

C O N F I D E N T I A L

1957

SUMMARY REPORT

on

REPPARFJORD COPPER DEPOSIT

NORWAY

by

C. W. ARCHIBALD B.A.Sc., P.Eng.

I N D E X

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Graph

Value of 2.5 million tons of 1.6% ore at various prices.

Maps

1. Assay Plan
2. Geological Plan Ulveryggen
3. Assay Plan Olle's Adit
4. Assay Plan Kydraten Adit
5. Sections of drill holes E,F,G,H,K,T,U,V,W,X.

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INTRODUCTION:

This is a brief report on the past summer's operations in Norway on the concession optioned by Invex Corporation Limited.

SUMMARY AND CONCLUSIONS:

Of the ten diamond drill holes completed, eight cut values of over 1.5% copper in appreciable widths. However, due to the exploratory nature of the holes - all parallel holes being spotted over 300 feet apart - it is impossible to delineate and calculate ore reserves, or to outline with certainty mineable ore bodies from the work so far done.

The ore bodies as cut by diamond drilling did not show a continuous mineralization to depth but appeared to be in the form of lenses in parallel and in echelon and with their vertical distance being more or less equal to their length. Where mineralized sections were observed on surface, possibly exposed by glaciation, part of the lens has been already eroded and therefore the vertical continuity remaining below surface would only be 100 to 200 feet.

Mineralization in the lenses is disseminated bornite and chalcopyrite in extremely fine particles which makes it extremely hard to see and which would increase mining and milling costs.

A program is outlined for exploration and the calculation of ore reserves and it looks like one more season should

be sufficient to do it. The current price for copper when taken into consideration with what we now know regarding the attitude and size of the mineralized sections and probable costs of mining them would determine when this work should be done.

AREA EXPLORED 1957 SEASON

That part of the concession including all of Ulveryggen mountain as far back as the old Brathammer deposit; an area roughly 2 miles long an 1/2 mile wide, was roughly prospected. Ulveryggen was mapped geologically (see map number 2) and part of Ulveryggen was drilled by ten diamond drill holes. This is only a small part of the concession but seemed to be the portion most favourable for mineral deposition.

WORK DONE

- 1) 7187.9 feet of diamond drilling with approximately EX size core was drilled in ten diamond drill holes. See map 1. All core was carefully logged, sampled, split and assayed and sections of these holes are attached.
- 2) Ulveryggen mountain was mapped geologically as shown on map 2 at 100 feet to the inch with particular care being taken to show all regional and topographical faults as it is the opinion of the writer that these faults are the reason for (at least in part) the ore deposition.
- 3) Sampled and sent for assay all of Olle's adit and Kydraten (see maps 3 and 4.)
- 4) Repaired old road and built new jeep road up to all present drill sites.
- 5) Built core racks; core shack and small bunk-house on Ulveryggen. Before leaving, windows were boarded up, buildings locked up and the whole tied down with cable to prevent the core being disturbed or any part being blown away during the winter.

DIAMOND DRILLING:

Hole "E", the one drilled farthest to the south-west, cut what appears to be the extension of the mineralized zone cut by hole "F" and at approximately the same vertical depth as that cut in "F" (220 feet vertically below surface). Three samples cut from this hole and sent for assay showed respectively 0.72% copper over 3.5 feet; 3.31% copper over 3.0 feet and 0.95% copper over 2.9 feet, making an average of 1.62% copper over a core length of 9.4 feet. Dependent on costs and tonnages this should make a mining grade and width. Indications of copper staining in trenches and on surface rock did not correlate with this diamond drill hole.

More parallel drill holes should be laid out as shown on map 1.

Hole "F" which was collared 340 feet north-east of "E" had two excellent ore intersections. The first section from 190 feet to 209.8 feet showed a core length of 19.8 feet assaying 1.70% copper. This is at a vertical depth of 180 feet. A second intersection from 229.6 feet to 234.4 feet assayed 1.91% copper. The assay from 190 feet to 234.4 feet gives 1.18% copper over a core length of 44.4 feet..

The mineralized areas cut in this hole appear to extend to both holes "E" and "G" and at least the 19.8 foot section should make mining grade and width.

Indications of copper staining in trenches and surface did not correlate with the good assays in this diamond drill hole nor did the position of the assay results obtained in Kydraten adit. More drilling will have to be done parallel this hole and it would aid the interpretation of the area by having a hole at the same angle but to cut the ore horizon at a greater depth (see recommendations).

Hole "G", 320 feet north-east of hole "F" again appears to line up a wide mineralized area with that in holes "F" and "E". It does not correspond to the mineralized sections in hole "T" to the north-east although it could with a section in hole "H" and the drive on ore in Olle's adit. This mineralized zone which in this hole runs from 145.4 feet to 184.7 or for a core length of 39.3 feet averages 1.80% copper and more close drilling will have to be done to the north-east to follow the continuation of it in this direction. Four other sections of mineralization which assay just under 1% copper over respectively 9.8 feet, 3.3 feet, 4.6 feet and 4.8 feet were also encountered in this drill hole.

An old hole drilled from Triangein tunnel dipping -10° and drilled N 40° W was reputed to have cut 85.0 feet which assayed 1.62% copper which would line up with the large intersection mentioned above in hole "G" and would tend to show that this mineralized zone continued at least this distance to the north-east.

More parallel drill holes are necessary as shown on plan 1 to thoroughly investigate the area about "G".

Holes "H" and "T" should be considered together as they were drilled "H" above "T" in the same plane and at approximately the same angle. "H" cut two mineralized sections of note. The first which is variable in grade but which shows an assay of 1.1% copper over a core length of 38.3 feet was from 215.2 feet to 254.0 or at a vertical depth of 190 feet. The second section from 570.3 feet shows 2% copper over a core length of 7.6 feet or 17.8 feet assaying 1.42%. This second section in hole "H" corresponds to a section cut in hole "T" which gave 1.86% copper over a core length of 32.2 feet. The above sections in "H" and "T" would be 390 feet and 575 feet vertically below surface respectively with the mineralized zone widening and grade improving to depth.

Small gabbroic dikes lie along one side of two of the mineralized sections (see cross-section through "H" or "T").

Assays obtained in Olle's adit do not correspond with the data of the drill holes.

Additional holes needed about this area are shown on plan number 1.

Hole "U" had two weak sections only which assayed 0.82% and 0.93% over 4.5 feet and 5.0 feet respectively (from 284.4 feet to 289.9 feet and 303.7 to 308.7 feet). These inter-sections lined up on strike with a mineralized zone in Olle's adit and could be the extension of this zone although intersected by a strong fault as shown on map 1.

Hole "V" showed no section that could be classified ore. Scattered copper mineralization was more apparent near the greenstone contact than anywhere else in the hole. This was the only hole not re-logged.

No evidence of mineralization is apparent on surface above this hole although the rock is for the most part not drift covered here.

Holes "K" and "W" should also be considered together as together they form a cross section of this area.

In the attached sections, the holes have been produced at 45° since no survey of the holes were made and hence the dip angle of the holes was not known. It is quite evident from the geology however, that the holes both flattened considerably at depth. Since hole "W" would start to flatten before it came under where "K" was collared, or earlier in ground relation than "K", the mineralized zones would be steeper than shown on the section of these holes (probably vertical) and the contacts of the greenstone would also show it to be steeply dipping.

At the same time, it is quite possible that both holes turned to right or were headed in a more northerly direction at the completion of the holes. Since hole "W" would start to turn before hole "K" this would account for hole "W" not cutting the gabbro as shown on the geological plan and for the wide width of gabbro as cut by hole "K". It would also account for the ore section at the 450 foot mark in "W" with no corresponding mineralization in "K" as this ore in all probability goes to the fault dike but is not found directly opposite this fault on the south-west.

Hole "K" showed two mineralized zones. The first, near surface, shows either 2.11% copper over 18.8 feet; 1.55% copper over 49.7 feet or 1.39% copper over a core length of 63.4 feet. The above sections would be from 46 feet to 64.8 feet; 35.9 feet to 85.6 feet or from 22.2 feet to 85.6 feet. A second weak intersection showing 0.90% copper from 498.7 feet to 502.1 feet was cut which could be the downward extension of surface showings at this point (see section).

Hole "W" cut one mineralized section from 241.8 feet to 250.2 feet which assayed 1.57% copper which is very likely the continuation of the values cut in hole "K". Other assays between 236.8 feet and 277.2 run from 0.43 to 0.90% copper showing a wide mineralized zone continues to depth and which may at a greater depth have a larger concentration of copper. A second section between 442.4 feet and 450.2 feet assayed 2.15% copper. Several other areas in this hole showed slight scattered fine copper mineralization.

Three additional parallel holes at 100 foot intervals are called for in this area as shown on plan 1.

Hole "X", the one drilled farthest north-east, was laid out by compass and due to a local magnetic variation, was not in the same direction as the remainder of the holes.

The only intersection above 1.5% in this hole; from 590.1 feet to 595.0 assayed 1.58% copper. The same area, between 574.4 feet and 595 feet (a core length of 15.6 feet), will assay 1.02% copper.

As no angle tests were made on this hole it was drawn on the section at -45° but like the other holes is believed to flatten at depth thus making the ore intersection farther to the north-west than is shown on plan 1.

GEOLOGICAL MAPPING

A geological map showing the general area of known copper occurrences on Ulveryggen Mountain was made to the scale of 1 inch = 100 feet.

This map, known as map number 2 shows not only the local geology, but position of trenches, adit mouths, diamond drill holes and jeep roads.

Faults shown are those locally recognizable as well as possible faulting defined topographically and probable faulting. From the little work done to date it would seem that the ore occurrences were directly related to certain of the faults with post ore faults cutting the ore and causing a movement to the north-west. One fault not shown on the map but which very nearly parallels the bottom border of the map appears to be a regional fault which borders not only this area but continues south-west to Brathammer mine (roughly 1 mile from the map area) and north-east to where a weak copper occurrence was explored years ago in Han' adit (roughly $3/4$ mile from the map area.) The faults as shown must be taken in to account when diamond drilling for continuation of ore.

The large gabbro dike shown here appears to be the axis of an anticline.

The main ore occurrences are found in a feldspathic sandstone (arkosic sandstone-Reitan) which does not have any sharp

contacts or delineating features that have been noticed so far except in the case of a few of the diamond drill holes where the ore cuts off sharply on the contact of small basic intrusives. Mineralization was thought to cut off at the contact of the sedimentary greenstone (holes "W" and "X") but in the case of hole "K" the mineralization was also apparent in the greenstone.

SAMPLING ADITS

Two adits only; Olle's and Kydraten, were sampled as shown on assay maps 3 and 4.

Olle's adit showed a section of the cross-cut north-west of the first drive to average 1.59% copper over 20.0 feet. This intersection was not duplicated by hole "T" although the old trench above the adit was supposed to have had comparable assays and one of our own check assays in 1956 gave a slightly lower assay over approximately the same width.

The second drive, or that farthest from the adit mouth, showed an average of 2.32% copper over drift width for a length of 100 feet. The cross-cut at the end of this drive was quite surprising in the poor assay results obtained (see map 3) as it showed a great discolouration by copper oxidation and especially so in the south-east face. This portion should be re-sampled.

Kydraten adit shows three excellent sections as follows: 3.16% copper over 20 feet; 0.84% copper over 40 feet and 2.02% copper over 20 feet. A length of 120 feet in this adit average 1.28% copper (see map 4).

PROSPECTING:

An area roughly 2 miles long by 1/2 mile wide within the concession was prospected this past summer. This area takes in the portion geologically mapped; about the same distance to the north-west and south-east as covered by the map and from 3/4 to

1 mile from the north-east and south-west ends of the map.

Small local areas of mineralization were discovered: ie the Lindavann showing marked on the geological map and several small fissure veins with quartz and chalcopryrite near Brathammer. Nothing new of any size was discovered.

Several old shafts not marked on the old maps were discovered on a 5 to 10 foot wide copper mineralized shear running north-east, south-west and 200 feet to the south-east of the Brathammer deposit. These shafts were to various depths up to 35 feet and spread along the shearing over a length of 500 feet. The mineralization in this shear appeared comparatively weak but some work should be done in this area.

Brathammer vein is a 30 inch quartz fissure vein well mineralized with chalcopryrite and pyrite and is exposed for a length of 100 feet. The vein dips 30° to the south-east and could cut the above mentioned shear zone which is nearly vertical. Except for two pillars, this vein is mined out as far as can be seen - which is 20 feet below the opening in the side of the hill to the water level in the excavation. One drill hole should be put through the vein area near the above mentioned shear zone to see if any vein matter remains or if there are any indications of further veins in echelon. It would be necessary to blast parts of the road to get a diamond drill up to this point or else take it up early in the spring on the snow.

COPPER OCCURRENCE

The copper deposition in the feldspathic sandstone on Ulveryggen is in the form of small grains and fine ore veins which intersect at various angles. The copper values have been infiltrated into the sandstone generally in the direction of strike and dip of the country rock and are in the shape of lenses cut by cross-faulting. The lenses appear to be in parallel and in echelon and will probably

continue to depth in the same manner.

Small movement only has been noticed in any of the cross-faults and generally in a north-south direction.

Minerals found are bornite, chalcopyrite and chalcocit in the order named.

POTENTIAL ORE RESERVES

On the work done this past summer, no body or ore was outlined. However, in the areas about drill holes "E", "F", "G", "H", "T", "W" and "K" and the adits Kydraten, Olle's and Erik's ore can now be blocked out.

Further ore should be encountered north-east of Signyvann.

Potential ore reserves in the above mentioned areas after drilling the additional holes as shown on map 1 should prove up 2,500,000 tons. If values continue the same as have been encountered, this tonnage will average better than 1.7% copper.

AREAS TO BE EXAMINED

Only a small portion of the concession has been prospected and only 1/4 of the area in which copper mineralization has been observed has been subjected to exploratory drilling. At some time, the geological map must be extended and further exploratory drilling done in likely areas. A good example of the hidden nature of the ore was in the bottom part of holes "H" and "T" where good widths and values were obtained although the ore was not found on surface where it is probably under a boulder covering.

To the east of Erik's adit where very few rock outcrop appear is good prospecting ground.

In the area of the Brathammer vein, much of the rock is exposed but there are numerous boulder covered valleys in which there could be concentrations of copper. As much of the copper is in

fine grains and of a disseminated nature, even the rock outcrops should be carefully checked as there has been extensive copper mineralization in this area.

RECOMMENDATIONS:

- (1) Some 21 diamond drill holes comprising 7200 feet of drilling as shown on map 1 (proposed drill holes) should be completed to prove up grade and tonnage of known occurrences. Possibly one or two additional short holes will be needed to delimit ore body's where it is found that ore grade or widths either continue past where expected or have been faulted and cut off.
- (2) 500 feet of diamond drilling at least should be done in the area of the Brathammer deposit. This drilling is however, in the nature of exploratory drilling and could be left until ore is proved on Ulveryggen.
- (3) A "Packsack" diamond drill should be bought and used to closely sample surface showings. I believe this would be much more advantageous to cleaning out the old trenches and blasting new ones.
- (4) Re-sample the inner cross-cut in Olle's adit.
- (5) Channel sample "John's" and "Erik's" adits.
- (6) Take bulk sample for metallurgical tests.
- (7) Use the pulps of the 1957 assays for rough metallurgical testing.

COSTS

The above recommended work would cost approximately \$50,000.00.

Sampling costs would probably be slightly higher.

Road work would be very small as all that would be necessary would be the repair and maintenance of the present road. A service road to Brathammer could be made for approximately \$1000.00.

Additional core racks would be necessary but the present core shack would suffice and the bunk-house could be used as a draughting office.

A gasoline operated drill for bulk sampling and the Packsack drill would be additional equipment.

GOVERNING FACTORS

The current market price for copper concentrates in relation to the cost of extraction, milling costs, transportation costs and size, disposition and grade of ore bodies will necessarily govern the advisability of continuing exploration now or in the future.

In this part of Norway, labour costs are low when compared with other parts of the world. Milling costs might be slightly higher than most copper mines as it is likely the ore will have to be finely ground for good recovery. Transportation costs would compare favourably with any place in the world. The ore would appear to be more or less lens shaped and of no great vertical extent which would cost much more to mine than an underground operation in which the ore was in a regular continuous body. Grade of ore is still an unknown factor and upon this more than the above considerations would depend the profit or loss of an operation.

Bi-product minerals with the exception of gold, which would help defray the costs of the operation appear to be lacking. Low gold assays were obtained from samples taken on surface in 1956, and a few samples have been sent for gold assay this year with negative results. When the remainder of the pulps from the diamond drill assays arrive in Canada, they will be sent for gold assay.

HYPOTHETICAL EVALUATION:

On the supposition that 2,500,000 tons of ore grading

1.6% copper after dilution can be blocked out in the areas mentioned in Potential Ore Reserves, an approximated cost can be worked out for one pound of copper which would give a rough valuation of the property.

The following must be taken into account:

- 1.) Mine labour in Norway - 18000 kroner per man per year including benefits etcetera (roughly \$2500.00)
- 2.) Other metals in the ore (of no economic value).
- 3.) Average mining rate 700 tons per day (10 year reserves).
- 4.) A 1.60% copper ore gives a copper concentrate containing 24% copper.
- 5.) Assumed smelter recovery 98%.
- 6.) Estimated overall recovery 87% - One ton of ore gives 32 pounds of copper. At 87% recovery = 27.84 pounds of copper or 480 pounds/ton concs.
- 7.) Ratio of concentration is 17.3 tons of ore to equal 1 ton concs.
- 8.) Necessity of grinding to - 200 mesh as shown in mill test 1956.
- 9.) Underground mining using glory hole and shrinkage stopping.

	<u>Cost/ton</u>	<u>Cost/ton concs.</u>	<u>Cost/lb. Cu.</u>
Mining (estimated)	\$2.70	\$46.71	\$0.0973
Milling (estimated)	1.20	20.76	0.0433
Overhead (estimated)	.30	5.19	0.0108
Freight for concs.	.0809	1.40	0.0029
Handling charges (est)	.1156	2.00	0.0042
Smelter charges	<u>1.21</u>	<u>21.00</u>	<u>0.0438</u>
Total	5.61	97.06	0.2023

Operating Cost for 2,500,000 tons - \$14,025,000.00

Graph 1 shows the relation between operating costs as shown above before depreciation and taxes and the varying amounts that can be derived at various copper prices.

All the above figures are before dereciation and taxes and to find the number of tons required and the price per pound of copper necessary to make any operation economic, these figures must also be taken into account. There are however, so many

variables connected with these figures that an example of capital costs only shall be given:

Capital cost of 700 ton mill	\$1,600,000.00
Mine development, equipment	1,400,000.00
Power, yards, tailings, etc.	50,000.00
Working Capital	<u>500,000.00</u>
Total	\$3,550,000.00

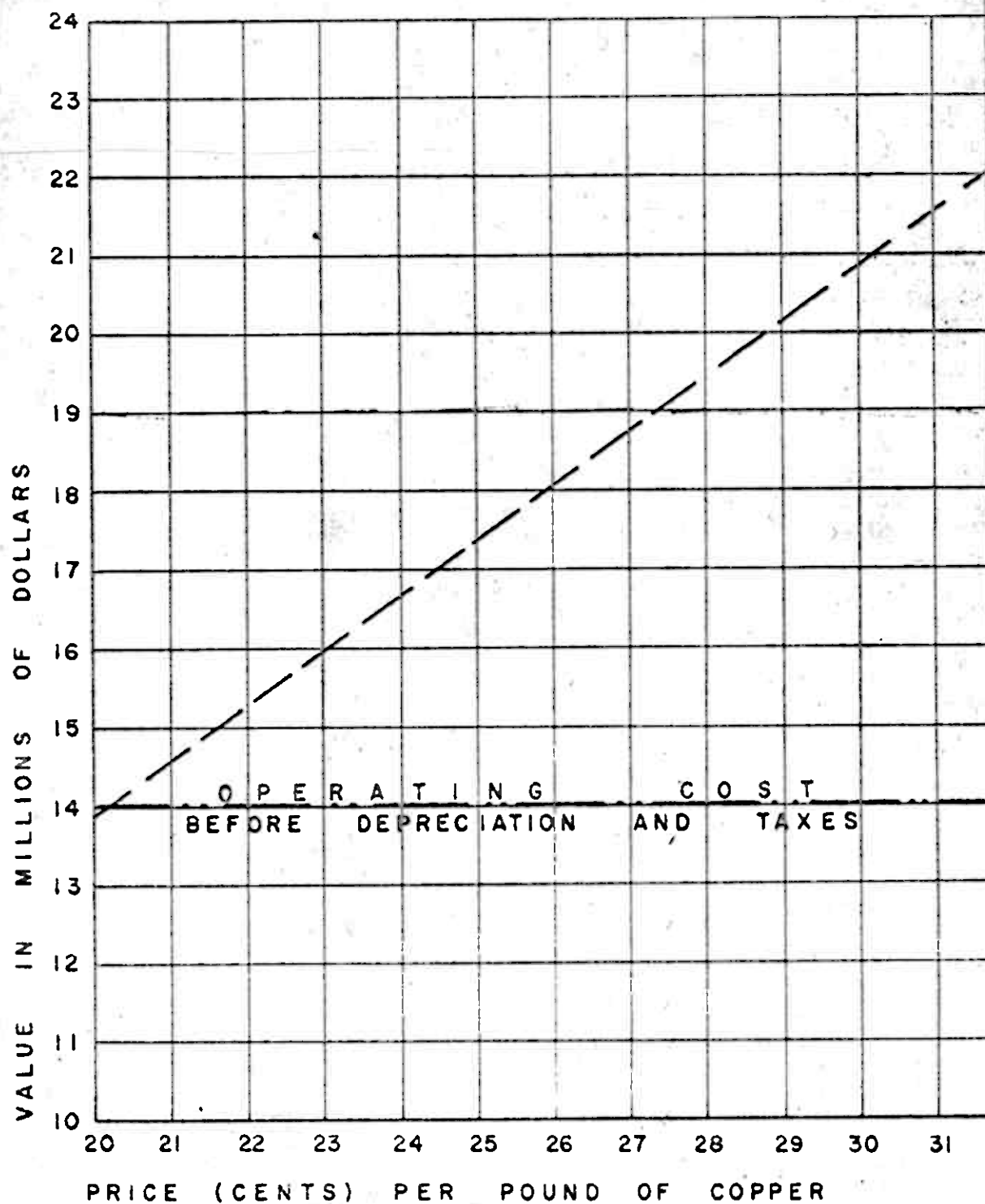
This figure, when added to that of operating cost, would show a cutt-off point on graph 1 above which price this size operation is economic.

With additional diamond drilling over and above the amount suggested under recommendations, it is quite probable that the tonnage which has been referred to above and upon which these calculations have been based could be at least doubled. In this evaluation no allowance is made for this possibility.

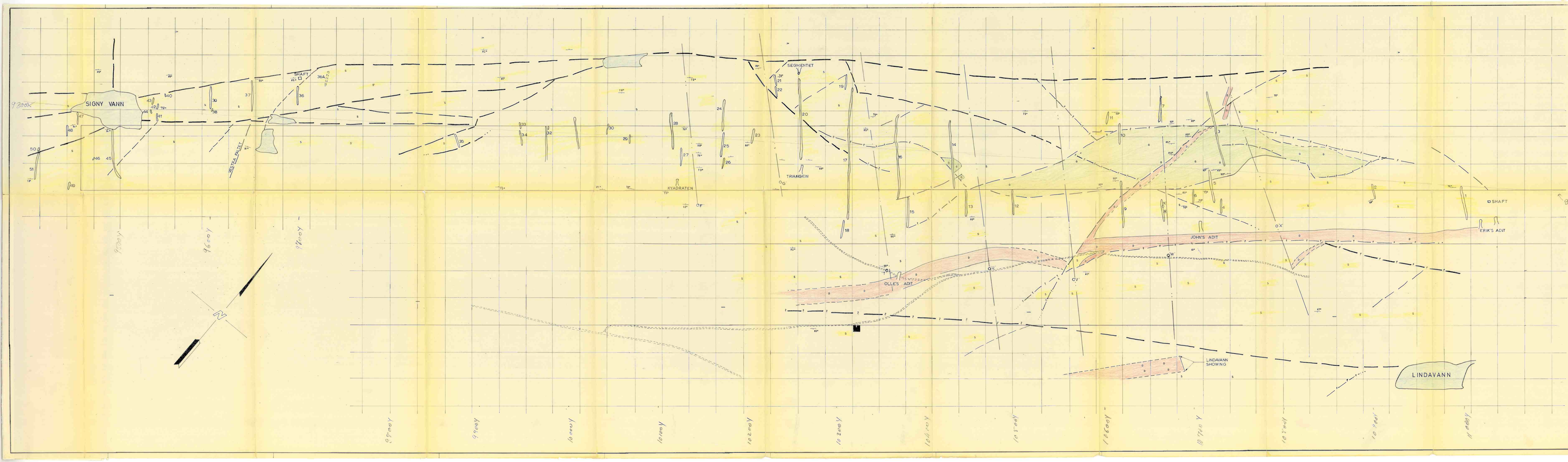
C. W. Archibald (sign.)

Toronto, Canada,
November 1957.

VALUE OF 2.5 MILLION TONS OF 1.6% ORE AT VARYING PRICES



GRAPH 1



LEGEND

- FAULTS
MAJOR (KNOWN) (POSSIBLE)
MINOR (LITTLE OR NO DISPLACEMENT) (KNOWN) (POSSIBLE)
- LITHOLOGIC UNITS
FELDSPATHIC SS. (SPARGAMITE)
GREENSTONE
DIABASE
- LITHOLOGIC BOUNDARIES
KNOWN
INFERRED
- STRIKE & DIP OF BEDS
- TRENCHES
- ADITS
- DIAMOND DRILL HOLES
- JEEP ROADS
- SECTION THROUGH DRILL HOLE
- SURVEYED BASE LINE

4 cm = 100 m

GEOLOGICAL PLAN
ULVERYGGEN MOUNTAIN
REPPARFJORD , NORWAY
SCALE: 1 INCH = 100 FEET
Målestokk 1:1000
1:2500

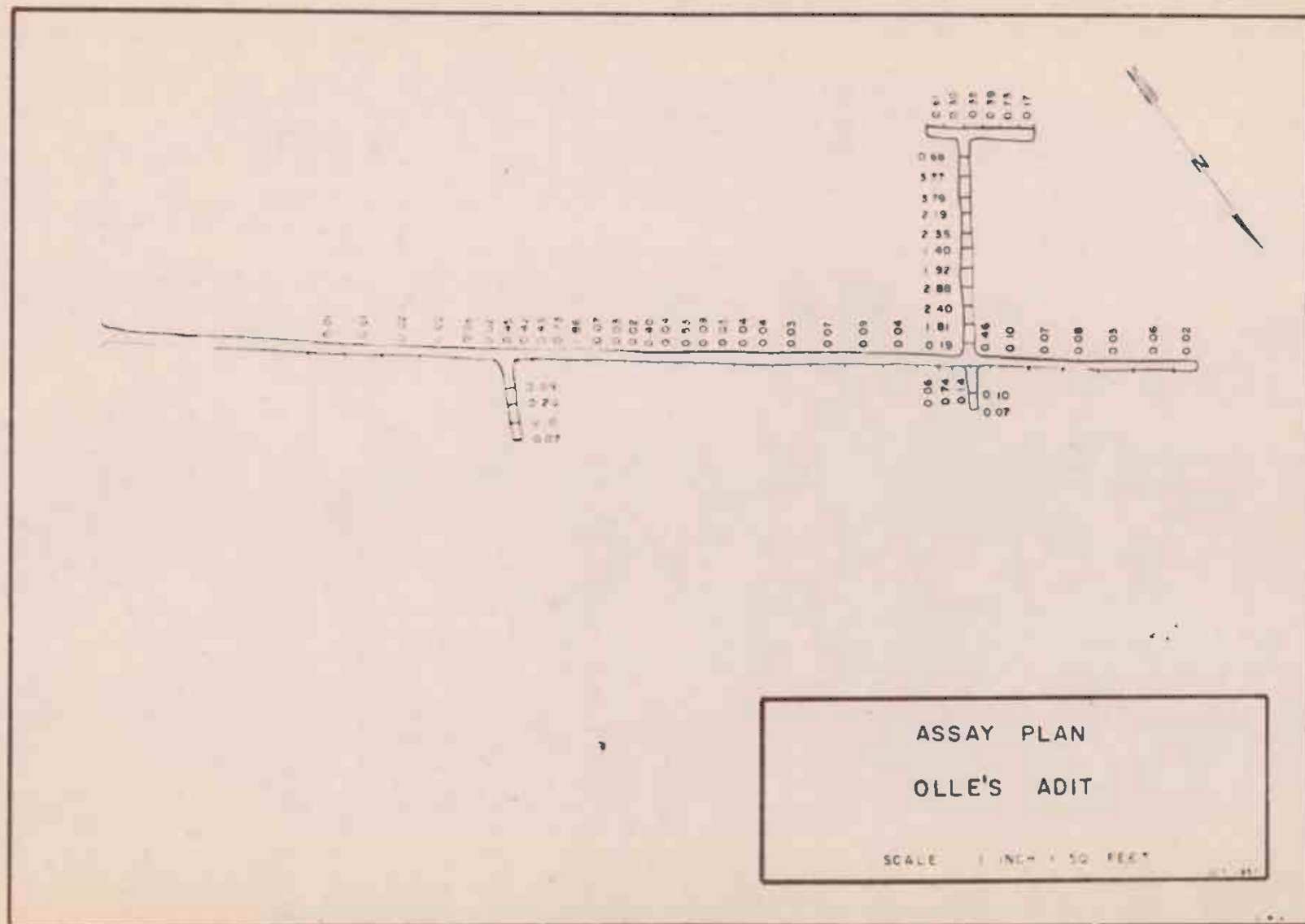


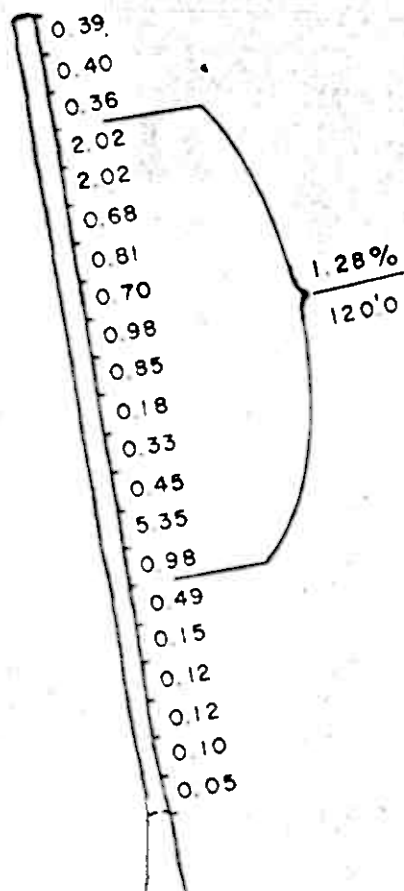
LEGEND

- DIAMOND DRILL HOLE
- ADIT
- TRENCH
- OUTLINE OF GABBRO
- OUTLINE OF GREENSTONE
- FAULT
- SHAFT
- OVER 1.5% COPPER
- BETWEEN 1.0% AND 1.5% COPPER
- BETWEEN 0.8% AND 1.0% COPPER

ASSAY PLAN
DIAMOND DRILL HOLES
REPPARFJORD NORWAY

SCALE : 1 INCH = 100 FEET
MÅLESTOKK 1 : 1000





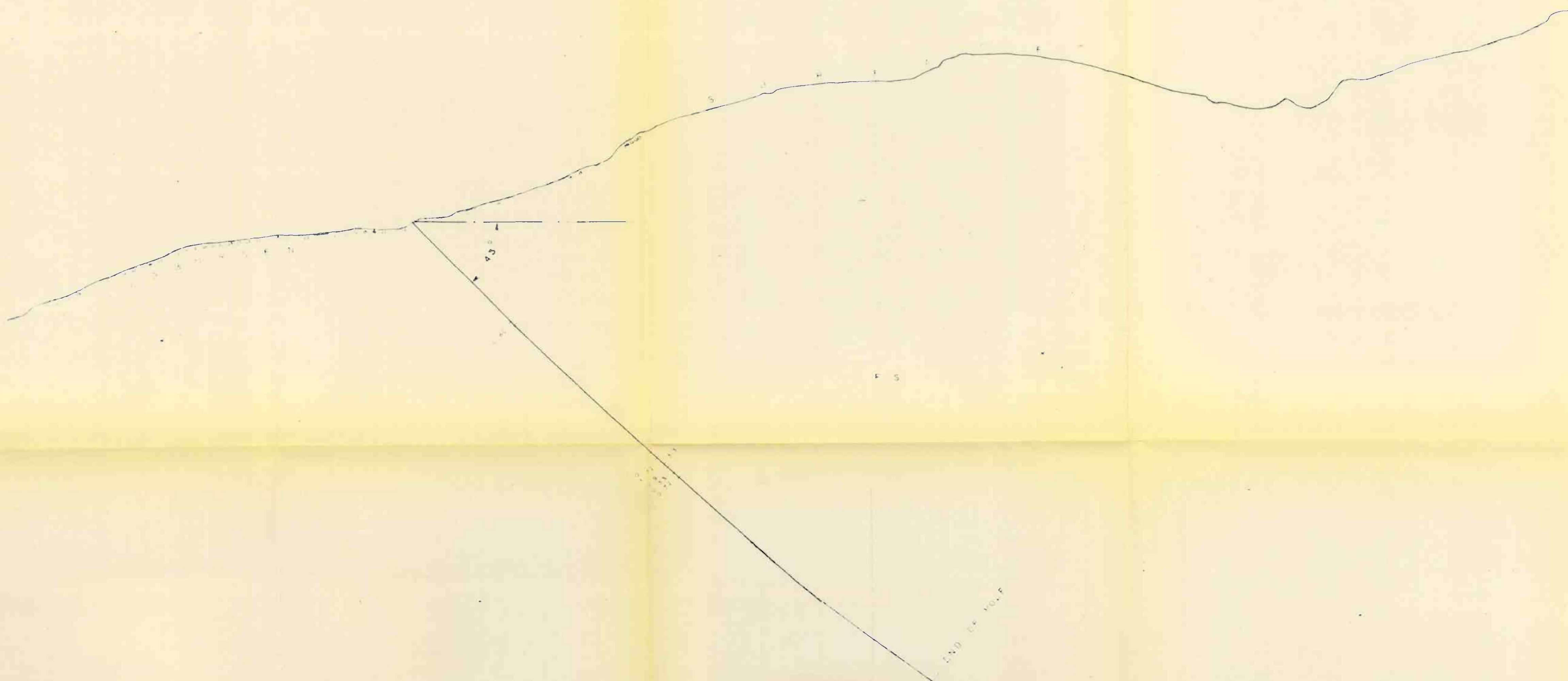
ASSAY PLAN
KYDRATEN ADIT

SCALE 1 INCH = 50 FEET

OCT. 1957

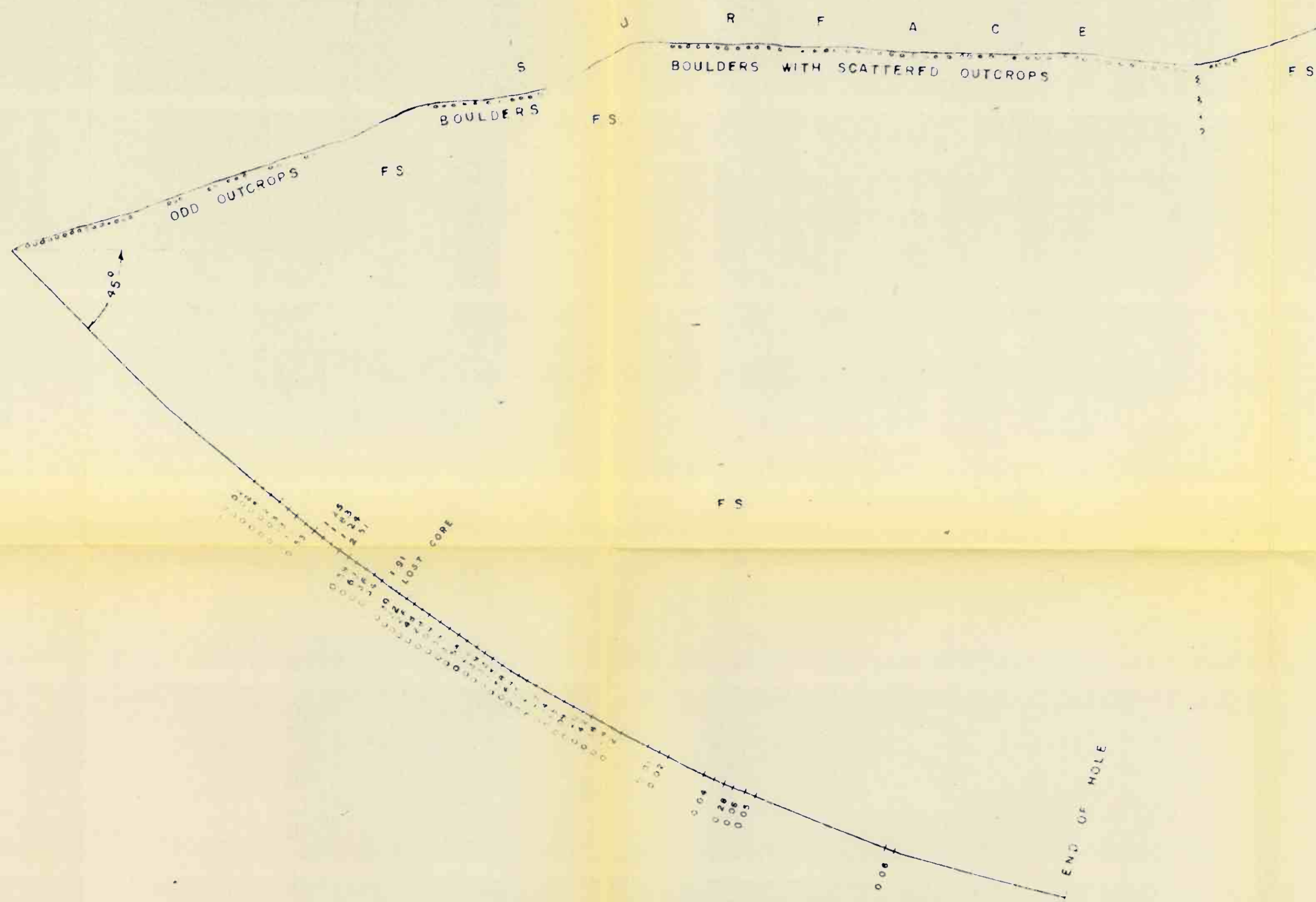
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PLAN 4



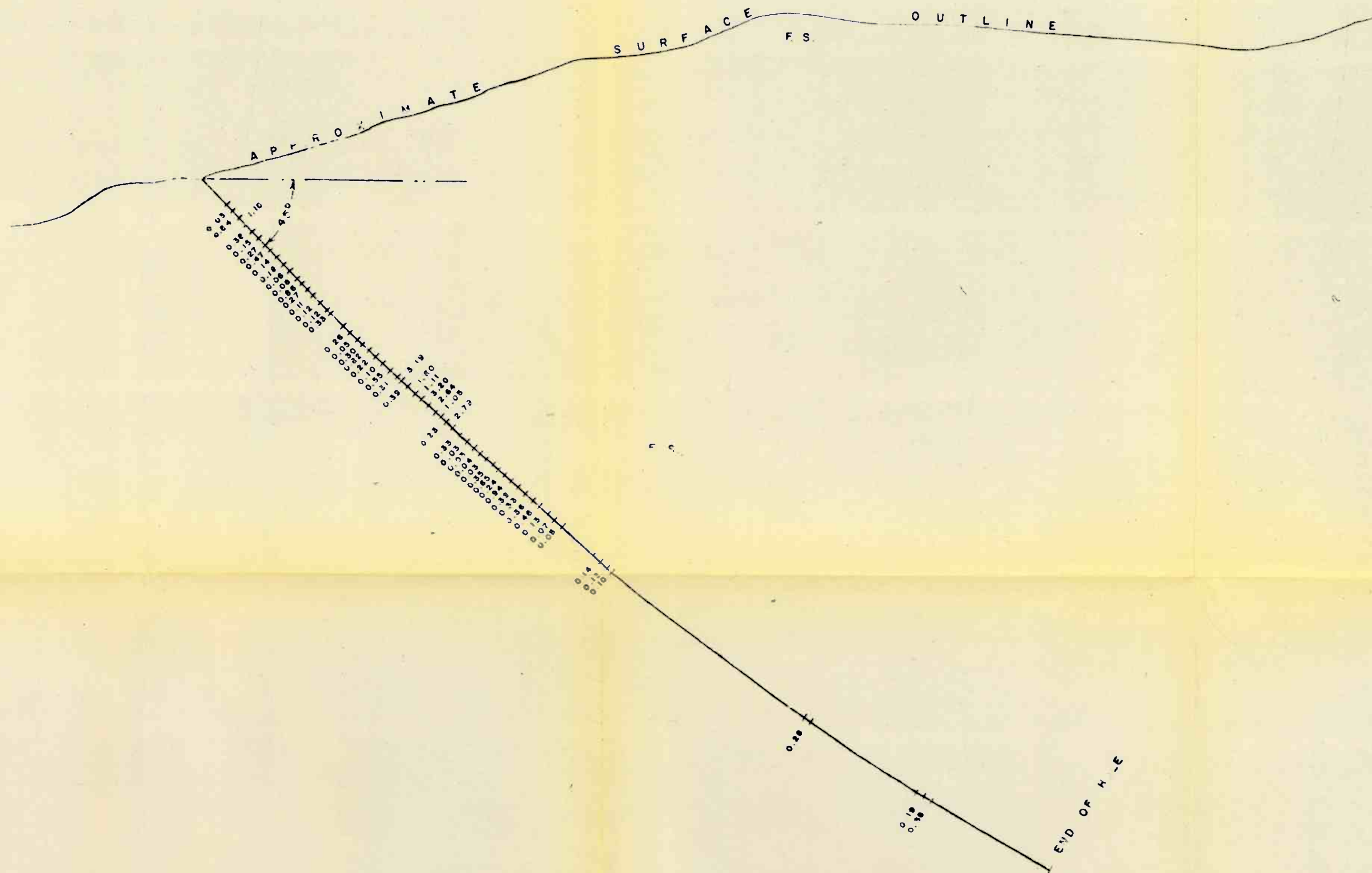
CROSS SECTION
THROUGH
DIAMOND DRILL HOLE 'E'
SHOWING ASSAYS
SCALE 1" INCH = 30 FEET

MÅLESTOKK 1:500



CROSS SECTION
THROUGH
DIAMOND DRILL HOLE 'F'
SHOWING ASSAYS
SCALE 1 INCH = 50 FEET

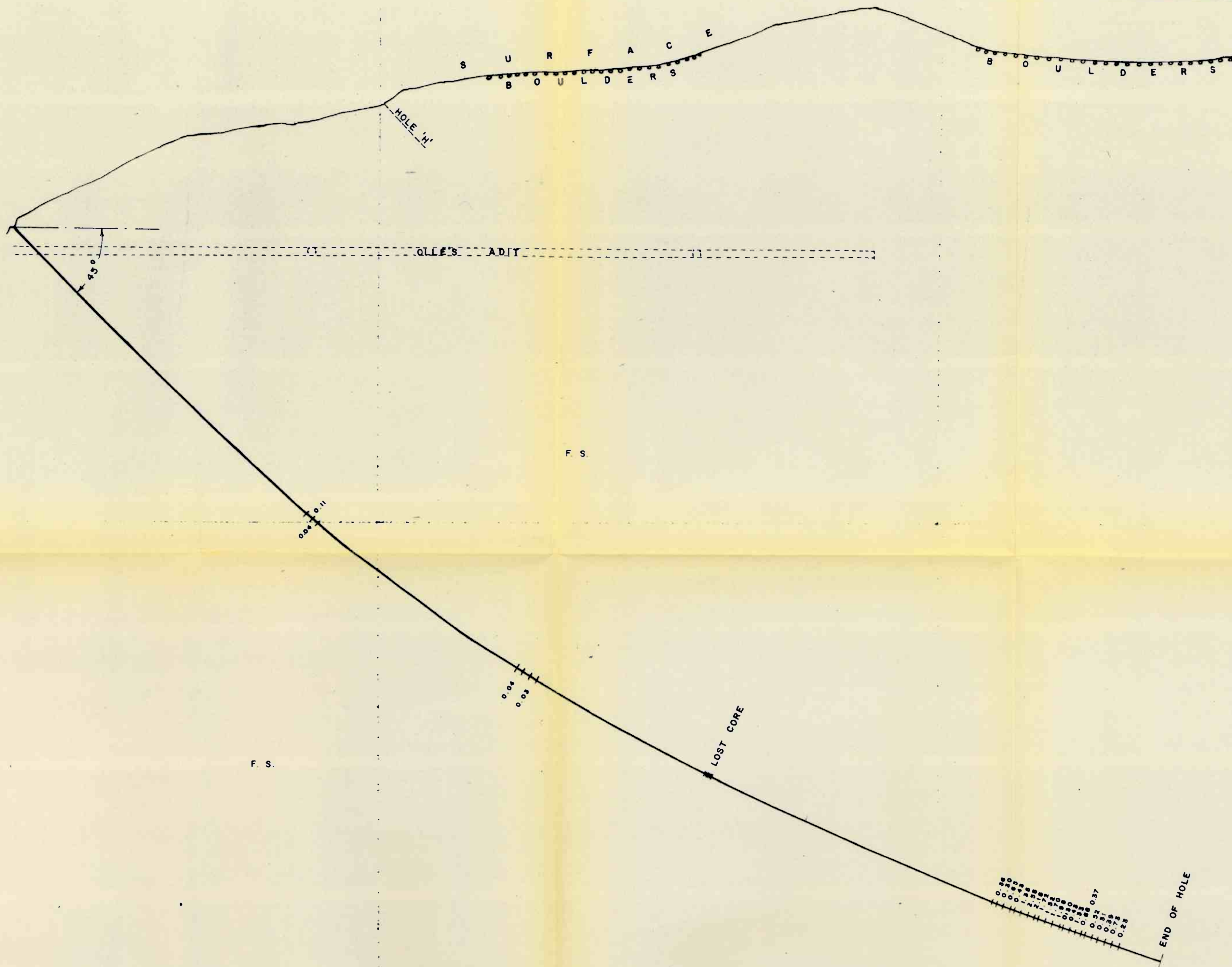
MÅLESTOKK 1:500



CROSS SECTION
THROUGH
DIAMOND DRILL HOLE 'G'
SHOWING ASSAYS

SCALE : 1 INCH = 50 FEET

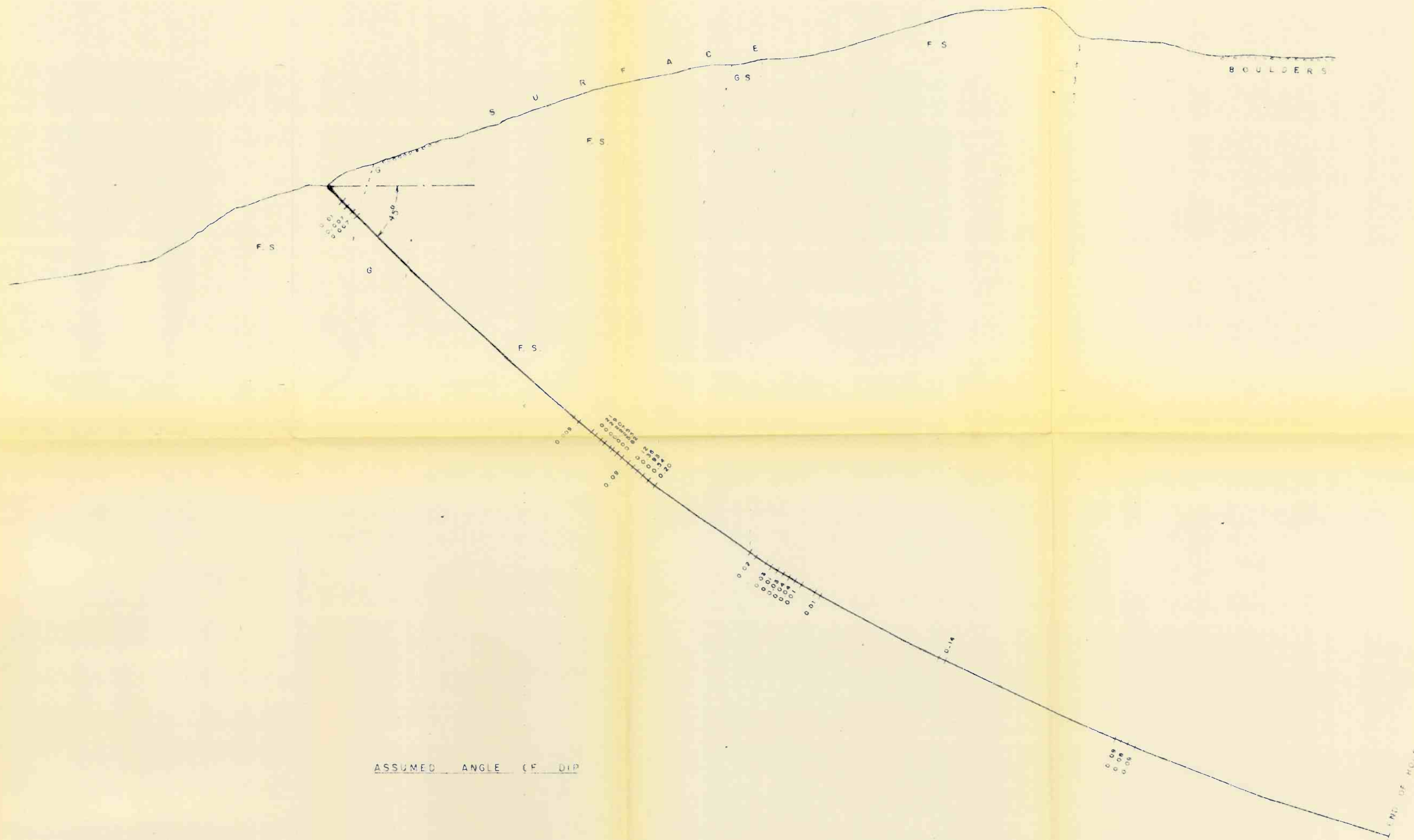
MÅLESTOKK 1:500



CROSS SECTION
THROUGH
DIAMOND DRILL HOLE 'T'
SHOWING ASSAYS
SCALE : 1 INCH = 50 FEET

MÅLESTOKK 1: 500

C.W.A.

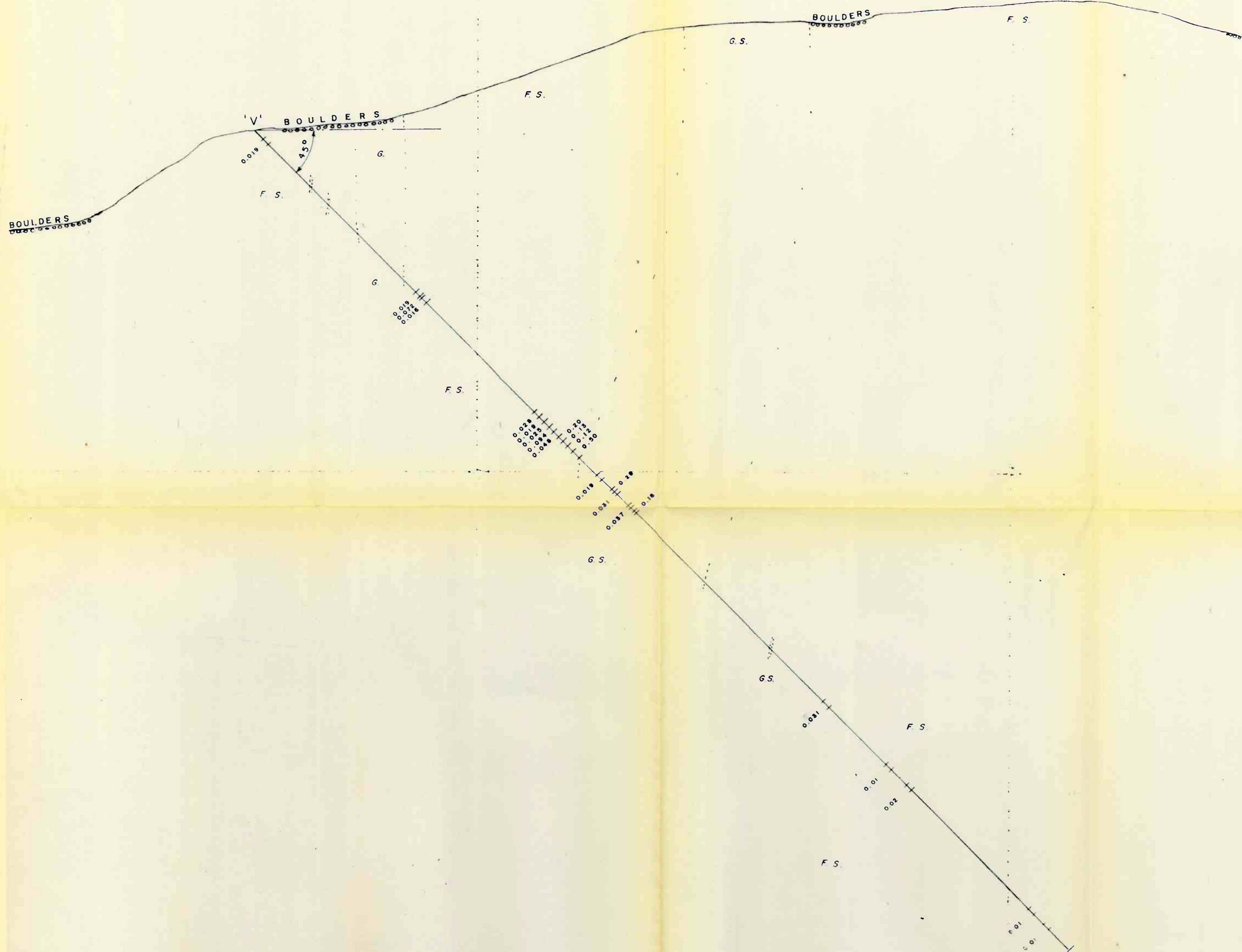


ASSUMED ANGLE OF DIP

CROSS SECTION
THROUGH
DIAMOND DRILL HOLE 'U'
SHOWING ASSAYS

SCALE 1 INCH = 50 FEET

MÅLESTOKK 1:500



CROSS SECTION
THROUGH
DIAMOND DRILL HOLE 'V'
SHOWING ASSAYS
SCALE • 1 INCH = 50 FEET
AUG 1957

