamorphic overprint in original
Stratigraphy, — = ore horizon

Table 4

MAIN DEPOSIT AREA
LITHOSTRATIGRAPHIC CODE

Intrusive Rocks

Unit 10	928	10-A	Granodiorite (kspar-plag, quartz>10%)
	929	B	Adamellite (qtz monzonite)
	939	C	Pegmatite
	956	D	Quartz diorite (kspar<<plag, qtz>10%)
	934	E	Diorite (kspar<plag, qtz>10%)
	925	F	Monzonite (kspar-plag, qtz<10%)
	932	G	Pyroxenite
	937	H	Granite (kspar>plag, qtz>10%)
	930	I	Syenite (kspar>plag, qtz<10%)
	938	Q	Bull qtz veins/pods

- 1 Foliated/lineated
- 2 Porphyritic
- 3 Aphanitic
- 4 Smokey qtz-bearing
- 5 Muscovite-bearing
- 6 Kspar-bearing
- 7 Biotite-bearing
- 8 Amphibole-bearing
- 9 Altered (kaolinite, montmorillonite)
- 0 Normal (equigranular)

Vangorda Formation

Unit 5	936	5-A	Variably calcareous, graphitic phyllite (hosts Unit 4; s 1E, hosts Unit 2)
	920	B	Calcareous muscovite-chlorite-biotite phyllite (greenschist equivalent of 3D)
	908	C	Metabasite
	910	D	Chloritic phyllite
	904	E	Phyllitic marble and silicified marble
	910	F	Laminarily banded, variably calcareous, chloritic phyllite (associated with 5C)
	949	G	Variably calcareous, graphitic phyllite.

- 1 Siliceous
- 2 Carbonaceous
- 3 Calcareous
- 4 Altered, pyritic (white mica envelope)
- 5 Banded/laminated
- 6 Non-calcareous
- 7 Chlorite laminations
- 8 Chloritic
- 9 Sulfide-bearing
- 0 Normal
- * Carbonate-bearing

Faro, Grum, Vangorda, DY Deposits

Unit 2/4	922	2/4-A	Sulfide-bearing, ribbon-banded, graphitic quartzite
	915	B	Pyrite-free quartzite (may contain base metal sulfides)
	916	C	Base metal-poor, pyritic quartzite
	942	D	Base metal-bearing, pyritic quartzite
	918	E	Massive pyritic sulfides
	923	F	Buckshot facies, massive sulfides
	928	G	Baritic facies, massive sulfides/sulfates (>10%BaSO ₄)
	924	H	Pyrrhotitic facies, massive sulfides
	949	J	Non-pyritic, massive sulfides/oxides
	921	K	Carbonate-bearing, massive pyritic sulfides
	914	L	

- 1 Siliceous
- 2 Coarse, porphyroblastic pyrite-bearing
- 3 Fine pyrite/marcasite-bearing
- 4 Sphalerite and/or galena-bearing
- 5 Carbonaceous
- 6 Barite-bearing
- 7 Pyrrhotite-bearing
- 8 Magnetite-bearing
- 9 Chalcopyrite-bearing
- 0 Normal
- * Carbonate-bearing

Mt. Nye Formation

Unit 3	916	3-I	Graphitic quartzite in non-calcareous phyllite/schist
	913	H	Tuffaceous calc-silicate phyllite/schist (assoc. with 3D; identical to 5F)
	941	G	Non-calcareous muscovite-chlorite-biotite phyllite/schist (s 1C, 1D)
	906	F	Marble and silicified marble (s 1G)
	963	E	Graphitic phyllite/schist (s 5A)
	913	D	Calc-silicate phyllite/schist (u. greenschist to amphibolite facies equiv. of 5B)
	908	C	Metabasite
	946	B	Chloritic phyllite/schist (c.f. 5D)
	912	3-A	Transition zone with unit 1 (interbanded chloritic phyllite, graphitic phyllite and pelites of Vangorda and Mt. Nye Fms.)

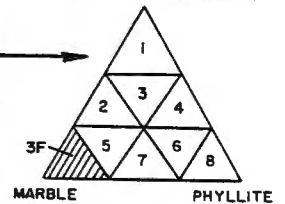
GRENSCHIST FACIES

AMPHIBOLITE FACIES

- 1 Siliceous
- 2 Carbonaceous
- 3 Calcareous
- 4 Altered, pyritic (ume)*
- 5 Banded/laminated
- 6 Sulfide-bearing
- 7 Chlorite laminations
- 8 Chloritic
- 9 Carbonaceous
- 0 Normal

- 1 Siliceous
- 2 Carbonaceous
- 3 Calcareous
- 4 Altered, pyritic (ume)*
- 5 Banded
- 6 Clotted
- 7 Staurolitic
- 8 Chloritic
- 9 Sulfide-bearing
- 0 Normal

CALC-SILICATE PHASES



* (ume) White mica envelope

Nov. 16/81
DsJ/BB.

T A B L E 5

LITHOLOGIC EQUIVALENCES

3E = 1E = 5A	=	Carbonaceous/graphitic phyllite
3G9 = 1D2 = 5B62*	=	Slightly carbonaceous phyllite
1F = 3C = 5C	=	Metabasite
3B = 5D = 1H	=	Chloritic schist/phyllite
3G0 = 1D0 = 5B6*	=	Pelitic phyllite/schist
3F = 1G	=	Marble

* Stratigraphic connotation carries with it some lithologic connotation.

A point that must be emphasized, since it seems to escape most workers in the district, is that the lithologic units are derived from map units and are designed to be cross sectional units, consequently there is variation in some units which oscillates about a monotonous norm. The best way to become familiar with these rocks and their variations is to look at them and the best way to look at them is by reference to the numerous carefully logged holes. Such examination will make clear the degree of variation, as well as what the norms are. Put another way, for the purposes of core logging, the rocks are their own best documentation.

In this regard, drillholes 456-75-12 and 13 on Section 118 are offered as a "type section" and study guide to the unmineralized stratigraphic section hosting the deposit. These holes traverse the Vangorda/Mt. Mye transition zone and are the holes on which the metamorphic stratigraphic nomenclature is based. Their hand-written and graphic logs are included in Appendix I. One of the best examples of very "distal" mineralization in the Faro deposit is shown by DDH 71-DS-01. Its log is included in Appendix I for study.

Unit 1D

Medium to dark grey brown muscovite biotite andalusite schist to coarse phyllite. The grey coloration is due to minor disseminated graphite (or simply carbonaceous material) which varies from negligible (brown rocks) to sufficient to cause a dark grey color on the foliation surface (grey rocks). Greater graphite content is noted by using the term 1D2 and the break occurs at approximately the break between medium dark grey and dark grey color on clean, dry foliation surface. 1D grades into 1E and 1CD as graphite increases and decreases respectively.

1D is usually pervasively S₂ foliated (PS₂) with S₁ preserved in lithons usually visible only in thin section. S₄ crenulations are commonly well developed.

Units 1E and 3E Graphitic Schist/Phyllite

Black to very dark grey carbonaceous muscovite biotite andalusite schist. Should be solidly and thoroughly carbonaceous enough to cause the rock to be conductive, i.e. should dirty hands and smudge paper easily (no quibbling about it!), anything less is 1D2. Andalusite commonly chiastolite.

Unit 1C

Medium to dark brown, commonly with purplish tinge, compositionally banded to nearly gneissose quartz feldspar biotite muscovite-staurolite-garnet schist. Foliation surfaces have distinctly silvery lustre. Coarser than 1D and less carbonaceous (i.e. not grey) and lacking andalusite psuedomorphs. Compositional banding consists of alternating quartz feldspar and mica rich bands parallel to S₂ generally a few millimeters thick.

Unit 1CD

1CD is a transitional rock from 1D to 1C; it generally does not have marked compositional banding and does have andalusite psuedomorphs but lacks the grey color of 1D - this is a very subjective unit which can only be logged with confidence by constant reference to previously logged holes and it is recommended that no stratigraphic significance be attached to it. 1CD is common above the ore in the northeast which may be due to metamorphism or decarbonation reactions as has been proposed for Grum and Dy (3G8 vs. 3G0).

Unit 3D - Calc Silicates

Compositionally banded dark purplish brown (biotite rich) and light greenish creme to off white (quartz diopside[±]actinolite plagioclase[±]calcite rich) calc silicate schist to phyllite. Generally calcareous and locally with thin interlayers of fine calcitic marble. Other common interlayers are pelitic schist (simply thicker biotite rich bands), chloritic phyllite and graphitic phyllite (3E).

Triangular compositional modifiers have been proposed but they are not generally used since early efforts to work with subdivisions of the calc silicates proved fruitless. Most logging from 1976 on, especially 1980-82, applied these modifiers very uncritically and it is recommended that the logged unit simply be considered 3D.

Unit 3A

3A is the basal unit of the Vangorda formation and is part of the transition zone into the Mt. Mye formation.

3A is characteristically a sequence of carbonaceous to graphitic schists (1D2-- 1E0) with interbanded medium olive-green chloritic phyllite (3B) and amphibolite (3C). Some calc silicate is interlayered.

For no apparent reason, 3A has caused considerable difficulty amongst various core loggers and mappers. It is, however, a distinctive unit. The top of 3A is the base of the normal calc silicates (3D) while the base of 3A is the top of normal schists (1D0). As a result of this problem, there

are wide variations in the thickness of 3A on sections but these must be taken with a grain of salt since much of the variation may reflect logging bias. Nonetheless, variation in thickness should be expected since this unit equates to the 5A/5D complex equivalent to the "dogmatic" horizon at Grum and DY. It and similar graphitic subunits there show thickness variations suggestive of facies changes around sub-basins. These 3A definition problems are particularly noticeable on cross sections 124, 125 and, of course, the northwest ends of long sections 14 to 21.

Units 3B and 1H Chloritic Schist

Medium olive green to dark green chlorite rich schist commonly with calcite; usually not strongly laminated. May be bleached, in which case it forms a rusty weathering buff dolomite or ankerite bearing rock logged as 1H4*. Where mottled dark green on the foliation, it may be derived from 3C/1F.

Unit 3C/1F Metabasite - Amphibolite

Weakly foliated dark green/off white mottled amphibolite usually displaying relict igneous texture. Contains amphibole after pyroxene as dark areas and plagioclase in light areas.

Unit 3F/1G Marble

Light to medium grey to off white, variably silicate-bearing, finely to coarsely crystalline marble. Some dark grey, possibly fetid marble has been logged as 3F9 and several holes contain a unit 3F2 which is a very calcareous version of the chloritic phyllites.

Intrusive Rocks

The dikes at Faro fall into two broad classifications for which many lithologies have been logged. The two main groups are a porphyritic hornblende biotite quartz diorite, 10E; and a usually smokey quartz feldspar biotite porphyry, 10F. The two suites are quite distinctive and should not be confused, nonetheless they have been.

Distinguishing features of the 10F clan is an off-white, nearly aphanitic ground mass (commonly kaolinized) in which are set subhedral quartz phenocrysts (commonly smokey) and nearly euhedral plagioclase and biotite crystals.

The 10E clan is also porphyritic but closer to serrate with stubby hornblende prisms, feldspar crystals and occasionally quartz and biotite in a ground mass of finely crystalline quartz feldspar material.

Many loggers have been more concerned with the correct description of the composition of the dike rock when, for the purposes of cross sections, what matters is to which of these two clans a given dike intersection belongs. In the future, it would be worthwhile to log the composition as the logger sees it and assign the rock to one of the dike sets discussed above with provision for new types of dikes as needed.

The shape of dikes on sections poses some of the same problems as faults and clearly a mapped model helps by giving something to extrapolate down to the drill holes. Observations in the pit clearly show most dikes dip steeply. Observations in drill core, however, show that there must be a

moderately northeast dipping 10E "sill" beneath the breccia cap (i.e. along the Quarterpounder). The interpretation shown on sections attempts to marry these two observations by having steep dikes branch off the sub-breccia cap sill producing something resembling a cariboo antler in cross section. Clearly the details of this geometry are not easily worked out and the result is sometimes not satisfactory (see Section 126 for example) but the basic model is probably correct.

The 10F clan has proved particularly difficult to deal with. The pit map shows a large 10F body trending about 110° along an important fault (normal, southside down) northwest of the area of this study. The 10F dikes at the northeast ends of Sections 124 - 126 have been interpreted as following this trend. In addition, a dike with a shallow apparent dip is shown below the ore on Section 124. This was thought to be a dike parallel to and below the Big Mac as shown on the long sections. What is drawn on Section 124 accounts for both interpretations and may bear more on the problem of "too many cooks" than it does on reality. On long section 23 and cross section 128+20, a 10F dike is shown which seems to go nowhere; this is doubtless not the correct interpretation and little significance should be attached to the 10F cross cutting 10E as the age relations of these two dike types have not been demonstrated in Zone 3.

Breccia Cap

The breccia cap is a large body of breccia at the northeast end of the ore body in Zone 3. The breccia is not well understood, thus will not be discussed in detail here. The breccia consists of angular blocks of dominantly 3D with lesser 3A and 1D and minor amounts of 10E and sulfides.

The blocks range in size from a small house to pebbles and are tightly packed in a hard, presumably siliceous, probable rock flour and minor 10E matrix. The breccia contains fragments of dike rock but is cut by dikes which are generally not brecciated, presumably indicating a genetic connection. The breccia is clearly post-D₂ and probably post-D₄, thus no significance should be attached to it in relation to ore genesis. The breccia occurs mainly between two intersecting normal faults, the Big Indian trending NNE (SW side down) and another dike trending ESE (SE side down) which parallels approximately the 10F body northwest of Zone 3 and probably is part of the Faro Fault (see Jennings 1971, 1975). The bulk (but not all) of the breccia occurs in the common downthrown block suggesting that the faults may have localized the breccia and perhaps that movement triggered the brecciation mechanism (possibly explosive evolution of a vapor phase related to 10E or 10F).

The southwest margin of the breccia cap is the Quarterpounder "fault" which is discussed under faults. The lower (southwest) boundary of the breccia cap is also marked a quartz diorite sill which is not strongly brecciated, thus presumably has intruded along the interface between brecciated and intact rock. The northeast dipping fault bounding the breccia cap is an elaboration of the earlier cross sectional interpretation proposed by Hanson and Mustard. In general, a moderately northeast dipping, nearly planar fault/sill concept works well. Major deviations have been explained as fault offsets by the Big Mac and Big Bird but it should be emphasized that the boundary could equally well be jagged and irregular with sharp bends in the contact explaining apparent offsets.

FARO DEPOSIT

Form

The shape of the Faro deposit is the result of the combined effect of formation and deformation. Repeated observation of the internal structure of the deposit leads to the suggestion that the deposit formed with a shape not grossly dissimilar from that it now shows, though the detailed outline of the deposit is much modified by folding (Figure 6).

The deposit thus probably formed as a large elongate assymmetric lens or pod shaped somewhat like an aerofoil. It formed parallel to bedding in the host sedimentary sequence. The axis of maximum thickness is displaced to the northeast from the center of the lens and it is about this thickness axis that ore type tends to be zoned with variably quartzose massive and semimassive sulfide near the axis grading outwards through thinner, more massive, then quartzose and finally graphite bearing quartzose ore facies. Baritic facies tend to be central and in the upper portions of the deposit. An upper subsidiary horizon is present on many sections over this thick central axis and there is a weak association of metabasite with the area as well. This arrangement of facies and the rapid changes in thickness shown on sections is tempting material for speculation about feeder zones beneath the axis and growth faults beneath the thickness changes, but one must keep in mind the state of deformation of the deposit and prevent speculation from becoming dogma!

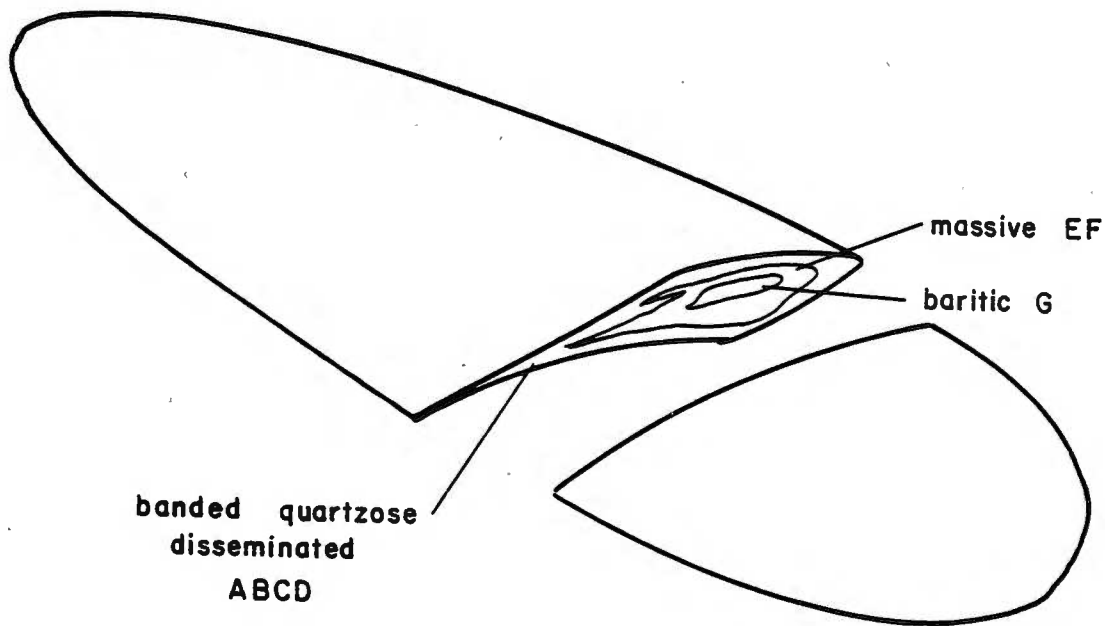


Fig. 6: Simplified form of Faro Deposit

Ore Types

The ore types in the Faro deposit and any of the other deposits in the district fall into two broad categories: massive and quartzose disseminated. Massive types can be essentially pyrite or can have various combinations of pyrite, galena, sphalerite, barite, magnetite, pyrrhotite or chalcopyrite. Disseminated types consist of a similar suite of minerals (except usually barite) in a quartz-mica-graphite gangue. Both types of ore are commonly conspicuously banded parallel to the metamorphic foliation.

Essentially all ore types are gradational with one another but certain logical subdivisions occur because the frequency of distribution of ore types is not random. These common ore types have been designated the major lithofacies. Deviations from these norms is accounted for by a series of modifiers. The gradational nature of the ore types creates problems of definition for boundary cases but experience shows that these problematica are inconsequential with respect to the bulk of ores that can be easily classified. The following notes briefly describe the various ore types and

present boundaries that have been historically used. P. S. Tolbert has redefined boundaries using assay results and the reader should consult his work for currently accepted definitions.

Unit 2A - Ribbon banded graphitic quartzite

Dark grey, finely banded rock with alternating bands of light colored granular quartz and sulfides and dark colored very fine grained quartz mica and carbonaceous materials. The S_2 folia will be medium dark grey to black, generally dark grey - cut surface of core is dark grey when dry, black when wet. The unit grades into 2C/D by decrease in graphite content, rocks that contain enough carbonaceous material to have medium grey folia are to be called 2C5, thus the boundary for 2A is based on color, 2A like 2CD normally has up to 30% total sulfides.* Rocks with more than 30% total sulfides are termed 2A3. 2A with greater than 5% Pb+Zn (4% now at Faro) are called 2A4, 2A is very siliceous and very hard (a knife will leave metal on the cut surface of core and generally will not be able to scratch it). Extraordinarily siliceous "cherty" varieties are seen rarely - they are very, very hard and are properly termed 2A1 - at Grum 4A1 has been used for rocks that are lighter grey than normal but not abnormally siliceous, this is misleading and such practice should be avoided.

Unit 2B - Non-pyritic quartzite

The term was coined for light grey, weakly micaceous quartzites with little or no sulfides. The rock should have no pyrite but may contain minor PbS or ZnS. 2B4 has been logged and indicates a very quartzose rock with more

* (ALL SULFIDE PERCENTAGES ARE BY VOLUME)

ZnS and PbS than normal but still no pyrite.

Unit 2C and 2D - Pyritic quartzite

These terms were coined for sulfide-bearing quartzites (using quartzite in the metamorphic sense) which normally have up to 30% total sulfides. 2C was used for pyrite dominant rocks, 2D for more base metal bearing variants, the dividing line was originally 5% Pb+Zn, now adjusted to 4% by R. S. Tolbert. Rocks with 30-60% total sulfides are called 2C3 or 2D3. Rocks of 2C and 2D normally contain some muscovite giving them light grey or white S₂ folia; if enough carbon is present that the folia are medium grey (comparable to a normal 3G or 5B phyllite), then the rock should be called 2C5 or 2D5. 2C4 is 2D0, therefore should not be used and 2D4/2D0 division is at 10% Pb+Zn.

Unit 2E - Massive pyritic sulfides

Coined for rocks with greater than 80% total sulfides, mainly as pyrite. 2E1 is used for nearly massive rocks with 60-80% total sulfides. 2E0 vs. 2E4 is a matter of grade with the division originally at 5%, now adjusted downward to 4% by R. S. Tolbert. Unit grades into 2G through increasing barite, thus 2E6 is used for rocks with less than 10% BaSO₄ (by volume). 2E5 has been used for massive or near massive sulfides with small graphitic lenses parallel to the foliation and for 2E with 2A interlayered.

Unit 2F - Buckshot Ore

This is a textural term applied to rocks with buckshot size pyrite porphroblasts (approximately 2 mm diameter) in a base metal sulfide matrix. This

is essentially a statement about grade as well, since a large amount of PbS and ZnS is required before this texture can be developed, thus the break from 2F0 to 2F4 is at 10% Pb+Zn.

Unit 2G - Baritic facies

Barite-bearing massive sulfide/sulfate rock with greater than 10% barite. Generally high grade, thus break from 2G0 to 2G4 is at 10%.

2G1 has been used where there is more quartz than barite but the rock otherwise fits requirements for 2G. 2G is commonly magnetite-bearing (2G8) with the division being made when the magnetite is a persistent and readily noticeable constituent. A rule of thumb about 2G is that it "burns black on the drilled surface" - this presumably is due to the streak of pyrite being visible on the white barite and the more vulnerable nature of pyrite in a baritic host.

Unit 2H - Pyrrhotitic massive sulfide

2H is dominantly pyrrhotite, though some pyrite is allowed. 2H2 is applied to more than about 10% porphyroblastic pyrite and 2H3 if the pyrite is fine. 2H1 implies more than 20% quartz. Breccia textures are common in 2H. 2H is commonly chalcopyrite-bearing.

Unit 2J - Non pyritic massive sulfides

This is an unusual rock which is essentially massive galena and sphalerite with only minor pyrite as porphyroblasts. 2J is also used for non-pyritic oxide-rich rocks which are essentially massive magnetite.

Unit 2K - carbonate bearing massive sulfides.

This term is applied to massive pyrite with large amoeboid blebs of flesh colored ankerite - it is not common at Faro but occurs widely in other deposits. It should not be applied to massive sulfides with only traces to a few percent of fine grained carbonate (for which 4E* is used).

Units 2L and 1D4 - White mica envelope

1D4 was originally coined to refer to schists enveloping the ore deposit which contain only muscovite as the mica. The rocks are off-white and commonly have a greasy feel on the S_2 foliation. Minor marcasite is common. The rock was originally thought to be a product of metasomatic reaction between the wall rocks and host rocks during metamorphism removing iron from silicates and fixing it in sulfides due to high FS_2 . Later, similar but more footwall biased alteration was noticed at Swim and other deposits. Since this alteration was thought to be caused by ore forming fluids, an ore facies number/letter designation was given, 4L (which of course would be 2L at Faro). Now both 2L and 1D4 are logged at Faro but there is no clear cut distinction between the two. 1D4 at Faro is clearly not footwall biased and its common association with faults and dikes suggests it is late rather than syngenetic with ore. It is thus probably wise to continue use of 1D4 to avoid the uncritical and unconscious assumption that this is all alteration related to ore-forming fluids.

An apparently abnormal development of 1D4 in association with and above metabasites near the upper ore horizon might indicate that some 1D4 is associated with dike or sill intrusion or flow extrusion essentially consanguineous with ore formation. Pyrrhotite mineralization well above the

ore lenses is associated with this abnormally developed 1D4.

The use of combinations of units such as 2EC has recently crept into increasing use at Faro and in other deposits. Originally, this applied to composite intervals where two lithologies were present; however, increasingly the term has started to appear on logs. This is not desirable and should be discontinued. Any interval can be logged using proper ore facies designation and conventions for interlayered lithologies, i.e. 2CE can and should be logged either as 2C3 or 2C0 (2E0), then it might be possible to tell what it is!!!

Structure

Folds

It is widely known that the structure of the Anvil Range is highly complex but at Faro much of the complexity can be overlooked. The deposit has suffered two early periods of intense deformation and recrystallization at amphibolite facies conditions and at least three later, less intense deformational episodes. The result of the first two events has been to coarsely recrystallize and impose a prominent layering or platiness to the rocks (S_2 , a metamorphic foliation). This is not to say that there are no folds resulting from the first and second deformations (D_1 and D_2) but simply that experience shows that they are small and do not significantly distort the shape of the orebody. They may, however, affect the shape of the deposit since the degree of rootless disharmonic internal D_1/D_2 folding of the Faro deposit is essentially unknown. Available data suggests large folds are not present and deep drilling around the deposit shows that orebody sized folds do not repeat the stratigraphy. The layering and gross shape

of the Faro deposit and boundaries of stratigraphic units thus can be considered as approximately parallel to S_2 . Near Faro, the foliation generally dips southwest but in the Zone No. 3 pit westerly dips are common, reflecting a broad warp in the foliation; the deposit also reflects this southwest dip.

Both the foliation and the orebody are affected by late folds and in Zone 3 the most important of these are F_4 folds formed during the fourth deformation event, D_4 . These are the major wrinkles in the orebody shown on cross sections. The folds are close to tight with axial planes inclined toward the northeast and axes plunging shallowly toward 290° . The folds are generally assymmetric, northwest verging (shaped like Z looking northwest) and have long limbs several times longer than short limbs. Short limbs are subvertical to steeply northeast dipping, they are up to approximately 100 feet high but in general 20 feet or less. A major F_4 fold hinge has been traced through the entire Zone 3 portion of the deposit trending 290° . This fold follows thickness and facies trends of the ore which have probably influenced deformation (Figure 7).

There has been a tendency to overestimate the effect of folding in early models of the deposit, since they are based on Zone 1 which seems to have larger amplitude F_4 folds. In Zone 3, serious limitations to the size of F_4 folds is provided by the scarcity of drill core intervals where S_2 dips steeply, thus folds have been down-played in this version. This is in contrast to many areas of Zone 1 where steep S_2 dips are far more common, particularly in drill core.

A point of importance worthy of note here is the usefulness of S_2 as a time marker. The Faro deposit (and other Anvil District deposits) contains many brecciated zones, some of which appear to be stratiform (since they form by brecciation caused by ductility contrast during sulfide flowage as part of the metamorphic recrystallization and deformation). Many visitors and newcomers to the district note the similarity to brecciated ore at Buchans or in Kuroko deposits, but here all breccias known to the authors contain variably oriented clasts with a metamorphic fabric (usually demonstrably including S_2); these are clearly post metamorphic and can have nothing to do with ore forming processes. This useful tool should be kept in mind by future workers.

Faults

Post metamorphic faults are common at the Faro deposit, at least one major fault system separating Zones 2 and 3 has been known for many years. More recent drilling and stripping has shown that many more occur and that the major fault systems are quite complex. These faults have posed the major problem standing in the way of a satisfying set of cross and long sections.

The inherent difficulty of dealing with faults which dip steeply within a field of generally vertical drillholes is widely appreciated. Several other aspects of the treatment of faults create considerable difficulty since they require special treatment in order to produce consistent cross and long sections. Foremost among these is the fact that drill holes are almost never exactly on section and faults clearly must be projected in a manner consistent with their orientation, not routinely parallel to the trend/plunge line used for lithologic units. It is further important to

41

avoid projection of lithologic data across faults since this is a major source of error. This is a coupled problem which necessitates absolute knowledge of the fault in space and relative location in a given borehole. At Faro, this could be achieved through routine pit mapping and careful integration of surface and subsurface data; this has not been done and it cannot be shortcut through use of drill hole data exclusively.

These problems, of course, pertain to faults known to exist, finding faults in a field of drill holes is a very difficult and time consuming job. The usual approach is to plot gouges and attempt to hook them up into logical patterns. Anyone who has tried this (and someone has for every Faro section!) will vouch for the general futility of it. On one hand, there are always more gouges than there are faults in a given drill hole. On the other hand, for many orientations of faults with respect to sections, the connection of related gouges forms anything but a logical pattern when holes deviate widely.

A second approach involves deviations from usual ore body stratigraphy or thickness suggestive of fault cut outs. This approach is commonly successful when used in conjunction with the above gouge data but several iterations of cross and long sections are usually required to account for all such "stratigraphic" anomalies.

A further approach is to scan cross and long sections for abrupt changes in elevation of ore (or other geologic units). When using this technique, it must be realized that there is substantial uncertainty in absolute location and elevation of logged units in drill holes which have not been down

hole surveyed, and it is not realistic to expect to find a fault with less throw than this uncertainty. At Faro, these uncertainties are large and faults with one to two 20-foot bench heights throw can be found from drill hole data alone only with luck.

All of these techniques have been used with varying success. In the absence of a reliable pit map, the assumption has been made that only certain mapped faults are significant and most significant faults are mapped.

Another assumption has been made that the major displacements will be found on only a few structures. The results suggest that both these assumptions were invalid. A satisfactory fault picture has not emerged. Huge uncertainties remain which affect tens of thousands of tons of ore and seriously jeopardize the predictive capability of any model derived from the sections.

The fault pattern is summarized in Figure 8. We wish to emphasize that the interpretation is tentative and highly uncertain. In order to enhance this impression, we have chosen to use names which are unlikely to persist. Only the Big Indian is a name of historic use, having been introduced by Jennings in 1971. The Big Indian was renamed the North Fork fault by 1976 but, in the ensuing years, considerable confusion has come up as to where the North Fork fault goes. Since the North Fork, as used by pit geologists in 1981-82, may be a splay of the fault system that should have been called North Fork, we have elected to suspend use of the name to avoid confusion. The fault system has instead been called the Big Bird Fault and it is probably related to the Big Indian. An unnamed fault or discontinuity has been used to bound the breccia cap since early interpretations by Jim Mustard and Daryl Hanson. The present interpretation is merely a modification of theirs -- the "fault" is termed the Quarterpounder.

The remainder of the faults are new and tend to be named after junk food; this is not coincidental.

Big Indian Faults

The Big Indian Fault has been known to exist from the early days of drilling of the Faro deposit. It has conventionally be considered to separate Zone 2 from Zone 3. The fault has long been known to be a northeast trending normal fault with southwest side down dropped. The dip of the fault appeared to vary from 45 to 60°. In the Zone 3 pit, the Big Indian Fault is the major control on ore localization. Surprisingly, a feature this well known and this important has not been well documented on maps.

The placement of the Big Indian Fault used for this study was derived from the limited blast hole assay data available in the Vancouver office, in conjunction with diamond drill hole data. Scrutiny of this information leads to the suggestion that the Big Indian is not a simple fault but a complex system of splays, most of which have relatively small throw.

Big Mac Fault

The Big Mac Fault is a northeast trending structure dipping steeply northwest. It strikes parallel to cross sections and cuts obliquely across Section 125+00, creating considerable problems there. It is mainly evident on long sections northeast of 19+00 and has an apparent downdrop of approximately 50 feet northwest side down in the ore. Above the ore, the boundary of breccia cap and the 10E sill emplaced along it appear to be offset by a substantially larger amount. This may indicate that the fault has a transcurrent component or that it is improperly understood. It is, for example, unclear whether the Quarterpounder Fault is actually cut by the Big Mac or whether the Big Mac is merely a reflection of an sharp bend in the shape of the boundary of the breccia cap. In this case, the ore would be displaced a small amount outside of the cap, with displacement decreasing with increasing distance from the breccia cap along a structure that roots in the broken fragments of the breccia.

Big Gulp Fault

This fault trends about 120° , dips steeply to the southwest, and is down-dropped to the south approximately 60 feet. It was noted on several cross sections independently, and sections lacking it originally looked more believable when it was added. The projection of the fault to surface is near

a mapped fault between 3A and 3D near DDH 82-F-17 and it is presumed to be the same fault.

The relation of the Big Gulp to other faults is unknown; it is presumed to truncate against the Big Bird.

McChicken Fault

This fault was also noted in cross section but was more clearly evident on long section due to elevation drops in the ore. It occurs near the major F_4 fold hinge and may be in part due to an inadequate understanding of that fold, since it tends to reverse the change in elevation of the ore that the fold creates. The fault trends approximately east-west and dips steeply south -- displacement is about 75 feet downthrown to the south.

The McChicken, like the Big Mac, cannot be drawn through long section 19+00. It is possible that the two fault offsets cancel each other on that section as shown below (Figure 9).

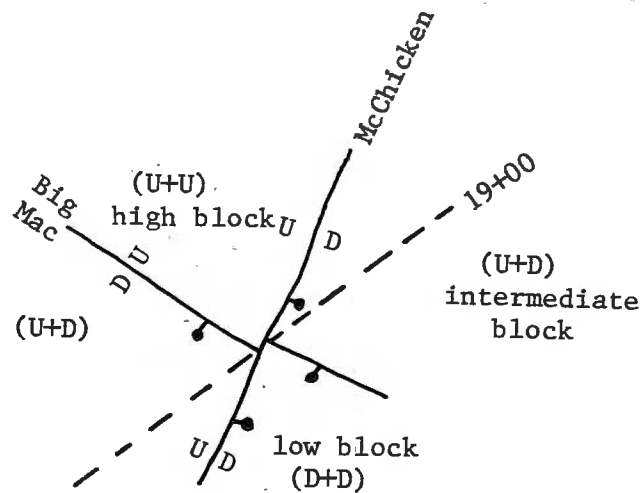


Fig. 9: Possible relationship of faults on section 19+00

Quarterpounder Fault

The Quarterpounder may not be a fault per se, but it is the northeast dipping, southwest margin of the breccia cap. Since 3A and 3D breccia are juxtaposed against 1D hangingwall to the ore, a substantial downdrop is required, but whether this downdrop is the result of downward movement of blocks in or along a diatrema margin is not known. The Quarterpounder is marked along much of its length by unbrecciated quartz diorite (10E) which appears to be intruded along it. Commonly, but not always, the quartz diorite is sheared and altered. The base of this sill is used as the locus, except where 3D breccia is found below it. Most brecciated rocks are placed in the hangingwall of the Quarterpounder, with the exception of some fault breccia.

The northeast extent of the Quarterpounder is identical with or confused with the portion of the Big Bird Fault that trends northeast. This suggests that this part of the Big Bird, like the Big Mac, may be related to sharp bends in the breccia cap boundary.

Big Bird Fault

The Big Bird Fault system as noted above is the old North Fork Fault of 1981-82 usage, exposed in the south wall of the Zone 3 pit. The fault system there is about 150 feet wide and consists of several faults. The main one apparently is the southwestern, which juxtaposes 3D against 1D and 1D4. This structure strikes northeast and dips approximately 55° , $\pm 10^{\circ}$ southwest. Because of the stratigraphic separation across the fault, it is assumed to be a normal fault. Everyone who has examined this fault agrees it is the major exposed fault to be seen in the pit walls at

suspension of mining. Because of its stratigraphic separation, it must have several hundred feet of throw and it and its near neighbors must separate Zone 3 from Zone 2 (the remnant of Zone 2 exposed in the pit walls). The magnitude of throw and this bounding relation to Zone 2, however, means it is the Big Indian Fault.

In Zone 3, another fault near DDH 77-12 is mapped which appears to be the direct extension of the major fault in the south wall. This fault, however, cannot be the Big Indian since the Big Indian is further east and it does not appear to have as much throw.

The reason for this contradiction is uncertain, but one of the many possible explanations adopted here is that the Big Bird system is a splay off the Big Indian which follows an irregular trend outlined in Figure 10.

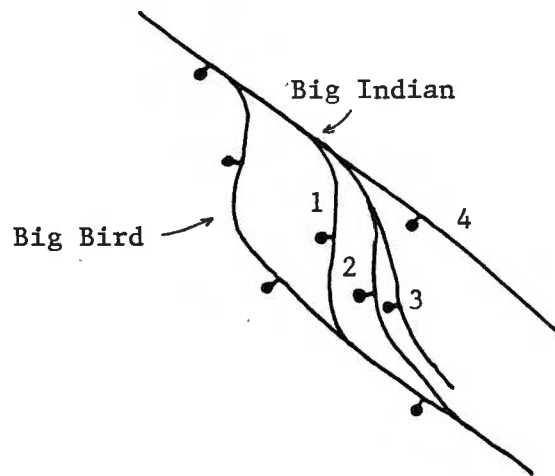


Fig. 10: Possible relation of Big Bird and Big Indian faults.

The second strand of the Big Bird shown on Fig. 10 is a steeper fault mapped in the pit just southwest of the main strand -- it is needed to explain why the rocks in 81-03 at the elevation are 1D rather than 3D or 3A as would be expected from nearby exposures.

The Big Bird can be traced easily as a planar fault from Section 14+125 where it is exposed to Section 19+00. On 19+00, there is a fault of comparable magnitude but it is not on line with the trace further southwest. These relations suggest that the Big Bird Fault system bends at approximately 18+00 to follow a more northeasterly course and may merge partly with the boundary of the breccia cap.

McRib Fault

The McRib Fault is hypothesized to exist beneath the Quarterpounder at the northeast end of Sections 124, 125 and 126 and probably occurs further to the east. It is thought to be a southeast striking, southwest dipping normal fault with approximately 75 feet of throw. The only evidence is the abrupt change in elevation of the base of ore noted on all three sections.

The Problem of the Missing Ore in DDH 81-09

DDH 81-09 appears to have drilled through the fault cut out along a structure which disrupts the ore body. In addition to 81-09, on Section 128+20, its bounding holes 67-07 and 81-13 hit sulfide intersections that appear to be significantly truncated by faulting. On nearby sections, holes 81-10 and 81-02 (Section 129+00), 74-20, 81-03, 82-F-12 and 66-E-06 (on Section 130+00) and 72-12 (on Ssection 131+22) also hit sulfide intersections truncated or complicated by faulting.

The size of this area of fault complication and the fact that two adjacent holes on a section could fail to intersect ore suggests that a large fault cut out is present, at least one that appears large to a vertical DDH. This, in turn, suggests a shallowly dipping fault with displacement

comparable to the thickness of the ore body or a more steeply dipping fault which intersects the orebody along a line approximately parallel to the cross sections, making it likely that two boreholes could miss ore. An alternative possibility would be that the F_4 fold hinge which passes through the area of major problem plays a part. For example, a left lateral strike slip dipping west cutting a Z-shaped F_4 fold would open a gap behind the short limb if the displacement were large enough. A wealth of other possibilities exists. The further implications of most of these possibilities and the imperfectly understood fault picture around the deposit suggests steeply dipping to moderately dipping normal faults are involved and the array of boreholes that hit fault complicated intersections suggests that the fault set is the Big Bird Fault (see Figure 11). The deposit geometry has been interpreted in this way and the large cut out is thought to be caused by the Big Bird Fault bending through Section 128+20.

A shallow dipping fault would affect a significant reduction in locally interpreted tonnage and this possibility cannot be ruled out.

Notes on Individual Sections

Sections 14+00, 14+125, 16+00

The area between the Big Indian Faults on this and adjoining sections is highly uncertain and poorly drilled out. The interpretation shown clearly predicts a great deal of ore that may not exist if the faults are drawn differently or, at the least, is not necessarily in the right place. For this reason, the area has been left out of the 3D mine model pending further development drilling. One of the major sources of the problem here is whether the Big Indian/Big Bird Fault system dips more shallowly or more steeply, i.e. $45 - 60^\circ$ versus $30 - 45^\circ$, or if both orientations of faults are involved in a complex listric faulting scenario (Figure 12).

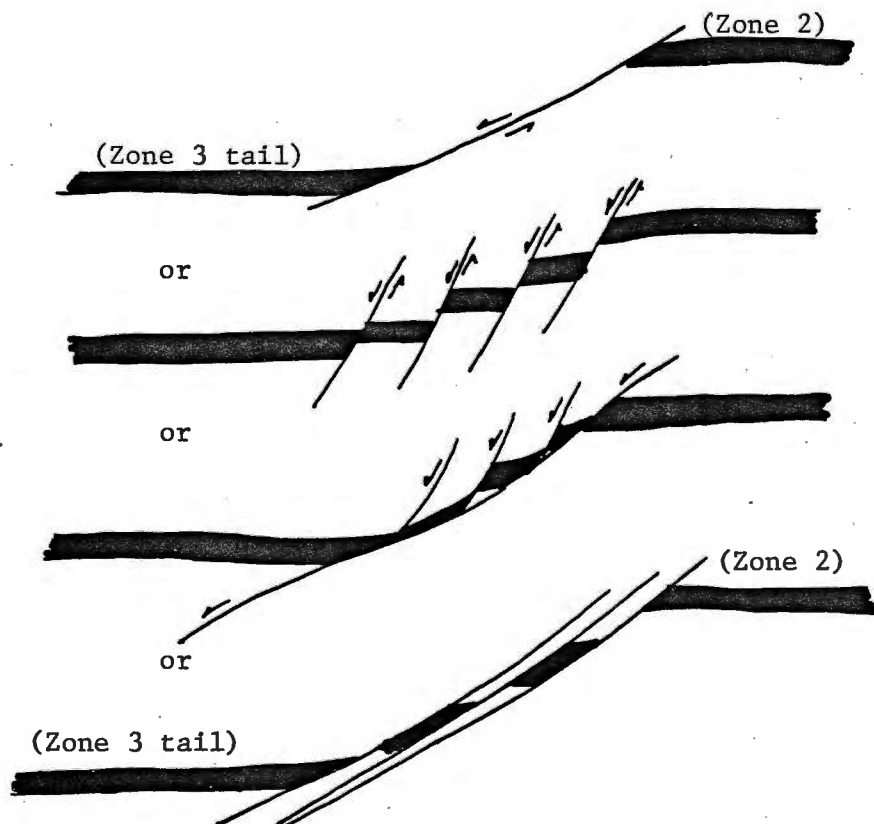


Fig. 12: Some of the possible fault scenarios between zones 2 and 3.

One feature worthy of note here is the change in apparent offset of Zone 3 and Zone 2 along the Big Indian/Big Bird Fault system. This is due to the fact that the tail of Zone 3 dips shallowly to the southwest while Zone 2 is approximately horizontal. This might suggest right lateral, transcurrent offset rather than normal displacement along part of the Big Indian system.

Right lateral displacement is limited to less than 200 feet along the Big Bird set because the upper horizon is not offset (Figure 13). The apparent presence of an upper horizon on Section 133 might be used to argue for right lateral displacement of approximately 600 feet or more. This possibility would suggest perhaps the Big Indian should be a steep fault which conflicts with mapped relations.

Section 17+00

Between 132+52 and 131+00, the faults prove very difficult to deal with since the DDH's are very far off section in opposite directions. Because of this, it is not clear which faults in core connect in space. One shallower fault might explain this section and eliminate the break in ore continuity which was caused by an early fault interpretation on cross section 130+00. Both generations of interpretations of these cross and long sections are available.

Section 18+00

The upper horizon has been put in between 124+22 and 127+09 in agreement with cross sections. It obviously looks odd but, since all the other sections have the upper horizon shaling out above the main horizon, it seemed

only logical that this one should also. The alternative is that the upper horizon on Sections 124, etc., is actually part of the main body of ore with an inter-ore waste band (Figure 14).

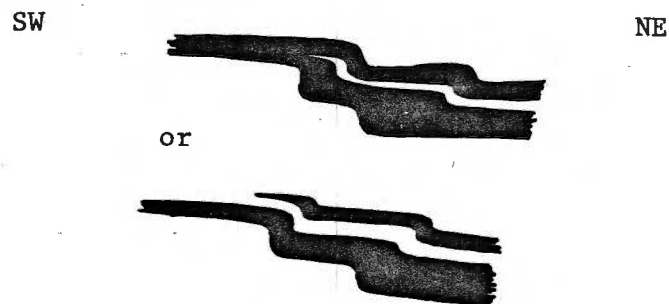


Fig. 14: Alternative interpretations of upper horizon

The McChicken Fault is put in here to account for differences in elevation of ore.

Section 19+00

This section shows an example of offset along the Big Mac Fault in the breccia cap but not in the ore -- more pointed to the northeast.

The possible fault between 128+20 and 132+52 is postulated to explain the absence of significant 2A at the base of the orebody in Hole 74-20 and the brecciated nature of the ore there. Also relevant is the sheared and brecciated top of ore in DDH 81-01 and other holes on 131+22. This could be the same possible fault as noted on Section 130+00 cutting DDH 74-20, but note the opposite sense in apparent throw which may imply either non-normal throw or rotation across the fault. Since such a shallow fault would affect many other sections and would take days to interpret with little benefit accruing compared to the number of similar problems ignored elsewhere, it has been noted but not incorporated into the model.

Section 19+94

Big Bird SE may not exist, as a series of F_4 Z-folds could equally well explain the drop in elevation of ore. This fault is not shown on cross sections. Similar arguments could be proposed for the Big Bird NW; however, sections to the northeast are somewhat more compelling in favor of this fault and it has been left in both the long and cross sections.

The problem of lack of offset on the Big Mac in the ore is evident here.

Note also the inherent difficulty of extending the Big Bird Fault to the northwest following its trace southwest of 19+00. See also the next two sections to the northeast.

Sections 20+26 and 21+00

The Big Bird SE is highly questionable here as noted before. These are the sections where one has to ask if the ore dips 22° or steps down over a series of faults.

The Big Indian is constrained to be deeper here because of drill hole data creating the odd trace on cross section.

High ore in DDH 80-03 on 21+00 could be explained by the Big Mac/McChicken intersection discussed in the section on faulting.

Section 22+00

This is one of the sections the Big Bird Fault looked good on. Note that

it cuts ore near the Quarterpounder but displaces ore by a lesser amount, which suggests that the northeast trending part of Big Bird in the ore might be related to a sharp bend in the boundary of the breccia cap from the Quarterpounder trend (135° dip NE) to the Big Bird trend (090° dips steep NE) above the ore. Thus the Quarterpounder and this northeast trending segment of the Big Bird become the same structure -- the bounding discontinuity of the breccia cap. Where the abrupt change occurs from one trend in the breccia cap boundary to another (i.e. here and near the Big Mac/Quarterpounder intersection), a small fault extends outward away from the breccia with a displacement that decreases (presumably it would have to be taken up on other small faults) as one moves away from the breccia.

Section 24+00

The Big Indian is flatter here in order to fit drillhole data.

Section 124+22

Note the odd looking 10F body discussed under intrusive rocks.

The abrupt step up in the 3A/1D contact near 26N may be due to offset along the extension of the McRib above the Quarterpounder.

Section 125+00

The 3A/1D problem here needs resolution -- it is uncertain whether 3A is logged correctly in this portion of the deposit. 1D may be changing facies into 1D2, interlayered with metabasite which, as 1D2 becomes more carbonaceous, would become indistinguishable from 3A.

Section 126+23

A possible fault is noted here -- it was originally interpreted by Jim Kier but had so little throw that it seemed unnecessary, so it was removed on this version of the section. In retrospect, the McChicken would project to this vicinity, thus perhaps a small displacement fault should be added back in.

The problem of the steep dikes in the pit and the shallower sub breccia cap sill is evident here. This section can clearly be redrawn to look more realistic, yet still fit both observations.

Section 127+09

Note the difficulty of extending the Big Bird fault through this section following an 020° trend (as on sections to the southwest) without making the section look contrived.

Section 128+20

Since the Big Bird did not appear to extend through 127+09 by extension of the 020° trend, and a fault of similar displacement occurred on long sections 20+26 --> 23+00 but following a trend of 090°, the assumption was made that they were the same fault which curves from the 020° to the 090° trend. The slip direction would be down the axis of curvature since both segments of the fault are normal, so no mechanical problems arise from this interpretation. The arched appearance of the fault on cross section derives from this "bent" fault trace. One could equally well use two intersecting faults but it has not been possible to extend either fault to the northwest or southwest respectively beyond the intersection.

The flat looking segment of the Big Bird fault system is due to the need to go directly from hanging wall to footwall in DDH's 67-07 and 81-09 to account for absence of ore and not perpetuate problems on adjacent sections. This probably reflects that the Big Bird Fault is shallower than drawn (compare to long section 17+00).

Section 129+00

The same "bent" fault trace seen on 128 occurs on this section.

The drop in elevation of ore and metabasite north of 19+94 has been explained as due to at least two faults in the past. This section reverts to the original no fault interpretation which unfortunately does not match the long sections where the drop in elevation is explained with the Big Bird SE.

Section 130+00

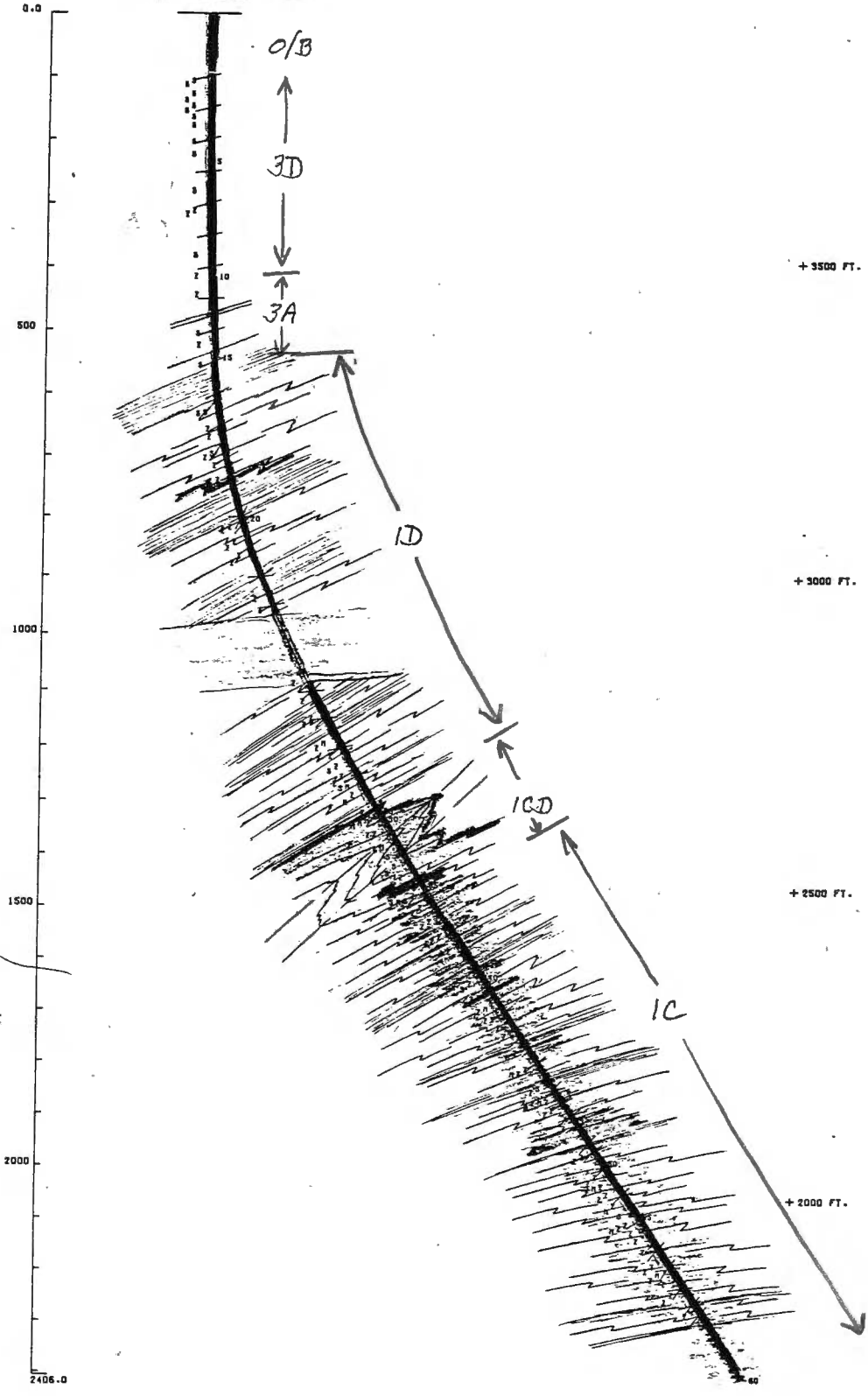
The two probable faults between 18 and 20+26N appear to be necessary to explain the jumble of lithologies here and the very unrealistic shape to the orebody -- it has not been possible to extend them to other sections, therefore they have been indicated as only possible -- see also long section 19+00.

Section 131+22

Curve in Big Indian Fault may be due to the shallow angle of incidence to section, coupled with DDH 81-16 being off section and uncertainty in mapped location of fault in pit.

APPENDIX I

DDH: 4567512-- 45 DEGREE PROFILE
(VIEW AZIMUTH =315 DEGREES)
ELEV: 3887 12639E : 7608 N



Diamond Drill Record

PAGE _____ OF _____

		HOLE SURVEY		
		FOOTAGE	AZIMUTH	DIP
DATE LOGGED	7607.80 AT			
EAST	126.38, 88 E			
ELEVATION	3,559.67 (revis.)			
LOGGED BY				
DATE LOGGED				
MAP REFERENCE NO.		METHOD:		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. 456-75-12
 CLAIM NAME _____
 COMMENCED _____
 FINISHED _____
 PROJECT NO. _____

2/8

3D

FROM	TO	RECOVERY	DESCRIPTION	SAMPLE				ASSAYS			RECOVERY				
				FROM	TO	WIDTH	NO.				INTERNAL	RECOVERY	INTERNAL	RECOVERY	
0	96		Overburden									96-97	1.0	267.5-272.5	8.0'
96	166.5		Calc-Sil-Phyllite or Calc-Phyllite; variably calcareous, thinly banded, lt. gray to beige, zone of blocky or broken core @ 96'-99'. Unit becomes increasingly biotitic towards base with banding varying between thin and laminar. 6" zone @ 96'-99' of pyritic (<1%), diopside-post D ₂ veinlet of qtz & calcite, locally carbonaceous; S ₂ = 78°-80° to c.a. @ 100'; S ₂ = 75° to c.a. @ 150'									97-98	1.0	277.5-278	3.8'
												98-100.5	10.5'		
												106.5-117	9.0'		
												117-120	2.5'		
166.5	191.5		Calc-Sil-Phyllite; blue-gray chlor-clino-amph assemblage bands intercalated with purplish-brown-bio-bands, non-calc, minor (<1%) zones of po & py near qtz veinlets, thinly to laminarily banded									120-124	4.0'		
												124-134	10.0'		
191.5	203.5		Calc-Sil-Phyllite; of siliceous, blue-gray-green chlor-clino-amph, massive to weakly banded, variably calcareous, minor py and po (<1%) in qtz-Qtz ₂ post D ₂ cross-cutting fractures; S ₂ = 75° to c.a. @ 200'									134-139	10.0'		
												144-154.3	10.5'		
203.5	234.5		Calc-Sil-Phyllite; strongly calcareous, becomes similar to 96'-166.5' after a short gradational unit of laminarily to moderately interbedded calcite rich layers & chlor-clino-amph bands. Biotite increases while chlor-clino-amph decreases to shortly disappear downhole. Zone of cumuly and blocky core @ 205'-207'									154.5-178	10.5'		
												178-188	10.0'		
												185-190	10.0'		
234.5	242.5		Calc-Sil-Phyllite; interbedded purplish-brown-bio, blue-gray chlor-clino-amph & scattered off-white calcite bands. This unit sees the re-introduction of the chlor-clino-amph bands and the reduction to only a few widely scattered calcareous bands. From 234.5'-237': Zone of blocky core and calcite/Qtz veinlets. Thinly Banded.									190-200	10.0'		
												200-207.5	7.5'		
												207.5-215	7.5'		
												215-235	10'		
250	276		Calc-Sil-Phyllite; thinly to laminarily banded alternating sequences of blue gray chlor-clino-amph, dk brown to purplish-brown-bio and widely scattered calcareous bands. 1" zone of strongly calcareous phyllite c.f. 203.5'-234.5' @ 200'. Breccia zones @ 253'; dk green matrix and @ 274' a 2" post D ₂ band with a lt. green matrix and polygonal clasts. Unit becomes perceptively more calcareous towards base.									235-246	10.75'		
												246-253.5	7.5'		
												253.5-274	10.5'		

Diamond Drill Record

COLLAR:	HOLE SURVEY		
NO. _____	FOOTAGE	AZIMUTH	DIP
EAST _____			
ELEVATION _____			
LOGGED BY _____			
DATE LOGGED _____			
MAP REFERENCE NO. _____	METHOD: _____		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. 456-75-12
 CLAIM NAME _____
 COMMENCED _____
 FINISHED _____
 PROJECT NO. _____

FROM	TO	RECOVY	DESCRIPTION	SAMPLE				ASSAYS				RECOVERY				
				FROM	TO	WIDTH	NO.					Interval	Recovery	Interval		
276	292		<u>Calc-Sil-Phyll</u> ; as 234.5-242.5, variably carbonaceous with a fair % of basine calc-stibages. Majority of unit is an alternating sequence of blue-gray chlor-clino-amph bands & purplish-brown bio-phyllite. Unit exhibits well grt. veinlets (ca 1% py associated) and epidote-filled hairline fractures. Biotite bands decrease towards base of unit in an irregular manner.										276-282.5	4.5'	422.5-424	10.0"
													280.5-284	3.5'	422.5-422	8.5"
													284-299	12'	422-431.5	8.0"
													299-326.5	9.25'	421.5-422	10.25"
292	415.5		<u>Calc-Sil-Phyllite and Bio Phyllite interbedded</u> ; reddish brown bio-phyllite comprises between 20%-30% of total unit while the blue-green-gray chlor-clino-amph makes up the remaining portion of the unit. The bio bands are spaced randomly throughout in varying thicknesses. Minor epidote development particularly within fracture zones suggesting a secondary origin, variably calcareous; $S_2 = 75^\circ$ to e.a. @ 300', $S_3 = 80^\circ$ to e.a. @ 350'; $S_2 = 80^\circ$ to e.a. @ 400'										308.5-313	4.25'	422-522.5	10.5"
													313-317	2.5'		
													317-323.5	3.4'		
													323.5-331	10'		
													331-344	10'		
415.5	423		<u>Carbonaceous Calc-Sil-Phyllite</u> ; thin to laminarily banded, gray to black carbonaceous phyllite; minor (<10%) Chlor-Clino-Amph bands + calcareous bands, variably pyritic; generally <1% but up to 15% own 1" bands, no base metals.										344-354	10'		
													354-364	10'		
													364-374.5	10'		
423	473		<u>Calc-Sil-Phyllite and Bio-Phyllite interbedded</u> ; as 292-415.5. However a 2' interval @ 414'-416' and a 1' interval @ 414'-415' of bio-musc-andul-schist assemblage. This demonstrates the gradational nature of the phyllite-schist map unit contact. Variably calcareous and randomly carbonaceous throughout interval. Minor py & po (<1%) bands and blebs. Zone of broken core @ 469'-472'. $S_2 = 90^\circ$ to e.a. @ 450'										374.5-386	10'		
													386-395	10'		
													395-405	10'		
													405-415	10'		
													415-418.5	3.5'		
473	476		<u>Bio-Musc-Andul-Schist</u> ; Brown to gray laminarily banded with near black andalusite porphy non-calc, non-mag; Description also applies to 344'-346' and 364'-365' BMA'S intervals										418.5-421.5	3.0'		
													421.5-431.5	10.0'		
476	534		<u>Transitional Zone of Interbedded Calc-Sil-Phyllite, Bio-Phyllite and Carbonaceous-Calc-Sil-Phyllite</u> ; as 292-415.5 & 423-473. But with a greater proportion of carbonaceous bands, weakly calcareous										431.5-441.5	10.0'		
													441.5-445	10.25'		

Diamond Drill Record

COLLAR:	HOLE SURVEY		
NORTH _____	FOOTAGE	AZIMUTH	DIP
EAST _____			
ELEVATION _____			
LOGGED BY _____			
DATE LOGGED _____			
MAP REFERENCE NO. _____	METHOD: _____		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. 45L-75-12
 CLAIM NAME _____
 COMMENCED _____
 FINISHED _____
 PROJECT NO. _____

FROM	TO	RECOVY	DESCRIPTION	SAMPLE				ASSAYS				RECOVERY					
				FROM	TO	WIDTH	NO.					Interval	Recovery	Interval			
1082.5	1303		<p><u>Bio-musc-andalusite schist</u>; med.-med. dk gray, heavily S_2 foliated, coaly porphyroblastic, 2 musc (bio-musc) polytic schist; possibly 2 generations of andalusite - second (pink) spatially associated w/ gtz veins/pods; D_2 truncation of D_1 fabric nearly complete as few F_2 hinges preserved; <u>interval 1099.5-1289.5 has pyrrhotite as a rock forming mineral ranging from <1% to 5% w/ pods 3-6" 30% p; one musc lamina permagmatic over 1099.5-1289.5; no real D_1 in origin; interval may represent down-dip projection of F_{and} sulfide zone</u>; $S_2 = 70^\circ$ to c.a. @ 1100'; $F_2 \approx$ line of S_2 strike @ 1148' where $S_2 = 70^\circ$ to c.a.; 1" gauge zone 1082.5-1083.5; $S_2 = 75^\circ$ to c.a. @ 1201' 2" gauge @ 1200'; $S_2 = 80-85^\circ$ to c.a. @ 1253 & is irregularly developed in F_2 hinge above F_2 line of S_2 strike; 1" gauge zone 1291.5-1292.5 is thin absent</p>									1082.5-1083.5	10'	1082.5-1203	10'		
														1075-1102	10'	1075-1309	6'
														1102-1112	10'	1091-1319	10'
														1112-1122	10'	1319-1319.5	10-25'
														1122-1132.5	10'		
														1132.5-1142.5	10'		
														1142.5-1153	10'		
														1153-1167	10'		
														1167-1173	10'		
														1173-1183	10'		
														1183-1193	10'		
														1193-1205	10'		
1303	1316		<p><u>Musc-bio-andalusite schist</u>; lt. gray beige, musc \gg bio polytic schist w/ med. blue gray and porphs.; interval slightly carbonaceous; blacky conc over interval w/ gauge zones 1303-1304; 1311.5-1312.5; ch. white mica envelope</p>											1205-1215	10'		
														1215-1224	10'		
1316	1316.3		<p><u>Qtz-felds. porphyry</u>; beige ^{very finely x-lined} post-D_2 muscovite dika fill</p>											1224-1233	10'		
														1233-1241.5	8.1'		
1316.3	1323		<p><u>Musc-bio-andalusite schist</u>; as 1303-1316; unit of white mica envelope on E pit wall</p>											1241.5-1252	10.5'		
														1252-1267	10'		
1323	1323.5		<p><u>Qtz-felds. porphyry</u>; as 1316-1316.3</p>											1267-1277	10'		
1323.5	1330.5		<p><u>Musc-bio-andalusite schist</u>; as 1303-1316; 6" gauge 1325-1328.5'</p>											1277-1282	10'		
1330.5	1331		<p><u>Hb-donate dika/sill</u>; sh. reddish brown, porphyritic (Hb-plag) p. D_2 sill</p>											1282-1293	10'		

Diamond Drill Record

COLLAR:	HOLE SURVEY		
NORTH:	FOOTAGE	AZIMUTH	DIP
EAST:			
ELEVATION:			
LOGGED BY:			
DATE LOGGED:			
MAP REFERENCE NO.:	METHOD:		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. <u>456-95-12</u>
CLAIM NAME _____
COMMENCED _____
FINISHED _____
PROJECT NO. _____

FROM	TO	RECOVY	DESCRIPTION	SAMPLE				ASSAYS				RECOVERY			
				FROM	TO	WIDTH	NO.					Int. %	Recovery		
1998.5	2004.5		Bio-Musc-Corn-Andal-Schist; dk brown, 2 mica schist with pyroxepite garnet and minor andalmit. $S_2 = 75^\circ$ to c.a. @ 2000'									1998.5-2004.5	10'	2305-2315	10.5'
2004.5	2014.5		Musc-Bio-Schist; as 1948.5-1961' & 1988.5-1998.5' Note all musc-bio schists in this hole similar to white mica envelope. Gauge zero @ 2007.5'-2011' & @ 2006.5-2008									2004.5-2014.5	9.75'	2265.5-2285	10'
2014.5	2086.5		Qtz-Feldspathic Bio-Musc Schist; med gray brown, bio-musc-schist with minor stau and garnet and incomplete ^{D4} transposition of D_2 fabric. $S_2 = 75^\circ$ to c.a. @ 2051'. Note many Fy hinges but can't measure accurately relative to S_2 .									2014.5-2086.5	10.5'	2147-2253	10'
2086.5	2090		Musc-Bio-Schist; at 1988.5'-1998.5'									2086.5-2090	10.25'	2272-2282	10'
2090	2188		Quartzo-Feldspathic-Bio-Musc-Corn-Schist; dk grey brown, bio-musc, sub-aluminous schist with no stau or andal; incomplete D_4 transposition of D_2 fabric; $S_2 = 90^\circ$ to c.a. @ 2100', $F_4 = 11$ to line of $S_2 \Sigma$ @ 2128, $S_2 \cong$ sub vertical from 2127'-2146', this may represent Fy hinge. With $S_0 = S_1 = 70^\circ$ to c.a. either end this interval; $S_2 = 70^\circ$ to c.a. @ 2157'									2090-2188	10.25'	2262-2282	10'
2188	2191		Chl-Chino-Amph Schist/Metabasite; massive med blue green, finely illino amph or metabasite of probable metabasite origin.									2188-2191	4.8'	2272-2282	3'
2191	2272	100	Quartzo-Feldspathic-Bio-Musc-Corn-Schist; as 2090-2188; S_2 sub vertical @ 2192-2230 this probably a moderately large Fy hinge zone. $S_2 \cong S_1 = 65^\circ$ to c.a. @ either end this interval; @ 2191-2192 good example of post- D_2 (F_4 ?) fold in S_2 w/ different orientations of F_3 and F_4 axis, axial plane of $F_4 \cong 85-90^\circ$ to c.a. @ 2191.5, F_3 axial plane $\cong 70^\circ$ to c.a. @ 2192.5; $S_2 = 70^\circ$ to c.a. @ 2203'									2191-2272	10.5'	2222.5-2232	10'
2272	2292											2272-2292	10'	2222-2232	10'
2292	2326											2292-2326	10'	2222-2232	10'
2326	2346											2326-2346	10'	2222-2232	10'
2346	2366											2346-2366	10'	2222-2232	10'
2366	2386											2366-2386	10'	2222-2232	10'
2386	2406											2386-2406	10'	2222-2232	10'
2406	2426											2406-2426	10'	2222-2232	10'
2426	2446											2426-2446	10'	2222-2232	10'
2446	2466											2446-2466	10'	2222-2232	10'
2466	2486											2466-2486	10'	2222-2232	10'
2486	2506											2486-2506	10'	2222-2232	10'
2506	2526											2506-2526	10'	2222-2232	10'
2526	2546											2526-2546	10'	2222-2232	10'
2546	2566											2546-2566	10'	2222-2232	10'
2566	2586											2566-2586	10'	2222-2232	10'
2586	2606											2586-2606	10'	2222-2232	10'
2606	2626											2606-2626	10'	2222-2232	10'
2626	2646											2626-2646	10'	2222-2232	10'
2646	2666											2646-2666	10'	2222-2232	10'
2666	2686											2666-2686	10'	2222-2232	10'
2686	2706											2686-2706	10'	2222-2232	10'
2706	2726											2706-2726	10'	2222-2232	10'
2726	2746											2726-2746	10'	2222-2232	10'
2746	2766											2746-2766	10'	2222-2232	10'
2766	2786											2766-2786	10'	2222-2232	10'
2786	2806											2786-2806	10'	2222-2232	10'
2806	2826											2806-2826	10'	2222-2232	10'
2826	2846											2826-2846	10'	2222-2232	10'
2846	2866											2846-2866	10'	2222-2232	10'
2866	2886											2866-2886	10'	2222-2232	10'
2886	2906											2886-2906	10'	2222-2232	10'
2906	2926											2906-2926	10'	2222-2232	10'
2926	2946											2926-2946	10'	2222-2232	10'
2946	2966											2946-2966	10'	2222-2232	10'
2966	2986											2966-2986	10'	2222-2232	10'
2986	3006											2986-3006	10'	2222-2232	10'
3006	3026											3006-3026	10'	2222-2232	10'
3026	3046											3026-3046	10'	2222-2232	10'
3046	3066											3046-3066	10'	2222-2232	10'
3066	3086											3066-3086	10'	2222-2232	10'
3086	3106											3086-3106	10'	2222-2232	10'
3106	3126											3106-3126	10'	2222-2232	10'
3126	3146											3126-3146	10'	2222-2232	10'
3146	3166											3146-3166	10'	2222-2232	10'
3166	3186											3166-3186	10'	2222-2232	10'
3186	3206											3186-3206	10'	2222-2232	10'
3206	3226											3206-3226	10'	2222-2232	10'
3226	3246											3226-3246	10'	2222-2232	10'
3246	3266											3246-3266	10'	2222-2232	10'
3266	3286											3266-3286	10'	2222-2232	10'
3286	3306											3286-3306	10'	2222-2232	10'
3306	3326											3306-3326	10'	2222-2232	10'
3326	3346											3326-3346	10'	2222-2232	10'
3346	3366											3346-3366	10'	2222-2232	10'
3366	3386											3366-3386	10'	2222-2232	10'
3386	3406											3386-3406	10'	2222-2232	10'
3406	3426											3406-3426	10'	2222-2232	10'
3426	3446											3426-3446	10'	2222-2232	10'
3446	3466											3446-3466	10'	2222-2232	10'
3466	3486											3466-3486	10'	2222-2232	10'
3486	3506											3486-3506	10'	2222-2232	10'
3506	3526											3506-3526	10'	2222-2232	10'
3526	3546											3526-3546	10'	2222-2232	10'
3546	3566											3546-3566	10'	2222-2232	10'
3566	3586											3566-3586	10'	2222-2232	10'
3586	3606											3586-3606	10'	2222-2232	10'

Diamond Drill Record

COLLAR:		HOLE SURVEY		
NORTH _____		FOOTAGE	AZIMUTH	DIP
EAST _____				
ELEVATION _____				
LOGGED BY _____				
DATE LOGGED _____				
MAP REFERENCE NO. _____		METHOD: _____		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. 456-75-12
 CLAIM NAME _____
 COMMENCED _____
 FINISHED _____
 PROJECT NO. _____

FROM	TO	RECOVY	DESCRIPTION	SAMPLE				ASSAYS					
				FROM	TO	WIDTH	NO.						
2272	2302	100%	<u>Musc-bio-schist-gne</u> schist; med greenish beige and dk brown, inter-banded sequence of musc-zbl-musc and bio-musc-schist w/ brown-pink pyralopite garnets; moderately complete Dy transposition of D ₂ folia; S ₁ =S ₂ =70° to ca. @ 2283'										
2302	2400		<u>Subvolcanic g. feldspar ± bio. granodiorite</u> feldsparite of Anaril Butte th; med olive, gray beige, variably kaolinitized(?), variably biotitic granitic rocks of Anaril Butte th; zone of laxation 2340-2342 w/ subrounded v. finely py. Kfs and subrounded to angular porphyritic granitic fragments in med-ol. gray aphanitic post-main-stage granitic matrix; white bull gty zone 2386-2387.75' (area where H ₂ O hit in hole)										
<p><u>Note:</u> S₂/S₄ relationships suggest a megaseismic F₄ fold hinge from ~ 2100' to 2255' (~150') where S₂ is subvertical or 11° to core axis than this interval.</p> <p>which map unit divided into 3 subdivisions in this hole:</p> <ol style="list-style-type: none"> 1) 534-1333' - gray, aphanitic bio-musc-and-schist 2) 1333-1528' - gray brown, weakly aphanitic, weakly gty. Kfs-bio-musc and schist (transverse zone) 3) 1528-2302' - brown, non-aphanitic gty. feldsparitic bio-musc + schist + gne schist 				<p style="text-align: right;">} probably several samples see log. F₄S</p>									

SUMMARY LOG

456-75-13

(Main Stratigraphic Units Only)

0.0 -	29.5	Overburden
29.5 -	787.5	3D
787.5 -	856.0	3A
856.0 -	1,588.0	1D
1,588.0 -	1,798.0	1CD
1,798.0 -	2,632.0	1CO

(units in feet)

Diamond Drill Record

COLLAR:	HOLE SURVEY		
	NORTH	FOOTAGE	AZIMUTH
EAST _____			
ELEVATION _____			
LOGGED BY _____			
DATE LOGGED _____			
MAP REFERENCE NO. _____	METHOD: _____		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. _____
 CLAIM NAME _____
 COMMENCED _____
 FINISHED _____
 PROJECT NO. _____

FROM	TO	RECOVY	DESCRIPTION	SAMPLE				ASSAYS					
				FROM	TO	WIDTH	NO.					Internal	Recovery
140	142.5		Crackled breccia in carbonaceous calc-silicate phyllite; med. dk grey green, thinly banded, slightly carbonaceous calc-silicate phyllite w/ several crackle breccia zones @ 45° to ca thru interval; brecciation post-D ₂ in age w/ deviate (?) glass as probable matrix for X; breccia frags of all sizes; all frags. of calc-silicate phyllite									152-160.5	8.9'
												160.5-171	10.3'
												171-180.5	8.9'
												180.5-190.5	10'
												190.5-192.5	7'
142.5	161		Calc-silicate phyllite; as 144-140; S ₂ = 80° to ca @ 150' w/ L ₂ = F ₂ @ 60° to line of S ₂ strike plunging 45									192.5-201.5	9.75'
												201.5-212	4.5'
161	177		Calc-silicate phyllite; med. dk blue green chlor-chromoph (?) calc-silicate bands (60-70%) and purplish brown bio phyll. bands (30-40%) of minor CaCO ₃ rich bands									212-214.5	2.5'
												214.5-223.5	9'
												223.5-231.5	9'
177	204		Calc-silicate phyllite; as 177.5-20.5; S ₂ = 70° to ca @ 180.5' where L ₂ = F ₂ = 50° to line of S ₂ strike plunging SE									231.5-241.5	9'
												241.5-251.5	10'
204	208		Calc-silicate phyllite; as 161-177									251.5-262	10.5'
208	229.5		Calc-silicate phyllite; as 229.5-80.5, 177-204; calcareous phyllite member of calc-silicate megunit; S ₂ = 80° to ca @ 219' where F ₂ = L ₂ = 40° to line of S ₂ strike plunging SW									262-272	10'
												272-282.5	10'
												282.5-292.5	10'
229.5	235		Calc-silicate phyllite; as 161-177, 204-208									292.5-302	9.6'
235	272		Calc-silicate phyllite; as 229.5-80.5, 177-204, 208-229.5; calcareous phyllite member of calc-silicate megunit; S ₂ = 80° to ca @ 250' where L ₂ = F ₂ = 40° to line of S ₂ strike; S ₂ = 85° to ca @ 263 where L ₂ = F ₂ = 30° to line of S ₂ strike and plunges SW									302-311	9'
												311-316	5'
												316-326	10'
												326-336	10'

Diamond Drill Record

COLLAR: NORTH _____ EAST _____ ELEVATION _____ LOGGED BY _____ DATE LOGGED _____ MAP REFERENCE NO. _____	HOLE SURVEY		
	FOOTAGE	AZIMUTH	DIP
	METHOD: _____		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. _____
 CLAIM NAME _____
 COMMENCED _____
 FINISHED _____
 PROJECT NO. _____

FROM	TO	RECOVY	DESCRIPTION	SAMPLE				ASSAYS			
				FROM	TO	WIDTH	NO.				
272	328		Graphitic calc-silicate phyllite; dk gray to black, thinly bedded, initially graphitic calcareous phyllite member of calc-silicate megasuit; essentially no calc-silicate minerals in this interval; $S_2 = 80^\circ$ to ca. @ 300.5 where $L_2 = F_2 = 35^\circ$ to line of S_2 strike and plunge W; from 311 to 328 unit becomes less graphitic with up to 20% calc-silicate bands							Interval	Accuracy
										326-346.5	10.2'
										346.5-355.5	10'
										356.5-369.5	3'
										369.5-381.5	10'
										381.5-391	1.9'
										391-381.5	10.2'
328	331		Calc-silicate phyllite; as 161-177, 204-208, 229.5-235; interval approx 60% blue green calc-silicate and 40% bio phyll lands							387.7-397	5'
										397-397	10'
331	399		Calc-silicate phyllite; as 29.5-80.5, 172-204, 208-229.5, 235-272; calcareous phyllite member of calc-silicate megasuit; $S_2 = 70^\circ$ to ca. @ 333 where $L_2 = F_2 = 20^\circ$ to line of S_2 strike and plunge SE; numerous 2-6" gray-white finely chise marble bands through interval; $S_2 = 75^\circ$ to ca. @ 358' where $L_2 = F_2 = 10^\circ$ to line of S_2 strike and plunge W							397-400.75	3.75'
										400.75-405	3.75'
										405-413.5	9.0'
										413.5-415.5	1.1'
										415.5-426	10.2'
399	402		Fault gouge in calc-silicate phyllite; 3' zone of clay with fault gouge @ about 70° to ca.; could be major D ₂ thrust							426-436.25	10.2'
										436.25-446.5	10.2'
402	444		Calc-silicate phyllite; as 331-399; calcareous phyllite member of calc-silicate phyllite megasuit; $S_2 = 70^\circ$ to ca. @ 408' where $L_2 = F_2 = 0^\circ$ to line of S_2 strike; 3" gouge zone @ 50° to ca. 415.25-415.5'; 1-3" gouge zone @ 60° to ca. @ 431.5'; 2" gouge zone @ 70° to ca. @ 438.15							446.5-459	10.2'
										459-463	6'
										463-473	10'
										473-476	3'
444	446.5		Calc-silicate phyllite; as 161-177, 01-208, 229.5-235, 328-331; approx 70% blue green calc-silicate member of calc-silicate megasuit							476-486	10'
										486-492.5	10.2'

Diamond Drill Record

COLLAR:	HOLE SURVEY		
NORTH _____	FOOTAGE	AZIMUTH	DIP
EAST _____			
ELEVATION _____			
LOGGED BY _____			
DATE LOGGED _____			
MAP REFERENCE NO. _____	METHOD: _____		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. _____
 CLAIM NAME _____
 COMMENCED _____
 FINISHED _____
 PROJECT NO. _____

FROM	TO	RECOVY	DESCRIPTION	SAMPLE				ASSAYS			
				FROM	TO	WIDTH	NO.				
446.5	452		Calc-silicate phyllite; as 331-399, 402-444; calcareous phyllite member of calc-silicate map unit; $S_2 = 85^\circ$ to c.a. @ 450 where $L_2 = F_2 = 0^\circ$ (all) to line of S_2 strike							Interval	Recovery
										446.5-506.5	10'
										506.5-516.25	10.2'
										516.25-522	10.1'
452	471		Calc-silicate phyllite; as 4114-446.5; blue green chloramphibole-bearing calc-silicate assemblage w/ approx 50% calc-silicate bands, 50% bio. phyll. bands							522-527	10'
										527-547	10'
										547-553	6'
471	483.25		Carbonaceous calc-silicate phyllite; cf. 331-399, 402-444, 446.5-452 except interval slightly carbonaceous; interval is variably carbonaceous calcareous phyllite member of calc-silicate map unit; D_2 transposition of D_1 fabric more complete than this interval than any in 29.5-483.25; $S_2 = 90^\circ$ to c.a. @ 476'							553-557	4'
										557-567	10'
										567-577	10'
										577-587.5	10.2'
										587.5-597.5	10'
483.25	484.5		Calc-silicate phyllite; as 444-446.5, 452-471							597.5-604	10'
484.5	489.5		Calc-silicate phyllite; as 331-399, 402-444, 446.5-452							604-618	10.2'
489.5	501		Calc-silicate phyllite; as 444-446.5, 452-471, 483.25-484.5; approx 90% blue green chloramph. bearing calc-silicate bands, 10% bio. phyll.; $S_2 = 65^\circ$ to c.a. @ 488.5 where $F_2 = L_2 = 0^\circ$ (all) to line of S_2 strike; note varying attitude of L_2/F_2 in S_2 plane implies curvilinear F_2 fold axes							618-628.5	10.2'
										628.5-637	10.1'
										637-649	10'
										649-659.5	10'
501	505.25		Calc-silicate phyllite; as 331-399, 402-444, 446.5-452, 484.5-489.5							659.5-677.5	10'
505.25	516		Calc-silicate phyllite; as 489.5-501; approx 80-90% blue green chloramphibole bearing assemblage; these mafic units may represent metabasaltic flows/phylls after calc-silicate succession							677.5-687.5	10'
										687.5-690	10.2'
										690-700	10'

or included!

Diamond Drill Record

COLLARI:	HOLE SURVEY		
NORTH _____	FOOTAGE	AZIMUTH	DIP
EAST _____			
ELEVATION _____			
LOGGED BY _____			
DATE LOGGED _____			
MAP REFERENCE NO. _____	METHOD: _____		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. _____
 CLAIM NAME _____
 COMMENCED _____
 FINISHED _____
 PROJECT NO. _____

FROM	TO	RECOVY	DESCRIPTION	SAMPLE				ASSAYS				Interval	Abnorm.
				FROM	TO	WIDTH	NO.						
516	531		Calc-silicate phyllite; as 501-505.25; calcareous phyllite member of calc-silicate map unit; $S_2 = 70^\circ$ to ca. @ 518.75 where $L_2 = F_2 = 0^\circ$ (or 11) to line of S_2 strike									700-710	11'
												710-714	4'
												714-723	9'
531	539		Calc-silicate phyllite; approx 50% blue green chloranph. bearing calc-silicate bands, 25% off-white marble bands and 25% med-dk brown bio. phyll. bands; 1" gtz-white filled, part D_2 cracks byia @ 45° to ca. @ 536.75'									723-733	10'
												733-741	8'
												741-744	2.75'
												744-754	10'
539	575.5		Calc-silicate phyllite; as 501-505.25, 516-534; calcareous phyllite member of calc-silicate map unit; approx 60% med-dk brown thinly bedded, slightly calcareous bio. phyll. bands and 40% 0.1-0.5" off-white calcareous or marble bands showing pervasive F_2 development; $S_2 = 75^\circ$ to ca @ 557 where $F_2 = 10^\circ$ to line of S_2 strike and plunges W									754-765	10'
												765-775	10'
												775-785	10'
												785-795.5	10.2'
												795.5-805.5	10'
												805.5-816	10.2'
575.5	578		Calc-silicate phyllite; as 505.25-516, 534-539; essentially 100% chloranph. bearing metatextite/amphibolite									816-826.25	10.1'
												826.25-832	5.5'
578	583		Calc-silicate phyllite; as 501-505.25, 516-534, 539-575.5; calcareous phyllite member of calc-silicate map unit; $S_2 = 80^\circ$ to ca. @ 580 where $F_2 = L_2 = 0^\circ$ (or 11) to line of S_2 strike									832-842.5	10.1'
												842.5-852.5	10'
												852.5-859	4.75'
583	601		Calc-silicate phyllite; sequence of interbedded blue green, chloranph. bearing metatextite assemblage and brown biotite phyllite with rare; interval 80% metatextite, 20% bio. phyllite;									859-867	8.5'
												867-877	10'
												877-887	10'

Diamond Drill Record

COLLAR:		HOLE SURVEY		
NORTH _____	EAST _____	FOOTAGE	AZIMUTH	DIP
ELEVATION _____	LOGGED BY _____			
DATE LOGGED _____	MAP REFERENCE NO. _____	METHOD: _____		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. _____
 CLAIM NAME _____
 COMMENCED _____
 FINISHED _____
 PROJECT NO. _____

FROM	TO	RECOVY	DESCRIPTION	SAMPLE				ASSAYS					
				FROM	TO	WIDTH	NO.						
			metasalts or amphibolite bands → significant metachert component to calc-silicate phyllite map unit										
601	614		Calc-silicate phyllite; as 501-505.25, 516-534, 539-575.5, 578-583; calcareous phyllite member of calc-silicate map unit; internal very finely banded w/ nearly complete D ₂ truncation of D ₁ folie; S ₂ = 80° to 0° @ 410.5 where F ₂ = L ₂ = 20° to line of S ₂ strike and plunge W									57-995	5.5'
												595.5-605	10'
												705-916	10.2'
												916-926	10
												926-945	10
												945-977	10
614	616		Calc-silicate phyllite; as 583-601; massive blue green metasalts									977-987	9.75
616	640.5		Calc-silicate phyllite; as 601-614; calcareous phyllite member of calc-silicate map unit; approx 5-10% metasalts bands, 10-20% off-white thin marble bands and 70-85% reddish brown biotite phyllite bands									987-997	10
640.5	644		Calc-silicate phyllite; as 583-601, 614-616; metasalts, massive blue green									997-998.5	9
644	653.5		Calc-silicate phyllite; as 616-640.5; S ₂ = 75° to 0° @ 649 where L ₂ = F ₂ = 0° (all) to line of S ₂ strike									998.5-999	1.9'
												999-1007	8.5'
653.5	657		Calc-silicate phyllite; as 583-601, 614-616, 640.5-644 & blue green weakly banded metasalts									1007-1007.5	10
												1007.5-1012.5	2.75'
657	659		Calc-silicate phyllite; as 616-640.5, 644-653.5; calcareous phyllite									1012.5-1022.5	10'
659	661		Calc-silicate phyllite; metasalts band as 583-601, 614-616, 640.5-644									1022.5-1032.5	10'
661	664.5		Calc-silicate phyllite; as 616-640.5, 644-653.5, 657-659									1032.5-1042.5	10'
664.5	749		Calc-silicate phyllite; interbedded blue green metasalts and biotite phyllite; banding on a scale of 0.5" to 3.0'; most of 100% interbedded bands have dimensions; internal similar to									1042.5-1053	10.1'
												1053-1053.5	10.2'
												1053.5-1063.5	10.1'
												1063.5-1073	10.1'

Diamond Drill Record

COLLAR:	HOLE SURVEY		
NORTH _____	FOOTAGE	AZIMUTH	DIP
EAST _____			
ELEVATION _____			
LOGGED BY _____			
DATE LOGGED _____			
MAP REFERENCE NO. _____	METHOD: _____		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. _____
 CLAIM NAME _____
 COMMENCED _____
 FINISHED _____
 PROJECT NO. _____

FROM	TO	RECOVY	DESCRIPTION	SAMPLE				ASSAYS			
				FROM	TO	WIDTH	NO.				
			@ 1208'; S ₂ = 70° to c.a. @ 1202'; S ₂ = 80° to c.a. 1223.5 where S ₂ = 80° to line of S ₂ strike and plunges SW; S ₁ = 85° to c.a. @ 1255'; S ₂ = 80° to c.a. @ 1290'; 4" gauge zone @ 80° to c.a. 1177.25-1177.5; 1" gauge 1252'-1254' @ 70° to c.a.								
1318.5	1327		Graphitic gtz-musc-schist; as 994-1054; interval non-magnetic and variably pyritic; 6" section 1-3% py 1326-1326.5'; S ₂ = 50° to c.a. @ 1326'; D ₂ transposition of D ₁ fabric nearly complete								
1327	1328		Gtz gneiss of ls/sill; lt gray, ^{aphanitic top} weakly porphyritic, mod. fractured and gtz healed, post-D ₂ sub-foliated but discordant granitic gtz gneiss w/ < 1% py					0	856	CS	
								856	1374	BIMS	At top number
								1374	1515	MOS	WME?
1328	1357.75		Graphitic gtz-musc-schist; as 994-1054, 1318.5-1327; interval non- magnetic and variably pyritic w/ 3-1" zones of 25% py (1345', 1349, 1352); post-D ₂ (F ₁ ?) fld hinges 1341-1345 on S ₂ sub-ll to c.a. over this interval, cannot determine cleave direction due to broken and blocky core over this interval; S ₂ = 75° to c.a. @ 1350'; 2" gauge 70° to c.a. @ 1351.5					1515	1568	BIMS	At top number??
								1568	1798	BIMS	Transition
								1798		QFBMS	OF lower number
1357.75	1364		Bio-musc-andalusite schist; as 1106.5-1318.5								
1364	1373.75		Porphyritic bio-schist; mod. brownish gray, porphyritic (log. bio), massive, post-D ₂ ductile (?) sill/dike showing strongly discordant contact relations; contact 70° to c.a. @ 1364, wing @ 50° @ 1373.75								
1373.75	1381		Musc bio-andalusite schist; lt-mod gray, weakly porphyroblastic, biotite lath-like, musc 2 hrs - bit; biotite - thin with some coarse								

1E19 [5A] 93 → 2A

Diamond Drill Record

COLLAR: DEPTH	HOLE SURVEY		
	FOOTAGE	AZIMUTH	DIP
LAST			
ELEVATION			
LOGGED BY			
DATE LOGGED			
MAP REFERENCE NO.	METHOD:		

COMPANY NAME _____
 PROPERTY NAME _____
 DRILLING CONTRACTOR _____
 ASSAYER _____
 PURPOSE OF HOLE _____

HOLE NO. _____
 CLAIM NAME _____
 COMMENCED _____
 FINISHED _____
 PROJECT NO. _____

FROM	TO	RECOVY	DESCRIPTION	SAMPLE				ASSAYS					
				FROM	TO	WIDTH	NO.						
2255	2254		Gas- <u>grey tactite</u> ; as 2214-2240.5, 2251-2254										
2254	2262		Bio-musc schist; dk brown, completely <u>D. transposed</u> , thin, mainly banded bio \rightarrow musc schist; typical bio rich schist assoc. w/ metabasites in lower member of schist unit; little or no andalusite										
2262	2288		Musc-bio-staur \pm gas schist; mostly dk brown bio-staur-gas schist with in large qty musc schist; sub-equal amts bio-and musc schist; 2" gauge zone @ 60' to ca. @ 2274.5'; S symmetry F ₂ folds @ 2278' where S ₁ = 80° to ca. and F ₁ = 0° (N11) to line of S ₁ strike; 2" gauge zone @ 70' to ca. @ 2271.5'; full qty 2283-2285'										
2288	2361		Bio-musc andalusite staur schist; med. gray brown, thickly banded, early prophyllitic bio-musc, pelitic schists identical to formation 2001 1333-1528' in 456-7512; nearly complete <u>D. transposition</u> of <u>D. plane</u> w/ no good F ₂ examples for symmetry determination; fine S symmetry F ₄ @ 2296', S symmetry F ₄ folds @ 2300.5'-2301; FANTASTIC S symmetry F ₄ folds 2303-2310; S ₁ = 75° to ca. @ 2302'; S ₂ = 80° to ca. @ 2317; symmetry: 2275.5-M, 2277.5-S, 2331-S, 2346-S, 2351-M, 2355-S										
2361	2632		Quartz-biotite bio-musc-gas-staur schist & bio-musc-staur-and-shal; med. brown, thickly banded, fine to med. prophyllitic pelitic schists as in middle member of schist unit in 456-7512; unit shows occurrence of similar bands and is the source of										

} Reverse SE E