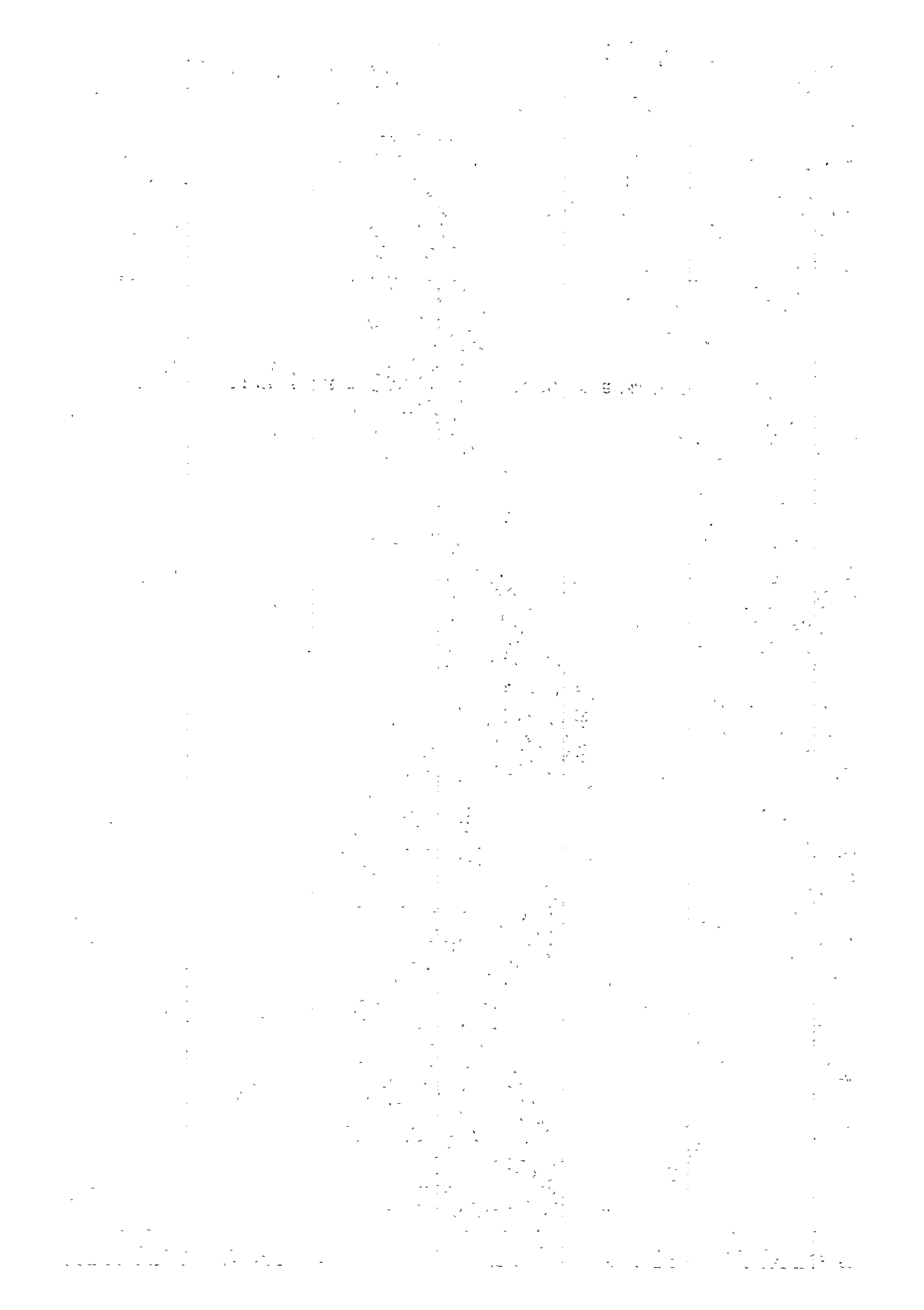


CHAPTER 6 DIAMOND DRILLING IN EZAN AREA



6. Diamond Drilling in Ezan Area

6-1 Introduction

6-1-1 Purpose of Diamond Drilling

As a part of the third phase surveys of the Geological survey for the development of chromite resources in the eastern part of the Turkish Republic, drilling was carried out to ascertain the relation between chromite ore deposits down to the depth more than 50 m below surface and geological structure in the Ezan area and Sulu Ocak areas, which had been chosen as the areas where geological environment is favourable for the emplacement of chromite ore deposits.

6-1-2 Outline of Diamond Drilling in 1979

A survey member in charge of the drilling was sent in advance to Kopdağ area on 25th June, 1979 and inspected drilling equipment and observed the actual location.

The equipment and material for exploration of Kopdağ was carried from Alaklı on 27th June, 1979, and the first drill hole (TJ-1) was commenced on 19th July, 1979.

Five drilling machines were used to drill 8 holes of total length of 542.60 m, drilling methods were wireline, ordinary and non core.

Table 6-1 Drilling Machine List

Drilling machine name	Unit	Capacity
Atlas Cop D-750	1	425 m
Acker N-18	2	500
Long year L-34	2	300
Total	5	

Eight crews, each of which was composed of 1 chief driller, 1 sub-driller, 4 workers, and one jeep driver, were prepared for the drilling in addition to 2 workers for water carrying.

Bentonite-mud water containing C.M.C. was used for the drilling, and the part near surface, where geology is known well, was drilled with tricon bits. However, the attempt to recover as much of the cores as possible was not successful, because of weathered ultrabasic rock, and total core recovery was 57.06%.

The drill areas and amount of drilling are as follows:

Table 6-2 Drilled Length of each Hole

Area/Hole No.	Number of holes	Drilled length (m)	Core recovery (%)
Armutlu TJ-1	1	76.95	73.07
Armutlu TJ-2	1	65.20	49.72
Batı Ezan TJ-3	1	91.10	50.26
Sulu-Ocak TJ-4	1	50.15	58.61
Batı Ezan TJ-5	1	102.20	62.54
B Cafa TJ-6	1	52.10	24.80
Sulu-Ocak TJ-7	1	22.40	34.80
Doğu Ezan TJ-8	1	82.50	61.06
Total	8	542.60	57.06

Diamond drilling took 104 days from 25th June, 1979 to 6th October, 1979. After completion of the drilling, the cores and machines were stored in the warehouse at the site in Araklı, and geologist in charge of drilling returned to Japan on 21st of November, 1979.

6-1-3 Core Logging and Analysis

All the cores obtained through the diamond drilling carried out in 1979 and 1980 were logged for lithology, alteration and mineralization by the site geologist, and the data were recorded on core-logging charts on a scale of 1:200. Analysis of geology in the field was performed by the correlation of the results of the core-logging with the surface geology. In core logging, lithology, fissures, sheared zone and alteration, especially of the ultrabasic rocks were observed and described in detail. The ultrabasic rocks were subdivided into many lithofacies.

6-2 Location of the Drill Holes

The sites of drill holes No. TJ-1, TJ-2, TJ-3, TJ-4, TJ-5, TJ-6, TJ-7 and TJ-8 in Ezan are located about 5 km far from Kopdağ camp via Sıçankale village and it takes about 30 min. by jeep. But, from Kopdağ camp to Araklı where branch office of M.T.A. is located, it takes 8 hours by jeep. The geographical location and elevation of the drill hole sites are as follows:

Table 6-3 Coordinates of Drill Hole

No. of holes	Longitudinal distance (E)	Latitudinal distance (N)	Elevation (m)
TJ-1	6.846	26.356	1.972
TJ-2	6.630	26.422	1.998
TJ-3	6.810	26.905	2.103
TJ-4	7.660	27.216	2.070
TJ-5	7.000	26.888	2.149
TJ-6	7.245	26.926	2.075
TJ-7	7.655	27.125	2.055
TJ-8	7.035	26.600	2.065

6-3 Preparatory

6-3-1 Road Construction and Maintenance

Various preparations were undertaken according to the timetable in order to commence the drilling work in the middle of July under the current drilling programme. The equipment and materials that had been in the custody of M.T.A. branch office in Araklı were checked, and proposed drilling sites were inspected by the drilling supervisor, who arrived at the base camp on 12th July.

In the drilling area, many roads, which connect villages, are present, but most of them are in very bad condition, and only the jeep can pass through.

National Roads Route 2 which connects Erzurum to Sivas via Erzincan, Route 40 which connects Askale to Gümüşhane and Trabzon, are asphalt, all weather roads. However, road connecting Karataş to Erbaş station is closed during winter (the middle of October to the end of May). Condition of this road was extremely bad and up to 30 km of the road had to be repaired during June.

The drill sites No. TJ-1, and TJ-2 are on the road in Armutlu, but the access road to the holes No. TJ-3, No. TJ-5 and No. TJ-8 in Batı Ezan was prepared, constructing a new road by using bulldozer for a distance of 160 m mending the present road for a distance of 450 m. The drill sites of No. TJ-4 and No. TJ-7 are on the road in Sulu Ocak, and 310 m of the present road had to be repaired.

6-3-2 Transportation of Equipment and Materials

The transportation of equipment and material to the drill sites No. TJ-1, on 13th July, No. TJ-2 on 19th July, No. TJ-3 on 22nd July, No. TJ-4 on 1st August, and No. TJ-6 on 28th August was by a 6 ton truck from the warehouse of M.T.A. Black Sea Branch in Araklı via Gümüşhane, Bayburt, and Karataş. Other equipment, materials and fuel for drilling were transported by 6 ton-truck and jeep from Araklı.

6-3-3 Preparation of Drilling Bases

Drilling bases No. TJ-1, No. TJ-2, No. TJ-3, No. TJ-5, No. TJ-6, and No. TJ-8 in Ezan area were prepared (15 x 10 m), a new road was constructed and the present road repaired by a bulldozer, drill bases No. TJ-4, and No. TJ-7 in Sulu Ocak area were also prepared and the present road leading to the site was mending.

6-3-4 Drilling Water Supply

Drilling water for the drill holes No. TJ-1 and No. TJ-2 was supplied by pumping water from a stream, water for No. TJ-3 was supplied by a pipe line from a stream 450 m away, but sometimes when it was not enough, water was delivered by a small truck with a steel tank of 1,000 l also water for No. TJ-5, No. TJ-6 and No. TJ-8 in Batı Ezan, No. TJ-4 and No. TJ-7 in Sulu Ocak was transported from a stream by a small truck.

6-4 Drilling

The overburden is not present in this area and each hole was drilled by beginning with 4-5/8" and 3-3/4" tricon bits, they were used for known rock which ranged from the surface to 10 m or 30 m. NQ and BQ wireline methods were applied below the depth of 50 m or 100 m, but it was hard to recover cores because of foliated serpentinite and serpentinitized dunite. These rocks are soft and fragile, bentonite-mud water becomes gel-nized by asbestos and hydro-magnesite.

Condition of drill holes was not good, and it was impossible to drill using the wireline method, ordinary method was applied, and the drilling was continued by extending the NX and BX casing pipes to enlarge the holes.

The drilling progress of each holes was as follows:

6-4-1 No. TJ-1 Hole

Total drilled length:	76.95 m
Total drilled core length:	76.95 m
Total core length:	56.23 m
Rock core recovery:	73.07%

The hole was drilled down to 0.5 m in the layer of surface soil with a metal bit of NWM size. Below this, drilling was continued with a NQ-WL bit and a diamond bit of NWM size. Drilling was continued by NQ-WL method from 0.5 to 61.75 m, rock was serpentized and drilling proceeded with core blocking. Therefore reamed by an NW casing shoe from 0.5 m to 45.75 m, then NW casing pipe was inserted, but the rock cracked extensively and caved in. BW casing pipe was inserted at the depth of 61.75 m, and drilling was continued to 76.95 m, but the hole was difficult to drill because of serpentized dunite that was soft and caving in. The hole was reamed by a BW casing shoe from 61.75 m to 64.05 m, trouble with casing shoe, hydraulic jack and engine

happended after BW casing pipe was inserted at the depth of 64.05 m. .
However, drilling was completed to the depth of 76.95 m with the object
duly achieved.

6-4-2 No. TJ-2 Hole

Total drilled length:	65.20 m
Total drilled core length:	53.20 m
Total core length:	26.45 m
Rock core recovery:	49.72%

4-5/8" tricone bit was used from the start of drilling until the
rock was reached at 3.05 m, then HW casing pipe was inserted.
Drilled by 3-3/4" tricone bit from 3.05 m to 13.30 m, then NW casing
pipe was inserted, and then the hole was drilled with the NQ-WL and
NWM diamond bits. Rocks was strongly serpentized and drilling
proceeded with core blocking, bentonite mud water gelation with
alkalization (PH10-11) took place.

The hole was drilled to the depth of 48.55 m. NW casing pipe
was inserted until 44.20 m after reaming the hole with NW casing shoe.
But it was difficult to drill by a NQ-WL bit because the hole collapsed.
BW casing pipe was inserted after drilling reached the depth of 57.95 m,
then BW casing shoe was used, BW casing pipe was inserted down to
57.95 m. Drilling was completed to the depth of 65.20 m with the object
duly achieved.

6-4-3 No. TJ-3 Hole

Total drilled length:	91.10 m
Total drilled core length:	75.70 m
Total core length:	38.05 m
Rock core recovery:	50.26%

3-3/4" tricone bit was used from the start of drilling to 15.20 m, then HW casing pipe was inserted. This hole was drilled with NQ-WL and NWM diamond bits down to 37.40 m, rock was strongly serpentinized and included asbestos, hydromagnesite. Due to the presence of asbestos, hydromagnesite, and cracks in dunite, the hole caved in. NW casing pipe was inserted at the depth of 28.95 m after the hole was reamed by NW casing shoe.

Drilled by BQ-WL method from 37.40 m to 59.60 m, BW casing pipe was inserted at the depth of 35.05 m. But the hole caved in and BW casing pipe was inserted down to 54.90 m after the hole was reamed by BW casing shoe. However it was still difficult to drill the serpentinized dunite, the hole was reamed by casing shoe. It was tried to insert BW casing pipe, but it was a failure due to deformation of casing shoe. BW casing pipe then taken out and it tried to insert it once more. However, the condition of hole was bad, and 2-15/16" tricone bit was used to take out caving material and sludge from the bottom. The end of casing pipe (length, 90 cm) fell down the hole. The drilling had to be stopped, and the drilling machine was turned quickly 1.80 m westward, and used 3-3/4" tricone bit, a new hole was drilled to 59.60 m. The hole was reamed with

a HW casing shoe, HW casing pipes were inserted down to 12.20 m and NW casing pipe was inserted down to 54.40 m, BW casing pipe was inserted at the depth of 59.60 m after washing by BQ-WL method. Bentonite mud water tended to be gelatized easily, being strongly influenced by alkaline materials such as asbestos, hydromagnesite and serpentine. The drilling was finished when the hole reached the depth of 91.10 m. Bentonite-mud water was used for the entire length of the hole.

6-4-4 No. TJ-4 Hole

Total drilled length:	50.15 m
Total drilled core length:	39.50 m
Total core length:	23.15 m
Rock core recovery:	58.61%

4-5/8" tricone bit was used from the start, and HW casing pipe was inserted to 2.80 m, then the drilling was continued by 3-3/4" tricone bit and NW casing pipe was inserted on reaching 10.65 m. Drilling was continued with NWM diamond ordinary method due to collapsing of the hole wall. Bentonite mud water was gelatized easily and had to be renewed. The hole was drilled to the depth of 42.15 m by a BWM diamond bit, and NW casing pipe was inserted down to 40.20 m after reaming with a NW casing shoe. It was difficult to drill because sheared zone was encountered.

Drilling was completed to the depth of 50.15 m with the object duly achieved. Bentonite-mud water was used for the entire length of the hole.

6-4-5 No. TJ-5 Hole

Total drilled length:	102.20 m
Total drilled core length:	59.40 m
Total core length:	37.15 m
Rock core recovery:	62.54%

4-5/8" tricone bit was used from the start of drilling and on reaching the rock at 12.20 m, HW casing pipe was inserted. 3-3/4" tricone bit was used from the depth 12.20 m to 21.35 m. Then, NW casing pipe was inserted to 42.70 m after the hole was drilled with 3-3/4" to the depth of 42.80 m. Drilled by NQ-WL method from the depth 42.80 m to 53.75 m, BW casing pipe was inserted to 53.35 m, below this, drilling was continued with BQ-WL method.

Bentonite mud water was gelatized easily and hold to be renewed. The hole was quickly collapsed. However, drilling was completed to the depth of 102.20 m with the object duly achieved after BW casing pipe was inserted to 84.35 m.

6-4-6 No. TJ-6 Hole

Total drilled length:	52.10 m
Total drilled core length:	21.57 m
Total core length:	5.35 m
Rock core recovery:	24.08 m

3-3/4" tricone bit was used from the start of drilling and on reaching 18.30 m, HW casing pipe was inserted. Then, 3-3/4" tricone bit was used from 18.30 m to 30.53 m and the NW casing pipe was inserted to 30.53 m, then the hole was drilled with a NWM diamond bit and a metal crown of ordinary method.

It was difficult to drilling because bentonite mud water gelatized easily and hole caved in quickly. NW casing pipe was inserted to 41.15 m after the hole was drilled to 41.15 m with a BWM diamond bit. On reaching the depth of 52.10 m, the clutch of drilling machine (longyear-34 type) was broken while reaming with BW casing shoe. The drilling was stopped, but drilling was completed to the depth of 52.10 m with the object duly achieved.

6-4-7 No. TJ-7 Hole

Total drilled length:	22.40 m
Total drilled core length:	10.20 m
Total core length:	3.55 m
Rock core recovery:	34.80%

4-5/8" tricone bit was used from the start of drilling and on reaching 4.25 m, HW casing pipe was securely inserted. Then 3-3/4" tricone bit was used and on reaching 12.20 m, NW casing pipe was inserted to 12.20 m, while drilling was carried out with a NWM diamond bit of ordinary method. Mud water was completely lost around the bottom of the hole (22.40 m) and a mud ball of bentonite was thrown into the hole to prevent water loss.

The hole was reamed with a NW casing shoe to prevent caving in. The casing pipes were inserted to 21.35 m, unfortunately, the engine of drilling machine (Longyear 34 type) was broken after insert of casing pipe, it was not possible to repair the engine for a few days, and then drilling had to stop. Due to the high altitude of the area, the weather was bad, it rained for 7 days at the end of September.

6-4-8 No. TJ-8 Hole .

Total drilled length:	82.50 m
Total drilled core length:	52.00 m
Total core length:	31.75 m
Rock core recovery:	61.06%

3-3/4" tricone bit was used from the start of drilling and on reaching 3.00 m, HW casing pipe was inserted. Then, the hole was drilled to 30.50 m with 3-3/4" tricone bit and HW casing pipe was inserted to 27.45 m after reaming with HW casing shoe. This hole was then drilled down to 73.20 m with NQ-WL method. The hole was reamed with a NW casing shoe from

30.50 m to 54.90 m, and NW casing pipe was inserted. When the hole is reached the depth of 73.20 m, mud water was completely lost, when a mud ball of bentonite was thrown into the hole to prevent water loss. BW casing pipe was inserted to 73.20 m in order to prevent caving in. Drilling was then carried out with BQ-WL method. Drilling was completed to the depth of 82.50 m with the object duly achieved.

Bentonite-mud water was used for the entire length of the hole.

6-5 Moving Operation

The drilling equipment and material were transported by truck and bulldozer, moving operations from site to site are as shown in the table (Table 6-10). No. TJ-8, No. TJ-5 and No. TJ-7 drilling machine was transferred for operation from No. TJ-1, No. TJ-2, and No. TJ-4 respectively. The transferring was done without difficulty, because the roads to the drilling sites were repaired so that 4 ton truck could be used.

6-6 Withdrawal Operations

Immediately after the completion of the drilling of No. TJ-5, the last hole, on 3rd October, 1979 withdrawal operations started.

The withdrawal of the casing pipes and the dismantling operations of the drills and piping facilities were carried out. All equipment,

material and the drilled cores were then sent back to Araklı by 9 trucks (one 30 ton trunk and eight 6 ton trucks) and stored in the warehouse of Eastern Black Sea Branch of M.T.A., in Araklı. The field operations were completed on 6th October, 1979.

6-7 Operational Records and Analysis

6-7-1 Analysis of Working Time

As shown in Table 6-40, drilling work time accounts for 82.5% of the total working time, which includes drilling time in the proportion of 23.8% and auxiliary work of 47.9% respectively to the total. The last consists mainly of drilling preparation, post-drilling work and recess, and also of other in the proportion of 25.3% to the total, such as hole enlarging, casing insertion, etc.

Moving operations occupied a comparatively low proportion of 17.5% of the total working time, because the main equipment could be moved by a truck as previously stated.

6-7-2 Drilling Results

As shown in Table 6-38, the drilling length per shift was 1.62 m for the total works operation and 4.64 m for the net drilling operations.

6-7-3 Core Recovery Rate

As shown in Table 6-38, the drilling core recovery was 40.86% on the overall and 57.06% excluding the no core drilling.

The reason why core recovery was less than 70%

1. Serpentinized dunite caused the collapse of the hole well
2. Serpentinized dunite was composed of serpentine, asbestos and hydromagnesite
3. PH of bentonite mud water became alkalic (pH11-12)
4. It was difficult to control the character of bentonite mud water as usual
5. Drilling by wireline method was hard for the above reasons.

6-8 Outline of Diamond Drilling in 1980

Preparatory works such as camp facilities, provision of vehicles and bullozer, mending the present road to the camp had been completed by M.T.A. until 19th June, 1980. With the arrival of drilling technicians at the camp site on 20th June, the drilling locations were inspected and the haulage roads were mended from the camp to drilling site, initiating the

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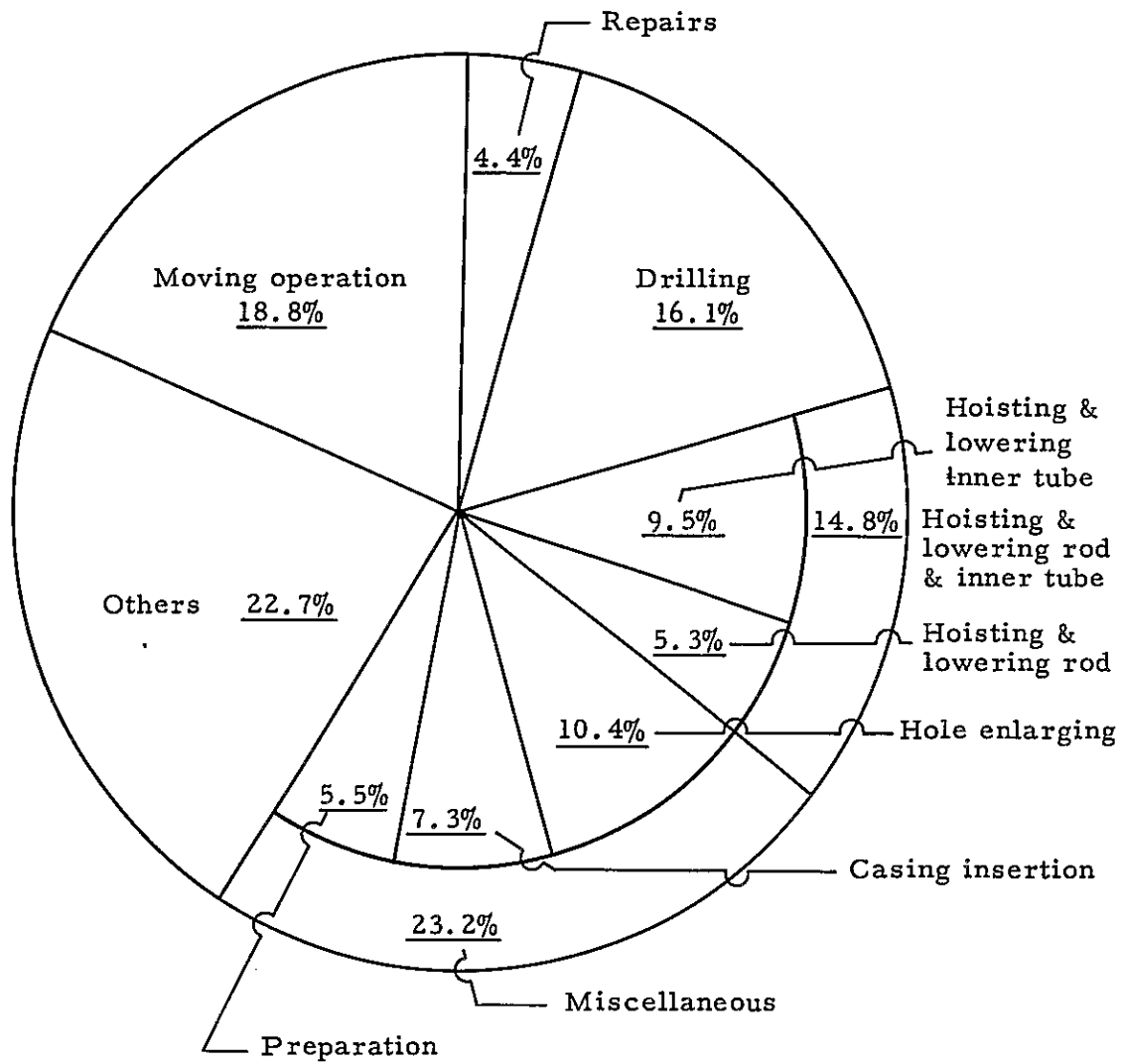
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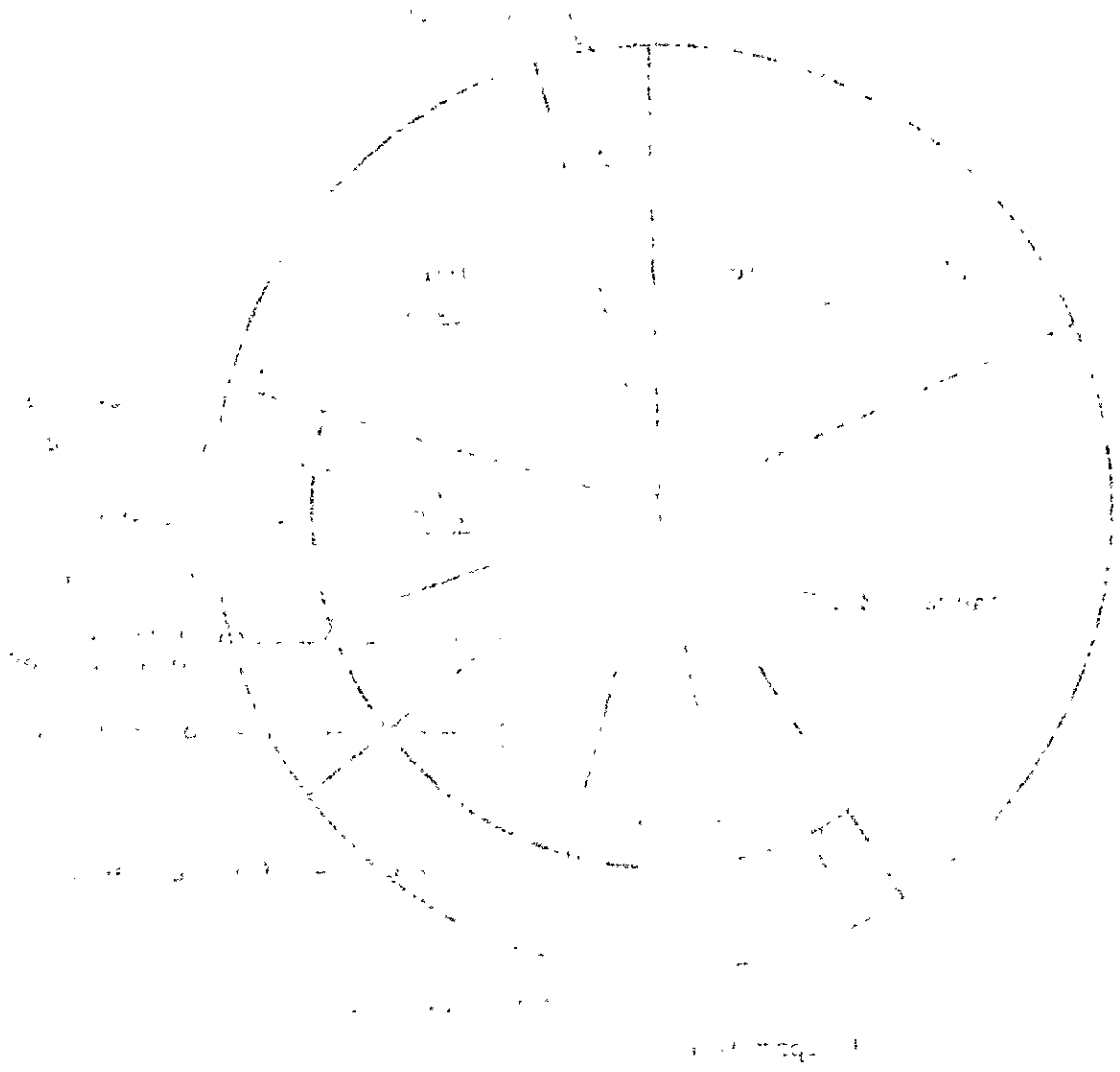
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Analysis of working time in Kopdağ area (1979)



1. The following table shows the results of a survey of 100 people.



transportation of equipment and supplies to the drilling site on 29th June. Drilling started on 17th July, and was completed on 29th September, six hole drilled during the period reached 461.55 meters in total length.

The drilling was carried out by one shift and three machines. One crew was a chief driller and 5 workers. Lignite mud water and over size diamond bit were used for the drilling. The 1980 drilling generally obtained satisfactory results as formerly with 1979 drilling.

The area for the drilling and amount of performance are as follows:

Table 6-4 Drilled Length of Each Hole

Area	Hole No.	Direction	Drilled length (m)	Core recovery (%)
C Kafa	TJ-9	S, -60°	47.40	38.9
Bati Ezan	TJ-10	S60°E, -60°	62.50	67.9
B Kafa	TJ-11	S70°W, -60°	81.40	89.3
B Kafa	TJ-12	-90°	106.00	91.3
C Kafa	TJ-13	-90°	63.95	60.7
B Kafa	TJ-14	-90°	100.30	92.4
Total			461.55	78.9

6-9 Location of the Drill Holes

Each site where the holes No. TJ-9 - TJ-14 were drilled in Ezan. ,
The geographical location and elevation of the drilling holes are as follows:

Table 6-5 Coordinates of Drill Hole

No. of holes	Longitudinal distance (E)	Latitudinal distance (N)	Elevation (m)
TJ-9 & TJ-13	7.342	26.960	2.025
TJ-10	6.891	26.891	2.110
TJ-11 & TJ-12	7.206	26.864	2.105
TJ-14	7.198	26.882	2.105

6-10 Preparation

6-10-1 Road Construction

The drilling sites of No. TJ-9, and No. TJ-13 in C Kafa were set up, mending the present road by using bulldozer by 80 m. The drilling sites of No. TJ-11, No. TJ-12 and No. TJ-14 are on the road in B Kafa, mending the present road by 700 m. Also, the drilling sites of No. TJ-10 are on the road in Bati Ezan, mending the present road by 70 m.

6-10-2 Transportation of Equipment and Materials

The transportation of equipment and materials to the drilling sites of No. TJ-9, on 29th June, No. TJ-10, on 9th July, and No. TJ-11 on 10th July respectively by a truck from the warehouse of M.T.A. Black Sea Branch in Arakli.

6-10-3 Preparation of Drilling Bases

Drilling bases of No. TJ-9 and No. TJ-13, in C Kafa and No. TJ-11, No. TJ-12, No. TJ-14 in B Kafa were developed by a bulldozer in connection with the mending of the present road. Drilling base of No. TJ-10 in Bati Ezan was developed by a bulldozer.

6-10-4 Drilling Water Supply

Drilling water for the drill holes of No. TJ-9, No. TJ-11, No. TJ-12, No. TJ-13, and No. TJ-14 was supplied from the upper stream 400 m away by the pipeline, but drilling water for the drill hole of No. TJ-10 was pumped up from stream 200 m away by the pipeline.

6-11 Drilling

The drilling aims for 1980 were to improve core recovery and drilling rate in order to perform the most suitable drilling method for the fractured and strongly serpentinized zone, as well as to prevent the loss of mud water, on the basis of 1979 former experience.

As a result of six drill holes, core recovery rate was 78.9% (average) for the total drilled length, drilled speed was 3.89 meters per shift for the total work conducted.

The drilling method in 1980 was summarized as follows:
4-5/8" tri-cone bit was used from the start for drilling to 9.15 m, then HW and NW casing pipes were inserted except No. TJ-9 hole, each hole was drilled by NQ-WL (oversize 78.2 m/m) method.

Intensely foliated serpentinite zone caused the loss of mud and to cave in during the drilling, which was particularly noticeable in the case of No. TJ-9.

The drilling of this portion was tested out to take a core by NQ-WL method, therefore NW casing pipes were inserted down to the required depth after reaming by NW casing shoe. Lignite mud water was used for the whole drill hole to protect the caving of the hole, due to improve core recovery.

6-11-1 No. TJ-9 Hole

Total drilled length:	47.40 m
Total drilled core length:	38.25 m
Total core length:	14.90 m
Rock core recovery:	38.9%

4-5/8" tri-cone bit was used from the start of drilling to 9.15 m, then HW and NW casing pipes were inserted. This hole was drilled with

NQ-WL diamond bit from the depth of 9.15 m to 43.90 m. The rock was composed of foliated serpentinite and strongly serpentinized dunite. The operation was extremely difficult due to the heavy caving and loss of mud water, and had to proceed with NW casing shoe to ream the hole and NW casing pipe was inserted at the depth of 39.65 m. It was difficult to drill with a NQ-WL diamond bit because the hole collapsed at the depth of 43.90 m. BW casing pipe was inserted. Drilled by BQ-WL method from 43.90 m to 47.40 m, drilling was completed to the depth of 47.40 m with the object duly achieved. Chromite orebody was intersected from the depth of 28.15 m to 29.15 m (width; 1.00 m), the drill hole found extension to dipside of C Kafa orebody. The drilling core recovery rate was low because foliated serpentinite and strongly serpentinized dunite caused the collapse of the hole wall, then drilling of WL method was made particularly to raise the core recovery rate due to control water circulation, rotational speed and thrust applied bit, but it was difficult to obtain a high recovery rate of core. Bentonite mud water was used from the start of drilling to 9.15 m and lignite mud water for 9.15 m - 47.40 m.

6-11-2 No. TJ-10 Hole

Total drilled length:	62.50 m
Total drilled core length:	53.35 m
Total core length:	36.15 m
Rock core recovery:	67.8%

4-5/8" tri-corne bit was used from the start of drilling to 9.15 m, then HW and NW casing pipes were inserted. Drilled by NWM diamond bit from the depth of 9.15 m to 23.50 m, it was hard drilling at the depth of 18.30 m because it was impossible to keep reaming the hole with NW casing shoe, owing to the heavy caving and loss of mud water. NW casing pipe was inserted down to 18.30 m. Drilled by NWM diaomond bit from 18.30 m to 23.50 m, it was difficult to drill farther than 23.50 m because the hole caved in for 18.30 - 23.50 m. Attempt failed to extend the NW casing pipe after the hole was reamed, owing to the soft rock, and 2-15/16" tri-corne bit was used in order to take out caving material in the bottom, but it was extremely difficult to cause heavy loss of mud water, the drill hole was stopped at 23.50 m, drilling site was removed into on interval of 2 m.

4-5/8" tri-corne bit was used from the start of drilling to 9.15 m, then HW casing pipe was inserted. This hole was drilled by NQ-WL diamond bit (over size 78.2 m/m) from 9.15 m to 62.50 m. Rock consists of foliated serpentinite and serpentitized dunite, when the bor-hole reached at the depth of 18.50 m, mud water was completely lost, then a mud ball of bentonite was thrown into the borhole to prevent the water loss, and the drilling was continued. An unexpected gallery was found at the depth of 56.40 m to 59.45 m, however, the chromite orebody was intersected at the depth of 62.00 m. Drilling was completed to the depth of 62.50 m with the object duly achieved. Bentonite mud water was used for 0 m - 9.15 m and lignite mud water for 9.15 m - 62.50 m.

6-11-3 No. TJ-11 Hole

Total drilled length:	81.40 m
Total drilled core length:	72.25 m
Total core length:	64.55 m
Rock core recovery:	89.3%

4-5/8" tri-cone bit was used from the start of drilling to 9.15 m, then HW casing pipes were inserted. Drilled by NQ-WL diamond bit (over size 78.2 mm) from the depth of 9.15 m to 81.40 m. Rock was composed of foliated serpentinite and fractured serpentinitized dunite. The chromite ore body was intersected from the depth of 36.00 m to 38.75 m (width; 2.75 m) and 66.35 m to 66.85 m (width; 0.50 m) though this hole happened to slight loss of it was satisfactory that mud water near the depth of 51.00 m. Drilling was completed to the depth of 81.40 m with the drill cone was taken at a high recovery rate the object duly achieved. Bentonite mud water was used for 0 m - 9.15 m and lignite mud water for 9.15 m - 81.40 m.

6-11-4 No. TJ-12 Hole

Total drilled length:	106.00 m
Total drilled core length:	94.00 m
Total core length:	85.85 m
Rock core recovery:	91.3%

4-5/8" tri-corne bit was used from the start of drilling to 12.00 m. Then HW casing pipe was inserted. This hole was drilled by NQ-WL diamond bit (over size 78.2 mm to 106.00 m. Rock was composed of foliated serpentinite and fractured serpentinitized dunite. The chromite overbody was intersected from the depth of 46.60 m to 51.00 m (width; 4.40 m), and 88.20 m to 89.30 m (width; 1.10 m), although loss of mud water happened at 29.80 m, it was successfully prevented further loss of mud water because a ball of bentonite was poured by into the borhole. In drilling at the depth of 81.00 m, though an oil pipe of drilling machine was broken, but it was repaired at "ERZURM - city". Drilling was completed to the depth of 106.00 m with the object duly achieved. Bentonite mud water was used for 0 m - 12.00 m and lignite mud water for 12.00 m - 106.00 m.

6-11-5. No. TJ-13.Hole

Total drilled length:	63.95 m
Total drilled core length:	51.95 m
Total core length:	31.40 m
Rock core recovery:	60.4%

4-5/8" tri-corne bit was used from the start of drilling to 12.00 m, then HW casing pipe was inserted. This hole was drilled by NQ-WL diamond bit (over size 78.2 mm), from the depth of 12.00 m to 63.95 m. Rock was composed of foliated serpentinite and serpentinitized dunite. The chromite ore body was intersected from 35.45 m to 41.50 m (width; 6.05 m).

In drilling the extremely soft layer such as foliated serpentinite, brecciated dunite, etc., efforts were made particularly to raise the core recovery rate by adjusting water circulation, Rotational speed and thrust applied bit, and making it difficult to obtain a high recovery rate of cores.

Drilling was completed to the depth of 63.95 m with the object duly achieved. Bentonite mud water was used for 0 m - 12.00 m and lignite mud water for 12.00 m - 63.95 m.

6-11-6 No. TJ-14 Hole

Total drilled length:	100.30 m
Total drilled core length:	85.30 m
Total core length:	78.80 m
Rock core recovery:	92.4%

4-5/8" tri-corne bit which was used from the start of drilling to 15.00 m, then HW casing pipe was inserted. This hole was drilled by NQ-WL diamond bit (over size 78.2 mm) from the depth of 15.00 m to 100.00 m. Rocks was composed of foliated serpentinite and serpentitized dunite. The chromite ore body was intersected from 63.70 m to 63.75 m (width; 3.65 m). Drilling was difficult due to the heavy caving and had to proceed with HW casing shoe to enlarge the hole and was extended it to the depth of 18.30 m. General conditions were satisfactory except where heavy core blocking happened, due to fragile nature of rock. Drilling was completed to the depth of 100.30 m with the object duly achieved.

Bentonite mud water was used for 0 m - 15.00 m and lignite mud water for 15.00 m - 100.30 m.

6-12 Withdrawing Operations

After the completion of dismantling at the site of No. TJ-14 hole 1st October, the equipment and supplies were transported to Arakli by trucks and stocked into the warehouse of Eastern Black sea Branch of M.T.A. The whole field operations were completed on 1st October, 1980.

6-13 Operational Records and Analysis

6-13-1 Analysis of Working Time

As shown in Table 6-41, of total working time, drilling work time accounts for 64.2%, which includes drilling time in the proportion of 22% and ancillary work of 15.1% respectively to the total. The last consisting mainly of drilling preparation, post-drilling work and recess, as well as others in the preparation of 6.8% to the total such as hole enlarging casing insertion, etc. Repairing work of 14.5% to the total mainly consisted in the prevention of caving and casing trouble in TJ-10 hole.

Of the total working time, 35.8% thereof occupied in moving operations which was mainly for the transportation of equipment and materials of No. TJ-9 and TJ-10.

6-13-2 Drilling Results

As shown in Table 6-39, the drilling length per shift was 3.89 meters for the total works carried out in six drill holes and 11.31 meters for the drilling operations.

6-13-3 Core Recovery Rate

The overall average rate of core recovery reached 78.9% excepting the non core drilling as shown in Table 6-39.

As regards the core recovery of each hole, there was unavoidable loss of cores because of heavy mud water losses and cavings caused in the drilling of three holes, such as No. TJ-9, No. TJ-10, and No. TJ-13 hole, which was core recovery rates of 38.9%, 67.8%, and 60.7% respectively because of suffering intensive serpentinization. Others reached higher results than 89.3%, thus gaining the total average as high as avobementioned core recovery rate.

6-14 Recommendations on the Drilling Methods to be applied in Ezan Area

As regards 1980 drilling, the following points were considered to set out the drilling method considering the drilling results obtained in 1979; one is to protect against the loss of mud water and caving, and the other is to increase core recovery rate.

Summaries are given below on the considerations

Remarks for drilling in Ezan area are as follows:

- 1) Generally, the intensely serpentized dunite and foliated serpentinite had a great variety of hardness and were very likely to cause the loss of mud water and the collapse of the hole well, which caused to decrease drilling efficiency. The collapse of the hole well also induced sometimes detention, breaking-off and other troubles, due to string vibration, in that case, complete recovery of drill hole is hardly expected.
- 2) Vibration of the string caused by the loss of mud water, caused in material and sludge reaming in the hole, hindered core recovery.
- 3) Bentonite mud tended to be gelatized easily due to dissolved alkaline materials, such as asbestos, hydromagnesite and serpentine.
- 4) In addition to the loss of mud water and frequent collapse of the drill hole, bit life was shortened due to the breakage and falling-off of diamond, because the strongly serpentized dunite had a great variety of hardness.

To cope with the above mentioned problems, following measures are to be taken:

- 1) Lignite mud water was used to stabilize the wall of drill hole as well as for smooth discharge of sludge.
- 2) Over-size diamond set bit was applied for the effective use of mud water.
- 3) Wireline method was adequate for the purpose of increasing the rate of core recovery.
- 4) The balance of mud water supply and drilling speed were kept in the drilling of the portion of strongly serpentinized dunite or foliated serpentinite.
- 5) The specifications of diamond set bit have been designed as follows:

Outside diameter for NQ-WL bit:	78.2 mm
Outside diameter for BQ-WL bit:	61.5 mm
Hardness of matrix:	R.C 35
Diamond size:	25 - 35
Steps:	6
Water way:	6

- 6) A mud ball of bentonite was thrown into the hole to prevent the water loss.
- 7) Soda ash has been added in mud water to inactivate the dissolution of hydromagnesite.

Suitable mud water in Ezan area

In an economically and rationally oriented view, use of mud water in order to increase the drilling efficiency is very important. Selection of the most suitable mud water is necessary to fit the characteristics of rocks and to adjust density for the condition of hole.

Mud water for Ezan area

Use of mud water "Bentonite" in drilling of soft layers such as foliated serpentinite, serpentized dunite, etc. would make it impossible to drill due to sticking or the swelling and collapse of hole wall. In drilling such a layer, "Lignite" mud water has to use.

- 1) Lignite mud water is extensively used for the prevention of the swelling and caving of the wall of holes and its function is the most suitable for the wire-line drilling method.
- 2) Standard components of lignite mud water are as follows:

Fresh water:	100
Bentonite:	5 ~ 6%
C.M.C	0.1 ~ 0.2%
Lignite:	3 ~ 4%
Caustic soda:	0.1 ~ 0.2%
Soda ash	1 ~ 2%

3) Standard qualities of lignite mud water for wire-line method are as follows:

Specific gravity:	1.04 ~ 1.07
Viscosity:	23 ~ 30 sec. (500/500 cc)
Water loss:	Under 7 cc
Mud. cake:	Under 0.5 mm
pH:	9.5 ~ 10.0
PV	5 ~ 10 cp
YV	1 ~ 5 lb/100 ft ²
Gel.	1 lb/100 ft ²

4) Characteristics of lignite

- (1) Lignite mud water is the general designation of mud water which consists mainly of bentonite added by some lignite, and pH is adjusted to keep at 9.5 ~ 10.0 by caustic soda.
- (2) When lignite is added to bentonite mud water, lignite, without being ionized, adheres to the surface of clay particles and forms a strong protecting coat, which functions to restrain either swelling or condensation of clay materials, such as salt, cement, gypsum, etc.
- (3) It has an excellent quality to prevent mudstone or shale from collapsing into a muddy or swollen state and is good for the prevention of cavedowns of holes.
- (4) It can maintain low viscosity, gel strength and liquidity.

Fig 6-1 NO. TJ-1 hole PROGRESS RECORD OF DIAMOND DRILLING

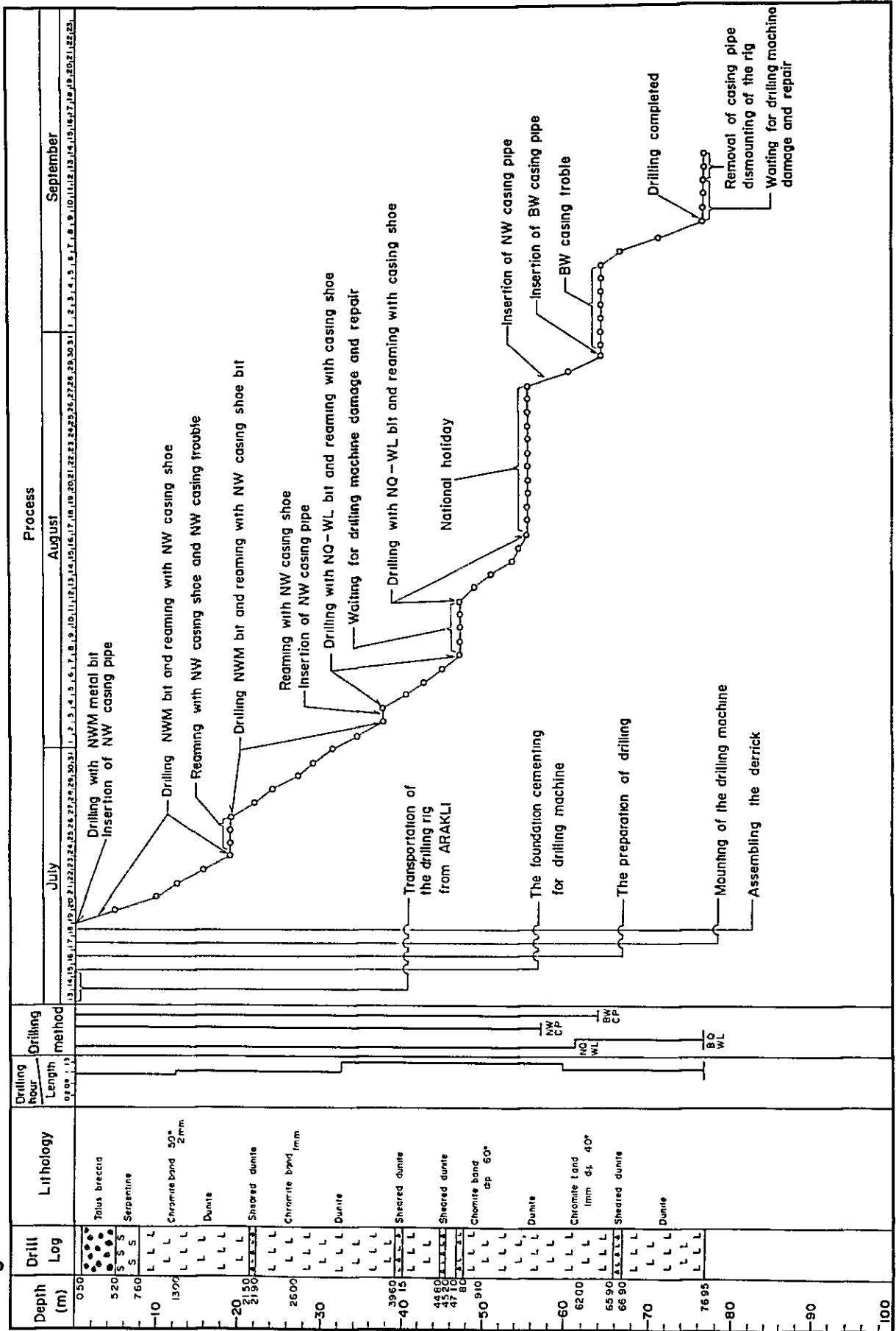


Fig 6-2 NO. T.J-2 hole PROGRESS RECORD OF DIAMOND DRILLING

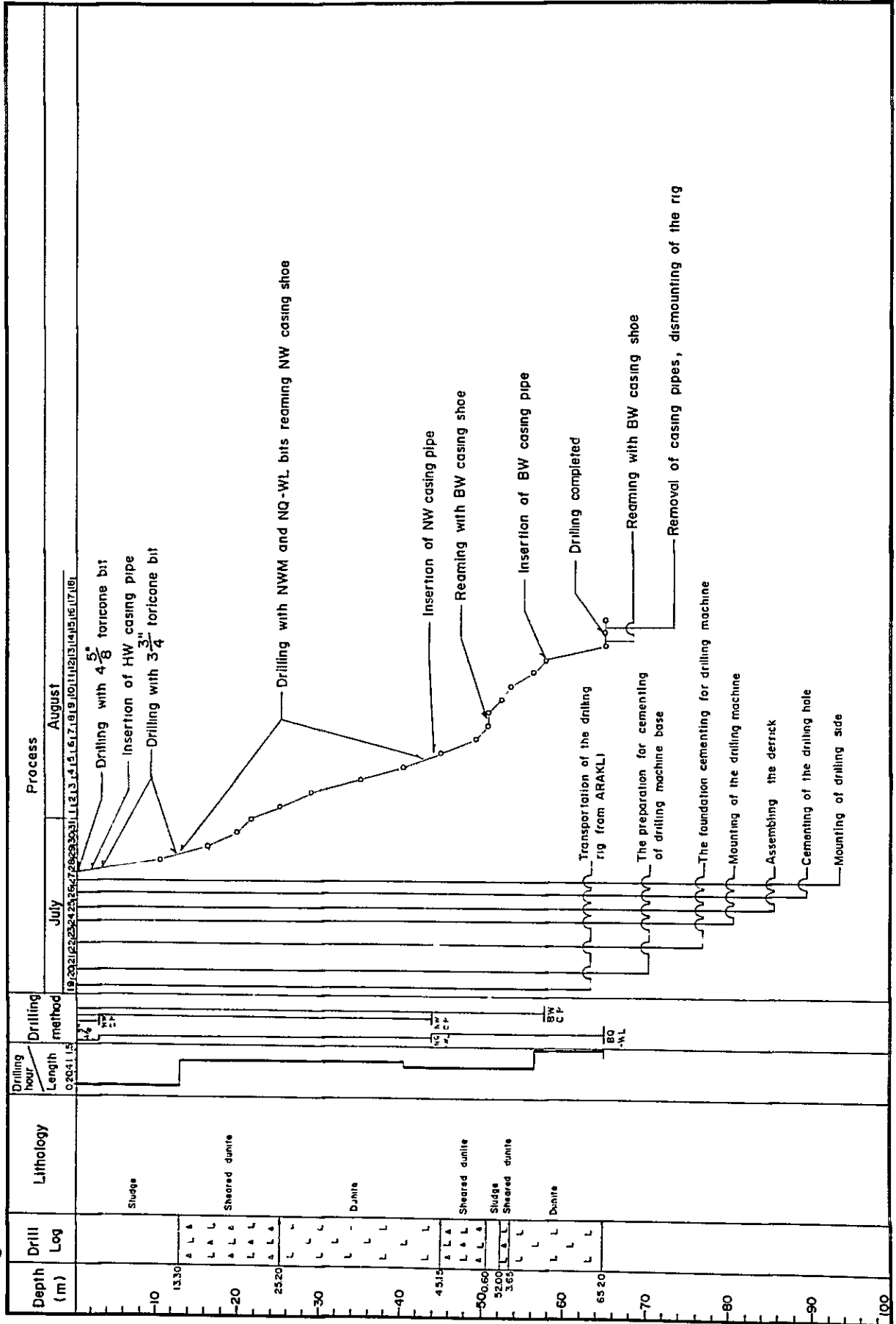


Fig 6-3 NO. TJ-3 hole PROGRESS RECORD OF DIAMOND DRILLING

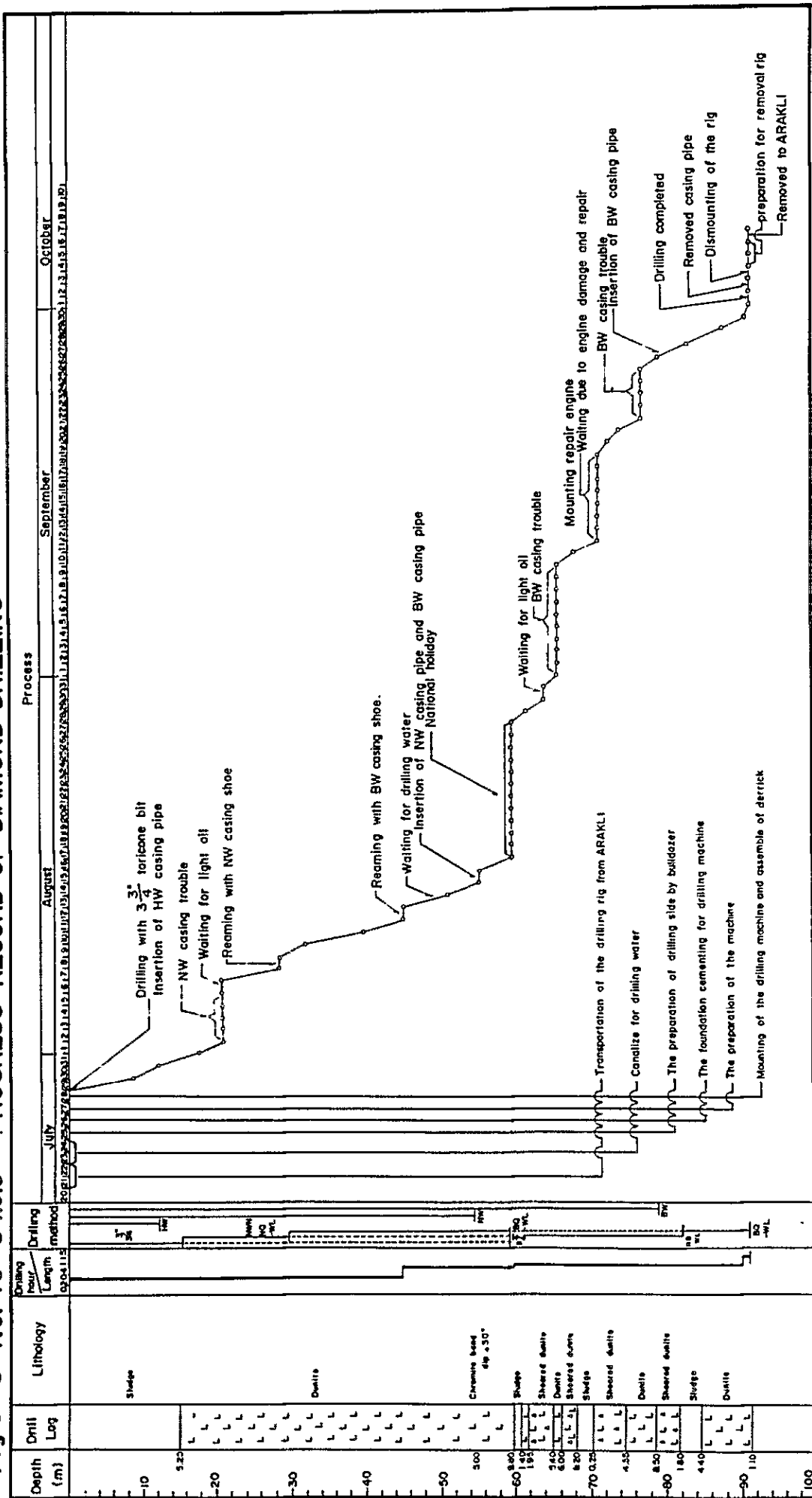


Fig 6-4 NO TJ-4 hole PROGRESS RECORD OF DIAMOND DRILLING

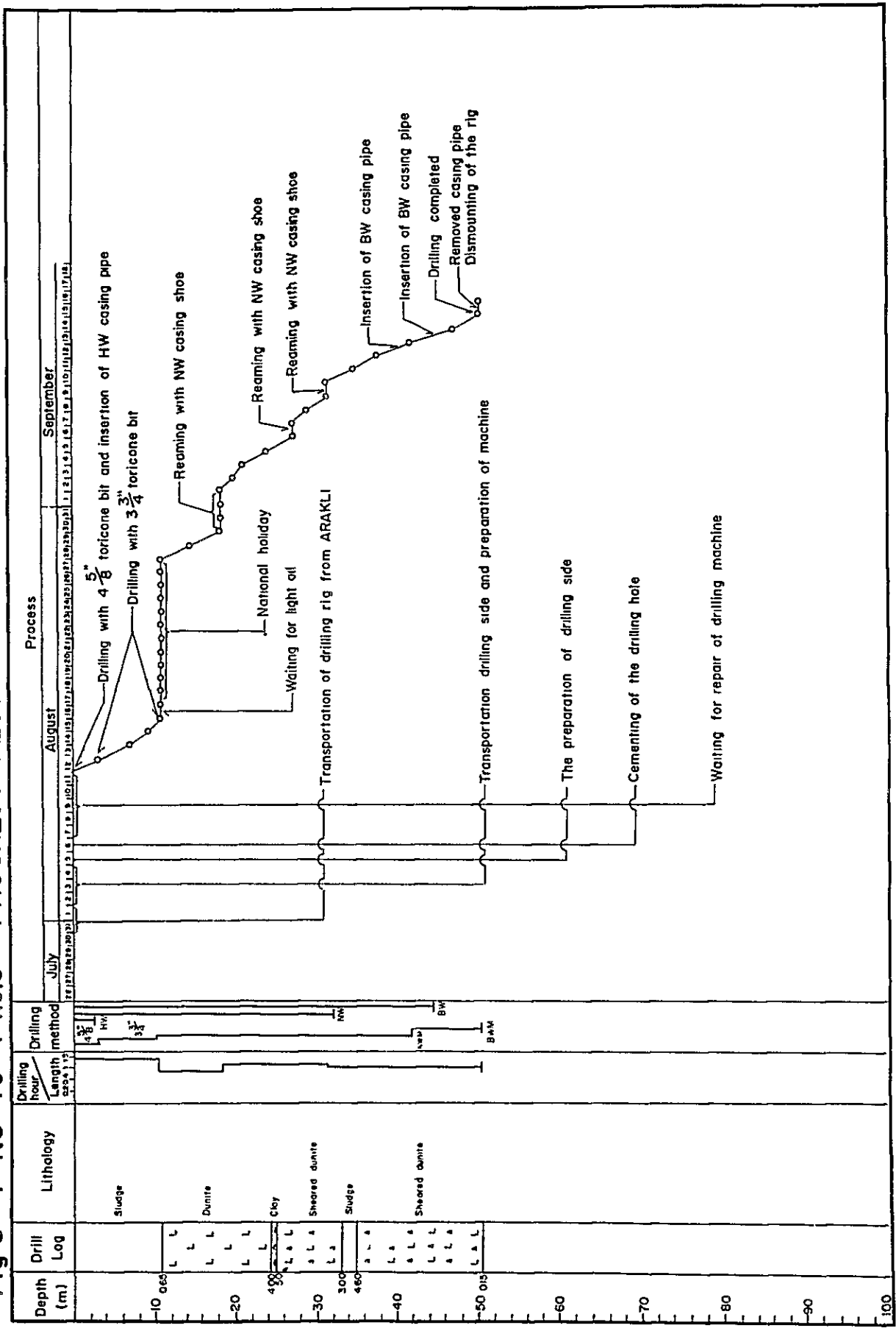


Fig 6-5 NO. TJ-5 hole PROGRESS RECORD OF DIAMOND DRILLING

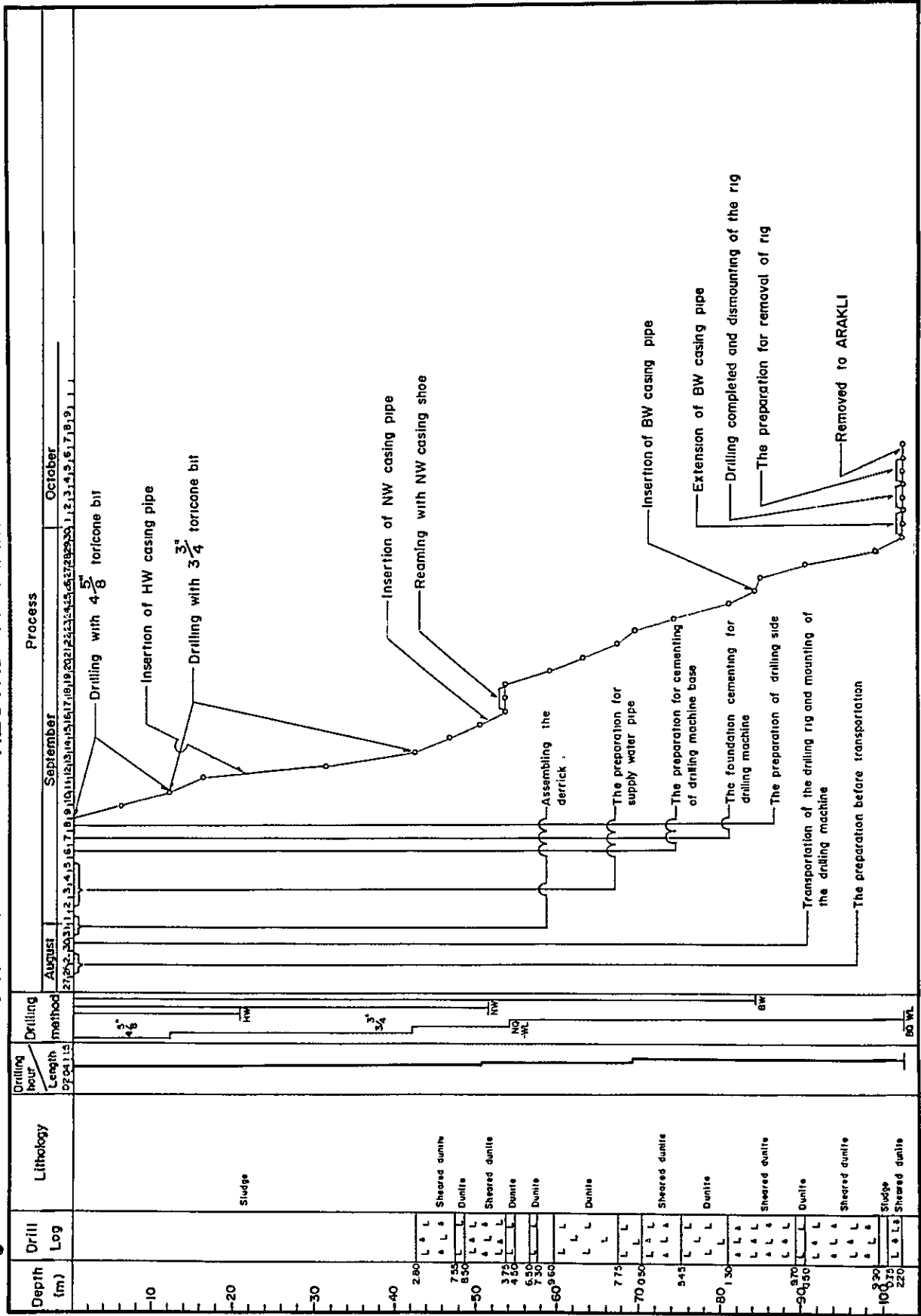


Fig.6-6 NO. TJ-6 hole PROGRESS RECORD OF DIAMOND DRILLING

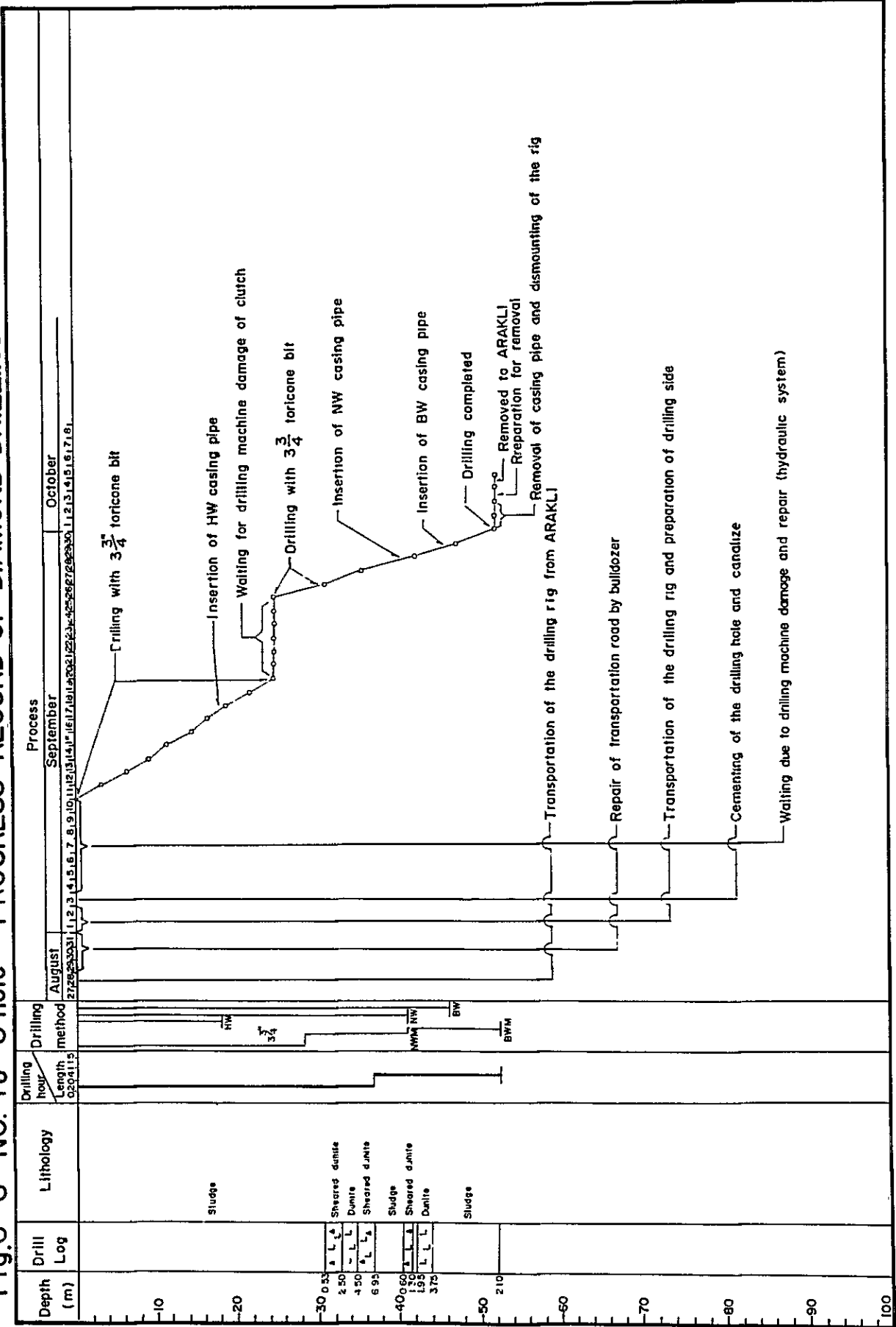


Fig 6-7 NO. TJ-7 hole PROGRESS RECORD OF DIAMOND DRILLING

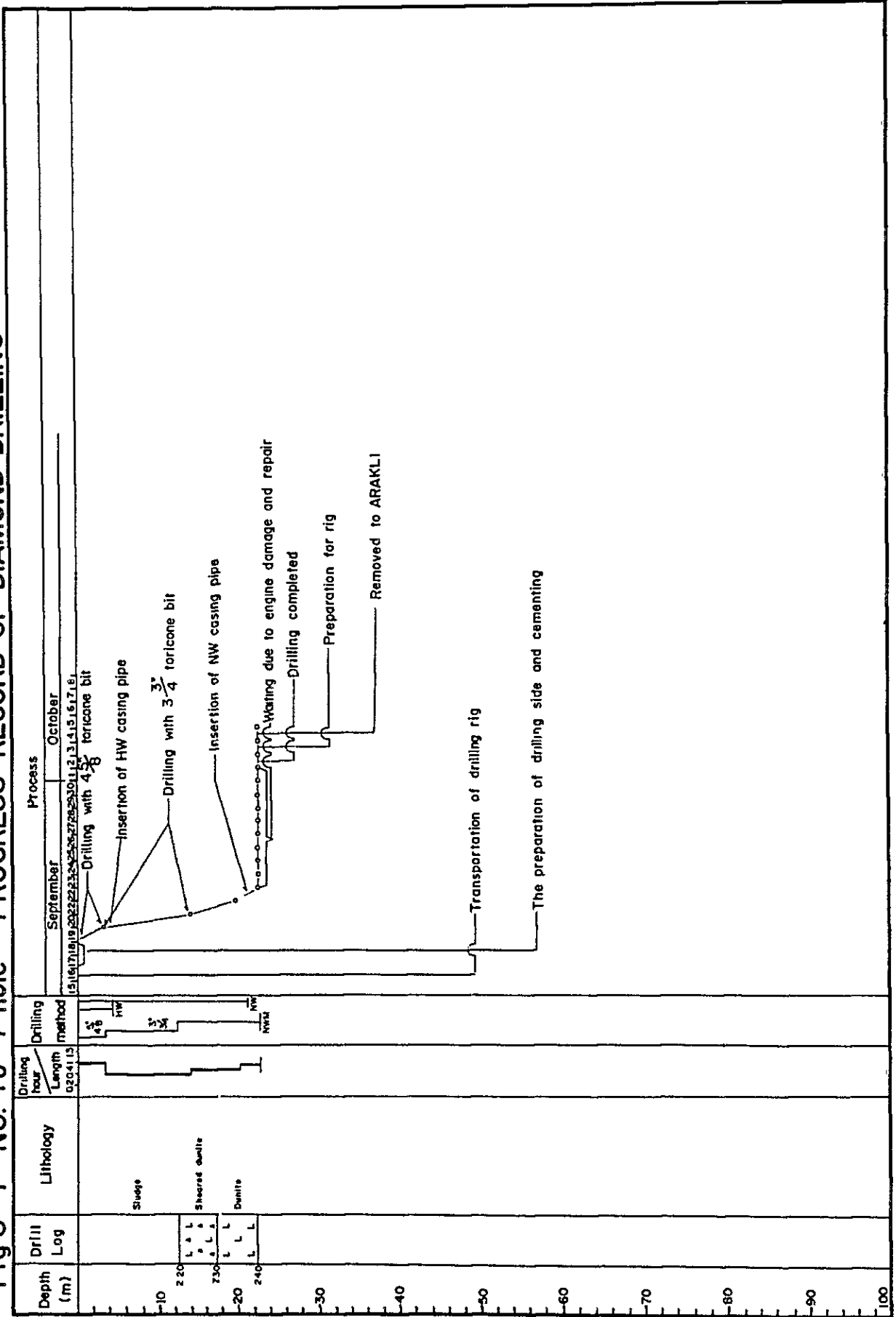


Fig 6-8 NO. TJ-8 hole PROGRESS RECORD OF DIAMOND DRILLING

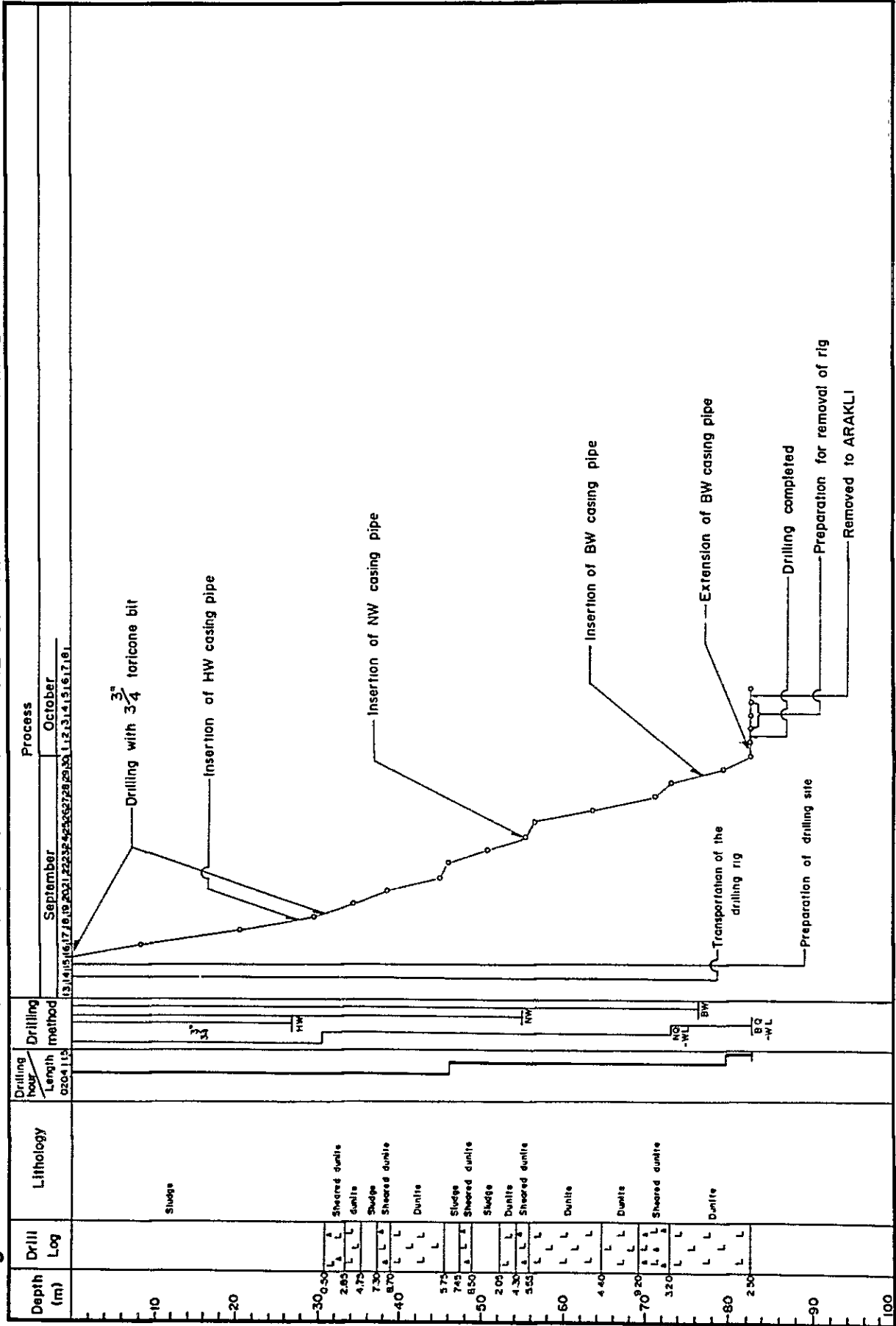


Fig.6-9 No. TJ-9 hole PROGRESS RECORD OF DIAMOND DRILLING

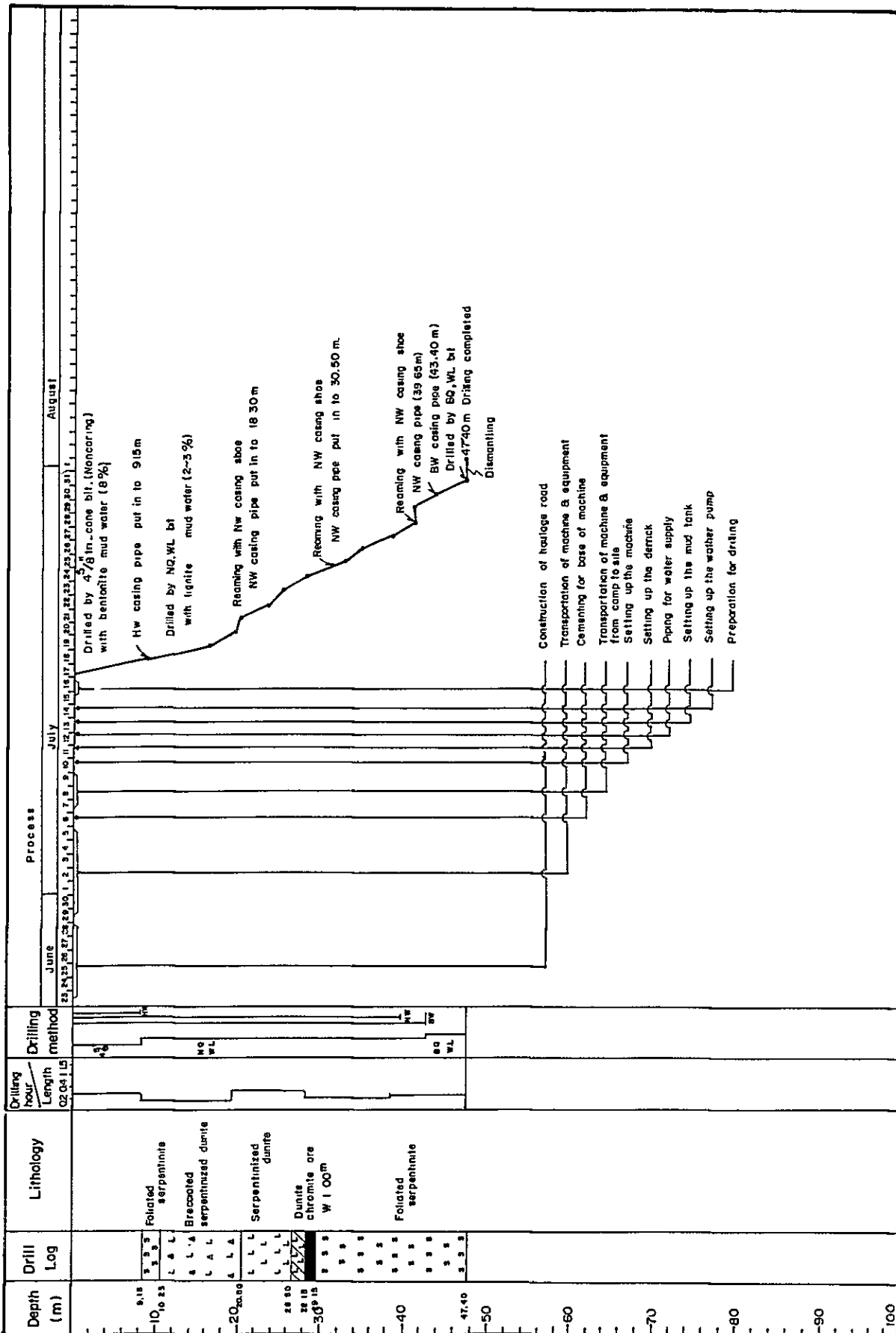


Fig. 6-10 No. TJ - 10 hole PROGRESS RECORD OF DIAMOND DRILLING

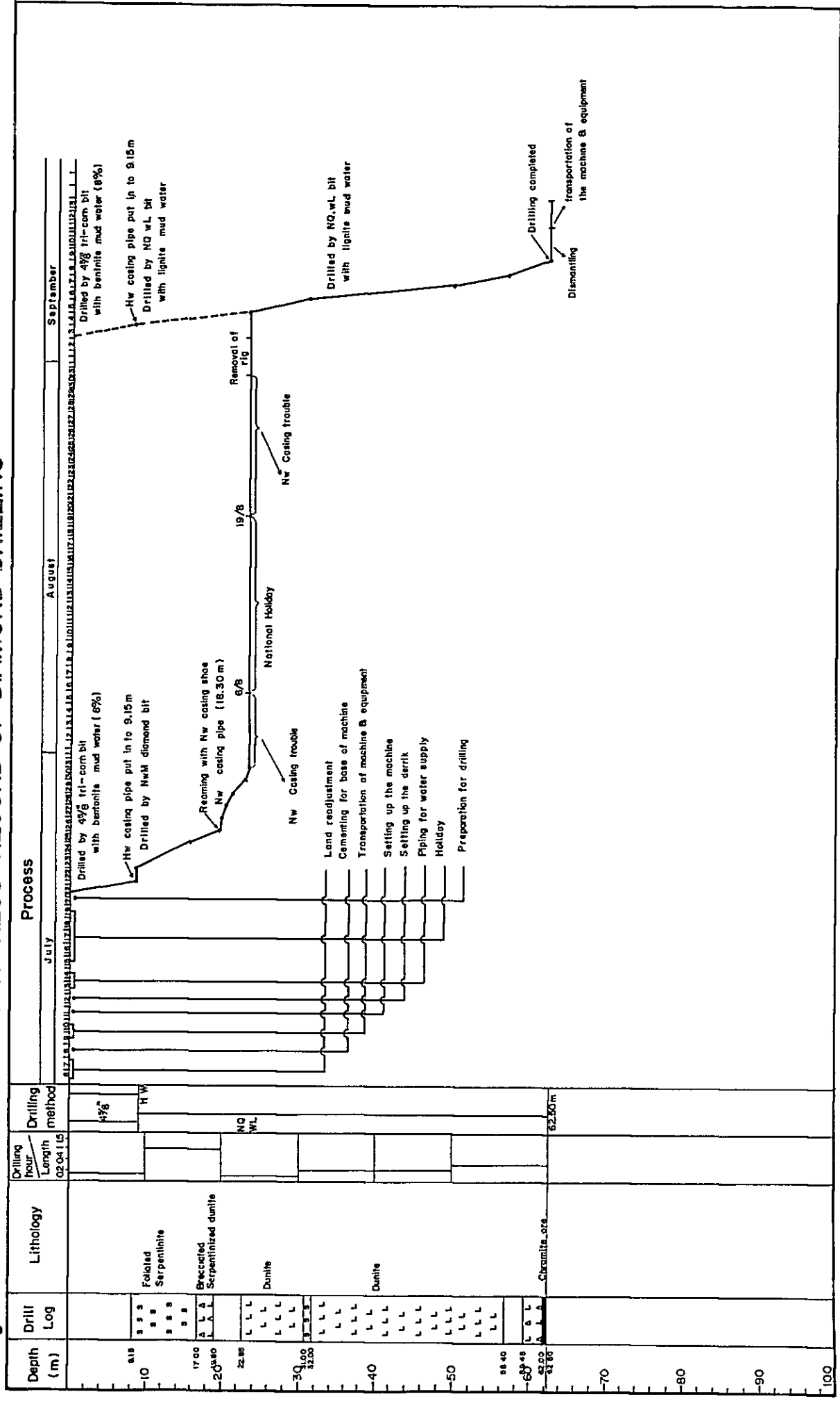


Fig. 6-II No. TJ-II hole PROGRESS RECORD OF DIAMOND DRILLING

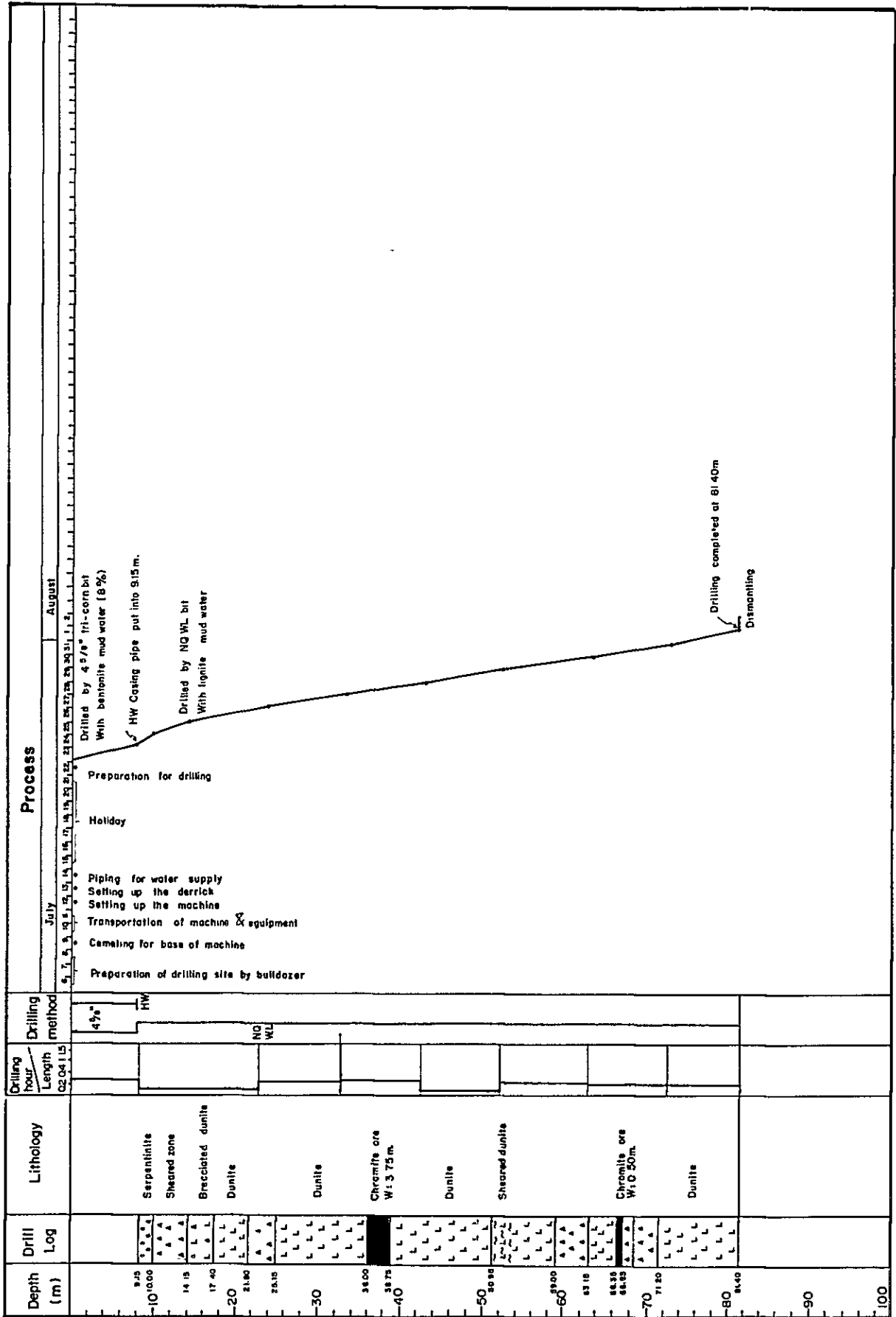


Fig. 6-12 No. TJ-12 hole PROGRESS RECORD OF DIAMOND DRILLING

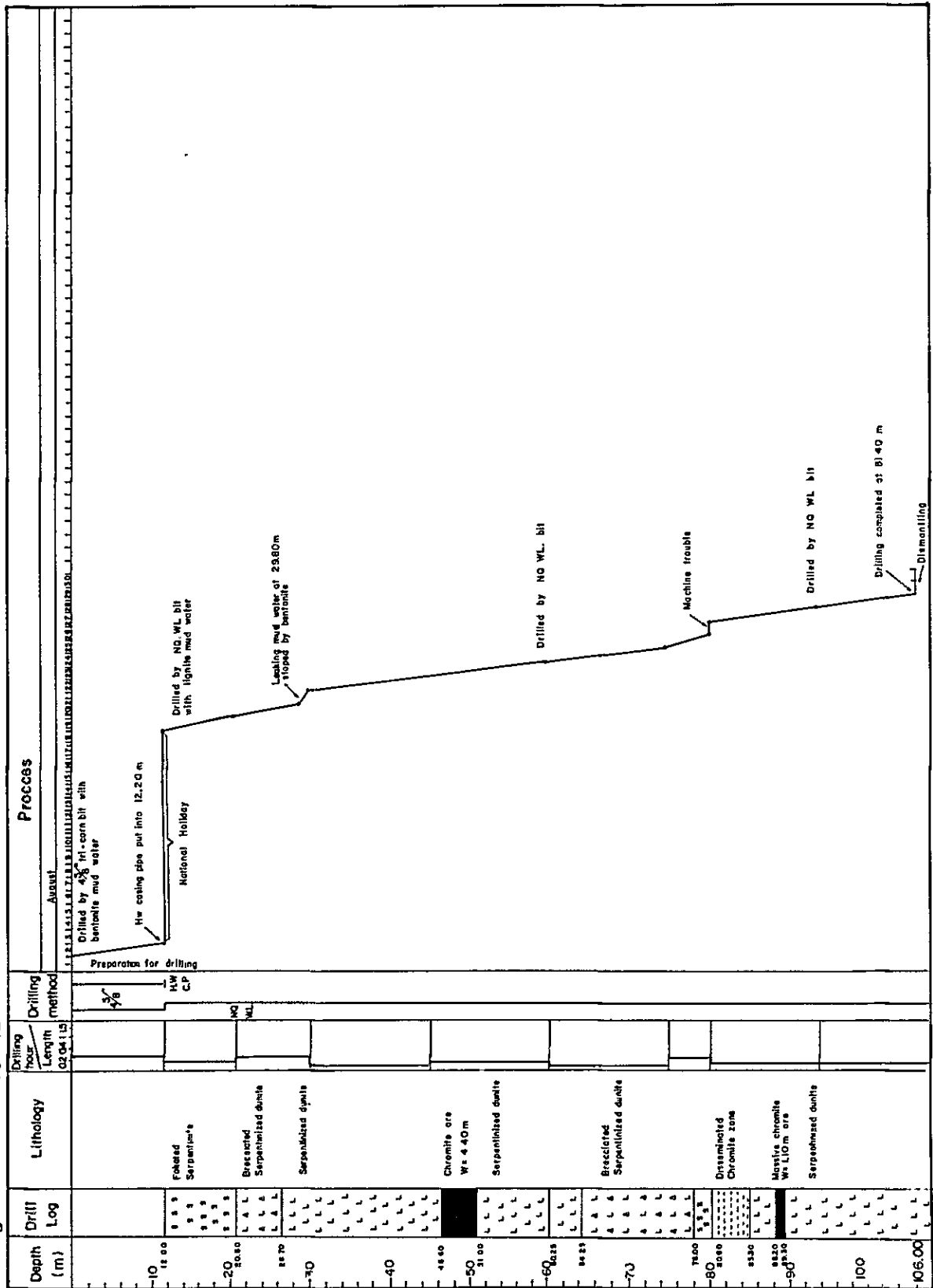


Fig. 6-13 No. T.J -13 hole PROGRESS RECORD OF DIAMOND DRILLING

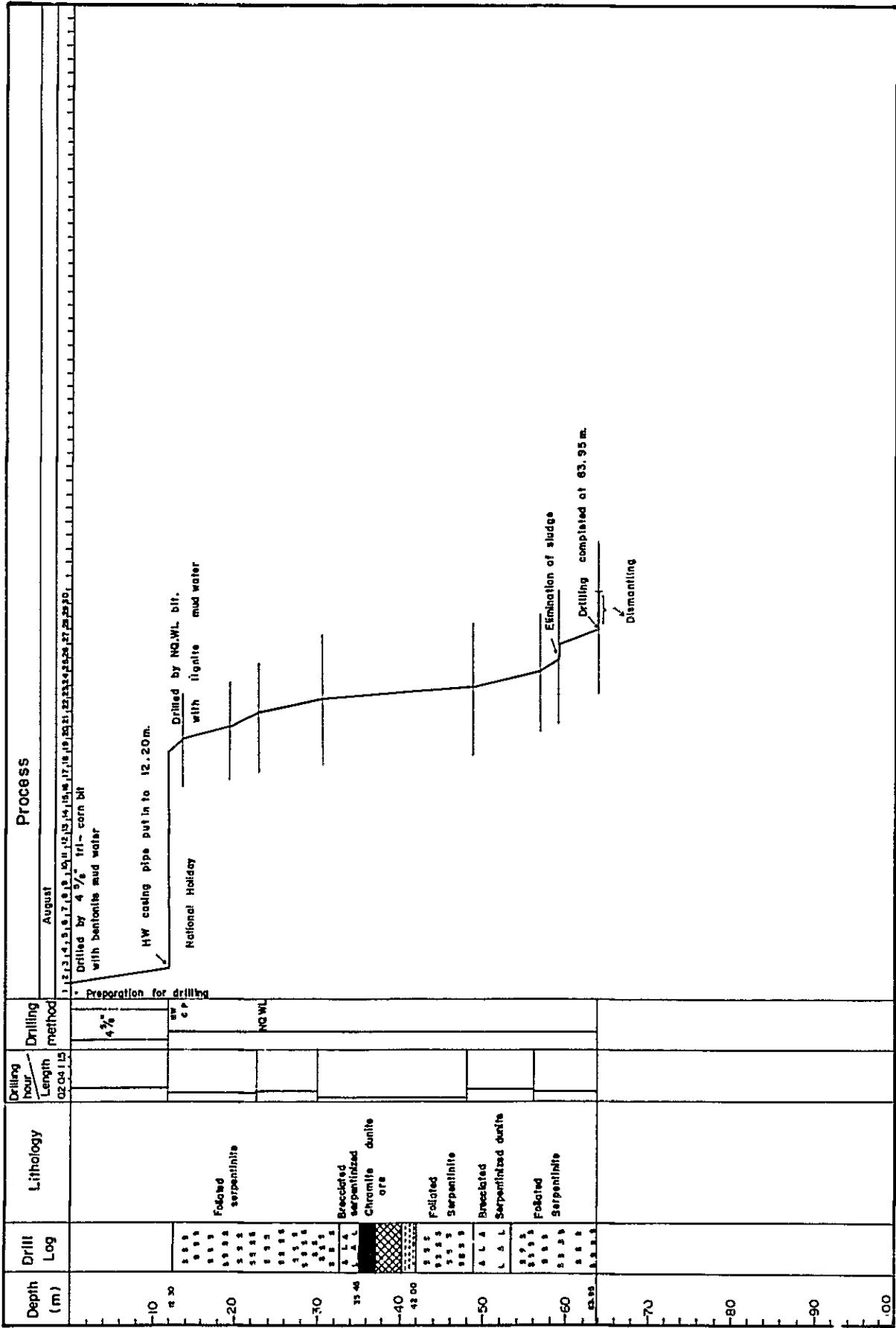


Fig. 6 - 14 No. TJ - 14 hole PROGRESS RECORD OF DIAMOND DRILLING

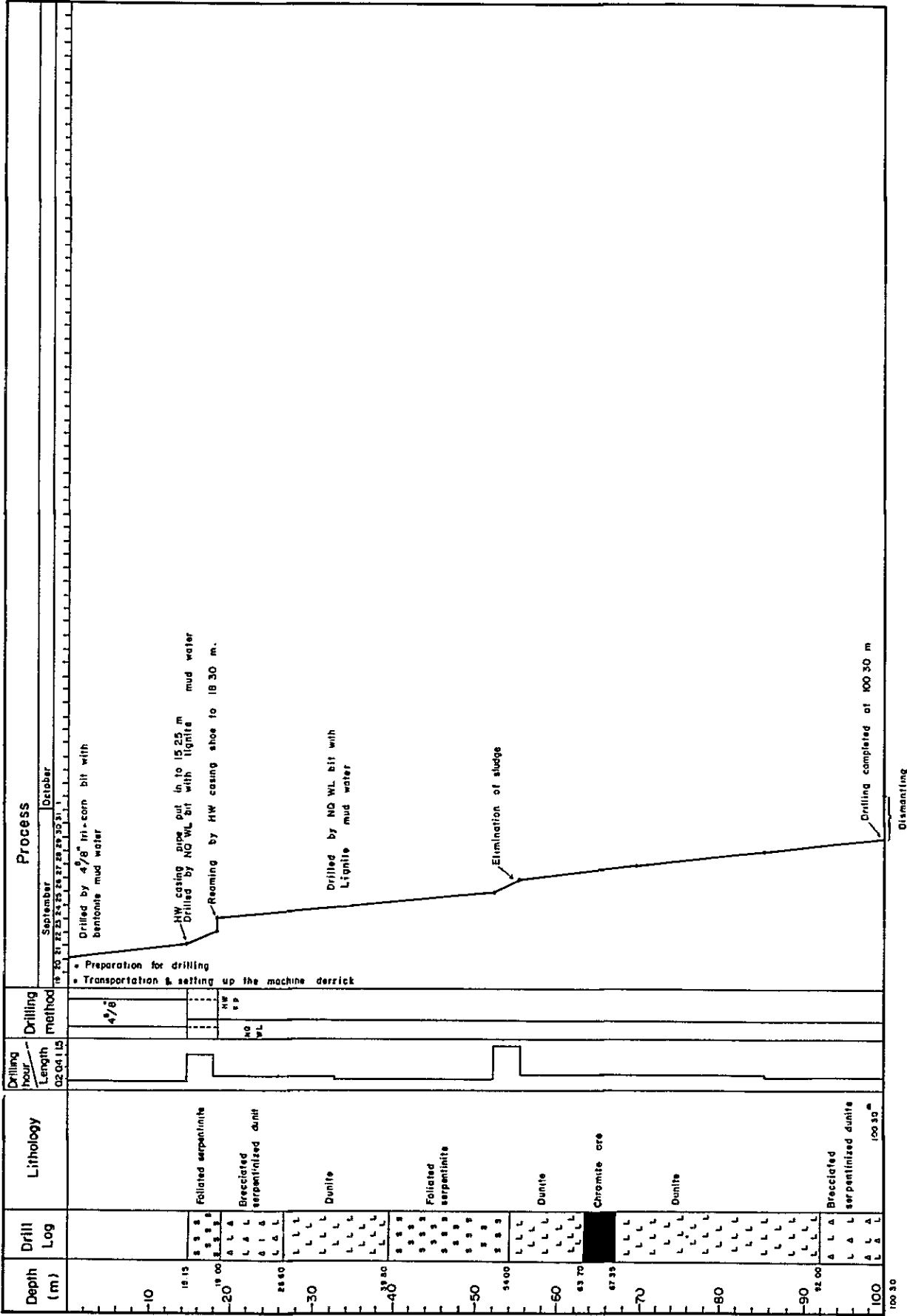


Table 6-6 Drilling Machines Used and Materials Consumed

Drilling Machines: Atlas cop D-750, TJ-1

Item	Model	Quantity	Capacity, Type, and Specification
Drilling machine	D-750	1 Set	Capacity(m) BQ-WL Rod 425 m
			Dimensions Height 1,250 mm
			Length 2,350 mm
			Width 900 mm
			Weight (with diesel engine) 1,300 kg
	Swivel Head		Spindle speed 1st 2nd 3rd 4th 5th reverse 245 470 875 1,590 2,000 275 r.p.m.
	Hoist		Hoisting capacity, max. 3,000 kg
	Oil pump		Capacity 0-100 l/min Max. pressure 70 kg/cm ²
Motor	F3L-912 (Deutz)	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 34 H.P.
Drilling pump	W1122B-1	1 Set	Weight 765 kg
			Piston diameter 70 mm
			Stroke 70 mm
			Discharge capacity 132 l/min
			Max. pressure 56 kg/cm ²
Motor	F2L-411D	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 16 H.P.
Derrick	Tripod	1 Set	Steel pipe
			Height 8.5 m
			Max. load capacity 8,000 kg
Drill rod	NQ-WL	30 pcs	NQ - 3 m
	BQ-WL	45 pcs	BQ - 3 m
	NW	23 pcs	NW - 3 m
Casing pipe	HW	3 pcs	HW - 3 m
	NW	20 pcs	NW - 3 m
	NW	1 pc	NW - 1.5 m
	BW	39 pcs	BW - 3 m
Rod safety clamps		1 set	
Water swivel		3 sets	Ball bearing
Hoisting swivel		1 set	

Table 6-7 Drilling Machines Used and Materials Consumed

Drilling Machines: Acker N-18, TJ-2

Item	Model	Quantity	Capacity, Type, and Specification
Drilling Machine	N-18	1 Set	Capacity(m) BQ-WL Rod 425 m Dimensions Height 1,500 mm Length 2,700 mm Width 1,200 mm Weight (with diesel engine) 1,600 kg
	Swivel Head		Spindle speed 1st 2nd 3rd 4th 5th reverse 245 470 875 1,590 2,000 275
	Hoist		Hoisting capacity 4,000 kg
	Oil pump		Capacity 0-100 l/min ² Max. pressure 70 kg/cm ²
	Motor	F4L-912	1 Set
Drilling pump	W1122B-1	1 Set	Weight 765 kg
			Piston diameter 70 mm Stroke 70 mm Discharge capacity 132 l/min ² Max. pressure 70 kg/cm ²
Motor	F2L-411D	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 16 H.P.
Derrick	Tripod	1 Set	Steel pipe
			Height 8.5 m Max. load capacity 8,000 kg
Drill rod	NQ-WL	20 pcs	NQ - 3 m
	BQ-WL	35 pcs	BQ - 3 m
	NW	11 pcs	NW - 3 m
	BW	5 pcs	BW - 3 m
Casing pipe	HW	2 pcs	HW - 3 m
	NW	20 pcs	NW - 3 m
	BW	25 pcs	BW - 3 m
Rod safety clamps		1 set	
Water swivel		1 set	Ball bearing
Hoisting swivel		1 set	

Table 6-8 Drilling Machines Used and Materials Consumed

Drilling Machines: Acker N-18, TJ-3

Item	Model	Quantity	Capacity, Type, and Specification
Drilling machine	N-18	1 Set	Capacity(m) BQ-WL Rod 500 m
			Dimensions Height 1,500 mm
			Length 2,700 mm
			Width 1,200 mm
			Weight (with diesel engine) 1,600 kg
	Swivel Head		Spindle speed 1st 2nd 3rd 4th 5th reverse 245 470 875 1,590 2,000 275
	Hoist		Hoisting capacity 4,000 kg
	Oil pump		Capacity 0 - 100 l/min, Max. pressure 70 kg/cm ²
Motor	F4L-912	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 51 P.S
Drilling pump	W1122B-1	1 Set	Weight 765 kg
			Piston diameter 70 mm
			Stroke 70 mm
			Discharge capacity 132 l/min, Max. pressure 70 kg/cm ²
Motor	F2L-411D	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 16 H.P.
Derrick	Tripod	1 Set	Steel pipe
			Height 8.5 m
			Max. load capacity 8,000 kg
Drill rod	NQ-WL	20 pcs	NQ - 3 m
	BQ-WL	35 pcs	BQ - 3 m
	NW	10 pcs	NW - 3 m
Casing pipe	HW	10 pcs	HW - 3 m
	NW	20 pcs	NW - 3 m
	BW	30 pcs	BW - 3 m
Rod safety clamps		1 set	
Water swivel		3 set	Ball bearing
Hoisting swivel		1 set	

Table 6-9 Drilling Machines Used and Materials Consumed

Drilling Machines: L-34 (Truck Mounted), TJ-4

Item	Model	Quantity	Capacity, Type, and Specification
Drilling machine	L-34	1 Set	Capacity(m) BQ-WL Rod 300 m
			Dimensions Height 1,700 mm
			Length 6,000 mm
			Width 3,000 mm
			Spindle speed
	Swivel Head		1st 2nd 3rd 4th reverse 250 470 900 1,600 275
	Hoist		Hoisting capacity 3,000 kg
	Oil pump		Capacity 0 - 100 l/min Max. pressure 70 kg/cm ²
Motor	Jeep motor	1 Set	Gasoline engine Revolution 1,800 r.p.m. Related power 36 H.P.
Drilling pump	W1122B-1	1 Set	Weight 765 kg Piston diameter 70 mm Stroke 70 mm Discharge capacity 132 l/min Max. pressure 70 kg/cm ²
Motor	F2L-411D	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 16 H.P.
Derrick		1 Set	Hydraulic mast Height 6.0 m Max. load capacity 3,000 kg
Drill rod	NW	10 pcs	NW - 3 m
	BW	20 pcs	BW - 3 m
Casing pipe	112mm	1 pc	112mm - 3 m
	NW	15 pcs	NW - 3 m
	NW	1 pc	NW - 1.5 m
	BW	22 pcs	BW - 3 m
Rod safety clamps		1 set	
Water swivel		3 sets	Ball bearing
Hoisting swivel		1 set	

Table 6-10 Drilling Machines Used and Materials Consumed

Drilling Machines: Acker N-18, TJ-5

Item	Model	Quantity	Capacity, Type, and Specification
Drilling machine	N-18	1 Set	Capacity(m) BQ-WL Rod 500 m
			Dimensions Height 1,500 mm
			Length 2,700 mm
			Width 1,200 mm
			Weight (with diesel engine) 1,600 kg
	Swivel Head		Spindle speed 1st 2nd 3rd 4th 5th reverse 245 470 875 1,590 2,000 275
	Hoist		Hoisting capacity 4,000 kg
	Oil pump		Capacity 0 - 100 l/min Max. pressure 70 kg/cm ²
Motor	F4L-912	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 51 P.S
Drilling pump	W1122B-1	1 Set	Weight 765 kg Piston diameter 70 mm Stroke 70 mm Discharge capacity 132 l/min Max. pressure 70 kg/cm ²
Motor	F2L-411D	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 16 H.P
Derrick	Tripod	1 Set	Steel pipe Height 8.5 m Max. load capacity 8,000 kg
Drill rod	NQ-WL	20 pcs	NQ - 3 m
	BQ-WL	35 pcs	BQ - 3 m
	NW	15 pcs	NW - 3 m
	BW	10 pcs	BW - 3 m
Casing pipe	HW	10 pcs	HW - 3 m
	NW	20 pcs	NW - 3 m
	BW	30 pcs	BW - 3 m
Rod safety clamps		1 Set	
Water swivel		3 Sets	Ball bearing
Hoisting swivel		1 Set	

Table 6-11 Drilling Machines Used and Materials Consumed

Drilling Machines: L-34 (Trunk Mounted), TJ-6

Item	Model	Quantity	Capacity, Type, and Specification
Drilling machine	L-34	1 Set	Capacity(m) BQ-WL Rod 300 m
			Dimensions Height 1,700 mm
			Length 6,000 mm
			Width 3,000 mm
	Swivel Head		Spindle speed 1st 2nd 3rd 4th reverse 250 470 900 1,600 275
	Hoist		Hoisting capacity 3,000 kg
	Oil pump		Capacity 0 - 100 l/min Max. pressure 70 kg/cm ²
Motor	Jeep motor	1 Set	Gasoline engine Revolution 1,800 r.p.m. Related power 36 H.P
Drilling pump	W1122B-1	1 Set	Weight 765 kg
			Piston diameter 70 mm
			Stroke 70 mm
			Discharge capacity 132 l/min
			Max. pressure 70 kg/cm ²
Motor	F2L-411D	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 16 H.P
Derrick		1 Set	Hydraulic mast
			Height 6.0 m
			Max. load capacity 3,000 kg
Drill rod	NW	20 pcs	NW - 3 m
	BW	30 pcs	BW - 3 m
Casing pipe	HW	8 pcs	HW - 3 m
	NW	15 pcs	NW - 3 m
	BW	30 pcs	BW - 3 m
Rod safety clamps		1 Set	
Water swivel		3 Sets	Ball bearing
Hoisting swivel		1 Set	

Table 6-12 Drilling Machines Used and Materials Consumed

Drilling Machines: L-34 (Track Mounted), TJ-7

Item	Model	Quantity	Capacity, Type, and Specification	
Drilling machine	L-34	1 Set	Capacity(m) BQ-WL Rod 300 m	
			Dimensions	Height 1,700 mm
				Length 6,000 mm
				Width 3,000 mm
	Swivel Head		Spindle speed	
			1st 2nd 3rd 4th reverse	
			250 470 900 1,600 275	
	Hoist		Hoisting capacity 3,000 kg	
	Oil pump		Capacity 0 - 100 l/min ²	
			Max. pressure 70 kg/cm ²	
Motor	Jeep motor	1 Set	Gasoline engine	
			Revolution 1,800 r.p.m.	
			Related power 36 H.P	
Drilling pump	W1122B-1	1 Set	Weight 765 kg	
			Piston diameter 70 mm	
			Stroke 70 mm	
			Discharge capacity 132 l/min	
			Max. pressure 70 kg/cm ²	
Motor	F2L-411D	1 Set	Diesel engine	
			Revolution 1,800 r.p.m.	
			Related power 16 H.P	
Derrick		1 Set	Hydraulic mast	
			Height 6.0 m	
			Max. load capacity 3,000 kg	
Drill rod	NW	10 pcs	NW - 3 m	
	BW	20 pcs	BW - 3 m	
Casing pipe	HW	3 pcs	HW - 3 m	
	HW	1 pc	HW - 1.5 m	
	NW	10 pcs	NW - 3 m	
	BW	15 pcs	BW - 3 m	
Rod safety clamps		1 Set		
Water swivel		3 Sets		
Hoisting swivel		1 Set	Ball bearing	

Table 6-13 Drilling Machines Used and Materials Consumed

Drilling Machines: Atlas cop D-750, TJ-8

Item	Model	Quantity	Capacity, Type, and Specification
Drilling machine	D-750	1 Set	Capacity(m) BQ-WL 425 m
			Dimensions Height 1,250 mm
			Length 2,350 mm
			Width 900 mm
			Weight (with diesel engine) 1,300 kg
	Swivel Head		Spindle speed 1st 2nd 3rd 4th 5th reverse 245 470 875 1,590 2,000 275 r.p.m.
	Hoist		Hoisting capacity, max. 3,000 kg
	Oil pump		Capacity 0 - 100 l/min ² Max. pressure 70 kg/cm ²
Motor	F3L-912 (Deutz)	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 340 H.P
Drilling pump	W1122B-1	1 Set	Weight 765 kg Piston diameter 70 mm Stroke 70 mm Discharge capacity 132 l/min ² Max. pressure 56 kg/cm ²
Motor	F2L-411D	1 Set	Diesel engine Revolution 1,900 r.p.m. Related power 16 H.P
Derrick	Tripod	1 Set	Steel pipe Height 8.5 m Max. load capacity 8,000 kg
Drill rod	NQ-WL	30 pcs	NQ - 3 m
	BQ-WL	45 pcs	BQ - 3 m
	NW	23 pcs	NW - 3 m
	BW	30 pcs	BW - 3 m
Casing pipe	HW	10 pcs	HW - 3 m
	NW	20 pcs	NW - 3 m
	BW	39 pcs	BW - 3 m
Rod safety clamps		1 Set	
Water swivel		3 Sets	Ball bearing
Hoisting swivel		1 Set	

Table 6-14 Drilling Machines Used and Materials Consumed

Drilling Machines: Acker N-18, TJ-9

Item	Model	Quantity	Capacity, Type, and Specification	
Drilling machine	N-18	1 Set	Capacity(m) BQ-WL Rod 500 m	
			Dimensions	Height 1,500 mm
				Length 2,700 mm
				Width 1,200 mm
				Weight (with diesel engine) 1,600 kg
	Swivel Head		Spindle speed	
			1st 2nd 3rd 4th 5th reverse	
			245 470 875 1,590 2,000 275	
	Hoist		Hoisting capacity 4,000 kg	
	Oil pump		Capacity 0 - 100 l/min ²	
			Max. pressure 70 kg/cm ²	
Motor	F4L-912	1 Set	Diesel engine	
			Revolution 1,800 r.p.m.	
			Related power 51 P.S	
Drilling pump	W1122B-1	1 Set	Weight 765 kg	
			Piston diameter 70 mm	
			Stroke 70 mm	
			Discharge capacity 132 l/min ²	
			Max. pressure 70 kg/cm ²	
Motor	F2L-411D	1 Set	Diesel engine	
			Revolution 1,800 r.p.m.	
			Related power 16 H.P	
Derrick	Tripod	1 Set	Steel pipe	
			Height 8.5 m	
			Max. load capacity 8,000 kg	
Drill rod	NQ-WL	16 pcs	NQ - 3 m	
	BQ-WL	17 pcs	BQ - 3 m	
	NW	10 pcs	NW - 3 m	
	BW	pcs	BW - 3 m	
Casing pipe	HW	3 pcs	HW - 3 m	
	NW	14 pcs	NW - 3 m	
	BW	15 pcs	BW - 3 m	
Rod safety clamps		1 Set		
Water swivel		1 Set	Ball bearing	
Hoisting swivel		1 Set		

Table 6-15 Drilling Machines Used and Materials Consumed

Drilling Machines: Acker N-18, TJ-10

Irem	Model	Quantity	Capacity, Type, and Specification
Drilling machine	N-18	1 Set	Capacity(m) BQ-WL Rod 500 m
			Dimensions Height 1,500 mm
			Length 2,700 mm
			Width 1,200 mm
			Weight (with diesel engine) 1,600 kg
	Swivel Head		Spindle speed 1st 2nd 3rd 4th 5th reverse 245 470 875 1,590 2,000 275
	Hoist		Hoisting capacity 4,000 kg
	Oil pump		Capacity 0 - 100 l/min Max. pressure 70 kg/cm ²
Motor	F4L-912	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 51 P.S
Drilling pump	W1122B-1	1 Set	Weight 765 kg
			Piston diameter 70 mm
			Stroke 70 mm
			Discharge capacity 132 l/min ₂ Max. pressure 70 kg/cm ²
Motor	F2L-411D	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 16 H.P
Derrick	Tripod	1 Set	Steel pipe
			Height 8.5 m Max. load capacity 8,000 kg
Drill rod	NQ-WL	21 pcs	NQ - 3 m
	BQ-WL	- pcs	BQ - 3 m
	NW	7 pcs	NW - 3 m
	BW	- pcs	BW - 3 m
Casing pipe	HW	3 pcs	HW - 3 m
	NW	- pcs	NW - 3 m
	BW	- pcs	BW - 3 m
Rod safety clamps		1 Set	
Water swivel		1 Set	Ball bearing
Hoisting swivel		1 Set	

Table 6-16 Drilling Machines Used and Materials Consumed

Drilling Machines: Acker N-18, TJ-11

Item	Model	Quantity	Capacity, Type, and Specification	
Drilling machine	N-18	1 Set	Capacity (m) BQ-WL Rod 500 m	
			Dimensions	Height 1,500 mm
				Length 2,700 mm
				Width 1,200 mm
			Weight (with diesel engine) 1,600 kg	
	Swivel Head		Spindle speed	
			1st 2nd 3rd 4th 5th reverse	
			245 470 875 1,590 2,000 275	
	Hoist		Hoisting capacity 4,000 kg	
	Oil pump		Capacity 0 - 100 l/min	
			Max. pressure 70 kg/cm ²	
Motor	F4L-912	1 Set	Diesel engine	
			Revolution 1,800 r.p.m.	
			Related power 51 P.S	
Drilling pump	W1122B-1	1 Set	Weight 765 kg	
			Piston diameter 70 mm	
			Stroke 70 mm	
			Discharge capacity 132 l/min	
			Max. pressure 70 kg/cm ²	
Motor	F2L-411D	1 Set	Diesel engine	
			Revolution 1,800 r.p.m.	
			Related power 16 H.P	
Derrick	Tripod	1 Set	Steel pipe	
			Height 8.5 m	
			Max. load capacity 8,000 kg	
Drill rod	NQ-WL	26 pcs	NQ - 3 m	
	BQ-WL	- pcs	BQ - 3 m	
	NW	5 pcs	NW - 3 m	
	BW	- pcs	BW - 3 m	
Casing pipe	HW	3 pcs	HW - 3 m	
	NW	- pcs	NW - 3 m	
	BW	- pcs	BW - 3 m	
Rod safety clamps		1 Set		
Water swivel		1 Set	Ball bearing	
Hoisting swivel		1 Set		

Table 6-17 Drilling Machines Used and Materials Consumed

Drilling Machines: Acker N-18, TJ-12

Item	Model	Quantity	Capacity, Type, and Specification	
Drilling machine	N-18	1 Set	Capacity(m) BQ-WL Rod 500 m	
			Dimensions	Height 1,500 mm
				Length 2,700 mm
				Width 1,200 mm
				Weight (with diesel engine) 1,600 kg
	Swivel Head		Spindle speed	
			1st 2nd 3rd 4th 5th reverse	
			245 470 875 1,590 2,000 275	
	Hoist		Hoisting capacity 4,000 kg	
	Oil pump		Capacity 0 - 100 l/min	
			Max. pressure 70 kg/cm ²	
Motor	F4L-912	1 Set	Diesel engine	
			Revolution 1,800 r.p.m.	
			Related power 51 P.S	
Drilling pump	W1122B-1	1 Set	Weight 765 kg	
			Piston diameter 70 mm	
			Stroke 70 mm	
			Discharge capacity 132 l/min	
			Max. pressure 70 kg/cm ²	
Motor	F2L-411D	1 Set	Diesel engine	
			Revolution 1,800 r.p.m.	
			Related power 16 H.P	
Derrick	Tripod	1 Set	Steel pipe	
			Height 8.5 m	
			Max. load capacity 8,000 kg	
Drill rod	NQ-WL	34 pcs	NQ - 3 m	
	BQ-WL	- pcs	BQ - 3 m	
	NW	5 pcs	NW - 3 m	
	BW	- pcs	BW - 3 m	
Casing pipe	HW	4 pcs	HW - 3 m	
	NW	- pcs	NW - 3 m	
	BW	- pcs	BW - 3 m	
Rod safety clamps		1 Set		
Water swivel		1 Set	Ball bearing	
Hoisting swivel		1 Set		

Table 6-18 Drilling Machines Used and Materials Consumed

Drilling Machines: Acker N-18, TJ-13

Item	Model	Quantity	Capacity, Type, and Specification	
Drilling machine	N-18	1 Set	Capacity(m) BQ-WL Rod 500 m	
			Dimensions	Height 1,500 mm
				Length 2,700 mm
				Width 1,200 mm
			Weight (with diesel engine) 1,600 kg	
	Swivel Head		Spindle speed 1st 2nd 3rd 4th 5th reverse 245 470 875 1,590 2,000 275	
	Hoist		Hoisting capacity 4,000 kg	
	Oil pump		Capacity 0 - 100 l/min ² Max. pressure 70 kg/cm ²	
Motor	F4L-912	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 51 P.S	
Drilling pump	W1122B-1	1 Set	Weight 765 kg	
			Piston diameter 70 mm	
			Stroke 70 mm	
			Discharge capacity 132 l/min Max. pressure 70 kg/cm ²	
Motor	F2L-411D	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 16 H.P	
Derrick	Tripod	1 Set	Steel pipe	
			Height 8.5 m Max. load capacity 8,000 kg	
Drill rod	NQ-WL	21 pcs	NQ - 3 m	
	BQ-WL	- pcs	BQ - 3 m	
	NW	5 pcs	NW - 3 m	
	BW	- pcs	BW - 3 m	
Casing	HW	4 pcs	HW - 3 m	
	NW	- pcs	NW - 3 m	
	BW	- pcs.	BW - 3 m	
Rod safety clamps		1 Set		
Water swivel		1 Set	Ball bearing	
Hoisting swivel		1 Set		

Table 6-19 Drilling Machines Used and Materials Consumed

Drilling Machines: Acker N-18, TJ-14

Item	Model	Quantity	Capacity, Type, and Specification
Drilling machine	N-18	1 Set	Capacity(m) BQ-WL Rod 500 m
			Dimensions Height 1,500 mm
			Length 2,700 mm
			Width 1,200 mm
			Weight (with diesel engine) 1,600 kg
	Swivel Head		Spindle speed 1st 2nd 3rd 4th 5th reverse 245 470 875 1,590 2,000 275
	Hoist		Hoisting capacity 4,000 kg
	Oil pump		Capacity 0 - 100 l/min ₂ Max. pressure 70 kg/cm ²
Motor	F4L-912	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 51 P.S
Drilling pump	W1122B-1	1 Set	Weight 765 kg
			Piston diameter 70 mm
			Stroke 70 mm
			Discharge capacity 132 l/min ₂
			Max. pressure 70 kg/cm ²
Motor	F2L-411D	1 Set	Diesel engine Revolution 1,800 r.p.m. Related power 16 H.P
Derrick	Tripod	1 Set	Steel pipe
			Height 8.5 m
			Max. load capacity 8,000 kg
Drill rod	NQ-WL	33 pcs	NQ - 3 m
	BQ-WL	- pcs	BQ - 3 m
	NW	5 pcs	NW - 3 m
	BW	- pcs	BW - 3 m
Casing pipe	HW	6 pcs	HW - 3 m
	NW	- pcs	NW - 3 m
	BW	- pcs	BW - 3 m
Rod safety clamps		1 Set	
Water swivel		1 Set	Ball bearing
Hoisting swivel		1 Set	

Table 6-20 Consumables Used (1979)

Description	Specification	Unit	Quantity							
			TJ-1	TJ-2	TJ-3	TJ-4	TJ-5	TJ-6	TJ-7	TJ-8
Gasoline		l				700		543	285	
Light oil		l	1263	630	1425	505	810	251	120	605
Mobil oil	# 90	l	16	2	12	2	2		10	
Mobil oil	# 30	l	84	5	35	37	62	25	13	30
Hydraulic oil	# 10	l	12		11	18	30	25		
Grease		kg	3	3	11	6	3			6
Bentonite		bag	12		53	25	44	10	11	39
Caustic soda		kg	1							
C. M. C.		kg	6		10	20	16		5	12
Metal crown	NWG	pec	3	4	3	4	1	2	1	1
Metal crown	BWG	pec	3	2	2	2	1			
Metal crown	NWM	pec	5	4	2	4	2	3	2	1
Metal crown	BWM	pec	3	3	3	2	2	2		1
Tri-cone bit	4 5/8	pec	1	1	1	1		1		
Tri-cone bit	3 3/4	pec	1	1	1	1		1		
Tri-cone bit	2 15/16	pec	1							
Double core tube	NQ. WL	set	1		1		1			1
Double core tube	BQ. WL	set	1				1			
Double core tube	NWM (M series)	set		1		1				
Double core tube	BWM (M series)	set	1							
Double core tube	NWG (sabit tip)	set		1						
Double core tube	BWG (sabit tip)	set	1							
Inner tube assembly	NQ-3.00m	set	1				1			
Inner tube assembly	BQ-3.00m	set	1				1			
Casing head	HW	pec	1							
Casing head	NW	set			1					
Casing head	BW	set					1			
Casing metal shoe	HW	pec	1	1	1		1	1		1
Casing metal shoe	NW	pec	3	1	3	1	2	1		1
Casing metal shoe	BW	pec	2	1	3	1	2			1
Cement	50 kg/bag	bag	8	8	18	8	18	9	8	8
Rag		kg	4	2	6	2	4	2		2
Core box		pec	12	7	9	5	8	4	1	8

(to be cont'd)

Consumables Used (1979)

Description	Specification	Unit	Quantity							
			TJ-1	TJ-2	TJ-3	TJ-4	TJ-5	TJ-6	TJ-7	TJ-8
Wire	# 12	kg			2	1		1	1	
Wire	# 10	kg	2	1	2		2		•	1
Nail		kg	3	2	4	1	2	3	2	2
Wire rope	6mm x 300m	roll			1					1
Wire rope	12mm x 40m	roll	1				1			
Manila rope		pec	1		1					
Valve steel ball		set	1			1				
Guide pipe	NQ	pec		1			1			1
Guide pipe	BQ	pec	1				1			
Guide coupling	NQ	pec		1			1			1
Guide coupling	BQ	pec	1				1			
Suction nose	50mm x 4.5m	pec	1	1						
Water swivel Packing		pec	4	6	4	4	8	2		2
V-belt	for engine	set			1					
V-belt	for drill machine	set								
V-belt	for pump	set	1		2	1				
Core lifter	NQ	pec	4	3	5		5			2
Core lifter	BQ	pec	5	6	6		4			1
Core lifter	NWM	pec						3	1	
Core lifter	BWM	pec								
Core lifter	NWG	pec	3	2	1	1	2			
Core lifter	BWG	pec	2	3	2	2	3	2		
Core lifter case	NQ	pec	2	3	4		3			2
Core lifter case	BQ	pec	2	3	3		2			1
Core lifter case	NWM	pec	2		2			3	1	1
Core lifter case	BWM	pec	1	2	2	1				
Casing pipe	NW	pec					7			
Casing pipe	BW	pec			9					

Table 6-21 Consumables Used (1980)

Description	Specification	Unit	Quantity					
			TJ-9	TJ-10	TJ-11	TJ-12	TJ-13	TJ-14
Light oil		ℓ	498	865	365	305	304	275
Mobil oil	# 90	ℓ	12	9	10	-	-	-
Mobil oil	# 30	ℓ	16	28	8	12	10	17
Hydraulic oil	# 10	ℓ	12	8	5	25	8	20
Grease		kg	10	7	5	12	11	16
Bentonite		bag	21	61	17	23	20	39
Caustic soda		kg	7	18	4	6	8	7
C. M. C.		kg	7	10	5	8	10	9
Metal crown	NWG	pec	1	1	-	-	-	-
Metal crown	BWG	pec	-	-	-	-	-	-
Metal crown	NWM	pec	1	1	-	-	-	-
Metal crown	BWM	pec	-	-	-	-	-	-
Tri-corne bit	4-5/8"	pec	1	1	1	1	1	1
Tri-corne bit	3-3/4"	pec	-	1	-	-	-	-
Tri-corne bit	2-15/16"	pec	1	-	-	-	1	1
Double core tube	NQ-WL	pec	1	1	1	1	1	1
Double core tube	BQ-WL	set	1	-	-	-	-	-
Double core tube	NWM (M series)	set	1	-	-	-	-	-
Double core tube	BWM (M series)	set						
Double core tube	NWG (Sabit tip)	set	1	1	-	-	1	-
Inner tube assembly	BWG (Sabit tip)	set	1	1	1	1	1	2
Inner tube assembly	NQ - 3.00 m	set	1	-	-	-	-	-
Casing head	HW	pec	1	1	1	1	1	1
Casing head	NW	pec	1	-	-	-	-	-
Casing head	BW	pec	1	-	-	-	-	-
Casing metal shoe	HW	pec	1	1	1	1	1	1
Casing metal shoe	NW	pec	1	-	-	-	-	-
Casing metal shoe	BW	pec	1	-	-	-	-	-
Cement	50 kg/bag	bag	8	22	12	2	2	6
Rag		kg	8	20	10	12	9	12
Core box		pec	6	7	14	17	8	15
Wire	# 12	kg	2	2	3	4	6	5
Wire	# 10	kg	2	3	2	-	-	4

(to be cont'd)

Table 6-23 Preparation and Removal (1980)

Item	Hole No.		TJ-9		TJ-10		TJ-11		TJ-12		TJ-13		TJ-14		Total		
	In	Out	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	Days	Man-shifts	
Preparation and removal			23rd Jun '80	6th Jul '80	6th Jul '80	1st Aug '80	1st Aug '80	19th Sep '80									
			16th Jul '80	20th Jul '80	22nd Jul '80												
			31st Jul '80	9th Sep '80	1st Aug '80	29th Aug '80	28th Aug '80	30th Sep '80									
		-	13th Sep '80	-	-	30th Aug '80	30th Aug '80	1st Oct '80									
Preparation	Access road		6.0	210	2.0	12	3.0	18	-	-	-	-	-	-	11.0	240	
	Haulage		7.0	42	2.0	12	2.0	12	-	-	-	-	1.0	5	12.0	71	
	Installation		8.0	66	3.0	18	3.0	18	0.5	3	1.0	6	1.0	5	16.5	116	
	Water pipe		1.0	6	2.0	12	1.0	6	-	-	-	-	-	-	4.0	24	
	Test run, etc.		2.0	12	1.0	6	1.0	6	-	-	-	-	-	-	4.0	24	
	Total		24.0	336	10.0	60	10.0	60	0.5	3	1.0	6	2.0	10	47.5	475	
Removal	Dismantling		1.0	6	2.0	12	0.5	3	0.5	3	1.0	5	1.0	5	5.0	28	
	Pipe removal		-	-	1.0	6	-	-	-	-	1.0	5	1.0	5	3.0	16	
	Haulage		-	-	2.0	12	-	-	-	-	-	-	1.0	5	3.0	17	
	Road rein-statement		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Others		-	-	-	-	-	-	1.5	9	1.0	5	-	-	2.5	14	
	Total		1.0	6	5.0	30	0.5	3	2.0	12	3.0	15	3.0	15	13.5	75	
Grand Total		25.0	342	15.0	90	10.5	63	2.5	15	4.0	21	5.0	25	61.0	550		

Table 6-24 Operational Results by Drill Hole, No. TJ-1

Working Period	Period				Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	13th Jul '79 - 18th Jul '79				6	6	0	45
	Drilling	19th Jul '79 - 8th Sep '79				52	37	15	540
	Removing	9th Sep '79 - 13th Sep '79				5	5	0	40
	Total	13th Jul '79 - 13th Sep '79				63	53	10	625
Drilling Length	Planned Length	150.00 ^m	Over-burden	0.50 ^m	Core Recovery for each 20 m section				
	Increase or Decrease in Length	-73.05 ^m	Core Length	56.23 ^m	Depth of Hole	Section	Total		
	Length Drilled	76.95 ^m	Core Recovery	73.07 %	0 -19.40m	63.92 %	63.92 %		
					19.40-38.25m	68.17 %	66.01 %		
Working Time	Drilling	123°00'	22.36 %	20.08 %	38.25-59.55m	81.83 %	71.67 %		
	Hoisting & Lowering Rod	77°30'	14.09 %	12.65 %	59.55-76.95m	77.59 %	73.07 %		
					m	%	%		
	Hoisting & Lowering I.T.	62°50'	11.42 %	10.26 %	m	%	%		
					Efficiency of Drilling				
	Miscellaneous	124°30'	22.63 %	20.33 %	76.95 m/Working Period		1.22 m/day		
	Repairing	32°00'	5.82 %	5.22 %	76.95 m/Working Days		1.45 m/day		
	Others	130°10'	23.68 %	21.25 %	76.95 m/Drilling Period		1.48 m/day		
	Total	550°00'	100 %	89.79 %	76.95 m/Net Drilling Days		2.08 m/day		
	Removing	Preparation	32°00'		5.23 %	Total workers/ 76.95 m		8.12 Man/m	
Moving		30°30'		4.98 %					
G. Total	612°30'			100 %	Total Drilling Workers/76.95 m		7.02 Man/m		
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%) Drilling Length		Recovery of Casing Pipe	Hoisting & Lowering rod 76 times		Hoisting & Lowering I/T 34 times		
	HW - m	- %		- %	Remarks				
	NW 57.95 m	75.31 %		100 %	G : Grand				
	BW 64.05 m	83.24 %		100 %	I.T.: Inner Tube				

Table 6-25 Operational Results by Drill Hole, No. TJ-2

Working Period	Period				Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	19th Jul '79 - 27th Jul '79				9	9	0	67
	Drilling	29th Jul '79 - 14th Aug '79				18	18	0	190
	Removing	15th Aug '79 - 15th Aug '79				1	1	0	7
	Total	19th Jul '79 - 15th Aug '79				28	28	0	264
Drilling Length	Planned Length	70.00 ^m	Over-burden	10.30 ^m	Core Recovery for each 20 m section				
	Increase or Decrease in Length	-4.80 ^m	Core Length	26.45 ^m	Depth of Hole	Section	Total		
	Length Drilled	65.20 ^m	Core Recovery	49.72 %	0 -20.10 m	38.27 %	38.27 %		
Working Time	Drilling	49°00'	24.14 %	17.56 %	20.10-40.55 m	69.44 %	60.59 %		
	Hoisting & Lowering Rod	41°00'	20.20 %	14.70 %	40.55-57.75 m	38.66 %	52.35 %		
	Hoisting & Lowering I.T.	6°00'	2.96 %	2.15 %	57.75-65.20 m	33.56 %	49.72 %		
	Miscellaneous	87°30'	43.10 %	31.36 %	m	%	%		
	Repairing	0	0 %	0 %	Efficiency of Drilling		65.20 m/Working Period 2.33 m/day		
	Others	19°30'	9.60 %	6.99 %	65.20 m/Working Days		2.33 m/day		
	Total	203°00'	100 %	72.76 %	65.20 m/Drilling Period		3.62 m/day		
	Removing	Preparation	65°00'		23.30 %	65.20 m/Net Drilling Days		3.62 m/day	
	Moving	11°00'		3.94 %	Total workers/ 65.20 m		4.05 Man/m		
	G. Total	279°00'		100 %	Total Drilling Workers/65.20 m		2.91 Man/m		
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%) Drilling Length	Recovery of Casing Pipe		Hoisting & Lowering rod 41 times	Hoisting & Lowering I/T 12 times			
	HW 3.05 m	4.68 %	100 %		Remarks G : Grand I.T.: Inner Tube				
	NW 44.20 m	67.79 %	100 %						
	BW 57.95 m	88.88 %	100 %						

Table 6-26 Operational Results by Drill Hole, No. TJ-3

Working Period	Period			Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	21st Jul '79 - 28th Jul '79			8	8	0	66.5
Drilling	29th Jul '79 - 1st Oct '79			65	45	20	516.0	
Removing	2nd Jul '79 - 6th Oct '79			5	5	0	39.0	
Total	21st Jul '79 - 6th Oct '79			78	58	20	621.5	
Drilling Length	Planned Length	105.00 ^m	Over-burden	0 ^m	Core Recovery for each 20 m section			
	Increase or Decrease in Length	-13.90 ^m	Core Length	38.05 ^m	Depth of Hole	Section	Total	
	Length Drilled	91.10 ^m	Core Recovery	50.26 %	0 -19.05m	100 %	100 %	
Working Time	Drilling	76°00'	11.71 %	10.37 %	19.05-37.40m	49.59 %	57.95 %	
	Hoisting & Lowering Rod	52°00'	8.01 %	7.09 %	37.40-59.60m	35.36 %	46.61 %	
	Hoisting & Lowering I.T.	34°30'	5.32 %	4.71 %	59.60-76.50m	55.92 %	49.18 %	
	Miscellaneous	172°00'	26.50 %	23.47 %	76.50-91.10m	51.71 %	50.26 %	
	Repairing	46°00'	7.09 %	6.28 %	m	%	%	
	Others	268°30'	41.37 %	36.62 %	Efficiency of Drilling			
	Total	649°00'	100 %	88.54 %	91.10 m/Working Period		1.17 m/day	
	Removing	Preparation	38°00'		5.18 %	91.10 m/Working Days		1.57 m/day
		Moving	46°00'		6.28 %	91.10 m/Drilling Period		1.40 m/day
	G. Total	733°00'		100 %	91.10 m/Net Drilling Days		2.02 m/day	
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%) Drilling Length	Recovery of Casing Pipe		Total Drilling Workers/91.10 m		5.66 Man/m	
	HW 15.20 m	16.68 %	100 %		Hoisting & Lowering rod 62 times	Hoisting & Lowering I/T 41 times		
	NW 54.90 m	69.26 %	100 %		Remarks			
	BW 79.30 m	87.05 %	65.38 %		G : Grand			
					I.T.: Inner Tube			

Table 6-27 Operational Results by Drill Hole, No. TJ-4

Working Period	Period				Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	31st Jul '79 - 11th Aug '79				12	7	5	62
	Drilling	12th Aug '79 - 14th Sep '79				34	23	11	240
	Removing	15th Sep '79 - 15th Sep '79				1	1	0	6
	Total	31st Aug '79 - 15th Sep '79				47	31	16	308
Drilling Length	Planned Length	50.00 ^m	Over-burden	0 m	Core Recovery for each 20 m section				
	Increase or Decrease in Length	0.15 ^m	Core Length	23.15 ^m	Depth of Hole	Section	Total		
	Length Drilled	50.15 ^m	Core Recovery	58.61 %	0 -20.00m	94.65 %	94.65 %		
Working Time	Drilling	50°00'	15.63 %	13.66 %	20.00-38.00m	49.72 %	65.08 %		
	Hoisting & Lowering Rod	25°30'	7.97 %	6.97 %	38.00-50.15m	44.03 %	58.61 %		
	Hoisting & Lowering I.T.	-	- %	- %	m	%	%.		
	Miscellaneous	109°00'	34.06 %	29.78 %	Efficiency of Drilling				
	Repairing	6°00'	1.88 %	1.64 %	50.15 m/Working Period		1.07 m/day		
	Others	129°30'	40.46 %	35.38 %	50.15 m/Working Days		1.62 m/day		
	Total	320°00'	100 %	87.43 %	50.15 m/Drilling Period		1.48 m/day		
	Removing	Preparation	42°00'		11.48 %	50.15 m/Net Drilling Days		2.18 m/day	
		Moving	4°00'		1.09 %	Total workers/ 50.15 m		6.14 Man/m	
	G. Total	366°00'		100 %	Total Drilling Workers/50.15 m		4.79 Man/m		
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%)	Recovery of Casing Pipe Length		Hoisting & Lowering rod	Hoisting & Lowering I/T			
	HW 2.80 m	5.58 %	100 %		41 times	0 times			
	NW 32.00 m	63.81 %	100 %		Remarks				
	BW 44.70 m	89.13 %	100 %		G : Grand I.T. : Inner Tube				

Table 6-28 Operational Results by Drill Hole, No. TJ-5

Working Period	Period			Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	28th Aug '79 - 8th Sep '79			12	12	0	99
	Drilling	9th Sep '79 - 3rd Oct '79			25	25	0	239
	Removing	4th Oct '79 - 6th Oct '79			3	3	0	25
	Total	28th Aug '79 - 6th Oct '79			40	40	0	363
Drilling Length	Planned Length	110.00 ^m	Over-burden	0 m	Core Recovery for each 20 m section			
	Increase or Decrease in Length	-7.80 ^m	Core Length	37.15 ^m	Depth of Hole	Section	Total	
	Length Drilled	102.20 ^m	Core Recovery	62.54 %	0 -16.55m	0 %	0 %	
					16.55-42.80m	0 %	0 %	
Working Time	Drilling	53°00'	21.77 %	13.93 %	42.80-59.30m	37.58 %	37.58 %	
	Hoisting & Lowering Rod	32°00'	13.14 %	8.41 %	59.30-81.45m	77.88 %	60.67 %	
					81.45-102.20m	66.02 %	62.54 %	
	Hoisting & Lowering I.T.	24°30'	10.06 %	6.44 %	m	%	%	
	Miscellaneous	109°00'	44.76 %	28.64 %	Efficiency of Drilling			
	Repairing	-	- %	- %	102.20 m/Working Period		2.56 m/day	
	Others	25°00'	10.27 %	6.57 %	102.20 m/Working Days		2.56 m/day	
	Total	243°30'	100 %	63.99 %	102.20 m/Drilling Period		4.09 m/day	
	Removing	Preparation	63°00'		16.56 %	120.20 m/Drilling Days		4.09 m/day
		Moving	74°00'		19.45 %	Total workers/	102.20 m	3.55 Man/m
G. Total	380°30'		100 %	Total Drilling Workers/102.20 m		2.34 Man/m		
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%)	Recovery of Casing Pipe		Hoisting & Lowering rod			
	HW 21.35 m	20.89 %	100 %		23 times		Hoisting & Lowering I/T 33 times	
	NW 51.85 m	50.73 %	58.82 %		Remarks			
	BW 84.35 m	82.53 %	100 %		G : Grand I.T.: Inner Tube			

Table 6-29 Operational Results by Drill Hole, No. TJ-6

Working Period	Period				Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	29th Aug '79 - 3th Sep '79				7	7	0	59
	Drilling	4th Sep '79 - 1st Oct '79				28	15	13	185
	Removing	2nd Oct '79 - 4th Oct '79				3	3	0	18
	Total	28th Aug '79 - 4th Oct '79				38	25	13	262
Drilling Length	Planned Length	110.00 ^m	Over-burden	0 m	Core Recovery for each 20 m section				
	Increase or Decrease in Length	-57.90 ^m	Core Length	5.35 ^m	Depth of Hole	Section	Total		
	Length Drilled	52.10 ^m	Core Recovery	24.80 %	0 -18.50m	0 %	0 %		
Working Time	Drilling	48°30'	19.47 %	14.69 %	18.50-41.95m	60.92 %	33.71 %		
	Hoisting & Lowering Rod	22°00'	8.83 %	6.66 %	41.95-52.10m	14.78 %	24.80 %		
	Hoisting & Lowering I.T.	-	- %	- %	m	%	%		
	Miscellaneous	23°00'	9.23 %	6.97 %	m	%	%		
	Repairing	48°00'	19.27 %	14.54 %	Efficiency of Drilling		52.10 m/Working Period		
	Others	107°30'	43.20 %	32.60 %	52.10 m/Working Days		1.37 m/day		
	Total	249°00'	100 %	75.46 %	52.10 m/Drilling Period		2.08 m/day		
	Removing Preparation	45°00'		13.64 %	52.10 m/Net Drilling Days		1.86 m/day		
	Moving	36°00'		10.90 %	Total workers/ 52.10 m		3.47 m/day		
	G. Total	330°00'		100 %	Total Drilling Workers/52.10 m		5.03 Man/m		
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%) Drilling Length	Recovery of Casing Pipe		Total Drilling Workers/52.10 m		3.55 Man/m		
	HW 18.30 m	35.12 %	100 %		Hoisting & Lowering rod	42 times	Hoisting & Lowering I/T	0 times	
	NW 41.15 m	78.98 %	100 %		Remarks				
	BW 46.10 m	88.48 %	100 %		G : Grand				
					I.T.: Inner Tube				

Table 6-30 Operational Results by Drill Hole, No. TJ-7

Working Period	Period				Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	16th Sep '79 - 18th Sep '79				3	3	0	30
	Drilling	19th Sep '79 - 2nd Oct '79				14	4	10	101
	Removing	3rd Oct '79 - 4th Oct '79				2	2	0	10
	Total	16th Sep '79 - 4th Oct '79				19	9	10	141
Drilling Length	Planned Length	40.00 ^m	Over-burden	0 ^m	Core Recovery for each 20 m section				
	Increase or Decrease in Length	-17.60 ^m	Core Length	3.55 ^m	Depth of Hole	Section	Total		
	Length Drilled	22.40 ^m	Core Recovery	34.80 %	0 -22.40m	34.80 %	34.80 %		
Working Time	Drilling	11°30'	27.38 %	16.20 %	m	%	%		
	Hoisting & Lowering Rod	6°30'	15.48 %	9.15 %	m	%	%		
	Hoisting & Lowering I.T.	-	- %	- %	m	%	%		
	Miscellaneous	21°30'	51.19 %	30.28 %	Efficiency of Drilling				
	Repairing	-	- %	- %	22.40 m/Working Period		1.18 m/day		
	Others	2°30'	5.95 %	3.52 %	22.40 m/Working Days		2.49 m/day		
	Total	42°00'	100 %	59.15 %	22.40 m/Drilling Period		1.60 m/day		
	Removing	Preparation	20°00'		28.17 %	22.40 m/Net Drilling Days		5.60 m/day	
		Moving	9°00'		12.68 %	Total workers/ 22.40 m		6.29 Man/m	
	G. Total	71°00'		100 %	Total Drilling Workers/22.40 m		4.51 Man/m		
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%) Drilling Length	Recovery of Casing Pipe		Hoisting & Lowering rod 13 times		Hoisting & Lowering I/T 0 times		
	HW 4.25 m	18.97 %	100 %		Remarks G : Grand I.T.: Inner Tube				
	NW 21.35 m	95.31 %	100 %						
	BW m	%	%						

Table 6-31 Operational Results by Drill Hole, No. TJ-8

Working Period	Period			Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	14th Sep '79 - 15th Sep '79			2	2	0	33
Drilling	16th Sep '79 - 2nd Oct '79			17	17	0	196	
Removing	3rd Oct '79 - 5th Oct '79			3	3	0	30	
Total	14th Sep '79 - 5th Oct '79			22	22	0	259	
Drilling Length	Planned Length	110.00 ^m	Overburden	0 ^m	Core Recovery for each 20 m section			
	Increase or Decrease in Length	-27.50 ^m	Core Length	31.75 ^m	Depth of Hole	Section	Total	
	Length Drilled	82.50 ^m	Core Recovery	61.06 %	0 -20.65m	0 %	0 %	
Working Time	Drilling	71°30'	39.50 %	31.09 %	20.65-38.75m	50.91 %	50.91 %	
	Hoisting & Lowering Rod	27°30'	15.19 %	11.96 %	38.75-56.45m	48.31 %	49.13 %	
	Hoisting & Lowering I.T.	32°30'	17.96 %	14.13 %	56.45-82.50m	72.94 %	61.06 %	
	Miscellaneous	49°30'	27.35 %	21.52 %	m	%	%	
	Repairing	-	- %	- %	m	%	%	
	Others	-	- %	- %	Efficiency of Drilling			
	Total	181°00'	100 %	78.70 %	82.50 m/Working Period		3.75 m/day	
	Removing	Preparation	13°00'		5.65 %	82.50 m/Working Days		3.75 m/day
		Moving	36°00'		15.65 %	82.50 m/Drilling Period		4.85 m/day
	G. Total	230°00'		100 %	82.50 m/Net Drilling Days		4.85 m/day	
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%) Drilling Length	Recovery of Casing Pipe		Total Drilling Workers/82.50 m		2.38 Man/m	
	HW 27.45 m	33.27 %	100 %		Hoisting & Lowering rod 15 times	Hoisting & Lowering I/T 43 times		
	NW 54.90 m	66.55 %	100 %		Remarks			
	BW 76.25 m	92.42 %	100 %		G : Grand			
					I.T.: Inner Tube			

Table 6-32 Operational Results by Drill Hole, No. TJ-9

	Period			Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Working Period	Preparation	23rd Jun '80 - 16th Jul '80		24	24	-	336
Drilling		17th Jul '80 - 30th Jul '80		14	14	-	85.9	
Removing		31st Jul '80 -		1	1	-	6	
Total		23rd Jun '80 - 31st Jul '80		29	29	-	427.9	
Drilling Length	Planned Length	55.00 ^m	Over-burden	9.15 ^m	Core Recovery for each 100 m section			
	Increase or Decrease in Length	-7.60 ^m	Core Length	14.90 ^m	Depth of Hole	Section	Total	
	Length Drilled	47.40 ^m	Core Recovery	38.9 %	0 -20.50m	29.5 %	%	
					20.50-41.35m	49.6 %	%	
Working Time	Drilling	20°30'	14.7 %	6.0 %	41.35-47.40m	24.6 %	%	
	Hoisting & Lowering Rod	24°30'	17.5 %	7.2 %	m	%	%	
					m	%	%	
	Hoisting & Lowering I.T.	6°00'	4.3 %	1.8 %	m	%	%	
	Miscellaneous	66°00'	47.2 %	19.4 %	Efficiency of Drilling			
	Repairing	10°15'	7.4 %	3.0 %	47.40 m/Working Period		1.64 m/day	
	Others	12°30'	8.9 %	3.7 %	47.40 m/Working Days		1.64 m/day	
	Total	139°45'	100 %	41.1 %	47.40 m/Drilling Period		3.39 m/day	
	Removing	Preparation	192°00'	-	56.5 %	47.40 m/Net Drilling Days		3.39 m/day
		Moving	8°00'	-	2.4 %	Total workers/ 47.40 m		9.0 Man/m
G. Total	339°45'	-	100 %	Total Drilling Workers/47.40 m		1.81 Man/m		
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%) Drilling Length		Recovery of Casing Pipe		Remarks G : Grand I.T.: Inner Tube		
	HW 9.15 m	19.3 %		100 %				
	NW 39.65 m	87.1 %		100 %				
	BW 43.90 m	92.5 %		100 %				

Table 6-33 Operational Results by Drill Hole, No. TJ-10

Working Period	Period			Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	6th Jul '80 - 20th Jul '80			15	10	5	60
	Drilling	21st Jul '80 - 8th Sep '80			50	36	14	285.3
	Removing	9th Sep '80 - 13th Sep '80			5	5	-	30
	Total	6th Jul '80 - 13th Sep '80			70	51	19	375.3
Drilling Length	Planned Length	60.00 ^m	Overburden	9.15 ^m	Core Recovery for each 100 m section			
	Increase or Decrease in Length	±2.50 ^m	Core Length	36.15 ^m	Depth of Hole	Section	Total	
	Length Drilled	62.50 ^m	Core Recovery	67.8 %	m	%	%	
Working Time	Drilling	32°45'	9.5 %	6.8 %	0 -19.80m	49.8 %	49.8 %	
	Hoisting & Lowering Rod	11°00'	3.2 %	2.2 %	19.80-40.25m	79.7 %	69.5 %	
					40.25-59.45m	68.0 %	68.9 %	
	Hoisting & Lowering I.T.	9°00'	2.6 %	1.8 %	59.45-62.50m	49.2 %	67.8 %	
					m	%	%	
	Miscellaneous	55°05'	15.9 %	11.6 %	Efficiency of Drilling			
	Repairing	180°00'	52.0 %	37.4 %	62.50 m/Working Period		0.89 m/day	
	Others	58°00'	16.8 %	12.0 %	62.50 m/Working Days		1.23 m/day	
	Total	345°50'	100 %	71.8 %	62.50 m/Drilling Period		1.25 m/day	
	Removing	Preparation	80°00'	-	16.6 %	62.50 m/Net Drilling Days		1.74 m/day
Moving		56°00'	-	11.6 %	Total workers/ 62.50 m		6.0 Man/m	
G. Total	481°50'	-	100 %	Total Drilling Workers/62.50 m		4.56 Man/m		
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%) Drilling Length	Recovery of Casing Pipe Length		Remarks			
	HW 9.15 m	14.6 %	100 %		G : Grand			
	NW - m	- %	%		I.T.: Inner Tube			
	BW - m	- %	%					

Table 6-34 Operational Results by Drill Hole, No. TJ-11

Working Period	Period			Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	6th Jul '80 - 22nd Jul '80			17	10	7	60
	Drilling	23rd Jul '80 - 1st Aug '80			10	10	-	93.6
	Removing	1st Aug '80 -			0.5	0.5	-	3
	Total				27.5	20.5	7	156.6
Drilling Length	Planned Length	80.00 ^m	Over-burden	9.15 ^m	Core Recovery for each 100 m section			
	Increase or Decrease in Length	+1.40 ^m	Core Length	64.55 ^m	Depth of Hole	Section	Total	
	Length Drilled	81.40 ^m	Core Recovery	89.3 %	0 -20.45m	78.8 %	78.8 %	
					20.45-40.00m	93.6 %	88.2 %	
Working Time	Drilling	28°00'	24.7 %	14.2 %	40.00-60.10m	89.6 %	88.7 %	
	Hoisting & Lowering Rod	22°00'	19.4 %	11.2 %	60.10-81.40m	90.8 %	89.3 %	
					m	%	%	
	Hoisting & Lowering I.T.	14°00'	12.4 %	7.1 %	m	%	%	
					Efficiency of Drilling			
	Miscellaneous	25°30'	22.5 %	12.9 %	81.40 m/Working Period		2.96 m/day	
	Repairing	1°00'	0.9 %	0.5 %	81.40 m/Working Days		3.97 m/day	
	Others	22°45'	20.1 %	11.5 %	81.40 m/Drilling Period		8.10 m/day	
	Total	113°15'	100 %	57.4 %	81.40 m/Net Drilling Days		8.10 m/day	
	Removing	Preparation	80°00'	-	40.6 %	Total workers/ 81.40 m		1.92 Man/m
Moving		4°00'	-	2.0 %				
G. Total		197°15'	-	100 %	Total Drilling Workers/81.40 m			1.15 Man/
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%) Drilling Length		Recovery of Casing Pipe		Remarks		
	HW 9.15 m	11.2 %		100 %		G : Grand		
	NW m	%		%		I.T.: Inner Tube		
	BW m	%		%				

Table 6-35 Operational Results by Drill Hole, No. TJ-12

Working Period	Period				Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	1st Aug '80 -				0.5	0.5	-	3
	Drilling	2nd Aug '80 - 28th Aug '80				27.0	11.0	16	90.7
	Removing	29th Aug '80 - 30th Aug '80				2.0	2.0	-	12
	Total	1st Aug '80 - 30th Aug '80				29.5	13.5	16	105.7
Drilling Length	Planned Length	100.00 ^m	Over-burden	12.0 ^m	Core Recovery for each 100 m section				
	Increase or Decrease in Length	+6.00 ^m	Core Length	85.85 ^m	Depth of Hole	Section	Total		
	Length Drilled	106.00 ^m	Core Recovery	91.3 %	0 -20.60m	89.0 %	89.0 %		
Working Time	Drilling	29°45'	21.9 %	18.2 %	20.60-40.55m	74.9 %	79.2 %		
	Hoisting & Lowering Rod	15°45'	11.6 %	9.6 %	40.55-60.25m	93.9 %	85.2 %		
	Hoisting & Lowering I.T.	14°30'	10.7 %	8.9 %	60.25-80.10m	100 %	89.5 %		
	Miscellaneous	22°30'	16.6 %	13.8 %	80.10-106.00m	96.1 %	91.3 %		
	Repairing	23°00'	16.9 %	14.1 %	m	%	%		
	Others	30°15'	22.3 %	18.5 %	Efficiency of Drilling				
	Total	135°45'	100 %	83.2 %	106.00 m/Working Period		3.59 m/day		
	Removing	Preparation	4°00'	-	2.5 %	106.00 m/Working Days		7.85 m/day	
	Moving	23°30'	-	14.3 %	106.00 m/Drilling Period		3.92 m/day		
	G. Total	163°15'	-	100 %	106.00 m/Net Drilling Days		9.64 m/day		
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%)	Recovery of Casing Pipe		Total Drilling Workers/106.00 m				0.86 Man/m
	HW 12.00 m	11.3 %	100 %		Remarks				
	NW m	%	%		G : Grand				
	BW m	%	%		I.T.: Inner Tube				

Table 6-36 Operational Results by Drill Hole, No. TJ-13

Working Period	Period				Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	1st Aug '80 -				1	1	-	6
	Drilling	2nd Aug '80 - 27th Aug '80				26	10	16	85.2
	Removing	28th Aug '80 - 30th Aug '80				3	3	-	15
	Total	1st Aug '80 - 30th Aug '80				30	14	16	106.2
Drilling Length	Planned Length	60.00 ^m	Overburden	12.00 ^m	Core Recovery for each 100 m section				
	Increase or Decrease in Length	-3.95 ^m	Core Length	31.40 ^m	Depth of Hole	Section	Total		
	Length Drilled	63.95 ^m	Core Recovery	60.4 %	m	%	%		
					0 -20.25m	9.9 %	9.9 %		
Working Time	Drilling	18°45'	14.5 %	12.0 %	20.25-41.30m	75.7 %	61.3 %		
	Hoisting & Lowering Rod	10°00'	7.8 %	6.4 %	41.30-63.95m	59.4 %	60.4 %		
					m	%	%		
	Hoisting & Lowering I.T.	7°15'	5.6 %	4.6 %	m	%	%		
	Miscellaneous	42°15'	32.8 %	27.0 %	Efficiency of Drilling				
	Repairing	-	- %	- %	63.95 m/Working Period		2.13 m/day		
	Others	50°45'	39.3 %	32.4 %	63.95 m/Working Days		4.57 m/day		
	Total	129°00'	100 %	82.4 %	63.95 m/Drilling Period		2.45 m/day		
	Removing	Preparation	3°30'	-	2.2 %	63.95 m/Net Drilling Days		6.39 m/day	
		Moving	24°00'	-	15.4 %	Total workers/ 63.95 m		1.66 Man/m	
G. Total	156°30'	-	100 %	Total Drilling Workers/63.95 m		1.33 Man/m			
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%) Drilling Length		Recovery of Casing Pipe		Remarks G : Grand I.T.: Inner Tube			
	HW 12.00 m	18.7 %		100 %					
	NW m	%		%					
	BW m	%		%					

Table 6-37 Operational Results by Drill Hole TJ-14

Working Period	Period			Number of Days	Actual Working Days	Day Off	Total Number of Workers	
	Preparation	19th Sep '80 - 20th Sep '80			2	2	-	10
	Drilling	21st Sep '80 - 29th Sep '80			9	9	-	80.1
	Removing	30th Sep '80 - 1st Oct '80			3	3	-	15
	Total	19th Sep '80 - 1st Oct '80			14	14	-	105.1
Drilling Length	Planned Length	100.00 ^m	Over-burden	15.00 ^m	Core Recovery for each 100 m section			
	Increase or Decrease in Length	+0.30 ^m	Core Length	78.8 ^m	Depth of Hole	Section	Total	
	Length Drilled	100.30 ^m	Core Recovery	92.4 %	0 -19.90m	57.1 %	57.1 %	
Working Time	Drilling	43°00'	50.6 %	30.7 %	19.90-41.85m	94.1 %	87.3 %	
	Hoisting & Lowering Rod	10°45'	12.7 %	7.6 %	41.85-60.15m	90.4 %	88.6 %	
	Hoisting & Lowering I.T.	7°30'	8.8 %	5.4 %	60.15-81.50m	93.7 %	90.2 %	
	Miscellaneous	11°45'	13.8 %	8.4 %	81.50-100.30m	100 %	92.4 %	
	Repairing	-	- %	- %	m	%	%	
	Others	12°00'	14.1 %	8.6 %	Efficiency of Drilling			
	Total	85°00'	100 %	60.7 %	100.30 m/Working Period		7.16 m/day	
	Removing Preparation	22°00'	-	15.7 %	100.30 m/Working Days		7.16 m/day	
	Removing Moving	33°00'	-	23.6 %	100.30 m/Drilling Period		11.14 m/day	
	G. Total	140°00'	-	100 %	100.30 m/Net Drilling Days		11.14 m/day	
Casing Pipe Inserted	Pipe Size & Meterage	Inserted Length (%) Drilling Length	Recovery of Casing Pipe		Total Drilling Workers/100.30 m		0.80 Man/m	
	HW 15.00 m	14.6 %	100 %		Remarks			
	NW m	%	%		G : Grand			
	BW m	%	%		I.T.: Inner Tube			

Table 6-38 Summary Operational Data by Drill Holes (1979)

Drill hole No.	Type of machine	Drilling Period	Drilling length	Core		No. of drilling shift		Drilling speed		Remarks
				Length	Recovery	Drilling	Total	* m/shift	** m/shift	
TJ-1	D-750	19th Jul '79 - 8th Sep '79	76.95 ^m	56.23 ^m	73.07%	27	63	2.85	1.22	- m
TJ-2	N- 18	28th Jul '79 - 14th Aug '79	65.20	26.45	49.72	16	28	4.08	2.33	12.00
TJ-3	N- 18	29th Jul '79 - 1st Oct '79	91.10	38.05	50.26	24	78	3.80	1.17	15.40
TJ-4	L- 34	12th Aug '79 - 14th Sep '79	50.15	23.15	58.61	17	47	2.95	1.07	10.65
TJ-5	N- 18	9th Sep '79 - 3rd Oct '79	102.20	37.15	62.54	19	40	5.38	2.56	42.80
TJ-6	L- 34	4th Sep '79 - 1st Oct '79	52.10	5.35	24.80	14	38	3.72	1.37	30.53 .
TJ-7	L- 34	19th Sep '79 - 2nd Oct '79	22.40	3.55	34.80	4	19	5.60	1.18	12.20
TJ-8	D-750	16th Sep '79 - 2nd Oct '79	82.50	31.75	61.06	15	22	5.50	3.75	30.50
Total			542.60	221.68	57.06	136	335	3.99	1.62	154.08

* Drilled per one shift covering net drilling operations.

** Drilled per one shift covering total works conducted.

Table 6-39 Summary Operational Data by Drill Holes (1980)

Drill hole No.	Type of machine	Drilling Period	Drilling length	Core		No. of drilling shift.		Drilling speed		Remarks	
				Length	Recovery	Drilling	Casting etc.	* m/shift	** m/shift		
TJ-9	Acker N-18	17th Jul. '80 - 30th Jul '80	47.40 ^m	14.90 ^m	38.9 %	6.5	11.0	17.5	7.29	2.71	Overburden 9.15m
TJ-10	"	21st Jul '80 - 8th Sep '80	62.50	36.15	67.8	6.6	36.6	43.2	9.47	1.45	9.15
TJ-11	"	23rd Jul '80 - 1st Aug '80	81.40	64.55	89.3	8.0	6.2	14.2	10.18	5.73	9.15
TJ-12	"	2nd Aug '80 - 28th Aug '80	106.00	85.85	91.3	7.6	9.4	17.0	13.95	6.24	12.00
TJ-13	"	2nd Aug '80 - 27th Aug '80	63.95	31.40	60.7	4.5	11.6	16.1	14.21	3.97	12.00
TJ-14	"	21st Sep '80 - 29th Sep '80	100.30	78.80	92.4	7.6	3.0	10.6	13.20	9.46	15.00
Total				461.55	311.65	78.8	40.8	118.6	11.31	3.89	66.45

* Drilled per one shift covering net drilling operations.
** Drilled per one shift covering total works conducted.

Table 6-40 Working Time by Drill Hole (1979)

Borehole No.	Drilling	Hoisting & lowering rod & I.F.		Miscellaneous			Repairs	Others	Moving operation	Total
		Rod	Inner tube	Casing insertion	Hole reaming	Others				
TJ-1	123°00'	77°30'	62°50'	48°30'	61°30'	14°30'	32°00'	130°10'	62°30'	612°30'
TJ-2	49°00'	41°00'	6°00'	18°30'	27°30'	41°30'	-	19°30'	76°00'	279°00'
TJ-3	76°00'	52°00'	34°30'	47°20'	82°40'	42°00'	46°00'	268°30'	84°00'	733°00'
TJ-4	50°00'	25°30'	-	29°30'	55°30'	24°00'	6°00'	129°30'	46°00'	366°00'
TJ-5	53°00'	32°00'	24°30'	42°00'	39°30'	27°30'	-	25°00'	137°00'	380°30'
TJ-6	48°30'	22°00'	-	8°00'	10°00'	5°00'	48°00'	107°30'	81°00'	330°00'
TJ-7	11°30'	6°30'	-	8°30'	10°30'	2°30'	-	2°30'	29°00'	71°00'
TJ-8	71°30'	27°30'	32°30'	16°30'	24°30'	8°30'	-	-	49°00'	230°00'
Total	482°30'	284°00'	160°20'	218°50'	311°40'	165°30'	132°00'	682°40'	564°30'	3002°00'
	16.1 %	9.5 %	5.3 %	7.3 %	10.4 %	5.5 %	4.4 %	22.7 %	18.8 %	100 %

Table 6-41 Working Time by Drill Hole (1980)

Drill hole No.	Drilling	Hoisting & lowering rod & I.T.		Miscellaneous			Repairs	Others	Moving operation	Total
		Rod	Inner tube	Casing insertion	Hole reaming	Others				
TJ- 9	20°30'	24°30'	6°00'	20°30'	18°30'	27°00'	10°15'	12°30'	200°00'	339°45'
TJ-10	32°45'	11°00'	9°00'	23°30'	16°45'	14°50'	180°00'	58°00'	136°00'	481°50'
TJ-11	28°00'	22°00'	14°00'	4°30'	-	21°00'	1°00'	22°45'	84°00'	197°15'
TJ-12	29°45'	15°45'	14°30'	3°00'	-	19°30'	23°00'	30°15'	27°30'	163°15'
TJ-13	18°45'	10°00'	7°15'	6°30'	-	35°45'	-	50°45'	27°30'	156°30'
TJ-14	43°00'	10°45'	7°30'	7°30'	-	4°15'	-	12°00'	55°00'	140°00'
Total	172°45'	94°00'	58°15'	65°30'	35°15'	122°20'	214°15'	186°15'	530°00'	1478°35'
	11.7 %	6.4 %	3.9 %	4.4 %	2.4 %	8.3 %	14.5 %	12.6 %	35.8 %	100 %

Table 6-42 Drilling Meterage of Diamond Bits (1979)

Item	Size	Type	Bit No.	Drilling meterage by drill hole. Unite meter									Total	
				TJ-1	TJ-2	TJ-3	TJ-4	TJ-5	TJ-6	TJ-7	TJ-8			
Diamond set bit	NX	NQ-WL	A-5683			2.25							2.25	
			A-5777			6.95							6.95	
			A-5862			1.40								1.40
			A-6274									17.65		17.65
			129Pb 1100			21.80								21.80
			129Pb 1108	32.10									6.08	38.18
			129Pb 1111		15.30				3.55					18.85
			130Pb 635		8.00									8.00
			130Pb 765									18.25		18.25
			130PA 781			12.00								12.00
			130PA 6198			2.60								2.60
			Total	32.10	23.30	47.00			3.55				41.98	147.93
		Drilled length/bit											13.45	
		NX	NWM	A-1568	5.35								5.35	
	A-1692			8.30									8.30	
	A-5386					13.20			5.92				19.15	
	A-7386								1.80				1.80	
	113Pb 149					18.30							18.30	
	113Pb 4040				7.20			7.40					14.60	
	118PA 1929								21.57				21.57	
	118PA 6067									2.45			2.45	
	Total			13.65	7.20		31.50	7.40	21.57	10.20			91.52	
		Drilled length/bit											11.44	
		NX	NWG	34Pb 3137	6.10								6.10	
		BX	BQ-WL	A-5723					27.45				27.45	
	A-5753										9.30		9.30	
	A-5804					9.45							9.45	
	A-5921							11.60					11.60	
	123Pb 1986				16.60			9.40					26.00	
	460Pb 5918			15.20									15.20	
	Total			15.20	16.60	9.45		48.45				9.30	99.00	
	Drilled length/bit											16.50		
	NX	BWM	100PC 1193				8.00					8.00		
Sub Total		Drilled length										352.55		
		Drilled length/bit										13.06		
Tri-cone bit	4-5/8"					2.80	12.20			3.70		18.70		
	3-3/4"			12.00	15.00	7.85	30.60	30.53	8.50	30.50		135.38		
	Total			12.00	15.00	10.65	42.80	30.53	12.20	30.50		154.08		
Metal Crown	NX	NWM		12.50		16.25					0.72	29.47		
		NWG		3.50		3.00						6.50		
		Total		16.00		19.25					0.72	35.97		
Grand Total				76.95	65.20	91.10	50.15	102.20	52.10	22.40	82.50	542.60		

Table 6-43 Drilling Meterage of Diamond Bits (1980)

Item	Size	Type	Bit No.	Drilling meterage by drill hole. Unite meter								Total	
				TJ-9	TJ-10	TJ-11	TJ-12	TJ-13	TJ-14				
Bit	NX	NQ-WL	J644							14.90			14.90
			J645		12.70								12.70
			J646					18.40					18.40
			J647					33.55					33.55
			J648		40.65		30.95						71.60
			J649			38.75	17.30						56.05
			J650						52.75				52.75
			J651			33.50							33.50
			J652				45.75		17.65				63.40
			J653			(2.40)							(2.40)
			100PC 3754	14.70									14.70
			AB146	3.60									3.60
			Total	18.30	53.35	72.25	94.00	51.95	85.30				375.15
	Drilled length/bit										34.10		
	NWM			118PA 5032	13.90								13.90
				Total	13.90								13.90
	Drilled length/bit	13.90									13.90		
	BX	BQ-WL		J658	2.55								2.55
				A8596	3.50								3.50
Total				6.05								6.05	
Drilled length/bit												3.02	
Reaming shell	NX		JG660		53.35							53.35	
			NQ-WL JG661			72.25	94.00		85.30			251.55	
			NWM A530	32.20								32.20	
			NQ-WL A537					51.95				51.95	
	Total	32.20	53.35	72.25	94.00	51.95	85.30			389.05			
	BX	BQ-WL		JG663	2.55								2.55
				475PC 2281	3.50								3.50
				Total	6.05								6.05
Tri-cone bit	4-5/8"			9.15	9.15	9.15	12.00	12.00	15.00			66.45	
Grand Total				47.40	62.50	81.40	106.00	63.95	100.30			461.55	

Table 6-44 Specifications of Diamond Bits (1979)

Size	Type	Carats per bit	Matrix H.R.C.	Stones per carat	Water way	Number	Remarks
NX	NQWL	30 et	30-40	40-60	4	A 5683	Reset
		30	30-40	40-60	4	A 5777	"
		30	30-40	40-60	4	A 5862	"
		30	30-40	40-60	4	A 6274	"
		30	30-40	25-40	4	129Pb1100	"
		30	30-40	25-40	4	129Pb1108	"
		30	30-40	25-40	4	129Pb1111	"
		30	30-40	40-60	4	130Pb 635	"
		30	30-40	40-60	4	130Pb 765	"
		30	30-40	40-60	4	130Pc 781	"
		30	30-40	40-60	4	130Pb6198	"
	NWM	24	30-40	40-60	4	A 1568	"
		24	30-40	40-60	4	A 1692	"
		24	30-40	60-100	4	A 5386	"
		24	30-40	40-60	4	A 7386	"
		24	30-40	25-40	4	113Pb 149	"
		24	30-40	25-40	4	113Pb4040	"
		24	30-40	15-25	4	118PA1929	"
		24	30-40	15-25	4	118PA6069	"
	NWG	24	30-40	25-40	4	34Pb3137	"
BX	BQWL	20	30-40	40-60	4	A 5723	"
		20	30-40	40-60	4	A 5753	"
		20	30-40	40-60	4	A 5804	"
		20	30-40	40-60	4	A 5921	"
		20	30-40	25-40	4	123Pb1986	"
		20	30-40	25-40	4	460A 5918	"
	BWM	16	30-40	40-60	4	100Pc1193	"

Specifications of Diamond Bits

Size	Type	Carats per bit	Matrix	Stones per carat	Water way	Number	Remarks	
Reaming shell (Diamond)	NQWL	16		20-40	4	485PA4128	Reset	
		16		20-40	4	485PA4190	"	
	NWM	12		20-40	4	480Pb4127	"	
	NWG	12		40-60	4	37Pb1542	"	
	BQWL	10		20-40	4	475Pc2299	"	
		10		20-40	4	475Pc2310	"	
		10		20-40	4	475Pc6011	"	
		10		20-40	4	475Pc6035	"	
	Casing shoe bit (Diamond)	NW	16		40-60	4	10410	"
			16		40-60	4	A 4683	"
16				40-60	4	A 4729	"	
16				40-60	4	A 4777	"	
BW		12		40-60	4	A10449	"	
		12		40-60	4	723PA2136	"	
		12		40-60	4	723PA3883	"	

CHAPTER 7. FUTURE PROSPECTS

7. Future Prospects

Results of the 1979 investigation

Tunceli area:

Mineralization - alteration zones of the area have been cleared off through three years of geological mapping and geochemical survey.

They were divided into two types, one related to the Bulanık quartz diorite and the other to dacitic lava domes. The former consists of a limonite vein network. One promising area lies on the north side of the Bulanık quartz diorite block from Mamlis to Garipuşağı area, and in the central part of the quartz diorite. It consists of Cu-Zn quartz veins with N-S direction and many limonite-quartz veins. The latter zone is disseminated, one promising area is Sin area, and it consists of Cu-Zn (sometimes Fe) dissemination.

Geophysical survey (I.P. method) was carried out in the above - mentioned areas. Qualitative interpretation maps were prepared (Fig. 7-1 ~ 7-4) based on the results of I.P. survey and geological mapping.

Anomalies of Mamlis area

- | | |
|--------------------------|-----------------|
| (1) Aşağı Mamlis: | A class anomaly |
| (2) Sivri Kaya: | B class anomaly |
| (3) Southeast Haydar T.: | A class anomaly |
| (4) Southwest Haydar T.: | B class anomaly |

Anomalies of Sin area

- (1) Eastern Çayir dere: A class anomaly
- (2) Western Hasrük dere: A class anomaly

Kopdağ area:

On the basis of results of the investigation in 1978, area and amount of work in the future were discussed, and in 1979, detailed geological mapping, trenching and core drilling were carried out in Coşan and Ezan mining areas, which had been assigned A priority. As a result of the investigation, the chromite ore in the area was found to be mainly of the disseminated type, a small amount of massive ore was found associated with the former, and sometimes, nodular and banded types of ore were also noticed. Details of ore horizons were cleared off by trenches, particularly, owing to severe serpentinization, trenching was one of the leading methods in Coşan and Ezan mining areas. Generally speaking, drilling exploration is suitable and effective to clarification of the extent and quality of an orebody in both strikeside and dipside extension. Hole drilling in Ezan was short, because of the small size of the unit orebody, and the extreme fragility of the host rock, due to severe serpentinization.

Unfortunately not all drilling planned for 1979 could be completed due to above-mentioned reasons and the shortness of field season, which is due to the high altitude of the area. Remaining drilling of Ezan area was however carried out in 1980. Based on the results of the investigation in

1979, areas and amount of work proposed to be done in the future were discussed and are listed in Table 7-1.

Table 7-1 List of Future Prospecting

	Prospecting method	Amount
Tunceli area	Detailed geological survey (1:2,000)	5 km ²
	Drilling in Sin area (3 holes)	650 m
	Drilling in Mamlis area (4 holes)	1,400 m
Ezan and Coşan area	Detailed geological survey (1:1,000)	1 km ²
	Trenching (10 places)	2,000 m ³
	Drilling (20 holes)	1,000 m

In the Kopdağ area, trenching and hole drilling should be followed up by detailed geological survey, and the above mentioned amount of work is the minimum required for future prospecting.

Exploration program in 1980

After the discussion of areas and methods for future prospecting, exploration program in 1980 is recommended.

Details are listed in Table 7-2, however, based on conditions in the field and the actual progress of exploration, this program should be changed as summarized below:

- (1) In Sin and Mamlis areas, five holes should be drilled in order to intersect the mineralized zones, and the total length of necessary drilling is estimated to be 1250 m. However, in Mamlis

area, prior to drilling it is necessary to more than 4 km, of road and therefore the road construction should be initiated (by a bulldozer) in the beginning of June, 1981. Drilling should be initiated southwest of Haydar T.

- (2) In Ezan area, twenty holes should be drilled in order to find out the size and grade of orebody at the dipside extension. The total length of necessary drilling is estimated to be 1000 m. Drilling is strictly limited to a period from the middle of June to the end of September, due to weather conditions. Construction of camping facilities should be initiated in the beginning of June.
- (3) Trenching should be carried out in Ezan and Coşan areas by a bulldozer, total amount planned is 2,000 m³.
- (4) Detailed geological survey and soil sampling are necessary to follow-up the results of geochemical anomaly survey in Tunceli area. Map scale for the survey is 1:2,000, the total area of the survey is estimated to be 5 km². Soil sampling by Ridge and Spur method should be undertaken, with density of sampling being 24 pieces per km².

Table 7-2 Survey Planned for 1980

A. Tunceli		
(1)	Detailed geological survey	5 km ² (Scale 1:2,000)
(2)	Soil sampling	5 km ² (24 pcs/km)
(3)	Drilling in Sin area	750 m (3 holes)
(4)	Drilling in Mamlis area	500 m (2 holes)
(5)	Road construction	4 km
B. Kopdağ area		
(1)	Drilling	1,000 m (20 holes)
(2)	Trenching	2,000 m ³
Drilling in Turkish-Japanese Collaboration is as follows:		
	Tunceli area	1,250 m (5 holes)
	Kopdağ area	less than 500 m

Table 7-3 Schedule of Drilling for 1980

Tunceli and Kopdag areas

	4	5	6	7	8	9	10	11
Sin Mah Camp making Mamlis Kopdağ	—	—	—	—	—	—	—	—
Sin mah Mamlis Kopdağ	—	—	—	—	—	—	—	—
Sin Mah Mamlis Kopdağ	—	—	150m 150m	100m 100m	200m 50m	100m 50m	100m 150m	50m
Drilling	—	—	100m	300m	300m	300m	—	—

Tunceli area; Bulldozer and 2 rigs(750), 2 shifts
Kopdag area ; Bulldozer and 3 rigs(Acker & D750)

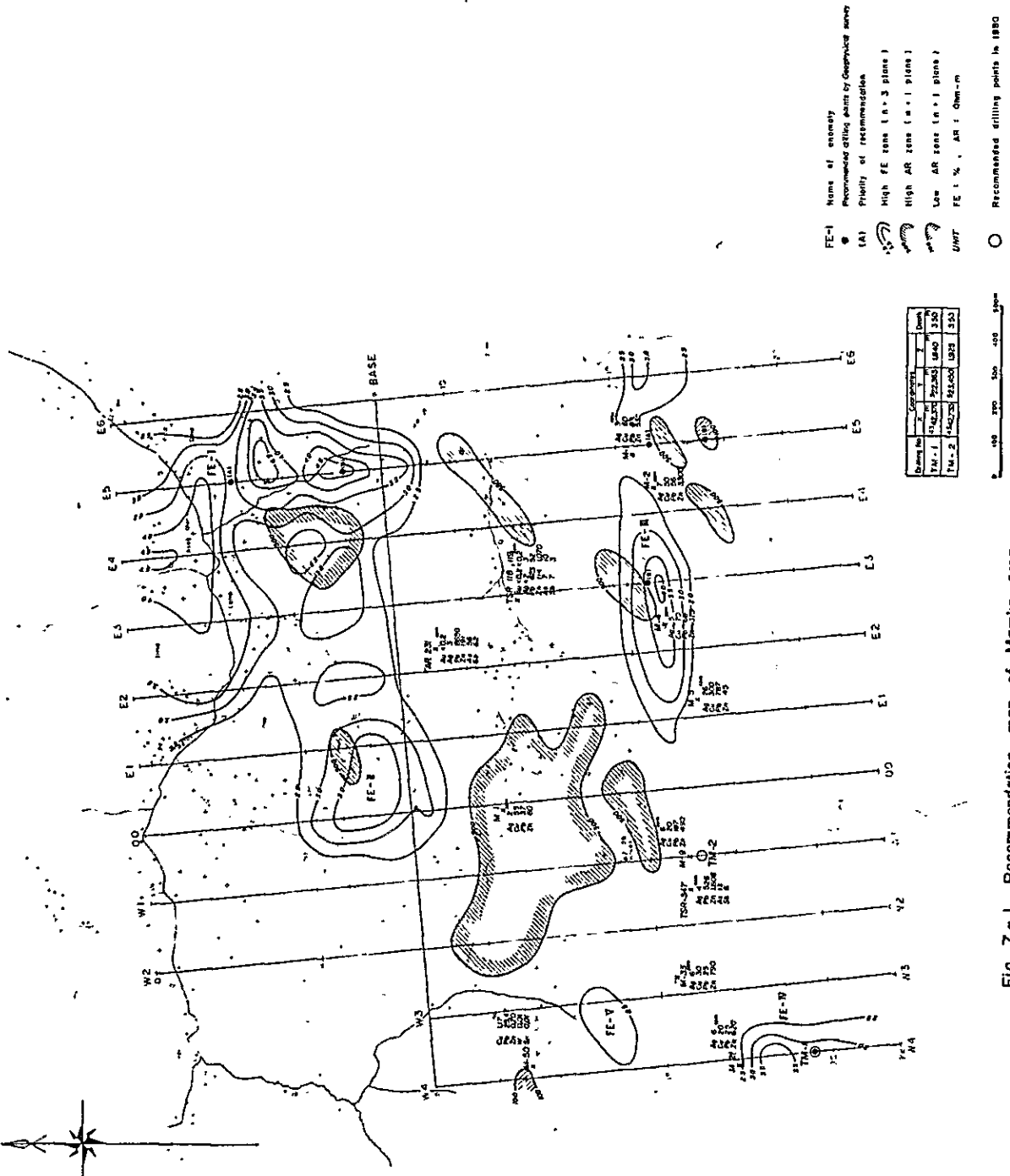
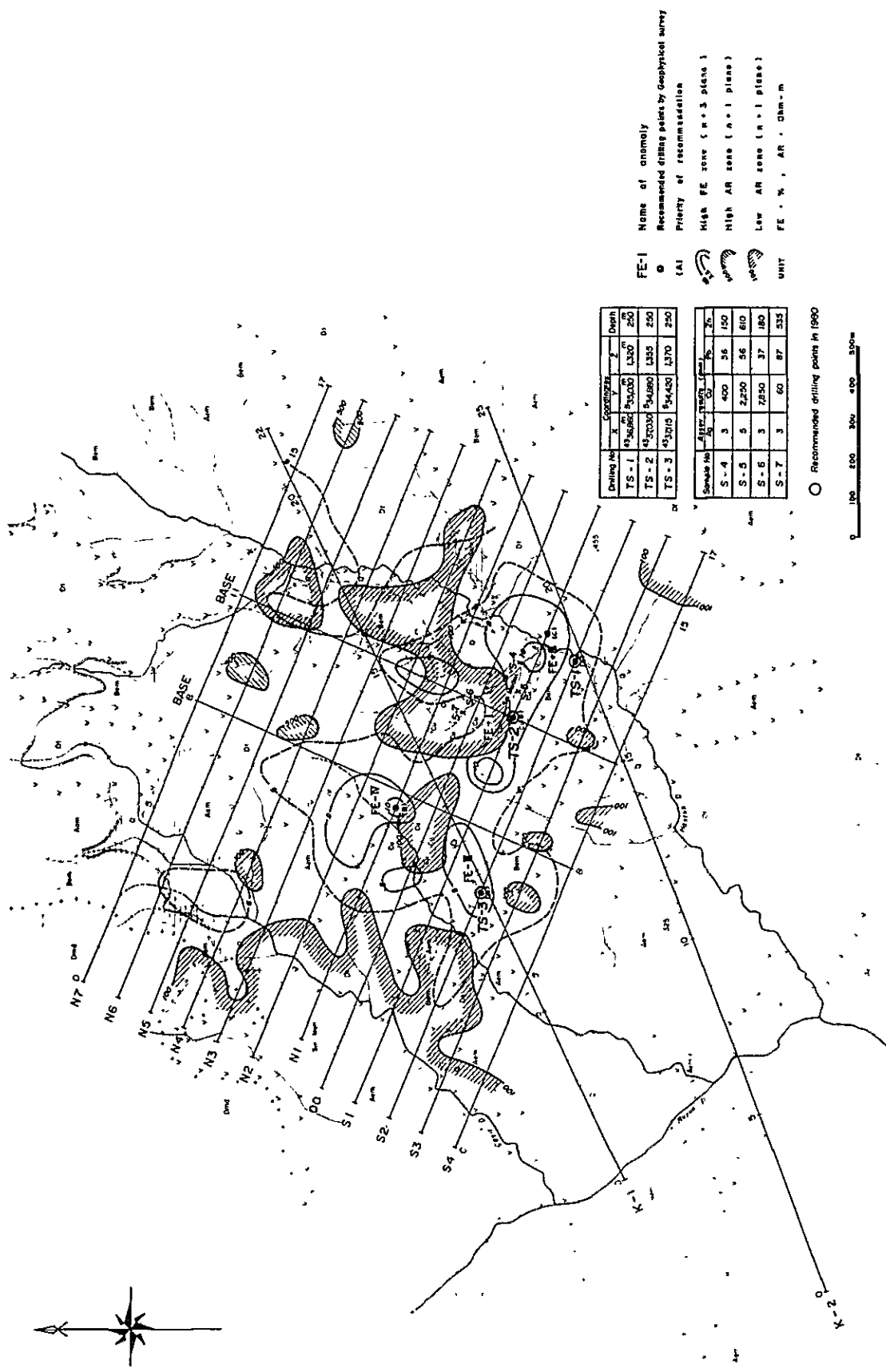


Fig. 7-1 Recommendation map of Mamits area



FE-1 Name of anomaly
 ○ Recommended drilling points by geophysical survey
 (A) Priority of recommendation
 High FE zone (n.s. plane)
 High AR zone (n.s. plane)
 Low AR zone (n.s. plane)
 UNIT FE - % , AR - Gm.m

Drilling No.	Coordinates	Depth
TS-1	432606 13200	250
TS-2	432035 13180	250
TS-3	432015 13170	250

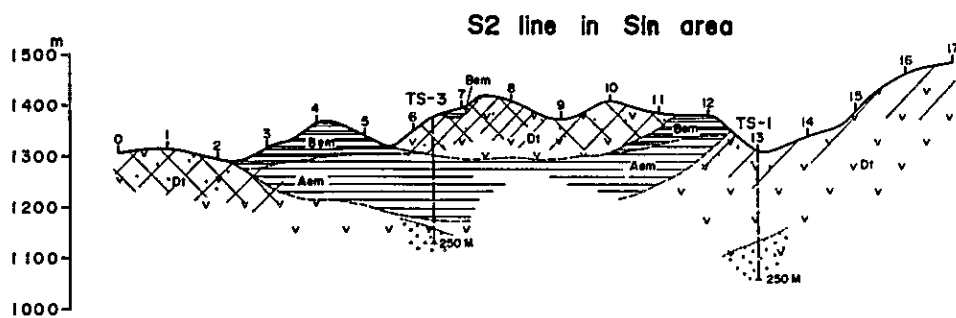
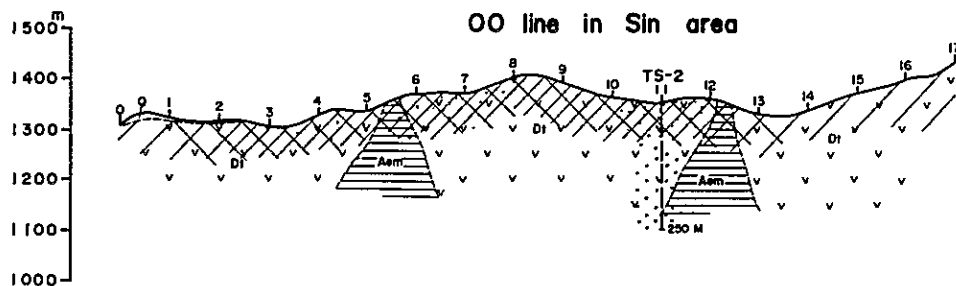
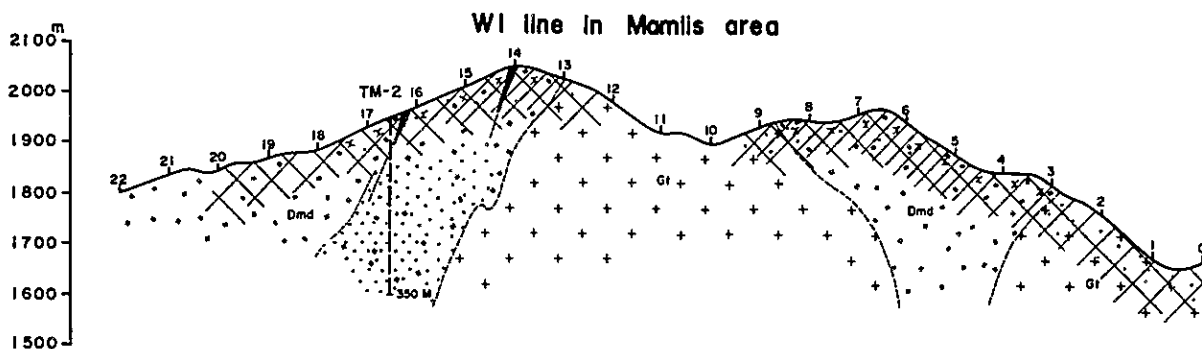
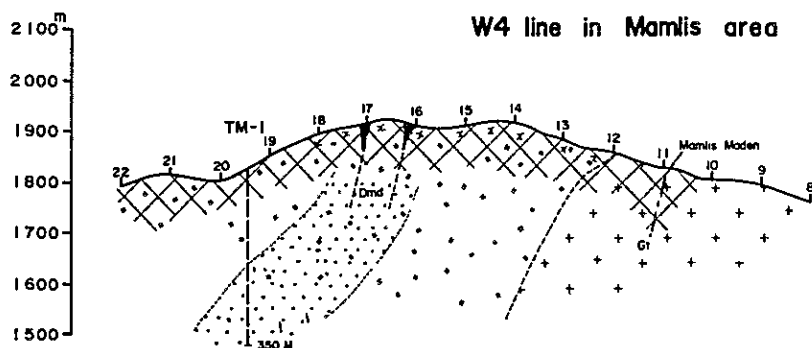
Sample No.	Depth (m)	FE (%)	AR (Gm.m)
S-1	3	400	36
S-2	5	2250	56
S-3	3	7250	37
S-4	3	60	87
S-5	3	335	

○ Recommended drilling points in 1990



Fig. 7 - 2 Recommendation map of Sin area

Fig.7-3 Geological profiles of Mamlis and Sin areas



LEGEND



Geological age and Formation	Stratigraphical marks and symbol	Lithology	Alteration and mineralization
Quaternary	Q		As Argillization zone
Miocene	Dmd	Dachau lava, Dacitic pyrobasics	As ditto , more than strong
Eocene	Kamgik F.	Mudstone, Sandstone, Conglomerate	Si Silicification zone
	Beretep F.	Red mudstone, Calcareous sandstone	Si ditto , more than strong
	Alakbajau F.	Mudstone, Sandstone (colcarous)	Lm Limonitization
Igneous rocks	D1	Dachau	Go Gossan
Territory	Pt	Porphyry	Va Cu, Pb and Zn vein
	Gi	Diorite	Do Disseminated zone

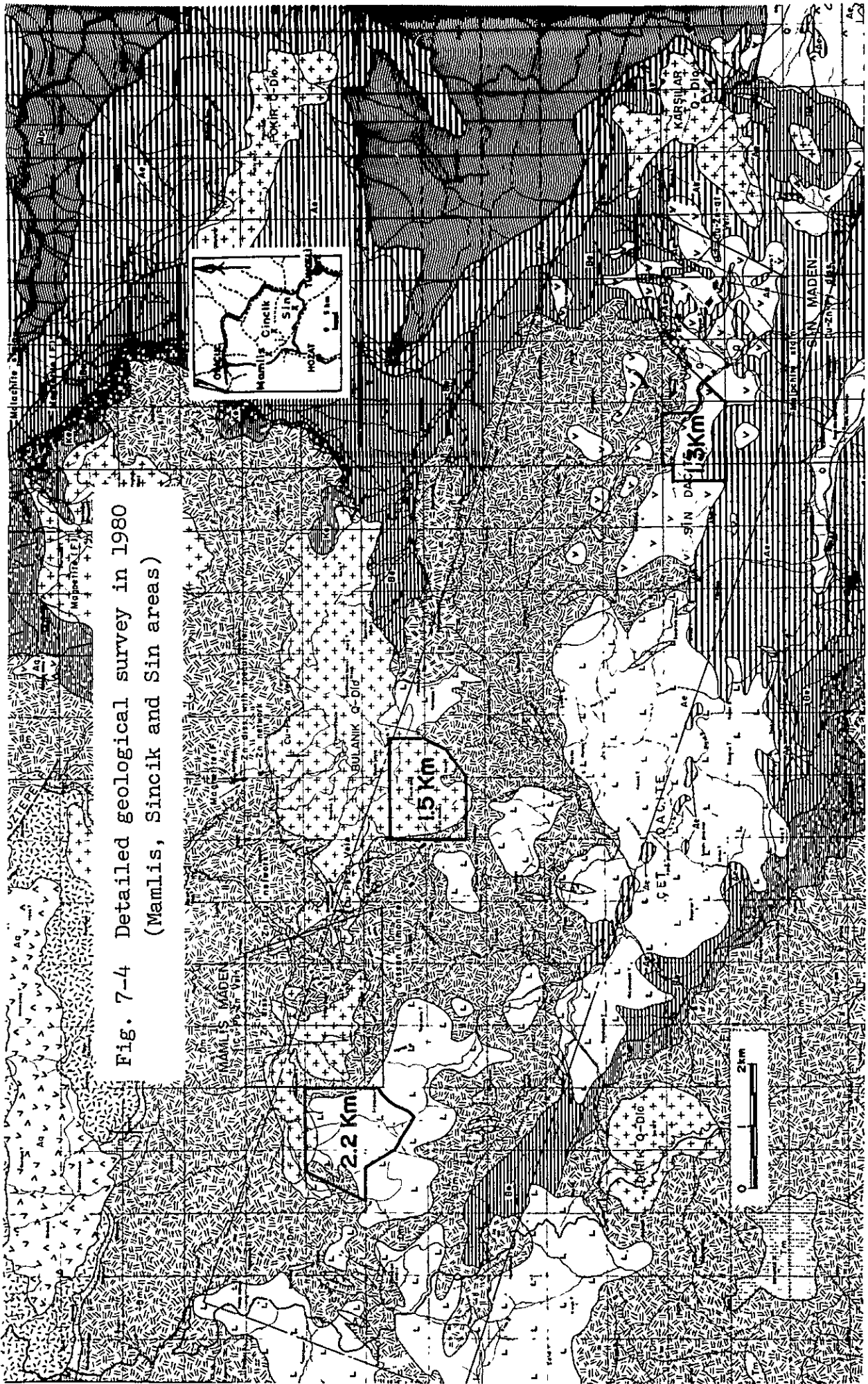


Fig. 7-4 Detailed geological survey in 1980
(Mamalis, Sincik and Sin areas)

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