5.1.3 Meteorological Conditions

Information and data contained herein are based on the weather data given by the Meteorological Department in Damascus for the nearest two climatological stations (4 six hourly observations) at Dmeir and Saba Biar.

Dmeir station is located at longitude 36° 41', latitude 33° 40' and elevation of 650 meters above mean sea level, about 35 km west of the plant site and records are available for the years from 1978 to 1991.

Saba Biar station is located at longitude 37° 41', latitude 33° 47' and elevation of 820 meters above mean sea level, about 90 km east of the plant site and records are available for the years from 1958 to 1985.

A comparison of the reports from these two stations indicates that the weather conditions are almost the same, although a slight difference due to altitude is noticed; generally winds in WSW-ENE direction are dominant in Dmeir while winds from the north are dominant in Saba Biar.

For the purpose of this feasibility study, the weather conditions of the plant site may be represented by data for Dmeir station.

1) Ambient Temperature

Monthly average bulb temperature, monthly average max. and min. temperatures, and monthly absolute max. and min. temperatures recorded at Dmeir and Saba Bier are given in Table 5.1 and Table 5.2. Salient data is delineated below.

	Dmeir ('78-'91)	Saba Biar ('72-'85)
Extreme high temperature	44.5℃ (Jul. '78)	43.5℃ (Jul. '78)
Monthly average maximum temperature	39.1℃ (Aug. '85)	37.5℃ (Aug. '85)
Extreme low temperature	-6.5℃ (Jan. '90)	-8.4℃ (Jan. '73)
Monthly average minimum temperature	0.1℃ (Jan. '90)	-2.9℃
Average temperature	17.0℃ (for all seasons from '78 to '91)	16.0℃ (for all seasons from '72 to '85)

2) Relative Humidity

Monthly average relative humidities recorded at Dmeir and Saba Bier are given in Table 5.3 and Table 5.4.

Salient data is delineated below.

	Dmeir (’78-’91)	Saba Biar (’72-’85)
Maximum	100%	100%
Average	52.7%	51.75%
Minimum	1-5%	1-6%

3) Precipitation

Generally no precipitation is observed during the period from May to September at Dmeir and from June to September at Saba Biar except in some years.

	Dmeir (’78-’91)	Saba Biar (’72-’85)
Monthly maximum	51.6 mm (Dec. ’88)	No record available
Daily maximum	35.1 mm (Dec. ’88)	40.7 mm (Dec. ’80)
Yearly	94.6 mm (’83) to 153.1 mm (’88)	No record available

Number of days with more than 0.1 mm rain:

Yearly	29 to 36 days	7 to 46 days
Monthly	13 days (Dec. ’87)	11 days (Jan. ’74/ Mar. ’76/Nov. ’82)

4) Barometric Pressure

	Dmeir (’78-’91)	Saba Biar (’72-’85)
Monthly average	936.1 hPa (Aug. ’79) to 946.3 hPa (Dec. ’83)	912.2 hPa (Jul. ’84) to 924.0 hPa (Nov. ’78)
Maximum	955.7hPa	932.8 hPa
Minimum	923.5 hPa	903.9 hPa

5) Snow Fall Depth

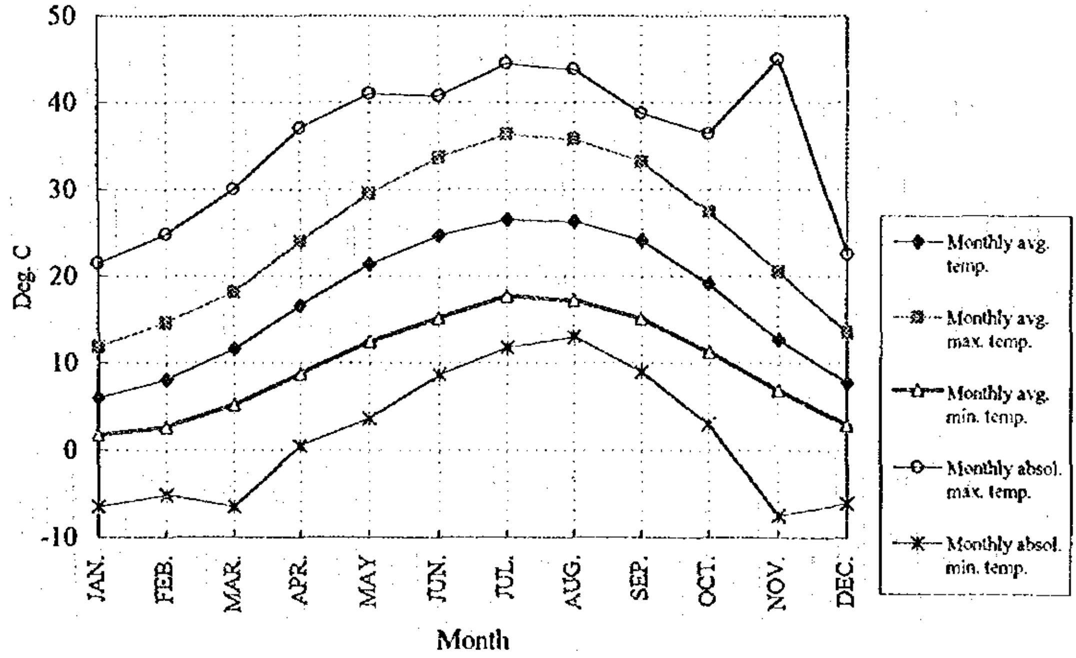
Except the following records, no snow fall has generally been recorded:

Dmeir (’78-’91)	Saba Biar (’72-’85)
5 mm (Feb. ’82)	12 mm (Jan. ’83)
3 mm (Feb. ’89)	11 mm (Jan. ’78)
1 mm (3 records)	5 mm (Feb. ’82)
2 or 1 mm (3 records)	

Table 5.1 Temperature (Deg. C) Recorded at Dmeir Station

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
Monthly average temp.	6.0	8.1	11.6	16.6	21.3	24.7	26.5	26.3	24.1	19.1	12.7	7.7
Monthly average max. temp.	11.9	14.6	18.2	24.0	29.5	33.7	36.3	35.8	33.2	27.4	20.5	13.5
Monthly average min. temp.	1.7	2.6	5.2	8.8	12.5	15.2	17.7	17.2	15.1	11.3	6.9	2.9
Monthly absol. max. temp.	21.5	24.8	30.0	37.0	41.0	40.8	44.5	43.8	38.8	36.4	45.0	22.5
Monthly absol. min. temp.	-6.5	-5.2	-6.5	0.5	3.6	8.6	11.8	13.0	9.0	3.0	-7.5	-6.1

Longitude: 36°41' Latitude: 33°40' Elevation: 650 m M.S.L.

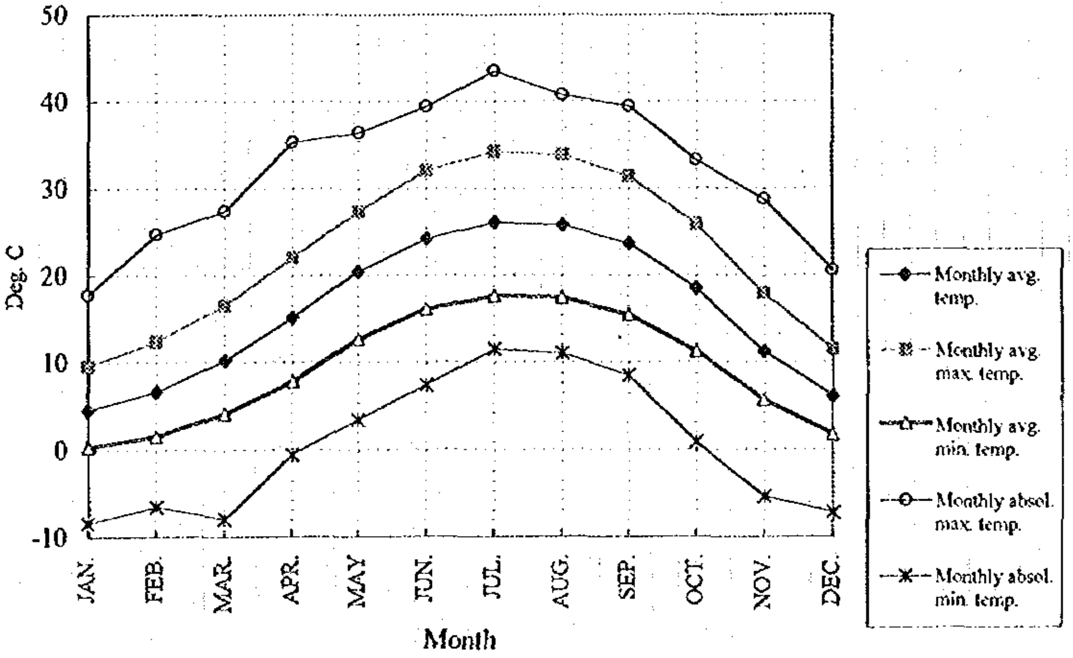


(Source: Meteorological Department)

Table 5.2 Temperature (Deg. C) Recorded at Saba Biar Station

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
Monthly average temp.	4.6	6.6	10.2	15.1	20.4	24.2	26.1	25.7	23.6	18.5	11.2	6.1
Monthly average max. temp.	9.6	12.4	16.5	22.0	27.3	32.0	34.2	33.8	31.4	25.8	17.9	11.5
Monthly average min. temp.	0.3	1.5	4.1	7.8	12.7	16.1	17.6	17.4	15.5	11.2	5.7	1.7
Monthly absol. max. temp.	17.8	24.7	27.4	35.3	36.4	39.4	43.5	40.7	39.5	33.2	28.7	20.5
Monthly absol. min. temp.	-8.4	-6.6	-8.0	-0.6	3.4	7.4	11.5	11.0	8.5	0.8	-5.4	-7.2

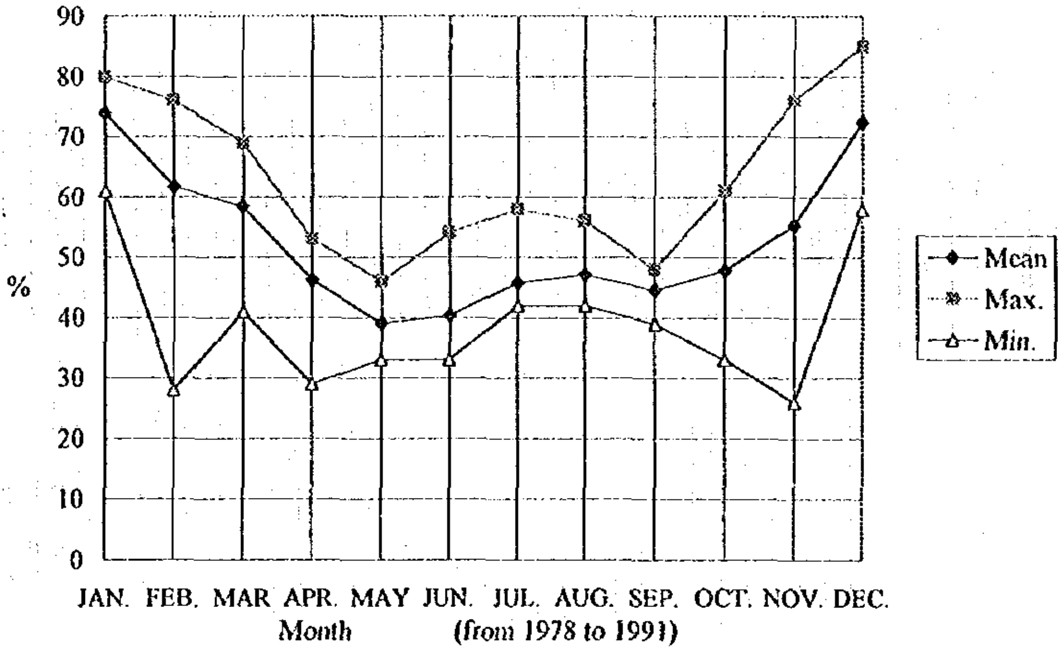
Longitude: 37°41' Latitude: 33°47' Elevation: 820 m M.S.L.



(Source: Meteorological Department)

Table 5.3 Relative Humidity (%) at Dmeir Station

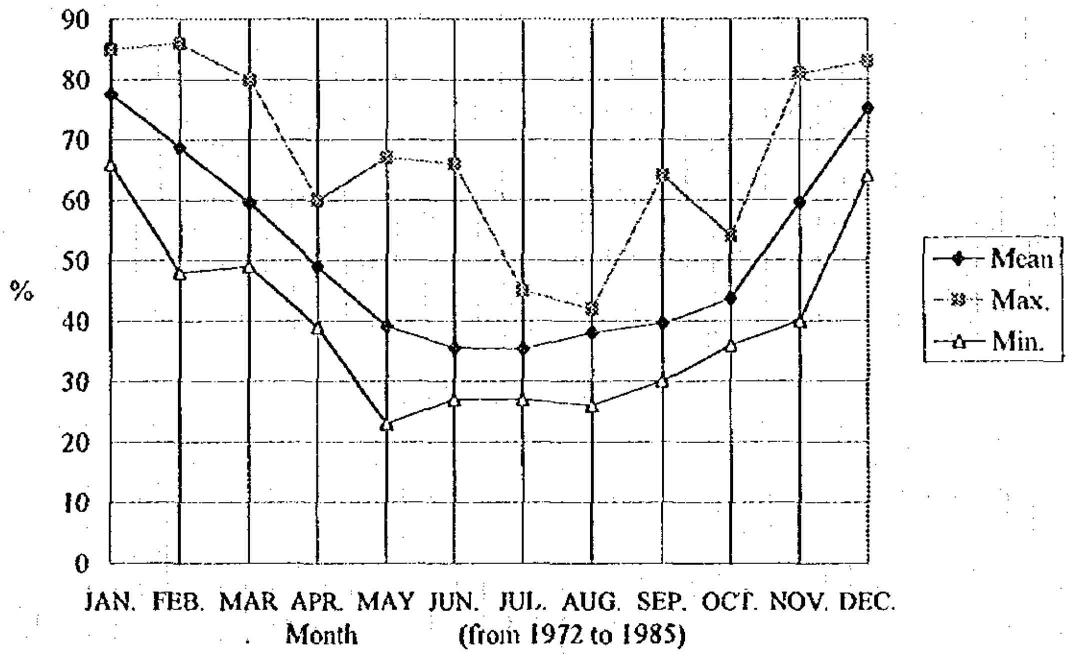
Year	Monthly Average Relative Humidity %											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
1978									48.0	33.0	41.0	75.0
1979		64.0	51.0	38.0	37.0	35.0	42.0	43.0	41.0	51.0	26.0	85.0
1980	78.0	75.0	69.0	52.0	36.0	33.0	45.0	48.0	48.0	41.0	51.0	72.0
1981			63.0	53.0	41.0							
1982												
1983	79.0	74.0	66.0	51.0	46.0	39.0	45.0	45.0	46.0	44.0	61.0	68.0
1984	75.0	49.0	56.0	52.0	35.0	42.0	44.0	49.0	41.0	41.0	76.0	76.0
1985	76.0	28.0	41.0	45.0	39.0	43.0	44.0	42.0	44.0	49.0	56.0	64.0
1986	67.0	66.0	49.0	45.0	44.0	39.0	44.0	47.0	39.0	53.0	65.0	74.0
1987	70.0	58.0	66.0	44.0	35.0	39.0	42.0	45.0	44.0	50.0	56.0	75.0
1988	80.0	76.0	67.0	53.0	36.0	40.0	46.0	51.0	46.0	61.0	59.0	75.0
1989	78.0	56.0	55.0	29.0	33.0	39.0	45.0	46.0	46.0	50.0	61.0	68.0
1990	61.0	71.0	56.0	48.0	42.0	41.0	49.0	46.0	48.0	49.0	49.0	58.0
1991	75.0	62.0	63.0	44.0	45.0	54.0	58.0	56.0	44.0	51.0	62.0	79.0
Mean	73.9	61.7	58.5	46.2	39.1	40.4	45.8	47.1	44.6	47.8	55.3	72.4
Max.	80.0	76.0	69.0	53.0	46.0	54.0	58.0	56.0	48.0	61.0	76.0	85.0
Min.	61.0	28.0	41.0	29.0	33.0	33.0	42.0	42.0	39.0	33.0	26.0	58.0



(Source: Meteorological Department)

Table 5.4 Relative Humidity (%) at Saba Biar Station

Year	Monthly Average Relative Humidity %											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
1972	82.0	86.0	67.0	60.0	67.0	66.0	45.0	41.0	39.0	43.0	64.0	64.0
1973	66.0	63.0	49.0	46.0	35.0	39.0	35.0	39.0	64.0	45.0	61.0	75.0
1974	85.0	80.0	80.0	51.0	40.0	40.0	35.0	42.0	39.0	37.0	61.0	76.0
1975	82.0	73.0	50.0	40.0	45.0	40.0	35.0	40.0	34.0	42.0	54.0	68.0
1976	73.0	69.0	63.0	52.0	40.0	29.0	36.0	40.0	38.0	43.0	40.0	71.0
1977	77.0	55.0	58.0	56.0	38.0	32.0	33.0	31.0	45.0	48.0	53.0	83.0
1978	78.0	59.0	52.0	41.0	23.0	29.0	27.0	40.0	43.0	36.0	44.0	80.0
1979	78.0	65.0	51.0	39.0	35.0	37.0	34.0	37.0	34.0	53.0	64.0	83.0
1980	82.0	77.0	68.0	53.0	33.0	27.0	36.0	39.0	41.0	41.0	59.0	78.0
1981	76.0	74.0	71.0	55.0	42.0	31.0	34.0	39.0	30.0	37.0	61.0	70.0
1982	74.0	66.0	57.0	48.0	44.0	31.0	41.0	38.0	37.0	54.0	70.0	80.0
1983	80.0	75.0	62.0	48.0	41.0	32.0	36.0	39.0	38.0	44.0	58.0	72.0
1984	73.0	48.0	58.0	51.0	29.0	32.0	37.0	42.0	33.0	39.0	81.0	80.0
1985	79.0	72.0	49.0	46.0	35.0	34.0	31.0	26.0	39.0	50.0	64.0	72.0
Mean	77.5	68.7	59.6	49.0	39.1	35.6	35.4	38.1	39.6	43.7	59.6	75.1
Max.	85.0	86.0	80.0	60.0	67.0	66.0	45.0	42.0	64.0	54.0	81.0	83.0
Min.	66.0	48.0	49.0	39.0	23.0	27.0	27.0	26.0	30.0	36.0	40.0	64.0



(Source: Meteorological Department)

5.2 PORT

5.2.1 Outlook

The coastline of Syria stretches approximately 180 km along the Mediterranean Sea. The coastal plain is narrow and extends from Ras Albasit in the north to Nahr El-Kebir in the south.

There are several ports along the coast from north to south: Latakia, Jableh, Banyas, Tartous and Arward. Latakia and Tartous are the two principal ports, and these ports handle not only cargo but also passengers. The distance between these two ports is about 90 km.

Latakia port is located about 180 km southwest of Aleppo, the second largest city in Syria. It serves maritime traffic mainly for the northern and central parts of Syria.

Tartous port is located about 100 km west of both Homs and Hama, and 250 km northerly of Damascus. The Lebanese border is situated about 30 km south from Tartous port, which serves maritime traffic mainly for the central and southern parts of Syria.

Banyas port is located just between Latakia and Tartous, and the port serves mainly for loading of oil for export.

Jableh and Arward are rather small ports compared to the above three ports. Arward is located on an island about 5 km south of Tartous port, and about 3 km offshore, west of Tartous city.

Tartous port, Pier B, is the most suitable import port for unloading of goods required for the plant construction and for temporary facilities required for the erection of the plant which have been transported by sea. The storage yard has not enough empty space at present, but can be used for this project. However, the unloading facilities as well as cargo handling facilities on land seem to be insufficient, therefore, vessels having their own equipment and/or additional cargo handling facilities on the pier might be required, or Latakia port might be used only for specially heavy and bulky cargoes, such as the kiln shell; this should be investigated after the actual size and weight are decided.

Goods unloaded at Tartous port shall be transported either by road directly to the plant site through Homs and the suburbs of Damascus, or by railway to Dmeir station, from where the goods shall be transported to the plant site by road.

5.2.2 Tartous Port

Tartous port was constructed as an all-weather deep-water port with breakwaters, approach channel, turning basin and anchorage basin for large as well as small ships. It consists of total 23 quays; the major parts of the port are Pier A, Pier B, Pier C, bulk terminal and inner area. Pier A was constructed first in 1968 and since then the port has been developed according to the increase of the port cargo. Tartous port is now one of the largest ports facing the Mediterranean Sea, having ample depths and quay lengths for international shipping. The largest ship ever to enter Tartous port is 60,000 tons. Amount of import and export goods through Tartous port is as shown in Table 5.6.

The sea and shore line in Syria belong to the country in general. A development plan for port facilities both on land and offshore is being made by the Ministry of Transportation; however, these facilities are constructed, administered, operated and maintained by the state-owned Port Company. The land area is owned by the Tartous Port Company (TPC) and amounts to about 1,100,000 m², while the water area, which is owned by the country, amounts to about 1,300,000 m². Total number of persons working under TPC is about 3,000.

1) Breakwater and Water Areas

Tartous port is protected by two breakwaters. The main breakwater facing south and west has a total length of about 2,600 m, while the sub-breakwater facing northwest has a length of about 1,600 m.

The approach channel is 200 m wide and 14.5 m deep. At the end of the channel, there is a turning basin 450 m in diameter and 13.5 m deep. Along the main breakwater, 10 mooring buoys are provided with a minimum 11 m depth. The difference of water level between high and low tides is only about 1 m.

2) Pier A

Pier A has southern quays totaling 800 m in length and max. -10.5 m in water depth, northern quays totaling 900 m in length and max. -12.0 m in water depth, and a western quay of 160 m length at the root of the pier.

The southern quays are used mainly for conventional ships and deal with all types of cargo. Quay cranes with trucks and sidings are provided. Cargoes are directly transferred between ship and truck or railway.

The northern quays and the western quay are used for the handling of grain and bulk cargoes such as iron, steel, timber and bagged cargoes. Behind the northern quays, there are 36 grain silos with a total storage capacity of 80,000 tons. There are 6 transit sheds on and around Pier A.

3) Pier B

Pier B, which will be the most suitable port for this project, has southern quays totaling 900 m in length, including 360 m in length with -12.0 m in water depth, and northern quays totaling 540 m in length, including 260 m in length with -13.0 m in water depth.

The southern quays are used mainly for general cargoes and the northern quays for the handling of unit loads such as container cargoes. There is no shed on the pier and all spaces are used as open storage areas. At the center of the pier, there is a railway siding; however, it is seldom used. At the root of the pier, there are some open storage yards which serve mainly as a container marshaling yard.

4) Pier C

Pier C has southern quays totaling 440 m in length and -12.0 ~ -13.0 m in water depth. About the half of the western side of the southern quays and northern side of the pier are used by the military. The commercial and military areas are divided by a fence.

Pier C handles bulk cargoes like iron, steel, cement/clinker, timber and imported cars. Railway sidings are provided in both the commercial and military areas. At the root of the pier, open storage areas are available, which are used as a container marshaling yard.

5) Cargo Handling Equipment

Following major cargo handling equipment is available at Tartous port.

Type	Capacity	Year	Number	Remarks
Floating crane	100 t	1971	1	Present capacity is 80-90 t
" "	32 t	1976	1	
Portable jib crane	Max.6 t	1973	17	
Mobile crane	75 t	1975	2	
" "	15 t	1977	27	
Mobile tower crane	40 t	1981	2	
" " "	27 t	1980	3	
Straddle carrier	35 t	1980	3	
Fork lift	35 t	1980	2	
" "	32 t	1980	1	
Tractor	40 t		9	

At Pier A, general cargoes are mainly handled by the rail-mounted portal jib cranes of small capacity installed on the quay side, or by a combination of jib cranes and ship equipment.

On the other hand, there is no rail-mounted crane at Piers B and C, and the cargoes are handled by mobile cranes, by ship equipment or by a combination of these. There is no special container crane, and containers are handled by container ship equipment or by a floating crane of 80 to 90 tons lifting capacity possessed by the TPC.

Cargo handling equipment at Latakia port is similar to that at Tatrous port, except that the following equipment is available at Latakia port.

Type	Capacity	Year	Number	Remarks
Portable jib crane	16 t	1990	2	
Mobile crane	65 t	1975	4	
Straddle carrier	125 t	1970	1	Tire mounted

6) Port Congestion

According to the port officer, there is no port congestion at the moment; however, Pier A sometimes has congestion on the pier due to land transportation problems as stated above.

7) Others

Ships from countries having no national relationship, and especially ships coming from Israel cannot enter Syrian ports. Documentation procedures for any ship arriving at Tartous port take about two days before entry to the port is permitted.

5.2.3 Transportation Route to the New Plant

Since the new cement plant site at Abu Al Shamat is located about 70 km east of Damascus, Tartous port will be the most suitable import port for unloading of goods transported by sea and required for plant construction, such as plant equipment, machinery and materials, as well as temporary facilities such as heavy equipment and various materials required for the erection of the plant.

Goods unloaded at Tartous port shall be transported either by road directly to the plant site through Homs and the suburbs of Damascus, or by railway to Dmeir station about 25 km west of the plant site, from where the goods shall be transported by road (refer to Map 5).

Table 5.5 Movement of Goods and Passengers

Name of Port	Latakia	Jableh	Banias	Tartous	Arwad	Total
1990						
Ships Entering	808	-	191	879	209	2,087
Goods (1,000 ton)						
Loaded	433	-	7,686	9,294	-	17,413
Unloaded	1,696	-	515	2,377	-	4,588
Passengers						
Departure	3,292	-	-	-	-	3,292
Arrival	3,765	-	-	-	-	3,765
1991						
Ships Entering	1,034	-	130	1,082	200	2,446
Goods (1,000 ton)						
Loaded	2,532	-	10,487	4,736	-	17,755
Unloaded	1,953	-	447	2,568	-	4,968
Passengers						
Departure	5,950	-	-	-	-	5,950
Arrival	13,278	-	-	-	-	13,278
1992						
Ships Entering	1,026	-	125	1,512	173	2,836
Goods (1,000 ton)						
Loaded	293	-	12,023	5,556	-	17,872
Unloaded	1,883	-	908	2,885	-	5,676
Passengers						
Departure	-	-	-	-	-	-
Arrival	1,806	-	-	216	-	2,022
1993						
Ships Entering	1,213	-	333	1,725	254	3,525
Goods (1,000 ton)						
Loaded	380	-	14,830	3,817	-	19,027
Unloaded	2,460	-	1,015	2,430	-	5,905
Passengers						
Departure	9,582	-	-	1,306	-	10,888
Arrival	21,773	-	-	48	-	21,821
1994						
Ships Entering	1,233	-	59	1,742	399	3,433
Goods (1,000 ton)						
Loaded	494	-	14,731	4,307	-	19,532
Unloaded	1,784	-	133	2,556	-	4,473
Passengers						
Departure	2,389	-	-	1,216	-	3,605
Arrival	4,298	-	-	1,459	-	5,757

(Source: Statistical Abstract 1994 & 1995)

Table 5.6 Goods Imported / Exported through Tartous Port

(thousand tons)

Year	1988	1989	1990	1991	1992	1993	1994
Imported Goods							
Cereals & cereal products	602	1,040	1,143	1,225	104	101	294
Rice	121	92	18	16	34	23	32
Sugar	207	213	204	230	181	205	341
Foodstuffs	96	205	333	84	392	413	385
Wood	63	76	70	82	121	155	141
Chemicals	315	229	309	62	156	85	68
Cement	11	5	2	7	4	6	7
Iron & Metal	247	231	220	334	298	640	784
Machinery	53	35	39	49	48	102	185
Automobiles	0	0	0	0	39	38	43
Miscellaneous	64	58	59	469	783	887	369
Total	1,779	2,184	2,397	2,558	2,160	2,655	2,649
Exported Goods							
Foodstuffs	2	38	8	19	21	71	6
Cereals	1	44	0	0	0	0	57
Cotton	5	8	4	5	5	11	18
Phosphate	1,824	1,634	1,257	1,103	926	607	777
Cement	70	589	90	21	0	0	0
Automobiles & Equipment	12	1	2	1	0	0	4
Empty Goods Vehicles	1	1	0	0	0	0	0
Containers	4	3	2	8	20	20	21
Miscellaneous	17	7	706	421	362	124	15
Total	1,972	2,295	2,069	1,578	1,334	833	898

(Source: Statistical Abstract 1993 - 1995)

5.3 ROAD

5.3.1 Outlook

The Syrian road network expanded rapidly in the 1980's. With the help of foreign finance, a number of new motorways were constructed, including the highway from Tartous to Latakia and from Damascus to Dar'a, about 110 km south of Damascus.

The length of roads in the whole of Syria and in each Province is as shown in Table 5.7. Construction of roads falls under the Ministry of Communication, while the transportation of cargoes either by road or railway falls under the Ministry of Transportation.

Roads continue to be the most important channel for commercial transport, accounting for over 90% of all traffic goods. In the absence of an efficient railway system and due to the relatively small distances within the country, they are also the main way of passenger transport.

The Aleppo-Hama-Homs-Damascus axis is the backbone of the local road network and an important transit route to Turkey, Lebanon, Jordan and the Gulf; however, Syria derives limited income from transit fees.

Considering the rapid increase in all types of vehicles in recent years as well as the serious congestion in Damascus and in Aleppo, further expansion of the loop line around the suburbs of Damascus has been planned by the government.

There is no specialized transportation company except a few companies in Syria, and almost all the vehicles for transport, such as loaders (trailers without side walls), trailers (with side walls) and trucks, are owned by private persons. Each owner has one to several vehicles and has a registration with the governmental Transportation Office, who will organize traffic activity. In or near the big cities, there are several Transportation Offices, some of which are located in Adra near Damascus, Tartous and Latakia, one for each Province.

In addition to the vehicles owned by private persons, some public sectors have their own vehicles, such as the military themselves, Military Housing Establishment, Kassioun Company, and so on, whose vehicles could be borrowed or rented upon request by the GOC (refer to Map 2).

5.3.2 Transport Route to the New Plant

Goods unloaded at Tartous port shall be transported either by road directly to the plant site through Homs and Adra, or by railway to Dmeir station, from where the goods shall be transported to the plant site by road.

The road from Tartous to Adra through Homs is a highway of two lanes, and that from Adra to Abu Al Shamat is a paved public road of one lane. In case special heavy and bulky cargoes are unloaded at Latakia port, the highway connecting Latakia and Tartous could be used.

There are more than 10 overhead bridges across the highway between Tartous and Homs, and few between Homs and Adra, the effective height of each bridge is 4.75 m. However, around any crossing point of the highway, there is a by-pass road, which has no bridge across any road or river or railway over or underneath the by-pass road.

Therefore there is no limitation for transportation as far as height and length are concerned. As for weight, about 100 tons of cargo including the weight of the vehicle was transported from Tartous to the Homs refinery plant, and heavy equipment was transported to the Tichirin power station near Dmeir.

5.3.3 Transport Facilities and Fees

Lifting facilities are available form the Tartous Port Company as described in Chapter 5.2, but are not possessed by private persons. There are six loaders registered with the Transportation Office at Tartous, each having a capacity of 100 tons. About 400 trucks and trailers of various types are available, including 26-ton capacity trailer (with box) and a six-wheel, 20-ton capacity truck.

The transportation fee for general cargo is calculated based on Syrian Decree No. 1400, issued on April 30, 1994, an abstract of which is as follows:

1) Basic fee for general cargo

Distance	Basic Fee
1 - 50 km	0.64 SP/ton/km
51 - 100 km	0.62 SP/ton/km
101 - 200 km	0.61 SP/ton/km
201 - km	0.57 SP/ton/km

Gross weight is applied for the basic fee; however, the cost for loading and unloading is not included in the above fee.

2) Excess charge for delay will be as follows:

Type of Truck	Excess Charge
Two (2) axles	425 SP/day/truck
Three (3) axles	485 SP/day/truck
Lorry	650 SP/day/truck

3) When the truck returns with no cargo, 35% excess charge is required.

4) When the transportation is destined for other provinces, 35% excess charge is required.

5) Transportation of containers shall require an additional 9 SP/ton for containers. Excess charge for empty return is 50% in case of container transportation.

6) Transportation fee for special cargoes shall be in accordance with Syrian Decree No. 65, issued on June 10, 1980.

The transportation fee for a loader of 100-ton capacity or by trailer of 26-ton capacity from Tartous to Damascus (not to Abu Al Shamat), excluding loading and unloading works, shall be as follows:

Basic fee for cargo less than 10 tons per piece: 160 SP/t

Additional fee by weight of cargo:

Weight per piece	Addition to basic fee
10 - 15 ton	+ 25%
15 - 30 ton	+ 40%
30 - 45 ton	+ 75%
45 - 60 ton	+ 120%
60 - 100 ton	by separate agreement

5.3.4 New Road Construction for the New Plant

The new cement plant site is located around 7 km from an existing branch point of the 1st class road at Abu Al Shamat, which connects Damascus and Tadmor/Palmyra.

A new 1st class road with two lanes shall be constructed by the concerned authorities because currently, the road is a poor, unpaved, single-pass road.

This road is used for all truck transport such as raw materials, bagged cement and cars & buses. The new road to be constructed is:

Class:	1st class road with 2 lanes
Length:	7 km
Truck passage:	Around 400 units per day (one way)

Table 5.7 Length of Roads

(km)

Year	Asphalted Roads	Paved Non-asphalted Roads	Levelled Roads	Total
1980	12969	4172	2678	19819
1981	14875	4156	2698	21729
1982	15880	4697	2682	23259
1983	16338	4682	1612	22632
1984	19950	5943	2914	28807
1985	20732	5467	2197	28396
1986	21791	5563	2002	29356
1987	22155	6018	1652	29825
1988	22498	6155	1559	30212
1989	22928	6565	1614	31107
1990	23778	7305	2129	33212
1991	24375	7431	2150	33956
1992	25887	7365	3003	36255
1993	26299	7910	2168	36377
1994	26993	8384	2098	37475

(Source: Statistical Abstract 1995)

Table 5.8 Length of Roads by Province

(km in 1994)

Mohafazat	Asphalted Roads	Paved Non-asphalted Roads	Levelled Roads	Total
Damascus	3134	0	0	3134
Homs	3352	38	65	3455
Hama	2423	519	430	3372
Tartous	2049	691	147	2887
Latakia	2463	167	0	2630
Idleb	2110	452	71	2633
Aleppo	3945	3808	524	8277
Al-Raqqa	1657	210	135	2002
Al-Hasekeh	1801	926	0	2727
Deir-ez-Zor	1574	706	140	2420
Al-Sweida	885	642	462	1989
Dar'a	1186	187	63	1436
Quneitra	414	38	61	512
Total	26993	8384	2098	37475

(Source: Statistical Abstract 1995)

5.4 RAILWAY

5.4.1 Outlook

The railway system in Syria consists of a number of ordinary (1,435 mm gauge width) and narrow gauge tracks with a total length of 2,342 km. The main line connects from Damascus through Homs, Hama, Aleppo, Ar-Raqqua, Deir-Er-Zor and Al-Hasakeh to Al Quamishli situated in the northeastern part of Syria and facing the boundary with Turkey. This main line is a single line with ordinary gauge tracks. It extends to Dar'a, in southwestern Syria and facing the boundary with Jordan using narrow gauge tracks. Secondary lines link the Syrian ports to important agricultural and industrial centers.

In the 1980's, the network was expanded under Soviet technical assistance, and a number of new lines, including those from Latakia to Qamishli, Deir-Er-Zor to Al Bukamal and Homs to Damascus were added to the existing tracks. The length of railways is as shown in Table 5.10.

Four million passengers use rail transport annually, but its primary importance lies in the transport of bulky industrial goods. The quantity of merchandise transported by railways is as shown in Table 5.11.

The railway was used for transportation to and from Turkey, Jordan and Iraq in former times, but not for Jordan or Iraq at present. Discussions about the installation of a new line from Damascus to Amman in Jordan have been under way for some time, but appear unlikely to result in concrete steps until additional finance is provided.

The installation of a railway shall be made by the Ministry of Transportation under the authorization of Ministry of Planning. Railway wagons shall also be furnished and the railway shall be operated by the Ministry of Transportation.

Tax on transportation is not required within the country of Syria (refer to Map 2 and Map 5).

5.4.2 Transport Route to the New Plant

Goods unloaded at Tartous port shall be transported either by road directly to the plant site, or by railway to Dmeir station, situated about 25 km west of the plant site, from where the goods shall be transported to the plant site by road.

The railway line connects Tartous to Dmeir through Homs and Mahin. The railway line connecting Latakia and Tartous has been operating since 1991; therefore, general cargoes can also be unloaded at Latakia port and transported by railway to Dmeir without passing through Aleppo (refer to Fig. 5.1).

5.4.3 Transportation Facilities and Fee

Various types and sizes of wagons are available for transportation of cargo. The largest flat type wagon is as illustrated in Fig 5.2. The wagon has four axles, loading area of 49 m^2, and a maximum loading capacity of 56 tons. The available number of 56-ton flat wagons is about 100 units. The maximum transportation weight is 800 tons per train trip.

The limitations for transportation are shown in Fig 5.3.

The transportation fee is classified into five classes according to the kind of goods, and is tabulated in Syrian Decree No. 6083, issued on May 26, 1994, an abstract of which is shown in the following table.

Table 5.9 Transportation Fee (SP/ton)

Distance (km)	Class 1	Class 2	Class 3	Class 4	Class 5
50	84	71	57	55	46
100	130	110	93	84	75
200	218	188	159	143	124
300	303	262	223	202	175
500	473	406	345	314	274
800	717	620	525	477	417

Machinery and equipment belong to Class 1, bulk cement to Class 4, and bagged cement to Class 5.

5.4.4 New Railway Construction for the New Plant

The Ministry of Transport shall construct a new single line railway from the existing Dmeir station to the new plant site. The length of the new railway line will be around 25 kms from Dmeir station.

RFMT commented that today transport capacity on this railway line is 20 round trips per day; however, current working ratio is less than 10 trips. They want to increase the transport services to more than current services.

JST proposes to apply this railway for transport of oil and bulk cement. Oil will be transported from Homs refinery to the new plant. The distance of the railway is around 240 km.

Bulk cement will be transported from the plant site to Dmeir (25 km); Damascus (70 km) and Dar'a (130 km) stations (refer to Fig. 5.4).

RFMT agrees to prepare oil tankers and bulk cement wagons which will be used for the new plant. New railway line is:

Rail Length = around 25 km (single line)
(Dmeir station to the new plant site)
Rail Gauge = 1,435 mm
Train Speed = 80 km / h

Table 5.10 Length of Railways

(km)

	1990	1991	1992	1993	1994
Ordinary Lines					
Latakia - Aleppo	860	860	860	860	860
Al Kamishli - Al Yarubieh	81	81	81	81	81
Aleppo - Hama - Homs - Damas	527	527	527	527	546
Aleppo - Midan Ekbes - Rai	166	166	166	166	166
Hama - Mhardeh	19	19	19	19	0
Homs - Kseyr	40	40	40	40	40
Akkari - Lebanese Boundaries	5	5	5	5	5
Mahin - Phosphate Mines	111	111	111	111	111
Homs - Al Akkari - Tartous	102	102	102	102	102
Tartous - Lattakia	0	104	104	104	104
Sub total	1911	2015	2015	2015	2014
Narrow Lines					
Damascus - Dar'a	127	127	127	127	127
Dar'a - Nasseb	13	13	13	13	13
Kumm Garz - Busra	34	34	34	34	34
Dar'a - Al Shajara	41	41	41	41	41
Al Shajara - Al Himmeh	25	25	25	25	25
Sergaya - Damascus	58	58	58	58	58
Al Kadam - Qatana	29	29	29	29	29
Sub Total	327	327	327	327	327
Grand Total	2238	2342	2342	2342	2341

(Source: Statistical Abstract 1995)

Table 5.11 Quantity of Merchandise Transported by Railways

(thousand tons)

	1990	1991	1992	1993	1994
Various Cereals	412	392	203	379	433
Flour	37	46	46	106	103
Foodstuffs	17	16	16	15	0
Sugar	16	41	5	0	0
Wood & Iron	24	22	39	86	100
Cotton	2	0	0	0	0
Phosphate	1318	1165	961	601	795
Fertilizer	50	57	51	50	29
Straw	5	6	4	4	2
Water	0	0	0	0	0
Fuels	1812	1816	1706	1640	2377
Cement	292	319	459	415	389
Sand	410	326	242	170	259
Other Commodities	325	292	280	243	236
Exported Commodities	30	39	73	92	52
Imported Commodities	486	629	200	100	75
Total	5236	5166	4285	3901	4850

(Source: Statistical Abstract 1995)

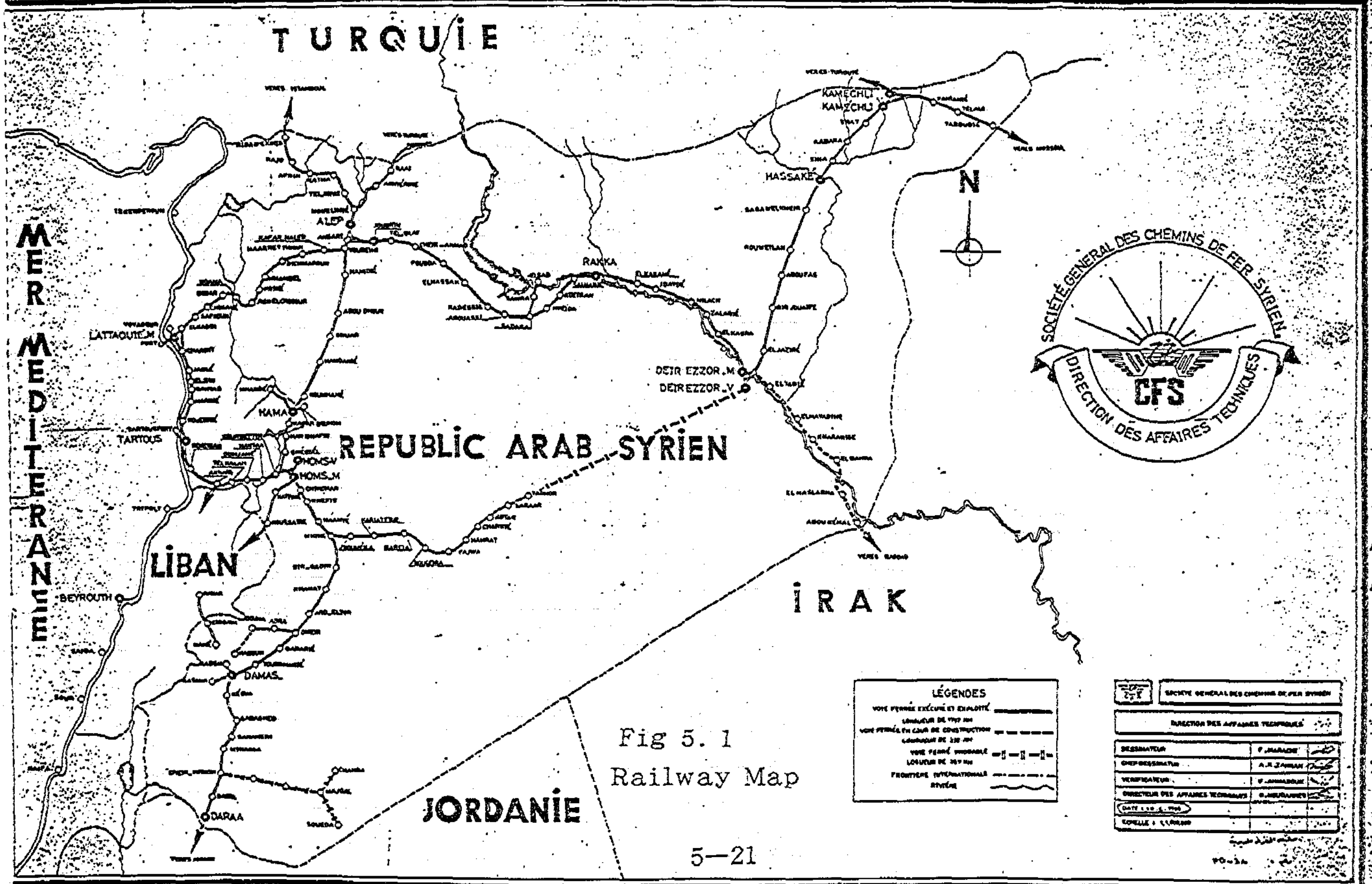
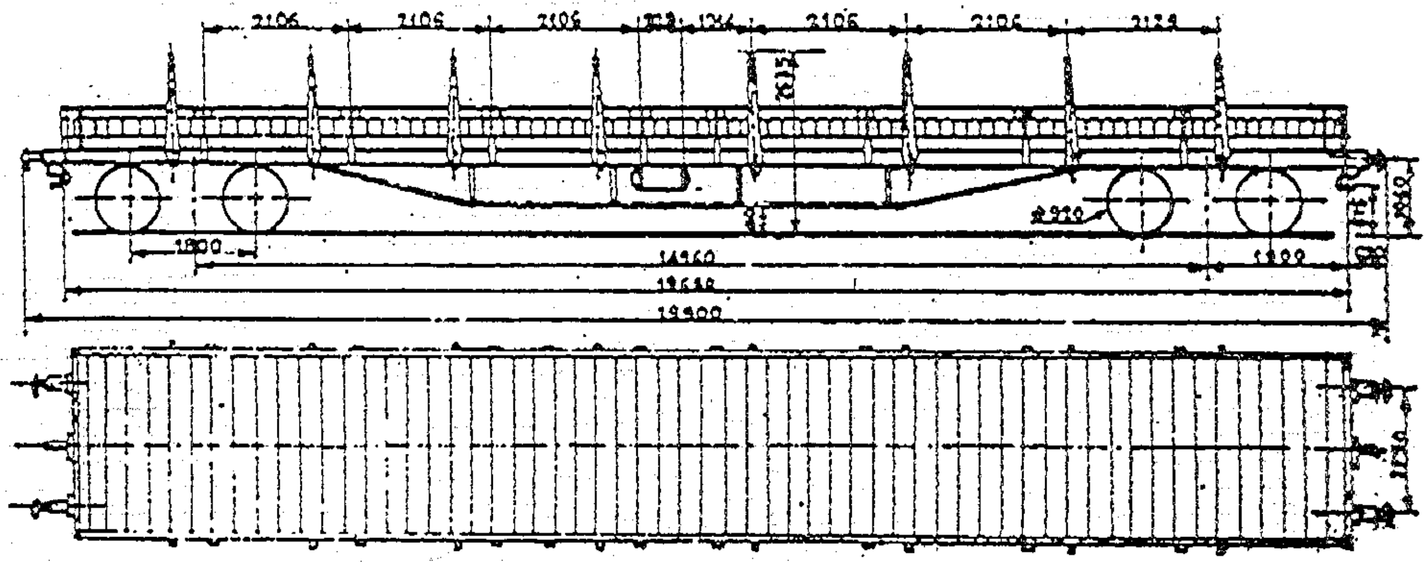


Fig 5. 1
Railway Map

Note; Drawing below shows flat wagon of the type Res.



Type	Res	Rmms	Ks	Kbs
Area (m2)	49	35	35	35
Max. Load (tons)	56	56	27.5	26
No. of Available Wagons	100	150	200	50

Fig 5. 2 Flat Type Wagon

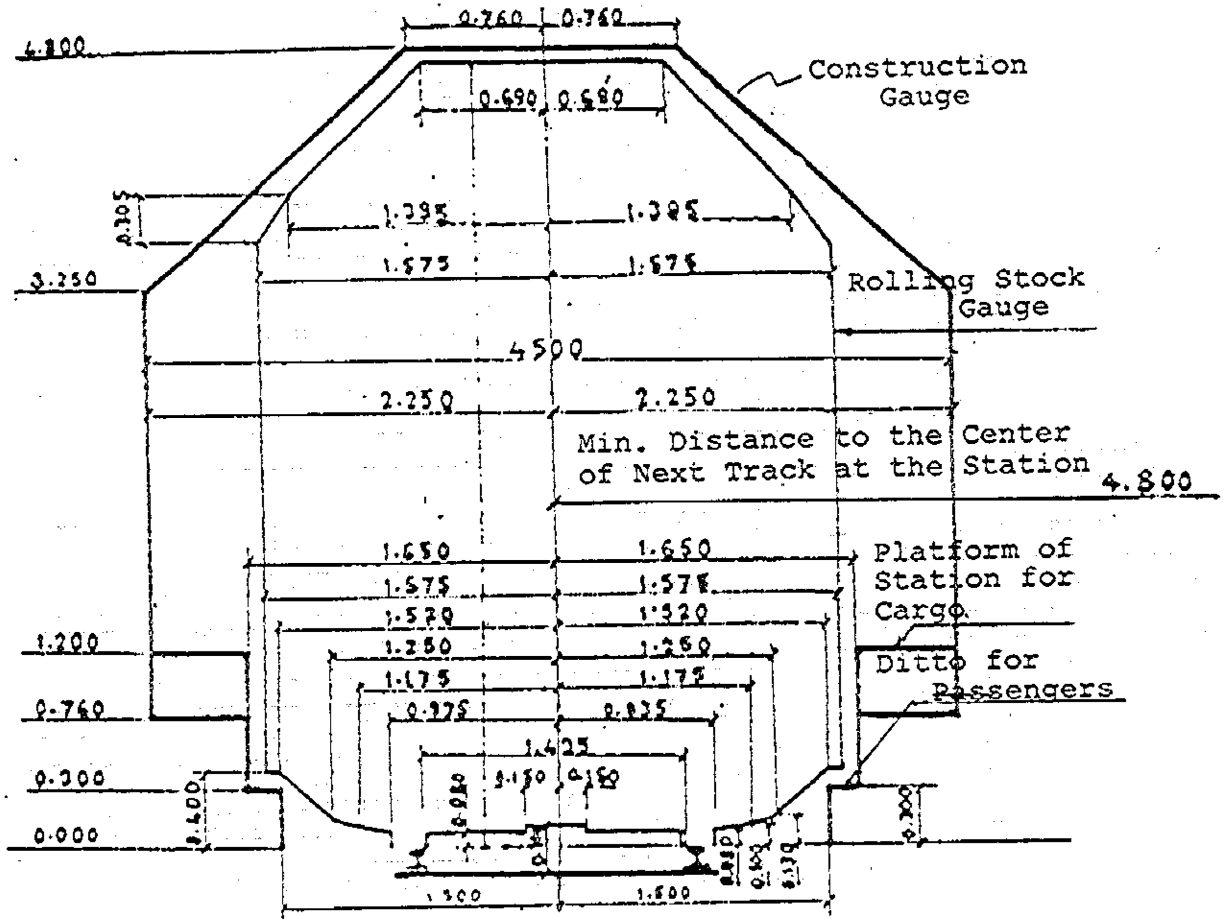
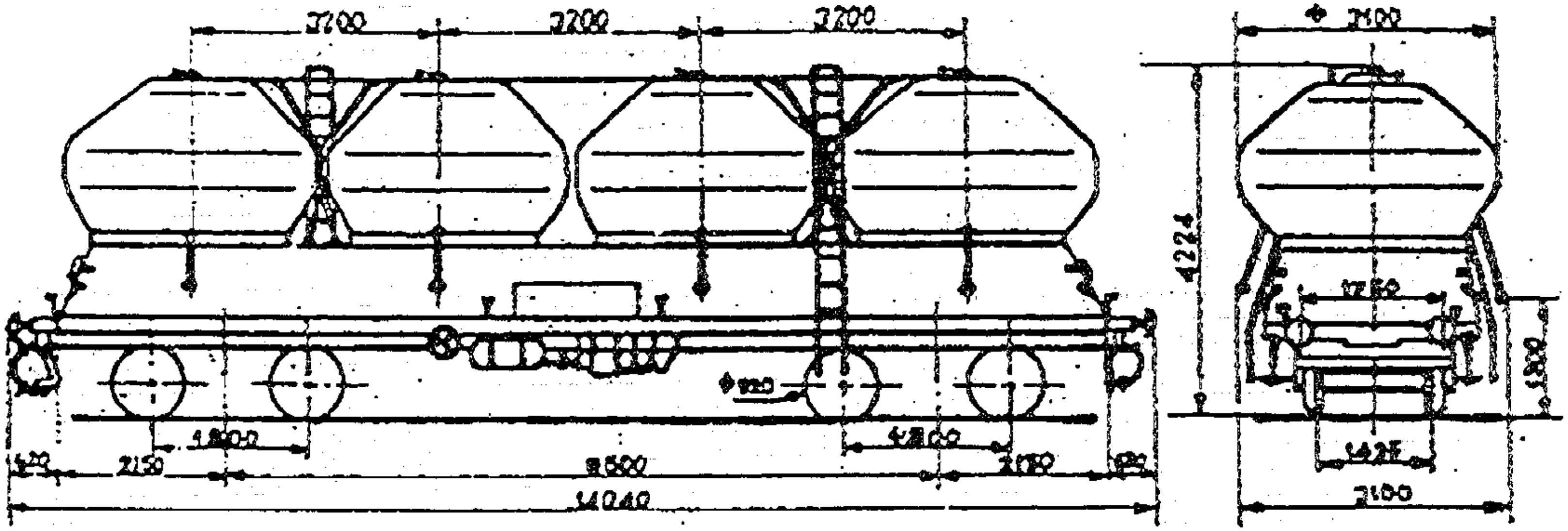


Fig 5. 3 Limitation of Transportation

Note: Drawing below is effective for the bulk cement wagon of the type for both Uacs and Uaces.



Type	Uacs	Uaces
Empty Weight	23.25 ton	24.5 ton
Tank Capacity	4 x 12.5 m3	4 x 12.5 m3
Total Capacity	50 m3	50 m3
No. of Available Wagons	30	17

Fig 5. 4 Bulk Cement Wagon

5.5 ELECTRIC POWER SUPPLY

5.5.1 Outlook

Before 1993, Syria suffered serious shortages of electricity supply. This situation has been improved by the starting up of operation of newly installed power generating stations since 1994.

According to PEDEEE, peak demand in 1994 in all of Syria was 2,650 MW while the total installed capacity at present is 4,000 MW. The generating capacity will be expanded to 6,000 MW by 2000 in order to meet future demand as well as to provide further marginal power. The current installed supply capacity has enough margin to meet demand, which is at the same level as the international standard. In regard to power transmission capacity, PEDEEE has now carried out its expansion to meet with current capacity of power generation.

Fuel used for the generators is oil and natural gas; however, since oil is a major export material, the government places priority on using natural gas for generating stations.

The current electricity fee for users is controlled at 1 SP per kwh (2.3 US ct).

Based on a meeting with GOC, MOI and PEDEEE, Syria is able to supply electricity to the new cement plant. The requirement of new plant will be 70 MW at 230 KV.

Table 5.12 Power Station

Name	Capacity
Tichrin Station	600 MW (200 MW×3)
Al-Nassrie	300 MW
Jurud	300 MW×1 unit
Jandar	600 MW (100 MW×4, 100 MW×2)
Muharde	640 MW (170 MW×2, 150 MW×2)
Banios	680 MW (170 MW×4)
Al-Thawra	800 MW (100 MW×8)
Al-Beath	75 MW (25 MW×3)
Al-Taiem	90 MW (30 MW×3)
Aleppo	1000 MW (under construction)
Total	4685 MW

(Source: GOC)

5.5.2 Power Supply to the New Plant

JST proposes to receive power from the nearest two power stations at Tichrin and Al-Nassrie by separate transmission lines. The reason for the two sources is to avoid power cuts due to breakdown of either power plant or transmission line.

These power stations are connected at Adra substation; however, new power supply transmission lines would provide power fed directly from each power station to the new cement plant in Abu Al Shamat.

Tichirin power station, which started operation last year, located about 35 km southwest of Abu Al Shamat, has two 200 MW oil fuel generators and one 200 MW gas turbine generator.

Al-Nassrie power station, which is located on the route from Jeirud to Al Qaryatein, about 35 km northwest of Abu Al Shamat, has a 300 MW generator and it is planned to increase capacity in the near future (refer to Map 5).

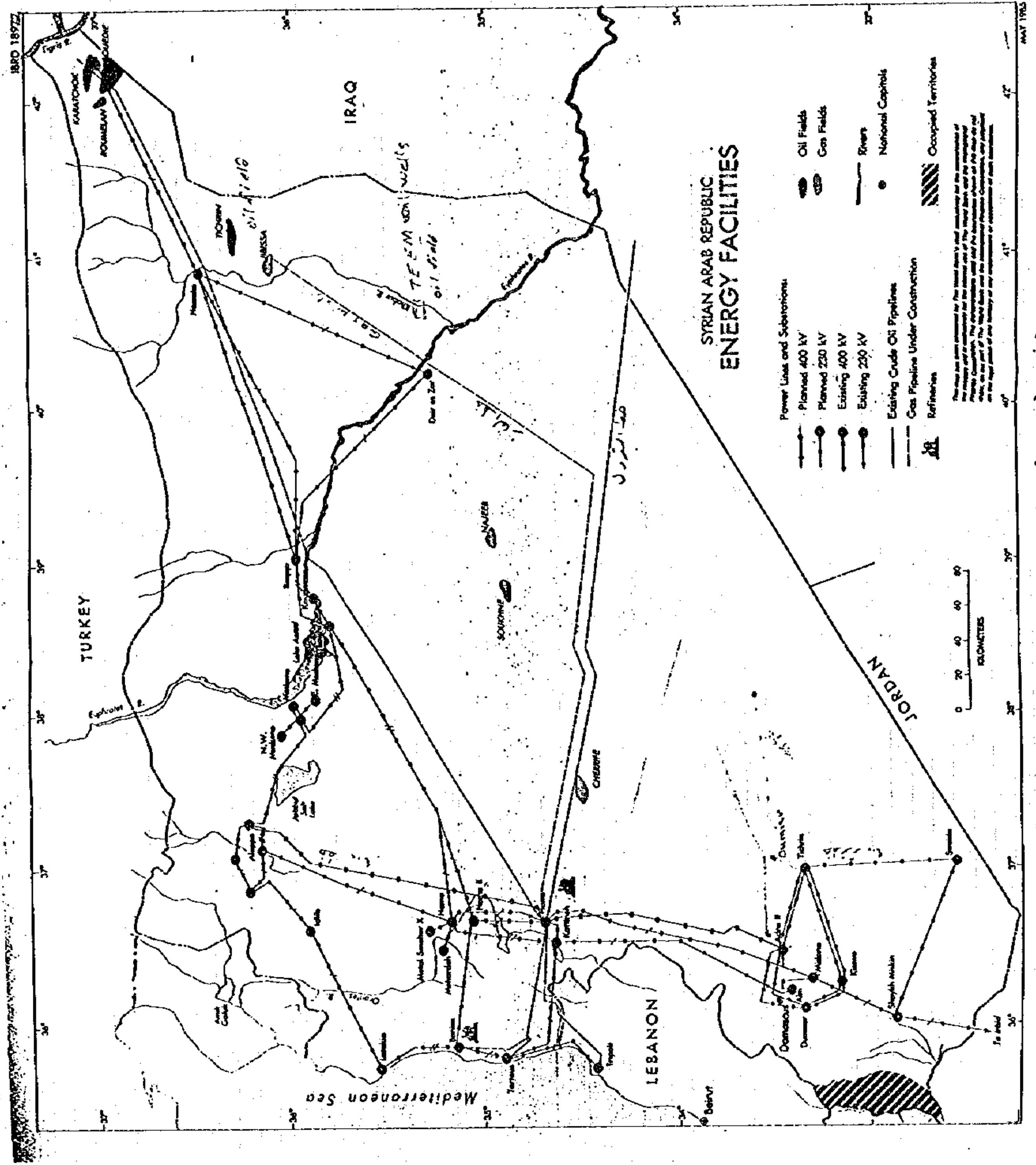


Fig 5. 5 Power Transmission Line

5.6 OIL SUPPLY

5.6.1 Outlook

Oil was first discovered in the 1950's by a German firm working in partnership with Syria's newly established state oil company.

The majority of Syria's oil is produced form wells situated in the Euphrates Valley, running across the northeastern region of Syria (refer to Map 4).

Between 1988 and 1992, domestic oil consumption increased by around 10% per annum. As the economy develops, this trend will continue.

Around 460,000 barrels/day of light crude is produced in this region.
The remaining 155,000 barrels/day is heavy crude oil produced in the northern region of Suwaidiyeh.

The government policy is to export 50% of Syrian oil produced in order to secure hard currency, and natural gas will become the major fuel supply for domestic markets.

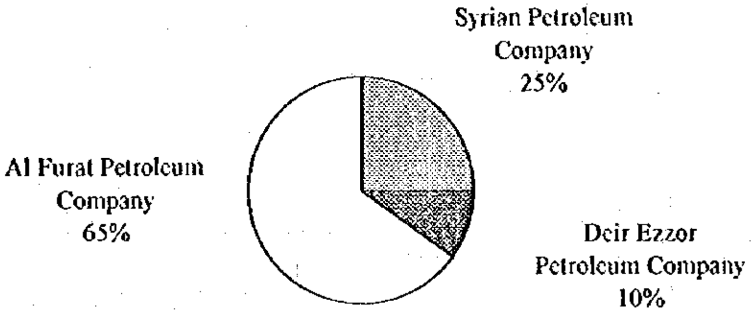


Fig. 5.6 Breakdown of Crude Oil Production (1995)
(Source: Ministry of Petroleum and Natural Resources, OBG)

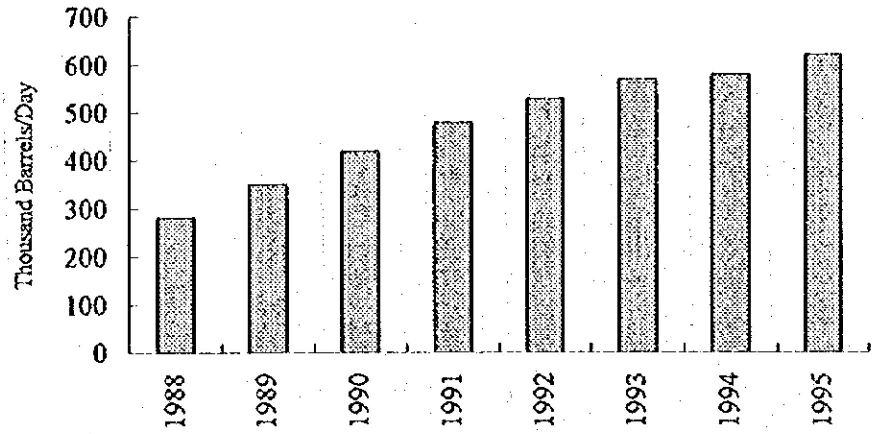


Fig. 5.7 Syrian Crude Oil Production 1988-1995
(Source: Ministry of Petroleum and Natural Resources, OBG)

5.6.2 Oil Supply to the New Plant

Oil will be supplied to the new plant from the refinery in Homs, around 240 kms from the new plant site, by railway tankers.

Oil supply in Syria is not so abundant at this moment because of increased construction of power plants today in the western provinces which mainly use oil. The government is on the way to converting from oil to natural gas in these power plants; however, capacity of current gas pipelines (refer to Map 4) is now limited to supplying gas to western provinces. SPC is planning to install a new gas pipeline from Palmyra to Damascus.

Since the completion of the new gas pipeline is uncertain, JST proposes to use oil in the new plant for the meantime; however, the new plant shall be equipped for both oil and gas so that when the new gas pipeline is installed, the plant will be able to convert from oil to gas immediately.

Total oil consumption required for the new plant will be around 234 thousand kl per year. MOI agreed to supply the said oil to the new plant.

5.7 NATURAL GAS SUPPLY

5.7.1 Outlook

Syria is making efforts to develop gas resources, particularly in the central area of the country.

Reportedly, independent observers currently estimate reserves to be around 220 billion cubic meters.

Gas is predominantly found in the Suwaidiyeh and Omar fields operated by SPC and Al-Furat, respectively.

Current output is estimated to average 18 million cubic metres per day. At present, reportedly secured reserves are estimated to be 60 billion cubic meters (refer to Map 4).

For the last five years, a US firm has estimated reserves in the Al-Shaer and Sharifeh area west of Palmyra; however, production from the wells had not begun by 1995 due to contractual reasons.

Government policy is to supply gas for a third of domestic energy by 2000; therefore, investment in gas production will continue and even accelerate.

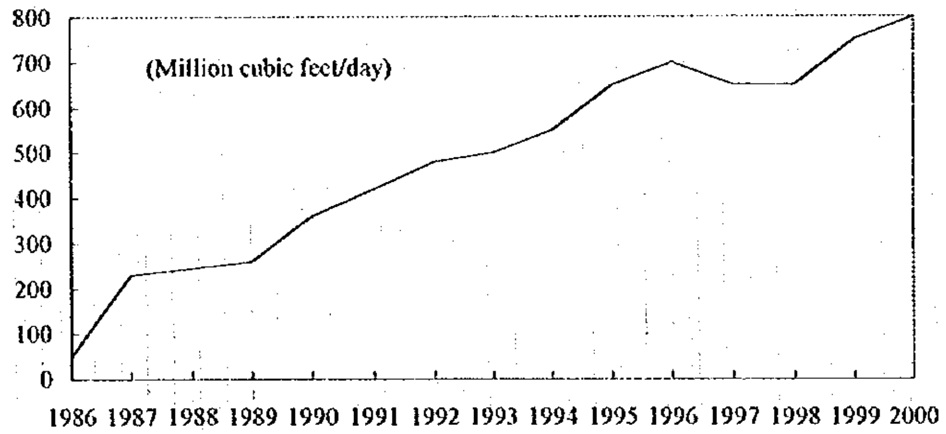


Fig. 5.8 Syrian Natural Gas Production 1986-2000 (Source: OPEC)

5.7.2 Gas Supply to the New Plant

Major supply sources of natural gas are Palmyra (central Syria) and Omar (eastern region around the river Euphrates); gas is distributed by pipeline network throughout the whole of Syria (refer to Map 4).

Main pipelines from eastern Syria run behind the Palmyra Mountains and east of Jeirud destined for Dmeir valve station (nearest Abu Al Shamat), where the pipeline branches, and are connected to Tichrin power station. The pipeline is 18 inches in diameter, four million cubic meters per day in capacity at 102 bars, and is provided with valve stations at intervals of about 30 to 33 km.

A pipeline from the above main line to the existing Adra cement plant was installed in 1994 (refer to Map 4); however, due to the new start-up of Tichirin power station, which is a big gas consumer, Adra cement plant has not received any gas from the authority due to the limited capacity of the present pipeline.

For this reason, it is not anticipated that an additional gas supply to the new plant would be possible.

The requirement for gas supply to the new plant is around 270 million Nm^3 per annum. SPC commented that the additional new pipeline to Damascus could be made when consumption is secured at around 6 million Nm^3 per day.

Therefore, JST proposes in the meantime to use oil as fuel for the new plant. The plant shall be equipped with the clinker burning systems for both gas and oil fuels in order to cope with the government policy on the supply of fuel to the new plant.

5.8 COMMUNICATIONS

5.8.1 Outlook

Telephone and telefacsimile are becoming more common in major cities at present.

Total telephone centers in Syria were 4,400 centers in 1994, which increased by 54% between 1990 and 1994.

The total number of telephone lines in 1994 was 699,589 lines, which increased by 32% between 1990 and 1994. In the increase of telephone lines, automatic lines increased by 51% and manual lines decreased by 44%.

Most of the improvements have been carried out in major cities; however, in rural areas there is still little improvement.

Regarding communication between Damascus and Japan, there are no problems at present. The government is currently making further improvements.

Table 5.13 Number of Telephone Lines

	1994	1993	1992	1991	1990
Main lines					
Automatic	583,145	435,000	401,000	377,826	376,646
Manual	84,345	115,312	112,403	119,489	119,714
Secondary Internal lines					
Automatic	15,537	15,880	15,380	15,174	15,121
Manual	547	750	652	825	817
Secondary External lines					
Automatic	15,640	18,088	18,134	16,508	15,727
Manual	375	1,945	1,946	2,203	2,050
Total					
Automatic	614,322	468,958	434,514	409,508	407,494
Manual	85,267	118,007	114,551	122,517	122,581
Grand Total	699,589	586,975	549,065	532,025	530,075

(Source: Statistical Abstract 1995)

5.8.2 Communications for the New Plant

There is one telephone center in Dmeir city about 25 km from the new plant.

A new transmission line is to be installed to the new plant from Dmeir center.

Ten external automatic telephones, 50 internal telephones and 2 telefacsimiles will be installed at the plant site.

5.9 LABOUR FORCE

5.9.1 Outlook

Around 28% of Syria's total population in 1991 were estimated to be economically active, creating a labour force of 3.5 million. Syria's average unemployment ratio in 1991 was 6.8% (male 5.2% and female 14.0%). Unemployment in 1991 was around 240 thousand, which is increasing today because of increasing population (refer to Table 3.5).

Current rate of illiteracy was estimated as 22.8% in urban and 39.4% in rural areas in 1991.

Although a large number of students graduate with technical degrees, very few university courses offer vocational training and graduates usually require additional training in their specialized field, including overseas training.

Large wage differences between Syria and other Arab countries continue to cause the migration of the country's most qualified personnel. The Gulf countries in particular are a large market for expatriate Syrian labour.

Due to the situation today, creation of job opportunities is given high priority by the Syrian government.

5.9.2 Manpower for the New Plant

GOC advised JST on the labour force as follows:

1) Total manpower will be 1,000, based on capacity of three million tons per annum because creating job opportunities must be a high priority.

2) Around 40 experienced key staff members including operators will be transferred from the existing Adra cement company, located 30 km west of the new plant. The remainder will have to be recruited from among new graduates and from other industries. The reason is that personnel who are working for existing cement companies will not be able to shift their families to another province and they do not want to change their lifestyle unless their working conditions are improved greatly over their present conditions.

JST, taking the above situation into consideration, proposes the following:

1) Around 40 key persons of the total manpower shall be recruited two years before starting up the new plant. They shall be trained for one year at the existing Adra and Tartous cement plants.

2) About 80 key persons shall be trained in foreign cement plants using the same production system as the new plant.

3) Technical and management assistance after starting commercial operation shall be given to the new company for at least three years. Details are proposed in Chapter 10.

5.10 WATER RESOURCES

5.10.1 Overview on geoelectrical prospecting

Groundwater conditions in the Abu Al Shamat region have been investigated by experts (hydrogeologists, geophysicists, etc.) from the Ministry of Irrigation for around 20 years.

Their investigations have been conducted mainly by vertical geoelectrical prospecting, called VES (Vertical Electric Sounding). The instrument which they are currently using is "AE-72" made in the USSR, whose capacity for prospecting reaches more than 800 m below surface with the Shlumberger method. According to them, the following knowledge and information have been acquired to date:

1) The mountainous land of this region, mainly composed of the Cretaceous and Paleogene systems, are often faulted in two main directions: latitudinal and longitudinal. In general, aquifers can be found at intersections of the faults in these two directions. Thus VES has been carried out intensively on these points.

2) From the lithological point of view, aquifers commonly exist in limestone layers overlying dolomitic ones which belong to the middle Cretaceous system. It has been proved by high resistivity in these layers.

3) The strata that have the highest possibility of bearing water belong to the Turonian stage (Cr_2t), and those that have the second highest possibility belong to the Campanian stage (Cr_2cp). The former are, however, estimated to be situated approximately 900 m below the surface around the new plant site

5.10.2 Existing wells in Abu Al Shamat

1) To the northwest of the new plant site, two wells whose depth are 830 m and 270 m have been dug for agricultural use at the foot of the mountainous land. However, the former well has dried up, and the latter can supply only as much water as 8 ~ 10 l/h..

2) Other than the above mentioned strata, smaller but shallower aquifers are distributed in the Paleogene system in the Abu Al Shamat region. They are thought to be perched water. In the vicinity of the new site, there are wells for military and agricultural use which are about 100 m deep and 4-5 l/h in pumping-up capacity.

3) The agricultural ministry recently dug a deep well, the depth of which is 900 m below ground surface in the mountainous area at around 4 km north of the new plant site (refer to Fig. 5.W.2) According to DRUMI, the well can supply 15t/h of water (pump specification is unknown).

5.10.3 Major wells in neighboring region

1) In Dmeir, the nearest town, located 25 km west of the plant site, there are three salt water wells (30 t/h), and one fresh water well (30 t/h), both of which are used for living water.

According to DRUMI, the Dmeir area has large quantity of salty underground water. Salinity content in the said water is in the range of 1,300 to 1,400 mg per liter. In order to use this water for drinking and/or industrial purposes, electrodialytic desalination is necessary to reduce salinity by 800 mg per liter.

2) In Adra City located about 30 km west of the plant site, there are 11 wells each of 100 ton per hour. This area has supplied 200 tons of water per day to Dmeir town since 1991.
According to GOC, concerned ministries are planning to supply fresh water (4,500 ton/day) from Adra city to Dmeir town by 2015.

3) In the village of Rohabeh located around 20 km western north of the plant site (refer to Fig. 5.W.2), there are six wells of 30 ton per hour each. These wells have supplied water for 9 years without drying up.

4) Other than the aforementioned information, DRUMI commented that the private sector recently found a prospective water basin in a province around 12 km northeast of Dmeir town. The water aquifer is estimated to exist around 900 m below ground surface.

5.10.4 VES in Abu Al Shamat

From the end of 1995 to the beginning of 1996, VES surveys in Abu Al Shamat have been carried out by GOC in cooperation with DRUMI (refer to Fig. 5.W.1). The results are summarized as follows:

1) The investigated points can be topographically divided into two areas: the flatland covered with quaternary sediment and the mountainous land area which is composed of the Cretaceous-Paleogene systems.

2) Based on the VES survey data, VES test results in the flatland area (points 6, 7, 8, 9 in Fig. 5.W.1) show the existence of high resistivity zones, which indicate probable water-bearing strata mainly belonging to the Paleogene system between the Paleocene (Pg_1 - Pg_2^1) and Eocene (Pg_2^{2-3}) series.

3) According to the VES data in Fig. 5.W.3, the mountainous area (refer to points 10 to 20 in Fig. 5.W.1), which mainly belongs to the middle Cretaceous system between the Cenomanian-Turonian (Cr_1cm+t) and Campanian (Cr_2cp) stages, is considered the more probable water catching area.
The reasons that aquifers in the Paleogene system in the flatland area are limited, compared with those in the middle Cretaceous systems in the mountainous area, are as mentioned in sub-section 3) in 5.10.1. Moreover, the mountainous area around points 11, 12, 13, 15, 20 in Fig 5.W.1 are located at an intersection of faults.

5.10.5 Purpose of the Pumping Test

JST advised GOC that test wells should be dug and water pumping tests be carried out to confirm available water from the test wells based on the VES prospecting carried out by the Syrian side / Ministry of Irrigation (refer to Fig. 5.W.1). The Syrian side with cooperation of JICA dug five wells and pumping tests were carried out. The purposes of the tests are as follows:

1) Based on the VES prospecting executed by the Syrian side, available water volume from the test wells and its characteristics are to be surveyed.
2) Estimate specifications of deep well pumps and water treatment facilities to be used in the new plant.
3) Collect basic data on the aquifers for further prospecting for water resources in broad areas in the region to secure industrial water for the new plant; this shall be carried out hereafter by the Syrian side.

Based on the data shown in Fig. 5.W.3, the Syrian side decided on five points for test wells, Nos. 9, 11, 12, 13 and 20 which are shown in Fig. 5.W.1. The reasons for selecting the above five points are:

1) No. 9 point is located in flatland in the region and is one of the possible points. This point is nearest to the plant site.
2) Nos. 11, 12 and 13 points are the most probable points in the area, judging from the results of VES prospecting. The aquifer(s) is estimated to exist around 450 m below the surface.
3) No. 20 point: the aquifer was estimated by the Ministry of Irrigation to exist around 650 m below surface.

5.10.6 Test Methods

Tests in this study included digging of test wells, water pumping tests and tests on quality of water.

Geophysical tests on the boreholes were surveyed on gamma logs, resistivity logs, spontaneous potential (SP) logs, and temperature logging.

1) Water pumping tests were continued for 72 hours in each well. Water quantity, static water level and dynamic water level were measured.
2) Tests of quality of water carried out were chemical analysis and microscopic examination for number of bacteria.
3) Geophysical tests on the boreholes were carried out using measuring instruments owned by the contractor.

5.10.7 Test Results

The test results this time are summarized in Tables 5.W.1 and 5.W.2. For geophysical test data and descriptions of rocks in the boreholes, refer to attached report in this chapter submitted by the Syrian counterpart (Ghadir Co.).

1) Aquifer 450m deep

a) There exists a hopeful aquifer 450m below ground surface where middle Cretaceous strata are sedimented.
b) Pumping tests for wells Nos. 11, 12 and 13 showed that minimum 20 tons per hour of water can be secured from each well. Possible water quantity from each well is expected to exceed 20 tons per hour because the pump used in this test was maximum 20 tons per hour (40 hp).
c) The intervals between well point Nos. 11 and 12, and Nos. 12 and 13 are around 450 to 500 m (refer to Fig. 5.W.1). With these intervals, JST estimate there will be a high possibility of acquiring at least 60 tons of water per hour from the three wells (refer to sub-section 5.10.8).
d) In addition to the above three wells, there are several hopeful water catching points in this region having similar geological conditions as indicated in sub-section 5.10.1. Therefore, it will probably be possible to acquire 130 tons per hour of water in this region if the number of wells is increased at the implementation stage.

2) Deeper new aquifer

a) DRUMI experts as well as drilling contractor (Ghadir Co.) estimated that a deeper but larger water-bearing stratum, which would extend to Rukheimeh through Nassrie and Jeirud, exists around 600 to 650 m below the surface.
b) Based on the information, Syrian side dug a well (No. 20) and executed pumping test. However, the results did not succeed in proving the assumption (only 7.5 ton/h water from No. 20 point was confirmed).
c) According to DRUMI, in consideration of recent findings for two new aquifers existing around 900m below ground surface, which are indicated sub-sections 5.10.3.3) and 4), a deeper aquifer in the new plant site will also exist around 950 m below surface.
d) Since this deeper aquifer is also expected to be utilized as an alternative resource for the new plant on a long-term basis, further exploration, together and in parallel with the 450m-below aquifer, should be continued.

3) Shallow aquifer

a) Pumping tests were conducted at No. 9 for the purpose of checking existence of a shallow aquifer which is inferred to exist in the Paleogene system below the flat land near the project site.
b) The test results showed little possibility of acquiring water from this stratum (only 7 t/h water was confirmed), and what water exists is considered as perched water.
c) This perched water has been used for agriculture and the military; therefore, it will not be used for the new plant.

5.10.8 Conclusions and Recommendations

Based on the aforementioned test results and information from experts of DRUMI and the water exploration contractor (Ghadir Co.), JST conclude and recommend as follows:

1) A hopeful aquifer exists 450m below the surface where middle Cretaceous strata are sedimented.

2) The volume of water found in these tests was studied independently for each well. Possible quantity that can be caught in the wells at point Nos. 11, 12 and 13 will be about 60 tons per hour in total.

3) Other new aquifers in this area, inferred to exist deeper than the above-mentioned 450 m below the surface would exist about 900 to 950 m below the surface.

JST estimate that the test results show a very high possibility of catching the water required for the new plant (130 t/h) in this region if the number of wells is increased. Therefore, JST propose that GOC continue further pumping tests and exploration as follows:

1) Checking of interference for water levels on the wells No. 11, 12 and 13.

a) Surveying the land level of each test well and correlate the static and dynamic water levels in order to confirm distribution of the aquifer.

b) Conduct further pumping tests on one well as the pumping well, and survey water levels for the other two wells in order to check influence on or interference with the other wells. The pumping well will be well No. 12, and test period shall be minimum 72 hours continuously. Water volume for pumping well and water levels in each well shall be recorded every 2 hours. If the interferences would be found on each water level, the pumping well will be shifted to well No. 11 or 13, and the same test will be conducted.

After finishing 72-hour-pumping-test, water levels shall continue to be checked once a day for a week.

c) It is recommended that pumping test using larger capacity pump (30 to 50 t/h) than that used in the test, and its influence on water levels in the others wells shall be carried out if Syrian side can prepare a larger capacity pump.

2) Further exploration

For the purpose of securing substitute water resources in future to compensate for possible drying up of the current 450 m below surface aquifer, GOC shall continue VES prospecting over a broad area of the region. The hopeful points are:

a) There are many areas having similar geological condition as indicated in sub-section 5.10.1. in mountainous arera in Abu Al Shamat. These points will be intensively surveyed aiming at areas 450 and 950 m below the surface in the region.

b) In addition to the region in Abu Al Shamat, JST advised GOC that VES prospecting will be conducted on neighboring regions such as Rohabeh and others where water wells have been operated on a long-term basis.

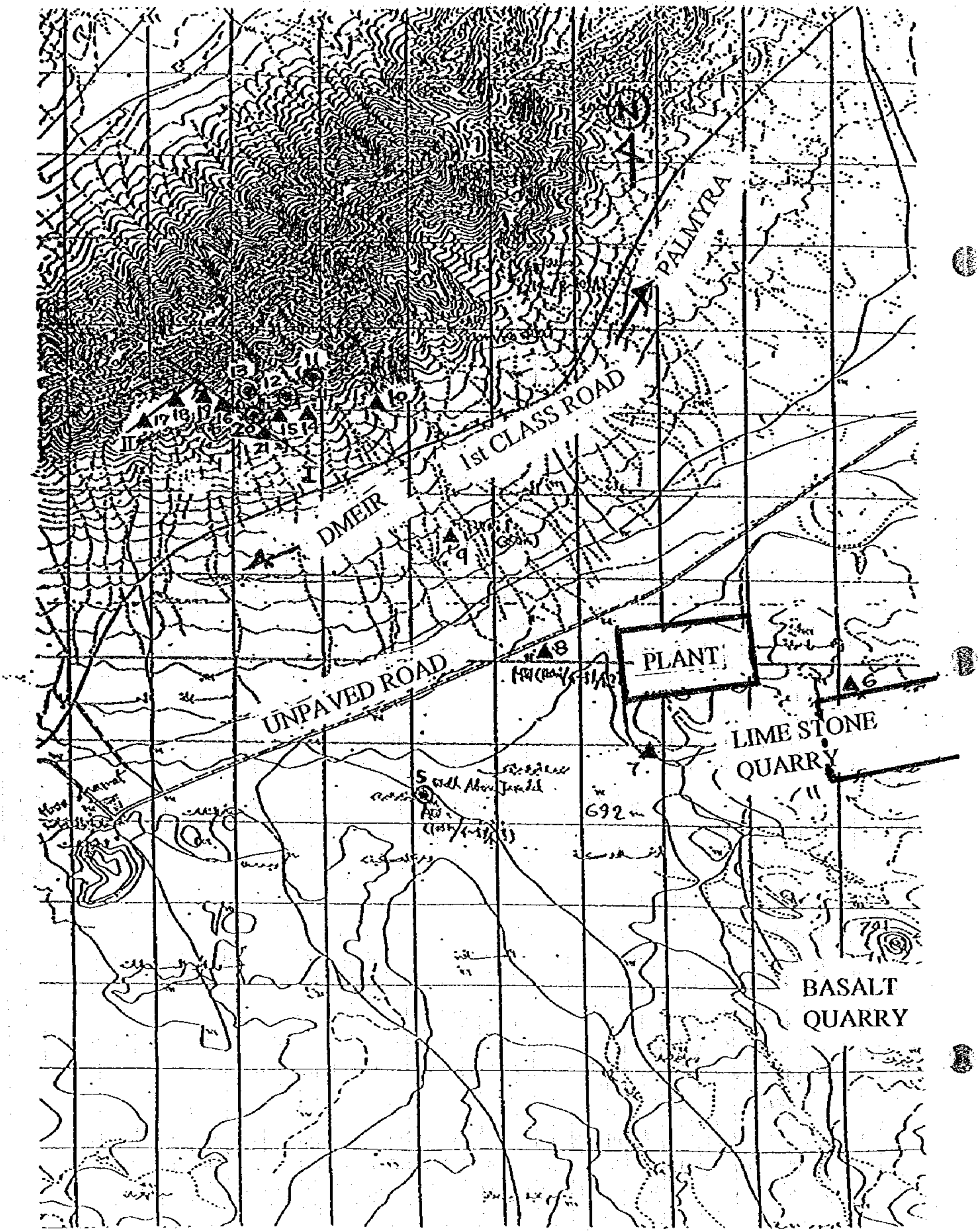


Fig. 5.W.1   VES SURVEYED POINT IN ABU AL SHAMAT

Fig. 5.W.2 Currently Confirmed Aquifers

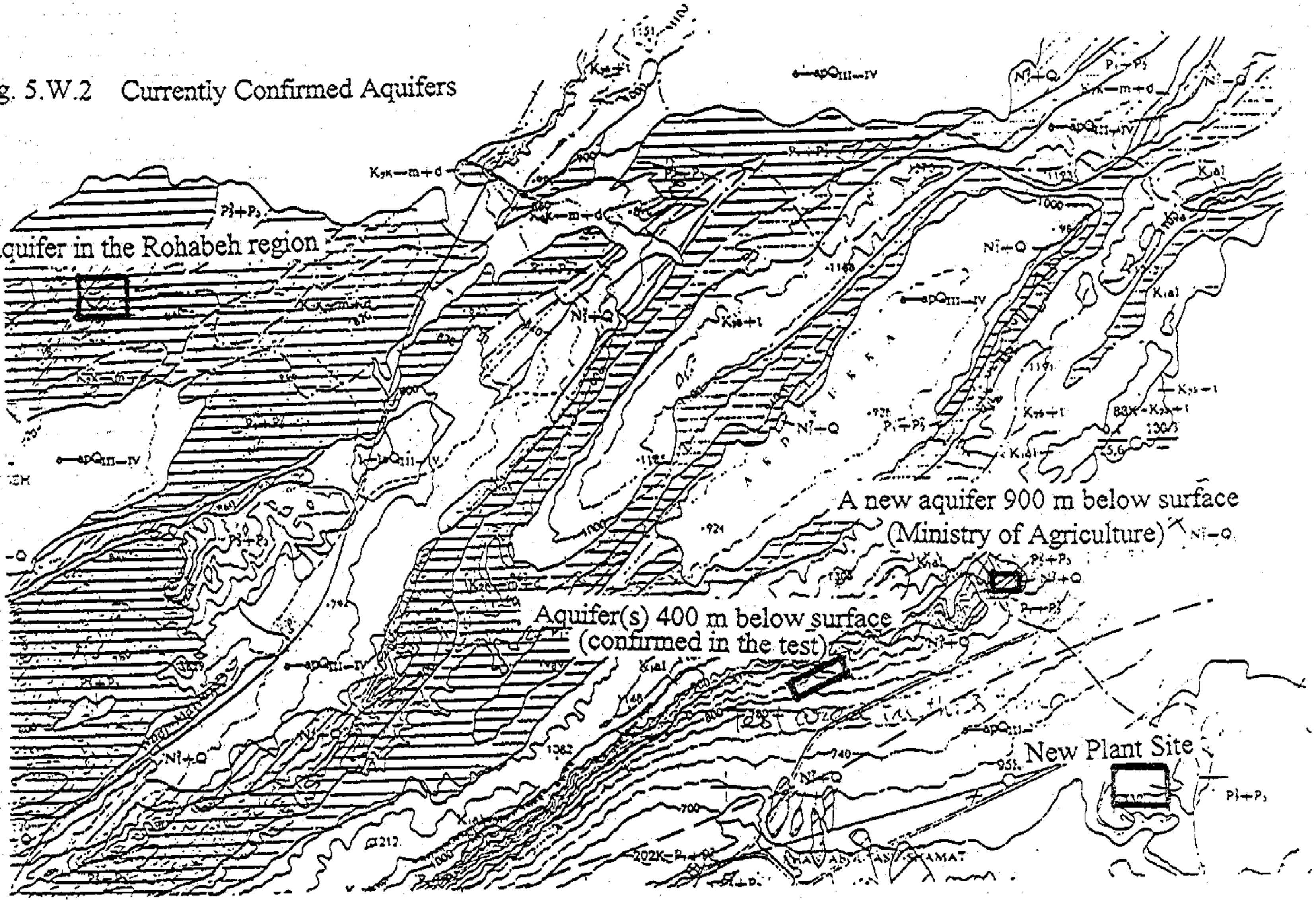


Table 5.W.1 Results of Water Pumping Test

Items	Unit	No. 9	No. 13	No. 11	No. 12	No. 20
Date of test (1996)	-	Mar. 20-23	Mar. 12-15	Jul. 7-9	Aug. 2-4	Aug. 5-7
Depth of well	m	35.2	452.5	450	450	650
Diameter of well	depth / inch	0-6 m / 15	0-6 m / 15	0-6 m / 15	0-6 m / 15	0-6 m / 15
		6-352 m / 12.75	6-452.5 m / 12.75	6-450 m / 12.75	6-450 m / 12.75	6-442 m / 12.75
						442-650 m / 8.5
Static water level	m	109	209.9	217	216	228
Dynamic water level	m	287	249.6	265	253	347
Water temperature						
Static level	℃	22.5	21	24	25	25
Bottom	℃	25	25	26.5	27	27
PH	-	7.5	7.12	7.42	7.47	7.72
TDS	g / l	-	0.32	0.41	0.37	0.572
CND	ms / cm	-	0.6	0.80	0.74	1.13
Pump specification						
Capacity	t / hr x HP	19.5 x 40	19.5 x 40	19.5 x 40	19.5 x 40	19.5 x 40
Pipe dia	inch	3	3	3	3	3
Manufacturer	-	Grundfos	Grundfos	Grundfos	Grundfos	Grundfos
Type		SP 16-50	SP 16-50	SP 16-50	SP 16-50	SP 16-50
Minimum water volume	t / h	≧ 7	≧ 19.5	≧ 20	≧ 20	≧ 7.5
Name of contractor	-	Ghadir	Ghadir	Ghadir	Ghadir	Ghadir

Table 5.W.2 Water Characteristics

Items	Unit	No. 9	No. 13	No. 11	No. 12	No. 20
Cations						
Calcium Ca^{++}	mg / l	84	36	48	64	60
	(m / l)	(4.19)	(1.80)	(2.4)	(3.19)	(2.99)
Magnesium Mg^{++}	mg / l	63	29	29	15	41
	(m / l)	(5.18)	(2.38)	(2.38)	(1.23)	(3.57)
Sodium Na^{+}	mg / l	104	48	40	34	60
	(m / l)	(4.52)	(2.09)	(1.74)	(1.48)	(2.61)
Potassium K^{+}	mg / l	9	1.5	2	1.5	3
	(m / l)	(0.23)	(0.04)	(0.05)	(0.04)	(0.08)
Iron Fe^{++}	mg / l	-	-	-	-	-
	(m / l)	-	-	-	-	-
Sub-total	mg / l	260	114	119	114.5	164
	(m / l)	(14.12)	(6.31)	(6.57)	(5.94)	(9.05)
Anions						
Bicarbonate $MHCO_3$	mg / l	317	171	171	159	244
	(m / l)	(5.2)	(2.80)	(2.80)	(2.61)	(4.00)
Carbonate CO_3	mg / l	-	-	-	-	-
	(m / l)	-	-	-	-	-
Sulfate SO_4	mg / l	100	48	78	60	136
	(m / l)	(3.75)	(1.00)	(1.62)	(1.25)	(2.83)
Chlorine Cl	mg / l	138	70	70	60	86
	(m / l)	(4.96)	(1.97)	(1.97)	(1.69)	(2.43)
Nitrate NO	mg / l	15	15	15	10	-
	(m / l)	(0.24)	(0.24)	(0.24)	(0.16)	-
Sub-total	mg / l	570	304	334	2.89	466
	(m / l)	(14.15)	(6.01)	(6.63)	(5.71)	(9.26)
Residue	mg / l	770	330	370	325	510
Coliform bacillus	/ 100 ml	1,500	3,000	7,000	1,000	2,000
Coliform organics	/ 100 ml	500	2,000	-	-	-

Note: This water cannot be drinkable. Thus water treatment facility is required to be installed in the new plant.

Fig. 5.W.3 VES Test Result (1/5)

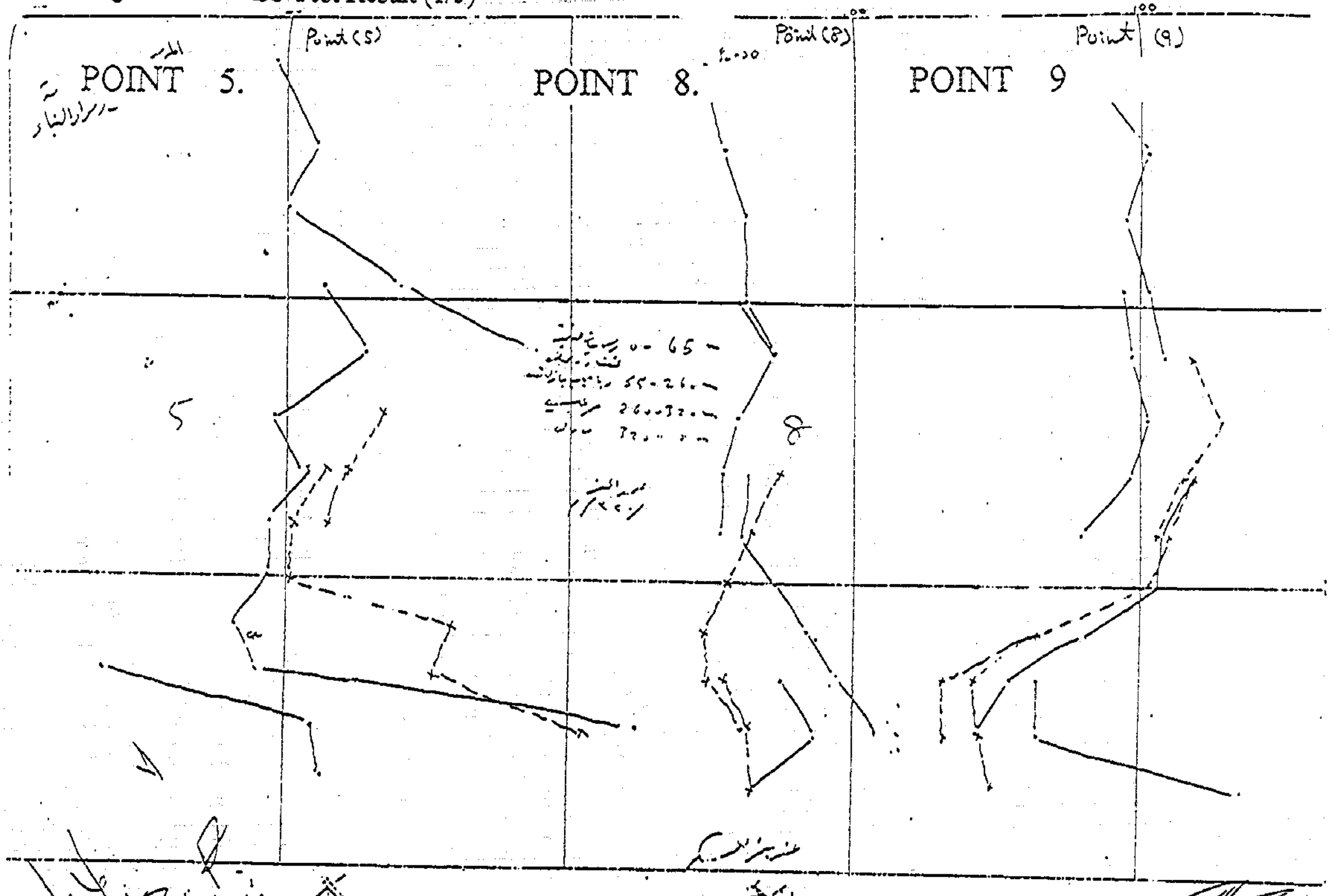


Fig. 5.W.3 VES Test Result (2/5) ves-2-

Point (12) ×
ves-3-

[illegible]

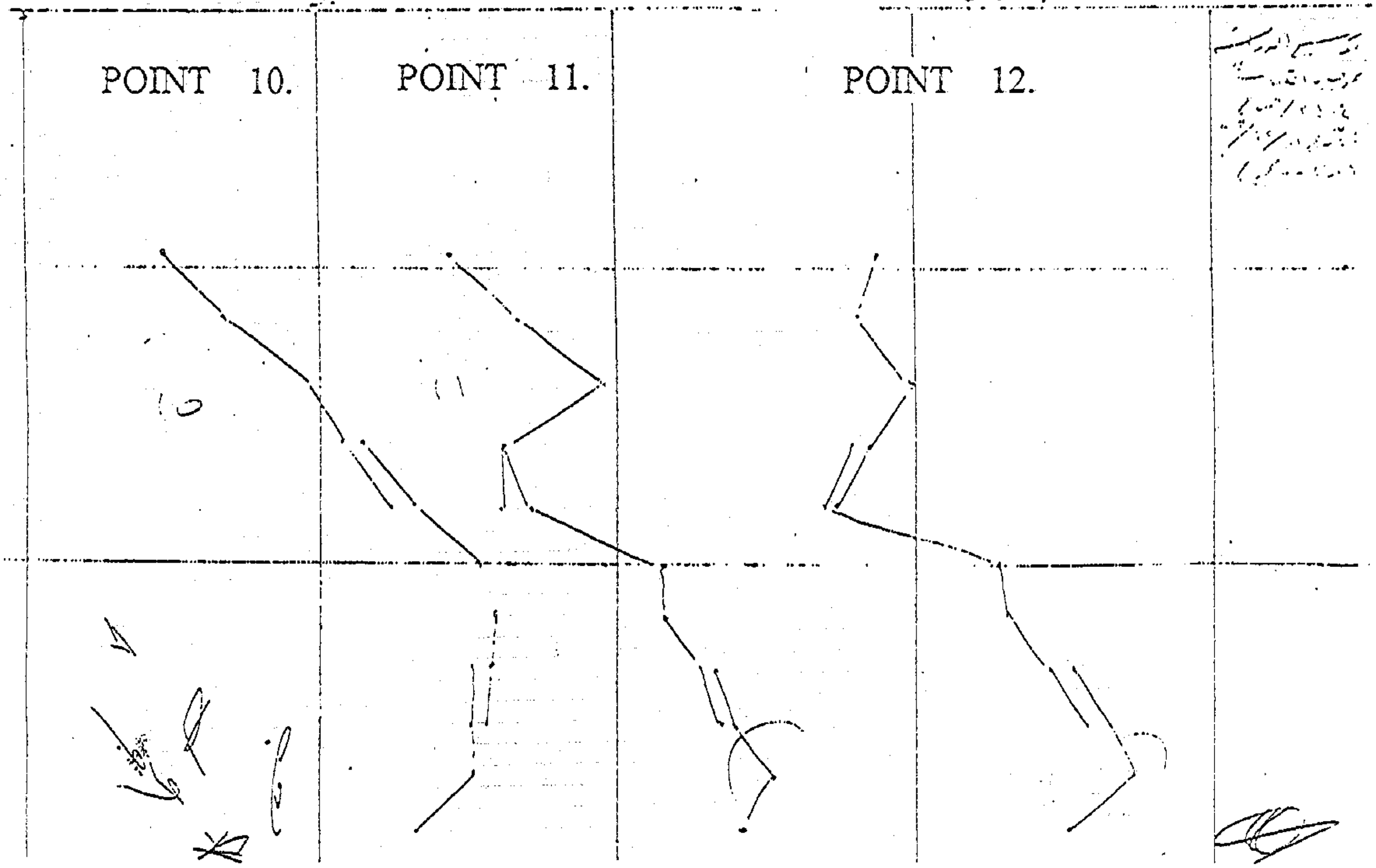


Fig. 5.W.3 VES Test Result (3/5)

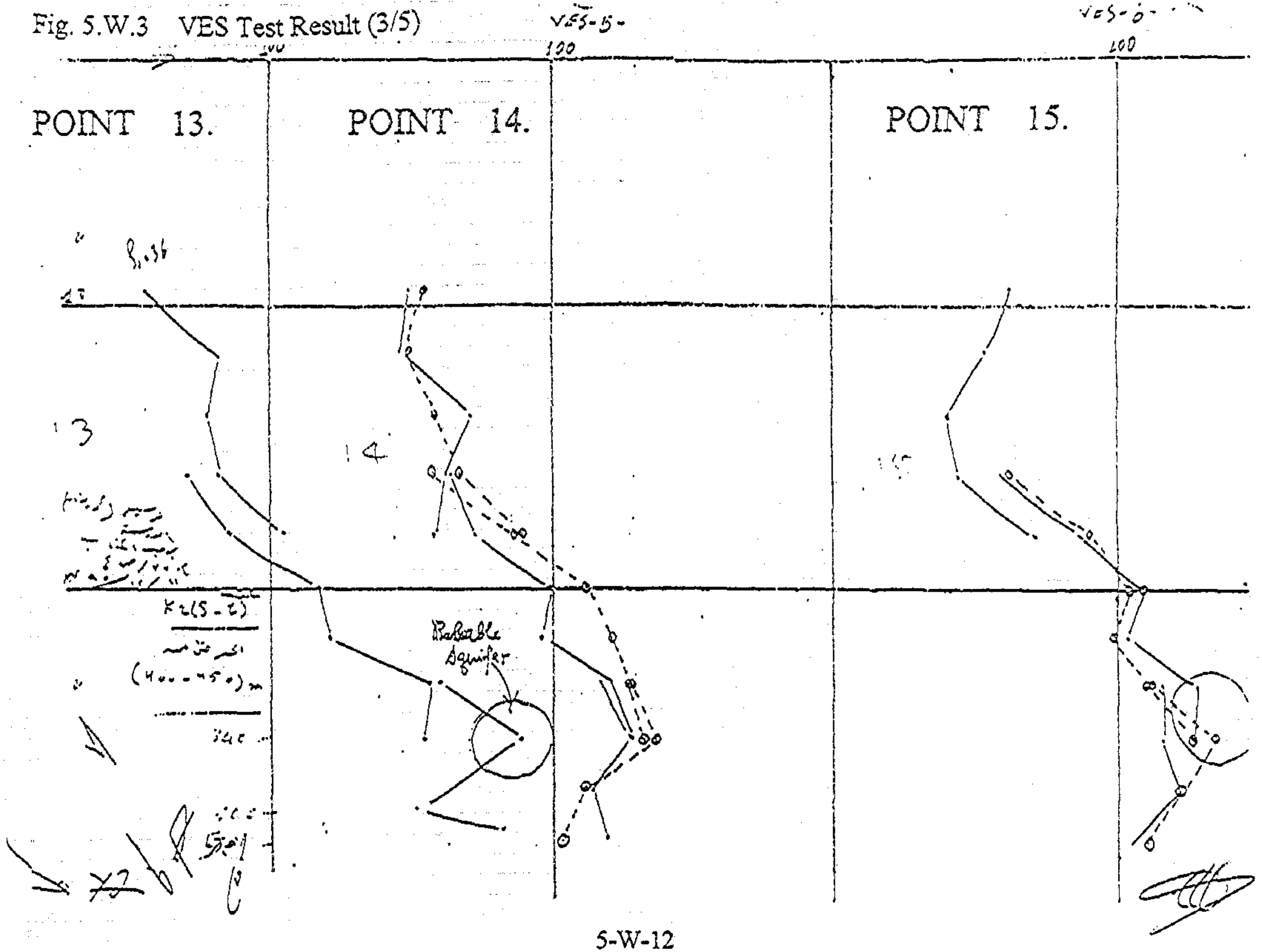
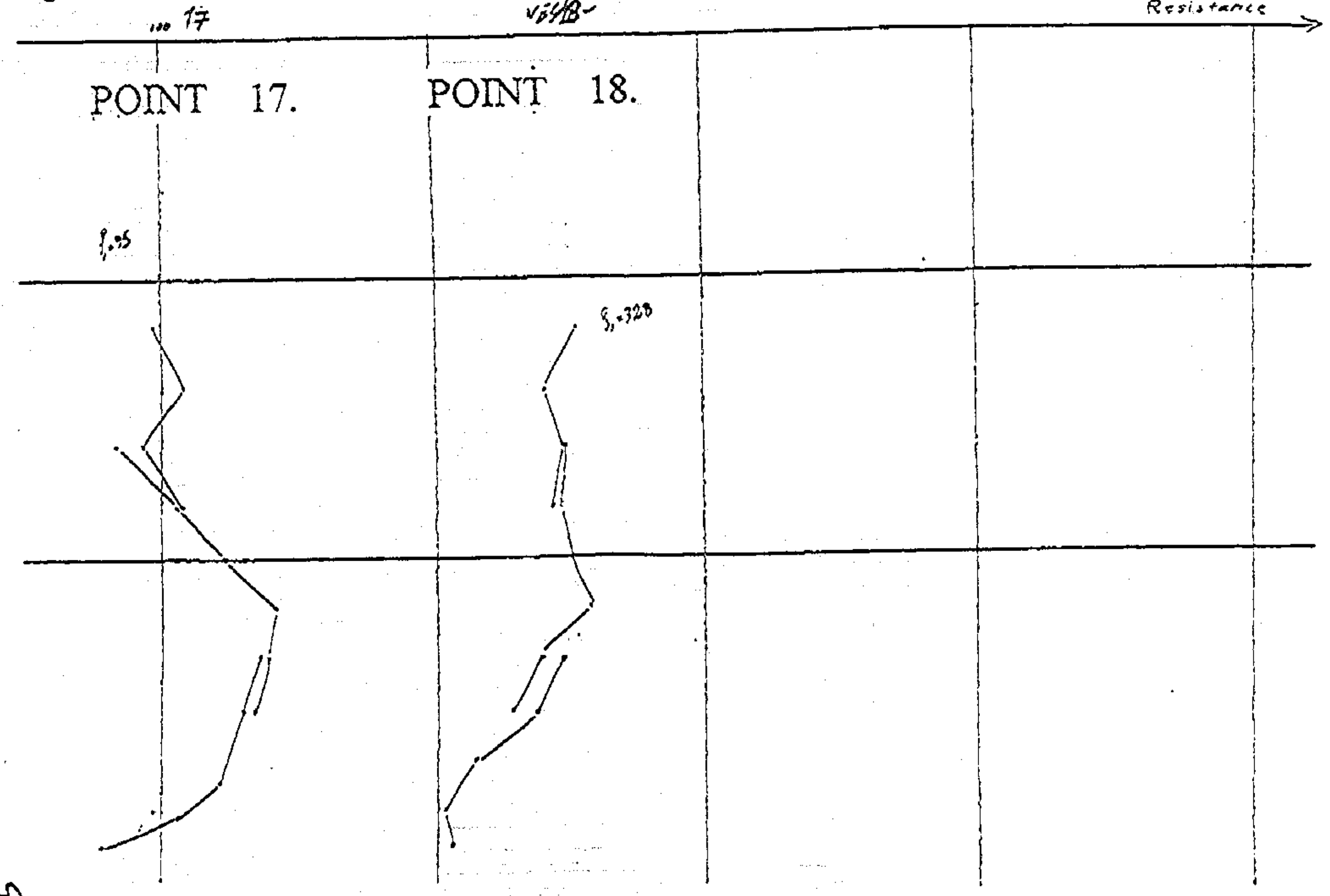
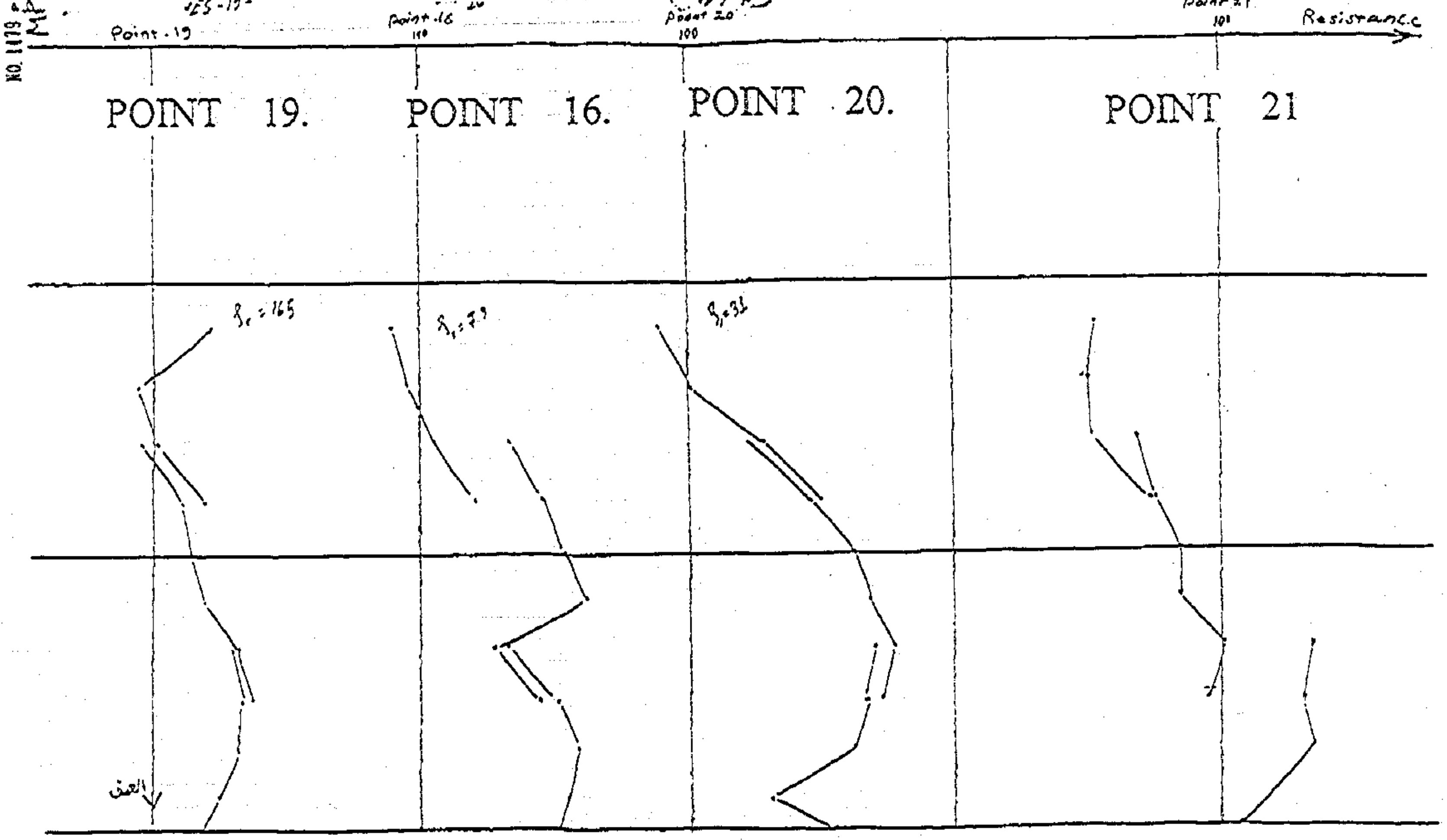


Fig. 5.W.3 VES Test Result (4/5)



MP0913/6

Fig. 5.W.3 VES Test Result (5/5)



WATER PUMPING TEST REPORTS

SUBMITTED BY

SYRIAN COUNTERPART

المؤسسة العامة للاسمنت ومواد البناء

General Organization for Cement and Building Materials

TELEFAX

FAX NO : 500/4043/F.S
DATE : 21/8/1996

NO. OF PAGES INCLUDING
THIS PAGE: (1)

TO : NIHON CEMENT CO. /JAPAN.
ATT : MR. TAKAKUSAKI
CC: JICA OFFICE / DAMASCUS.
NOTING THAT COPY OF REQUIRED REPORTS HAVE BEEN RECEIVED.

DEAR SIR,

KINDLY BE INFORMED THAT IN OUR FAX NO. 500/3068 DATED 13.08.1996 SENT TO JICA OFFICE IN DAMASCUS, WE HAVE TOLLED JICA THAT GHDIR CO. HAS COMPLETELY FINALIZED DRILLING AND CASING FOR THE FOLLOWING THREE WELLS BEFORE 12.08.1996 AND HAVE BEEN RECEIVED BY OUR REPRESENTATIVES; THESE WELLS ARE:

WELL NO.	DEPTH	(M^3/H)
20	650	7.5 MAX.
11	450	20 & OVER
12	450	20 & OVER

AS FOR WELLS NO. 11 AND 12. THEY HAVE BEEN PUMPED WITH 40 HORESPOWER PUMP, SUCH A PUMP WILL GIVE NO MORE THAN 20-22 M^3/H. IN CASE WE USE STRONGER PUMP, PROBABLY WELLS 11 AND 12 WILL PUMP MORE THAN ABOVE MENTIONED FIGUER. TAKING INTO CONSIDERATION THAT GHADIR CO. HAS SENT REPORTS ABOUT ABOVE 3 WELLS TO JICA OFFICE IN DAMASCUS ON 12.08.1996 INCLUDING WELL MEASURMENTS, STATIC AND DYNAMIC LEVELS, PUMP DEPTH, DRILLING DEPTH, GEOLOGICAL CROSSINGS AND THEIR AGES, ANALYSIS AND OTHER INFORMATIONS.

BEST REAGRDS.
ENG. AHMED ALHAMO
GENERAL DIRECTOR

GOCBM
P. O BOX 5265, DAMASCUS - SYRIA, TELEFAX : 963(11)6117111, TELEX 411369,
TELEPHONE : 963 (11) 6118444 - 6118666 - 6117444 - 6117503.

GHADIR
FOR WELLS DRILLING

Specification For No. 12 Point At Abu Al-Shamat :

- Starting Date Of Drilling : 20/07/1996
- Closing Date Of Drilling : 04/08/1996
- Protection Pipe Diameter : 13 "
- Deep Of The Well : 450 m
- Drilling Diameter : 15" (6.5m) + $12\frac{1}{4}$" (443.5m)

- Diameter Of Casing : 9" (4 mm)
- Plane Casing : 249 .
- Screen Casing : 200
- The Layer Level Which The Water appeared through drilling : 230 m
- Static level of water : 216 m
- Dynamic level of water : 253 m
- Flow : 20 m3/h
- Deep of pump installation : 274 m
- Date of test : 06/08/1996 .
- Section (description of rock) :

∴-35 m	Dolomite - Limestone .
35-312 m	Limestone
312-330 m	Marl
330-450 m	Marl With Bands and lenses of flint

GHADIR For Wells Drilling

GEOPHYSICAL WELL LOGGING

A: WELL INFORMATION :

WELL	: Point 12
AREA	: A6u - Al-Shamat
DEPTH	: 450 m
DIAMETER	: 15 " from 0-6.5 m 12.25 " , From 6.5 - 450
CASING DIAMETER	: 13" (6.5 m)
CASING FLUID	: Water + Foum .
STATIC LEVEL	: 217 m
DATE	: 03/8/1996

B: METHODS OF WORK :

1- Electric resistance .
2- Self Potential .
3- Gamma Rays .
4- Drilling fluid resistance .
5- Temperatue .

C : RESULTS :

1- Hydrogeology :

- Static level of water	: 217 m
- Fraction area	: (230-255) - (437-450)
- Temperature of water	: (stslic level) 25 ° (bottom) 27°
- Resistivity of drilling fluid	: ohm.m 17

NOTE :

PH of water = 7,47
TDS = 0.37. g/L
CND = 0.74 ms/cm

LITHOLOGICAL AND GEOPHYSICAL SECTION:

Layer/	Interval m	Thickness m	Resistivity ohm/m	Self Potential m. volt	Gamma ray cps/div	Formation
1	0 -35	35			25	Polomite Limestone
2	35-312	277	600	50	20	Limestone
3	312-330	18	25	60	50	Marl
4	330-450	120	40	70	70	Marl with bands and lenses of blint

ETABLISSEMENT PUBLIC DES EAUX DE FIGEH
DAMAS
LABORATOIRE DE CONTROLE DES EAUX

ANALYSE BACTERIOLOGIQUE D'EAU

N° 250

Demandeur : gaDir - Abo Alsheail point 12
Lieu du prélèvement :
Eau non traitée . Eau Traitée . Chlore ou produits chlorés .
Prélèvement effectué le : / / à / heures par :
Mode de transport du prélèvement : / / à heures .
8.8.96

RESULTAT

1) Dénombrement total des bactéries sur gélose nutritive :
nombre de colonies après 24 heures à 37 ° : 3000 par 100 ml.
Technique : membranes filtrantes .

2) COLIMETRIE :
Bacteries coliformes : 1000 par 100 ml
Escherichia coli : - par 100 ml
Technique : membranes filtrantes à 37° et 44° . Tests I.M.V.I.C.

Denombrement des Streptocoques fécaux :
Streptocoque fécaux : par 100 ml
Technique : membranes filtrantes . ROTHE et LITSKY .

OBSERVATIONS :

CONCLUSIONS : No patabel

Date d'envoi des résultats de l'analyse :

Le chef du laboratoire

ETABLISSEMENT PUBLIC DES EAUX DE FIGEH -- DAMAS --

LABORATOIRE DU CONTROLE DES EAUX

ANALYSE PHYSIQUO -- CHIMIQUE D'EAU N°:..250....

Demandeur gadir- Abo AlShamat. paint 12

Lieu du prélèvement

Prélevé le ....Reçu le 8.8.96 Terminé le ....

EXAMEN PHYSIQUE

t° : 28 pH : 7.9

Couleur: – Odeur: –

Saveur : – Tur : 5 N.T.U

Conductivité micromhos: 550 à 28...C°

EXAMEN CHIMIQUE

TH : 22 THm: 6

TA/TAC: 0/13 Cl_2; –

CO_2 : – O_2: –

NH_4 : – NO_2: –

BALANCE IONIQUE

CATIONS	mg/L	mé/L	ANIONS	mg/L	mé/L
Calcium Ca^{++}	64	3.19	Bicarbonate HCO_3^-	159	2.61
Magnesium Mg^{++}	15	1.23	Carbonate CO_3	–	–
Sodium Na^+	34	1.48	Sulfates SO_4	60	1.25
Pottassium K^+	1.5	0.04	Chlorure CL	60	1.69
Fer Fe^{++}	–	–	Nitrate NO_3^-	10	0.16
Somme	114	5.94	Somme	289	5.71

Résidu à 105°: ...375.....mg/L

Conclusions : potabel.

Damas, le

Le Chef du Laboratoire

GHADIR
FOR WELLS DRILLING

Specification For No. 20 Point At Abu Al-Shamat :

- Starting Date Of Drilling : 23/06/1996
- Closing Date Of Drilling : 24/07/1996
- Protection Pipe Diameter : 13 "
- Deep Of The Well : 650 m
- Drilling Diameter : 15" (6 m) + 12$\frac{1}{4}$" (442 m)+8$\frac{1}{2}$" (202 m)
- Diameter Of Casing : 9" (4 mm) + 6 " (4 mm)
- Plane Casing : 9" (233 m) .
- Screen Casing : 9" (200m) + 6" (219 m)
- The Layer Level Which The Water appeared through drilling : 340 m
- Static level of water : 210,8 m
- Dynamic level of water : 374 m
- Flow : 7,5 m3/h
- Deep of pump installation : 377 m
- Date of test : 26/07/1996 .
- Section (description of rock) :

0-30 m	Clacy Limestone .
30-166 m	Dolomite - Limestone .
166-185 m	Limestone (Faults zone)
185-237 m	Limestone (medium)
237-650 m	Marl

GEOPHYSICAL WELL LOGGING

A: WELL INFORMATION :

WELL : Point 20
AREA : A6u - Al-Shamat
DEPTH : 650 m
DIAMETER : 15 " from 0-6 m
12.25 " , FROM 6-448
CASING DIAMETER : $8\frac{1}{2}$" From 448-650 m
CASING FLUID : Water + Foum .
STATIC LEVEL : 228 m
DATE : 11/7/1996

B: METHODS OF WORK :

1- Electric resistance .
2- Self Potential .
3- Gamma Rays .
4- Drilling fluid resistance .
5- Temperatue .

C : RESULTS :

1- Hydrogeology :
- Static level of water : 228 m
- Fraction area ; 316-337 m
- Temperature of water : (ststic level) 25 °
(bottom) 27°
- Resistivity of drilling fluid : ohm.m 15

NOTE :

PH of water = 7,72
TDS = 0.572 g/L
CND = 1.13 ms/cm

LITHOLOGICAL AND GEOPHYSICAL SECTION:

Layer#	Interval m	Thickness m	Resistivity ohm/m	Self Potential m. volt	Gamma ray cps/div	Formation
1	0 - 30	30			30-40	Claey Limestone
2	30-166	136			15-20	Dolomite Limestone
3	166-185	19			100	Limestone (Faults zone)
4	185-237	52	1000	50	20-30	Limestone medium
5	237-650	413	20	20-50	80-100	Marl

ETABLISSEMENT PUBLIC DES EAUX DE FIGEH
DAMAS
LABORATOIRE DE CONTROLE DES EAUX

ANALYSE BACTERIOLOGIQUE D'EAU

N° 229

Demandeur :
Lieu du prélèvement : gaDir - Abo Alshamat - Pound
Eau non traitée . Eau Traitée ; Chlore ou produits chlorés .
Prélèvement effectué le : / / à / heures par :
Mode de transport du prélèvement : 31/7/96 à heures .

RESULTAT

1) Dénombrement total des bactéries sur gélose nutritive :
nombre de colonies après 24 heures à 37 ° : 4000 par 100 ml.
Technique : membranes filtrantes

2) COLIMETRIE :
Bacteries coliformes : 2000 par 100 ml
Escherichia coli : par 100 ml
Technique : membranes filtrantes à 37° et 44° ; Tests I.M.V.I.C.

Denombrement des Streptocoques fécaux :
Streptocoque fécaux : par 100 ml
Technique : membranes filtrantes . ROTHE et LITSKY .

OBSERVATIONS : No Potabel

CONCLUSIONS :

Date d'envoi des résultats de l'analyse :

Le chef du Laboratoire

ETABLISSEMENT PUBLIC DES EAUX DE FIGEH - DAMAS

LABORATOIRE DU CONTROLE DES EAUX

ANALYSE PHYSIQUO - CHIMIQUE D'EAU N°: ..229...

Demandeur gadir - Abo ALshamat paml 20

Lieu du prélèvement

Prélevé le ....Reçu le .... Terminé le 31.7.96..

EXAMEN PHYSIQUE

t° : 29 pH : 7-7

Couleur: – Odeur: –

Saveur : – Tur : 6.5

Conductivité micromhos: 800..à..29.C°

EXAMEN CHIMIQUE

TH : 32 THa: 17

TA/TAC: 0/20 Cl_2: –

CO_2 : – O_2: –

NH_4 : – NO_2: –

BALANCE IONIQUE

CATIONS	mg/L	m'/L	ANIONS	mg/L	m'/L
Calcium Ca^{++}	60	2.99	Bicarbonate HCO_3	244	4.00
Magnesium Mg^{++}	41	3.37	Carbonate CO_3	–	–
Sodium Na^{+}	60	2.61	Sulfates SO_4	136	2.83
Pottassium K^{+}	3	0.08	Chlorure CL	86	2.43
Fer Fe^{++}	–	–	Nitrate NO_3	a	0.0
Somme	164	9.05	Somme	466	9.26

Résidu à 105°: ...510.....mg/L

Conclusions : potabel

Damas, le

Le Chef du Laboratoire

GHADIR
FOR WELLS DRILLING

Specification for No. 11 point at Abu Al Shamat:

- Starting date of drilling : 25.07.1996
- Closing date of drilling : 4 .08.1996
- Protection pipe diameter : 13"
- Deep of the well : 450 M
- Drilling diamotor : 15" (6`5M)+ 12,1/4"(443,5 M)
- Diameter of casing : 9" (4mm)
- Plane casing : 271 m
- Screen casing : 150m
- The layer level which the water appear through drilling : 282m
- Static level of water : 218,30 m
- Dynamic level of water : 265 m
- Flow : 20 m3/h
- Deep of pump installation : 274 m
- Date of test : 09.08.1996
- Section (description of rock) :

0 - 20 m	Limestone (Dolomite)
20- 39 m	Block rock moving
39- 83 m	Clay limestone
83-213m	Chalky limestone
213-238m	Marl
238-282m	Limestone (medium)
282-320m	Aloveal rock (Gravels limestone)
320-450m	Marl

GEOPHYSICAL WELL LOGGING

A : WELL INFORMATION:

WELL : POINT 11
AREA : ABU-AL- SHAMAT
DEPTH : 450 M
DIAMETER : 15" FROM 0 - 6,5M
12,25" FROM 6,5-450M
CASING DIAMETER : 13" (6,5M)
DRILLING FLUID : WATER + FOUM
STATIC LEVEL : 217 M
DATE : 01.08.1996

B : METHODS OF WORK:

1 - ELECTRIC RESISTANCE.
2 - SELF POTENTIAL.
3 - GAMMA RAYS.
4 - DRILLING FLUID RESISTANCE.
5 - TEMPERATURE.

C : RESULTS:

1 - HYDROGEOLOGY:
- STATIC LEVEL OF WATER : 2.17 M
- FRACTION AREA : 282 - 320
- TEMPERATURE OF WATER : (STATIC LEVEL) 24°
  (BOTTOM) 26,5°
- RESISTIVITY OF DRILLING FLUID: 17 OHM.M

NOTE:

PH OF WATER = 7,42
TDS = 0,41 G/L
CND = 0.80 MS/CM

LITHOLOGICAL AND GEOPHYSICAL SECTION:

Layer#	Interval m	Thickness m	Resistivity ohm/m	Self Potential m. volt	Gamma ray cps/div	Formation
1	0 - 20	20			20	(Polomite)
2	20-39	19			65	Block rock moving
3	39-83	44			25	Clay Limestone
4	83-213	130			20	Limestone (Chalky)
5	213-238	25	50	60	30	Marl
6	238-282	44	600	70	15	Limestone
7	282-320	38	450	25	10	Gravels Limistone
8	320-450	130	30	50	40	Marl

-No,9

GHADIR
FOR WELLS DRILLING

Specification for No.1 point at Abu Al-Shamat :

- Date of starting of drilling : 24.02.1996
- Closing date of drilling : 05.03.1996
- Protection pipe diameter : 13" - 6m
- Deep of the well : 352,5m
- Drilling diameter : 15"(6m) + 12",25(346,5m)
- Diameter of casing : 9"(4mm)
- Plane casing : 200m
- Screen casing : 150m
- The layer level which the water appeared through drilling (very little). : 90m
- Static level of water : 109m
- Dynamic level of water : 283m
- Flow : 7,8 m3/h
- Deep of pump installation : 290m
- Date of test : 20-21-22-23/03/1996
- Section (description of rock) :

0 - 1m Alovel
1 - 100m chalky after that no returns.

2/16

LABORATOIRE DU CONTROLE DES EAUX

NO.9

piont (1)

ANALYSE PHYSIQUO - CHIMIQUE D'EAU N°:..........

Demandeur AL GADIR Co.

Lieu du prélèvement

Prélevé le 14.3.96.......Reçu le .... Terminé le ....

EXAMEN PHYSIQUE		EXAMEN CHIMIQUE	
t° : 17	pH : 7.5	TH : 47 F°	THc: 26 F°
Couleur: néant	Odeur: H_2S	TA/TAC: 0/26	Cl2: –
Saveur : –	Tur : 34 N.T.U	CO2 : –	O2: –
Conductivité micromhos: 1200 à 17 C°		NH4 : –	NO2: –

BALANCE - IONIQUE

CATIONS	mg/L	m/L	ANIONS	mg/L	m/L
Calcium Ca^{++}	84	4.19	Bicarbonate HCO_3	317	5.20
Magnesium Mg^{++}	63	5.18	Carbonate CO_3	–	
Sodium Na^{+}	104	4.52	Sulfates SO_4	180	3.75
Pottassium K^{+}	9	0.23	Chlorure Cl	158	4.46
Fer Fe^{++}	–	–	Nitrate NO_3	15	0.24
Somme	260	14.12	Somme	670	13.65

Résidu à 105°: 770 mg/L

Conclusions :

Damas, le

Le Chef du Laboratoire

3/16

No.9

DAMASCUS CITY WATER SUPPLY AND SEWERAGE AUTHORITY
El Nassr Street
Damascus Syrian Arab Republic

CONTROL OF WATER LABORATORY

Name and address of sender : AL GADIRG
Sender's reference number :
Date of collection : 23.3.96
Date of arrival at laboratory :
Date of commencing examination :

REPORT

Plate counts after 24 hours at 37 C°: 1500 per 100 ml
Number of coliform organisms : 500 per 100 ml

Date of report : 24/3/96

Remarks :

Signed

Lab. Dir.

المؤسسة العامة
لمياه الشرب والصرف الصحي
في محافظة [illegible]
مخبر مراقبة المياه

تقرير بالتحليل الجرثومي للمياه

اسم وعنوان المرسل [illegible]

رقم المرسل : ....

رقم المخبر : [illegible]

طبيعة العينة : [illegible]

تاريخ وساعة اخذ العينة [illegible]

تاريخ وساعة استلام العينة في المخبر : [illegible]

تاريخ وساعة اجراء الزرع : [illegible]

النتائج

١ ــ التعداد الكلي للجراثيم [illegible] / مل
- مدة الحضانة [illegible]
- درجة الحرارة [illegible]
- نوع الوسط الزرعي [illegible]

٢ ــ عدد العصيات الكولونيه [illegible] / ١٠٠ مل
- مدة الحضانة [illegible]
- درجة الحرارة [illegible]
- نوع الوسط الزرعي [illegible]

٣ ــ عدد عصيات الاشريشيا .... / ١٠٠ مل
- مدة الحضانة ....
- درجة الحرارة ....
- نوع الوسط الزرعي ....

٤ ــ تعداد الكورات العقدية ....
- مدة الحضانة ....
- درجة الحرارة ....
- نوع الوسط الزرعي ....

نظم هذا التقرير بتاريخ [illegible] اعطيت النتيجة هاتفيا بتاريخ ....

الاحظات : [illegible] غير قابلة للاستعمال البشري [illegible]

[illegible]

5-W-33

المرسل : [illegible]	المنظر [illegible]
تاريخ استلام العينة [illegible]	اللون [illegible]
تاريخ انجاز التحليل [illegible]	الرائحة [illegible]
مكان اخذ العينة [illegible]	التعكير [illegible]
طبيعة المياه [illegible]	الناقلية الكهربائية [illegible]
رقم النتيجة [illegible]	نسبة الـ pH ٧,٥

التحاليل المجملة

العسر الكلي T.H ٤٧ [illegible]	الكلور الحر المتبقي Cl^2 ملغ/ل
العسر المغنيزي T.H m ٢٦ »	البرمنغنات المستهلك $KMnO^4$ »
العسر الدائم T.H p ٤٦ »	الازوت بشكل نترات No^3 ١٥ »
القلوية T.A ٠ »	الازوت بشكل نتريت No^2 »
القلوية الكاملة T.A.C ٤٦ »	الأمونياك NH^4 »
الحامض الفحمي الحر Co^2 — ملغ/ل	الحامض الفحمي الأكل Co^2 »

التحاليل الكيماوية

الشوارد الموجبة				الشوارد السالبة			
	درجة فرنسية	معادل المليغرامي	ملغ/ل		درجة فرنسية	معادل المليغرامي	ملغ/ل
الكالسيوم Ca		[illegible]	[illegible]	ثاني فحمات HCo^3		[illegible]	[illegible]
المغنزيوم Mg		٥,١٨	[illegible]	الفحمات Co^3			
الصوديوم Na		[illegible]	[illegible]	الكبريتات So^4		[illegible]	[illegible]
البوتاسيوم K		[illegible]	٩	الكلورور Cl		[illegible]	[illegible]
الحديد Fe				النترات No^3		[illegible]	١٥
مجموع الشوارد الموجبة		[illegible]	[illegible]	مجموع الشوارد السالبة		[illegible]	[illegible]

مجموع الأملاح الترسبية نتيجة التبخر : [illegible] ملغ/ل

تدريبات خاصة وملاحظات :

المسؤول عن المخبر

6/16

درجة : درجة الفرنسية

ملغ/ل : مليغرام في اللتر

No.4

GEOPHYSICAL WELL LOGGING

A : WELL INFORMATION:

WELL : Point I
AREA : A6n - Al - Shamat
DEPTH : 352.5 m
DIAMETER : 15". from 0 - 6m
12,25" from 6 - 352,5 m
CASING DIAMETER : 9" (4mm)
DRILLING FLUID : Water + Foam.
STATIC LEVEL : 91m
DATE : 02.03.1996

B : METHODS OF WORK:

1 - Electric resistance.
2 - Self Potential.
3 - Gamma Rays.
4 - Drilling fluid resistance :
5 - Temperature .

C : RESULTS:

-1 - Hydrogeology:
- Static level of water : 91m
- Water layers interval : 91 - 140 m (very little)
- Temperature of water: 21° (static level)
25° (bottom)
- Resistivity of drilling fluid: 9 ohm.m

NOTE:
PH of water = 7.12
H2s (much)

p.7

2 - LITHOLOGICAL AND GEOPHYSICAL SECTION:

Layer#	Interval m	Thickness m	Resistivity ohm/m	Self Potential m volt	Gamma Ray cps/div	Formation
1	0 - 141	141	25-50	50-100	40-80	chalky and clay
2	141-327	186	20-40	50-60	10-500	Clay Limestone and flient
3	327-352,5	25,5	10-25	30-45	10-20	Marl

F/16

NO13

GHADIR
FOR WELLS DRILLING

Specification for No.2 point at Abu Al-Shamat :

- Starting date of drilling : 29.02.1996
- Closing date of drilling : 09.03.1996
- Protection pipe diameter : 13" - 6,5m
- Deep of the well : 452,5m
- Drilling diameter : 15"(6m) + 12",25(446,5m)
- Diameter of casing : 9"(4mm)
- Plane casing : 300m
- Screen casing : 152m
- The layer level which the water appeared through drilling : 350m
- Static level of water : 209,90m
- Dynamic level of water : 249,60m
- Flow : 19,5 m3/h
- Deep of pump installation : 300m
- Date of test : 12-13-14-15-16/03/1996
- Section (description of rock) :

0 - 155m	Limestone (very hard)
155 - 180m	Clay limestone
180 - 290m	Limestone (medium) hard
290 - 350m	Clay limestone
350 - 396m	Fraction limestone + Flignt
396 - 452,5m	Marl

9/16

No.17

GEOPHYSICAL WELL LOGGING

A : WELL INFORMATION:

WELL	:	Point 2
AREA	:	Abu - Al - Shamat
DEPTH	:	452.5 m
DIAMETER	:	15" from 0 - 6m
		12,25" from 6 - 452,5 m
CASING DIAMETER	:	9" ([illegible]mm)
DRILLING FLUID	:	Water + Foam.
STATIC LEVEL	:	220 m
DATE		07.03.1996

B : METHODS OF WORK:

1 - Electric resistance.
2 - Self Potential.
3 - Gamma Rays.
4 - Drilling fluid resistance .
5 - Temperature.

C : RESULTS:

1 - Hydrogeology:
- Static level of water : 220m
- Water layers internal : 366 - 387m
- Fraction area : 350 - 390
- Temperature of water: 22,5°(static level)
  25 ° (bottom)
- Resistivity of drilling fluid: 23,5 ohm.m

NOTE:-
PH of water = 6.16
TDS = 0,3 g/L
= 0,6 ms/cm

10/16

2 - LITHOLOGICAL AND GEOPHYSICAL SECTION:

Layers	Interval m	Thickness m	Resistivity ohm m	Self Potential m. volt	Gamma Ray cps/div	Formation
1	0 - 155	155			20 - 40	Limestone very hard
2	155-180	25			60 - 70	Clay Limestone
3	180-186	6			200	Fructured Fault area
4	186-290	104	100-150	-120	60 - 80	Limestone medium
5	290-350	60	25	-120	80	Clay Limestone
6	350-396	46	150-200	50-60	20 - 80	Fraction Limestone
7	396-452,5	56,5	50 - 70	120	100-140	Marl

غدير
شركة غدير لحفر الآبار م.م.
رأس مالها ١٨٥ مليون ل.س

الرقم : ش.غ / ٥٦ / م ن
التاريخ : ٢٠ / ٣ / ١٩٩٦

السادة الوكالة اليابانية للتعاون الدولي (جايكا) المحترمين

تحية طيبة ،
نرفق لكم فيمايلي نسختين من المواصفات الفنية لبئر أبو الشامات رقم / ٢ /
يرجى الاطلاع

شاكرين لكم حسن تعاونكم معنا ....

- صورة الى
المؤسسة العامة للإسمنت ومواد البناء

المهندس رفيق الخضر
المدير العام

شركة غدير لحفر الآبار
GHADIR
For Wells Drilling

ص.ب
٩٢٠٠
دمشق سوريا
هاتف
٢٢٢١ ٨٠٠/٨٠١/٨٠٢
تلكس
٤١١٢٩١
فاكس
٢٢١٢ ٠٢١

12/16

شــركة عـلـيـو لحفر الابـار

الموضوع : حفر بئر ابو الشـامات رقم/٢/

حضـارة رقم/٢/

ترسل اليكم فيما يلي نسختين من المواصفات الفنية لبئر ابـو الشـامـات رقم / ٢ /

- تاريـخ البدء بالحفر ٢٩ / ٢ / ١٩٩٦
- تاريـخ الانتهاء من الحفر ٩ / ٣ / ١٩٩٦
- قسـطل حماية "١٣" بطول ٦ر٥ م
- عمـق البئر ١٥٢ر٥ م
- قطـر الحفر "١٥" (٦م) + "١٢ر٢٥" (٤٤٦م)
- قطـر قساطل الاكساء "٩" سماكة ٤مم
- طول قساطل الاكساء العادية ٣٠٠م
- طول قساطل الاكساء المثقبة ١٥٢م
- منسوب الطبقة التي ظهرت فيها المياه أثناء الحفر ٢٥٠م
- المنسوب الستاتيكي للمياه ٢٠٩ر٩٠م
- المنسوب الديناميكي للمياه ٢١٩ر٦٠م
- تصـريف البئـر ١٩ر٥م³/سـا
- قطر المضخـــة "٨
- عمق تركيب المضخة أثناء التجربة ٣٠٠م
- تاريخ اجراء التجربة ١٢ – ١٦/ ٣ / ١٩٩٦
- العمـود الجيولوجي

٠ – ١٥٥م حجر كلسي عالي القساوة

١٥٥ – ١٨٠م حجر كلسي غضاري

١٨٠ – ٢٩٠م حجر كلسي متوسط القساوة

٢٩٠ – ٢٥٠م حجر كلسي غضاري

٢٥٠ – ٢٩٦م حجر كلسي متشقق مع صوان

٢٩٦ – ١٥٢م مـارن

Wells Drilling

شركة شدير لحفر الابار

حفارة رقم/٢/

الموضوع : حفر بئر ابو الشامات رقم/٢/

نرسل اليكم فيما يلي المختصر من المواصفات الفنية لبئر ابو الشامات رقم / ٢ /

- تاريخ البدء بالحفر ٢٩ / ٣ / ١٩٩٦
- تاريخ الانتهاء من الحفر ١ / ٣ / ١٩٩٦
- قسطل حماية ١٣" بطول ٦ م
- عمق البئر ٤٥٢ر٥ م
- قطر الحفر ١٥" (٦م) + ١٢ر٢٥" (٤٤٦م)
- قطر قساطل الاكساء ٩" سماكة ٤مم
- طول قساطل الاكساء العادية ٣٠٠م
- طول قساطل الاكساء المثقبة ١٥٢م
- منسوب الطبقة التي ظهرت فيها المياه أثناء الحفر ٣٥٠م
- المنسوب الستاتيكي للمياه ٢٠٩ر١٠م
- المنسوب الديناميكي للمياه ٢١٩ر٦٠م
- تصرف البئر ١٩ر٥م٢/سا
- قطر المضخة ٨"
- عمق تركيب المضخة أثناء التجربة ٣٠٠م
- تاريخ اجراء التجربة ١٢ — ١٦ / ٣/ ١٩٩٦
- العمود الجيولوجي

٠ — ١٥٥م حجر كلسي عالي القساوة

١٥٥ — ١٨٠م حجر كلسي غضاري

١٨٠ — ٢٩٠م حجر كلسي متوسط القساوة

٢٩٠ — ٣٥٠م حجر كلسي غضاري

٣٥٠ — ٣٩٦م حجر كلسي متشقق مع مارن

٣٩٦ — ٤٥٢م مارن

NO,13

DAMASCUS CITY WATER SUPPLY AND SEWERAGE AUTHORITY
El Nassr Street
Damascus Syrian Arab Republic

point(2)

CONTROL OF WATER LABORATORY

Name and address of sender : AL-CADIR Co.

Sender's reference number :

Date of collection : 16.3.96

Date of arrival at laboratory :

Date of commencing examination :

REPORT

Plate counts after 24 hours at 37 C°: 3000 per 100 ml

Number of coliform organisms : 2000 per 100 ml

Date of report : 17.3.96

Remarks :

Signed

Lab. Dir.

15/16

5-W-43

ÉTABLISSEMENT PUBLIC DES EAUX DE FIGEH - DAMAS

LABORATOIRE DU CONTROLE DES EAUX

No. 13

ANALYSE PHYSIQUO - CHIMIQUE D'EAU N°:..........

Demandeur AL GADIR Co.

Lieu du prélèvement

Prélevé le ...16-3-96 Reçu le .... Terminé le ....

EXAMEN PHYSIQUE		EXAMEN CHIMIQUE	
t° : 18	pH : 7.9	TH : 21 F	THa: 12 F
Couleur: néant	Odeur: néant	TA/TAC: 0 / 14 F	CL2: ~
Saveur : —	Tur : 14 N.T.U	CO2 :	O2:
Conductivité micromhos: 575 à 18 C°		NH4 :	NO2:

BALANCE IONIQUE

CATIONS	mg/L	mé/L	ANIONS	mg/L	mé/L
Calcium Ca^{++}	36	1.80	Bicarbonate HCO_3	171	2.80
Magnesium Mg^{++}	29	2.38	Carbonate CO_3	—	—
Sodium Na^{+}	48	2.09	Sulfates SO_4	48	1.00
Pottassium K^{+}	15	0.04	Chlorure CL	70	1.97
Fer Fe^{++}			Nitrate NO_3	15	0.24
Somme	114	6.31	Somme	304	6.01

Résidu à 105°: ...330......mg/L

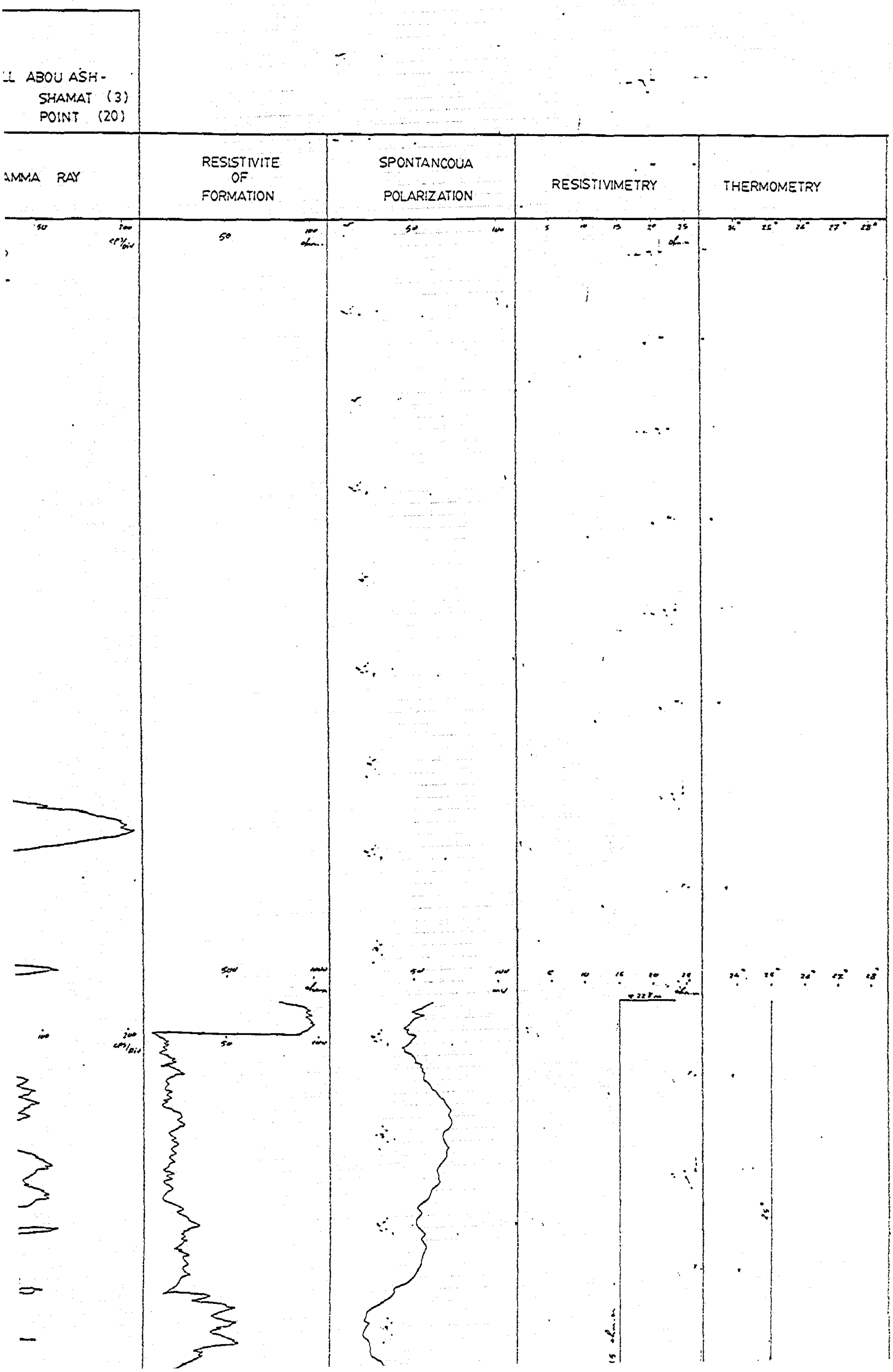
Conclusions :

Damas, le

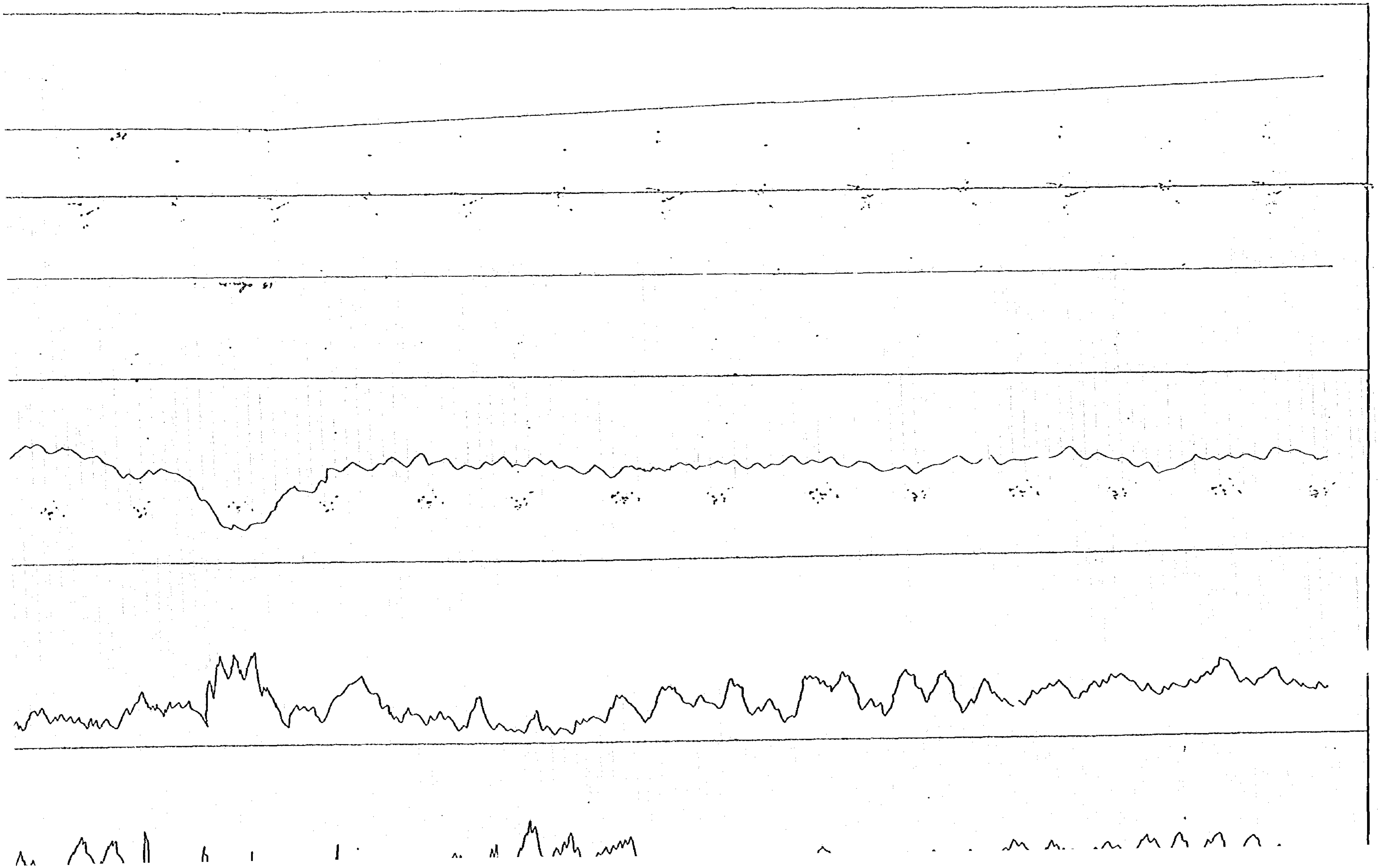
Le Chef du Laboratoire

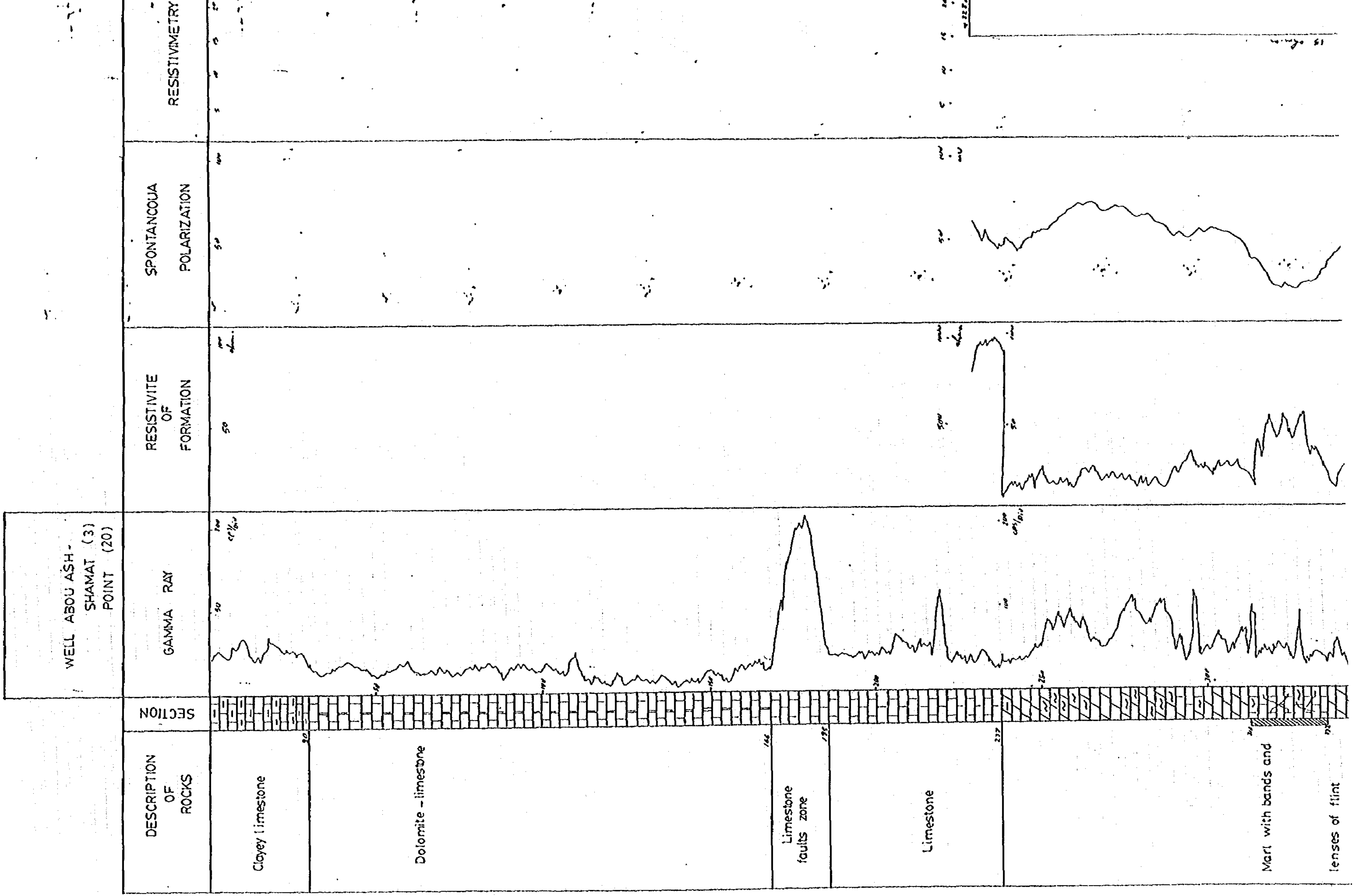
F. Nahl

16/16



L ABOU ASH-
SHAMAT (3)
POINT (20)
AMMA RAY
RESISTIVITE OF FORMATION
SPONTANCOUA POLARIZATION
RESISTIVIMETRY
THERMOMETRY
50
100
cps/div
50
100
ohm
50
100
5
10
15
20
25
ohm
24°
25°
26°
27°
28°
500
1000
ohm
mV
100
200
cps/div
25°




WELL ABOU ASH-SHAMAT (3)
POINT (20)
RESISTIVMETRY
SPONTANCOUA POLARIZATION
RESISTIVITE OF FORMATION
GAMMA RAY
SECTION
DESCRIPTION OF ROCKS
Clayey limestone
Dolomite - limestone
Limestone faults zone
Limestone
Marl with bands and lenses of flint
50
100
50
100
500
50
100
200
50
100
150
200
250
300
90
166
195
227

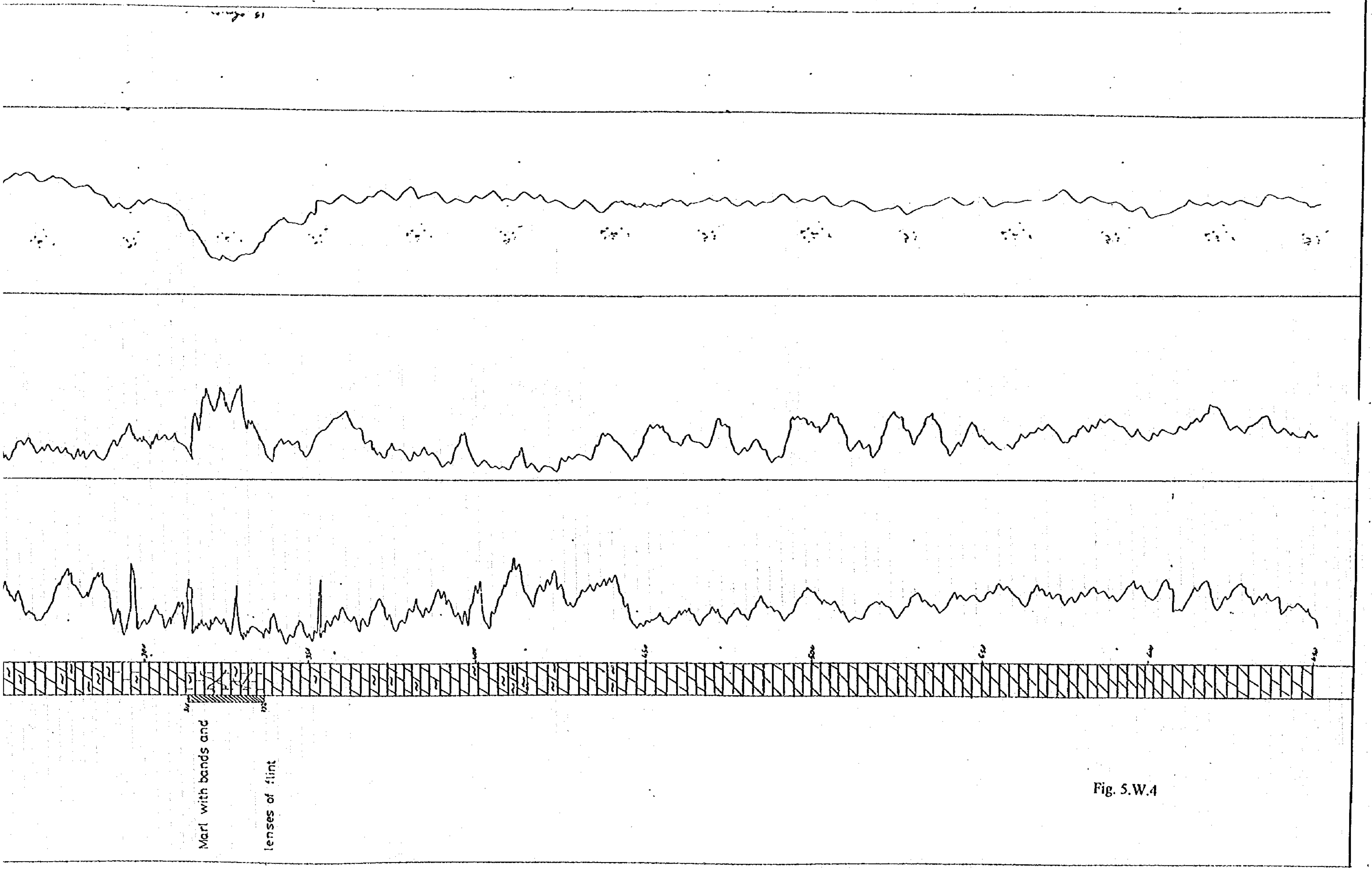
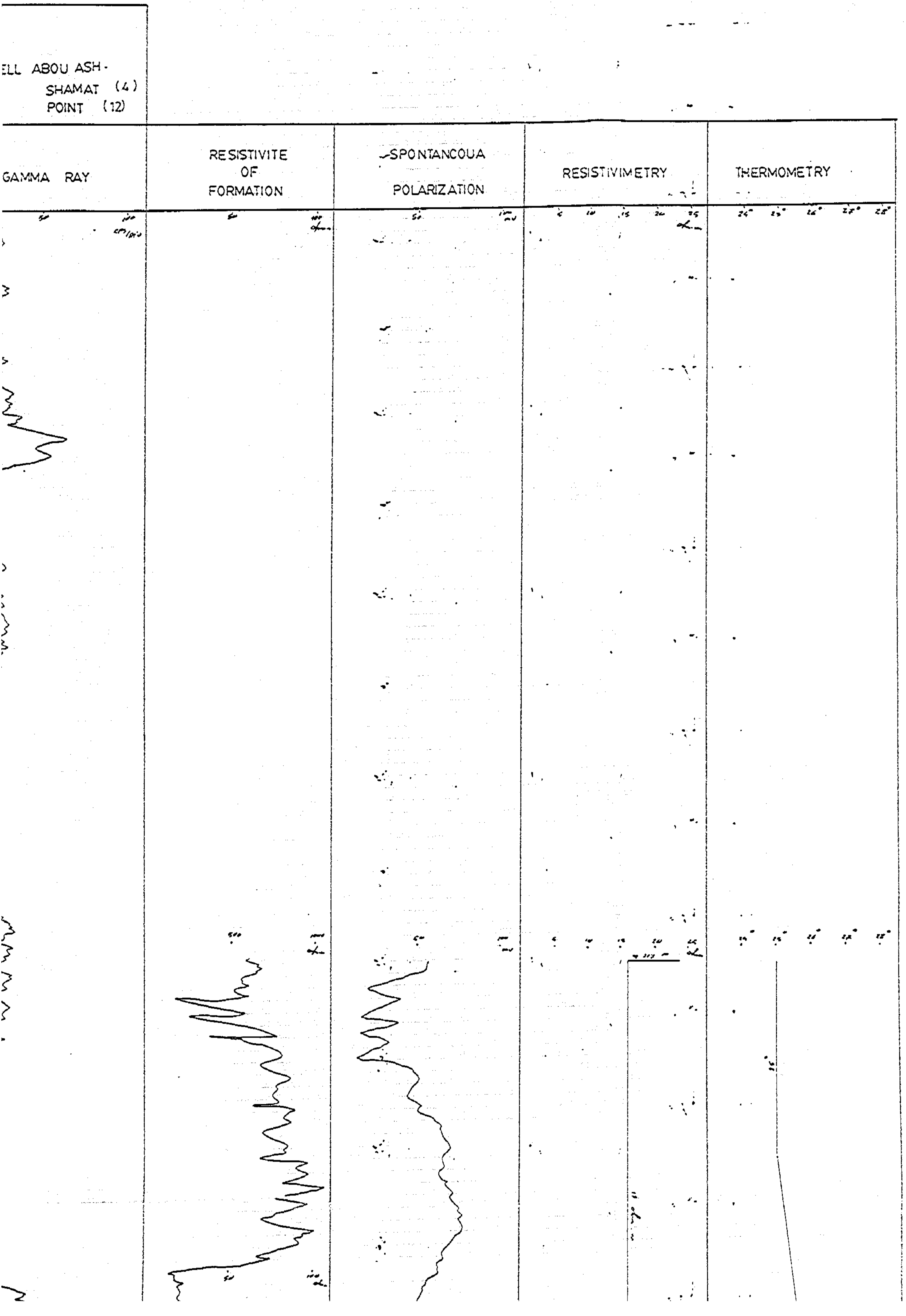
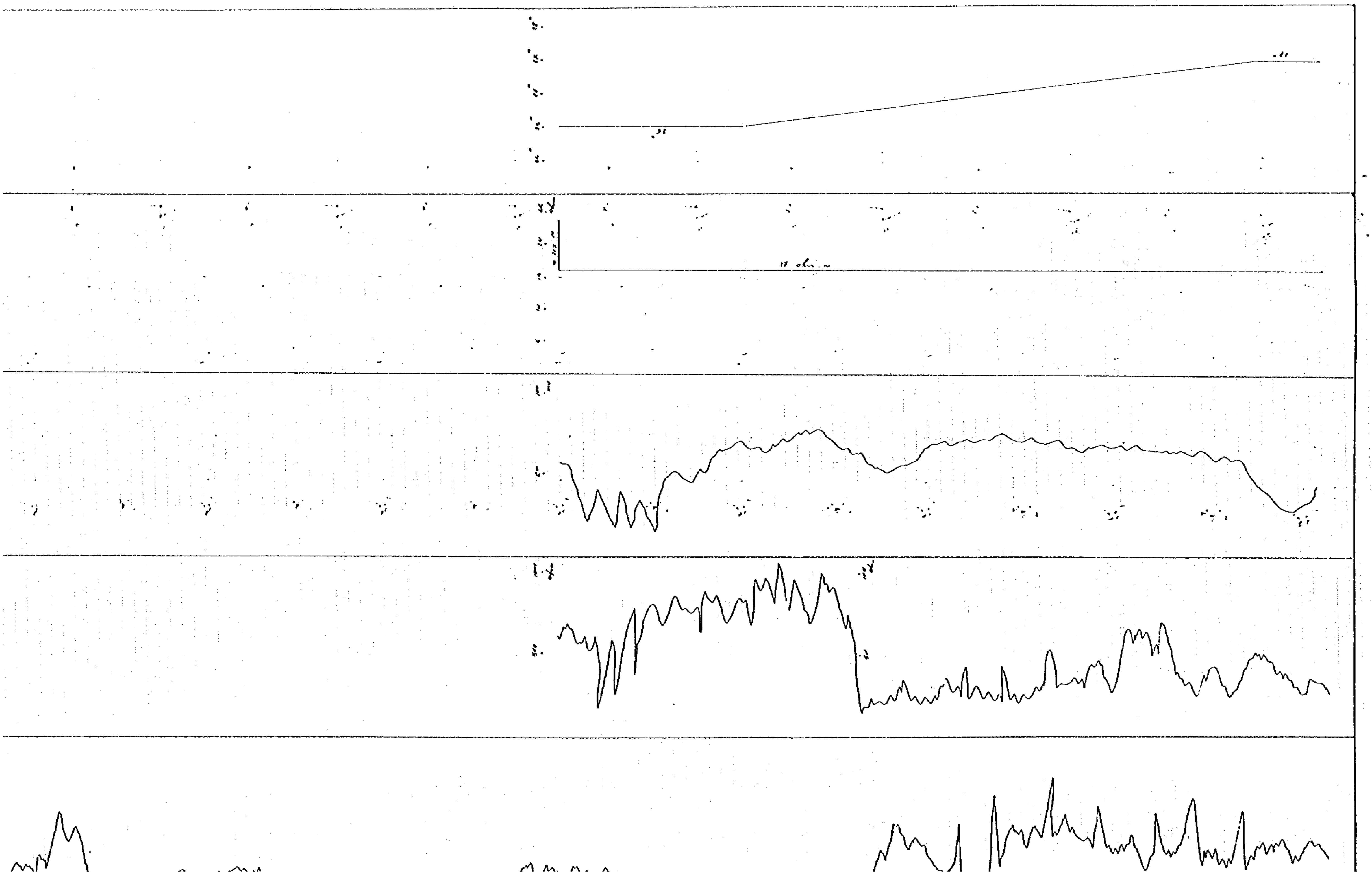
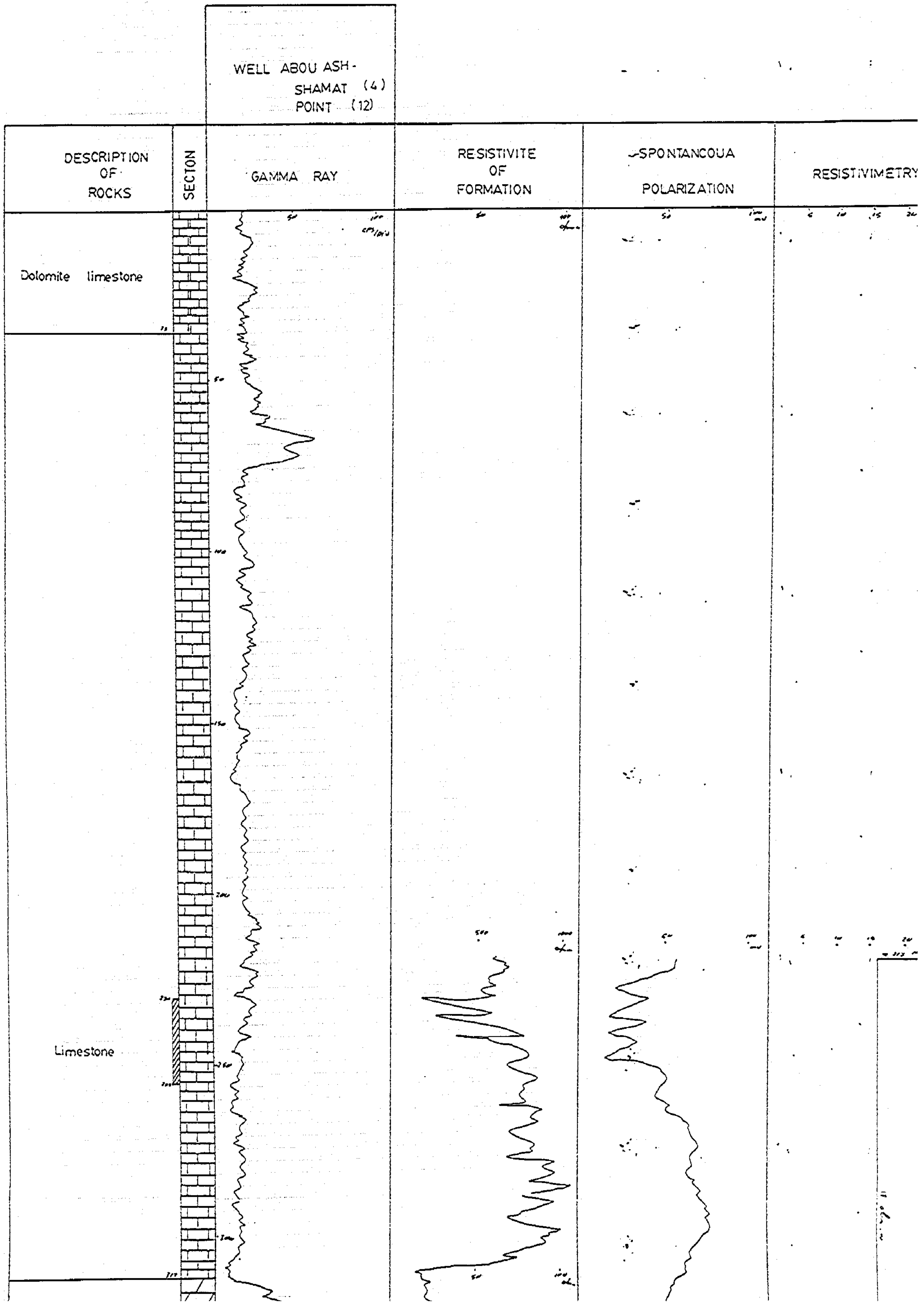

300
350
400
450
500
550
600
650
Marl with bands and
lenses of flint

Fig. 5.W.4


ELL ABOU ASH-
SHAMAT (4)
POINT (12)
GAMMA RAY
RESISTIVITE
OF
FORMATION
~SPONTANCOUA
POLARIZATION
RESISTIVIMETRY
THERMOMETRY
50
100
50
50
5
10
15
20
25
24°
25°
26°
27°
28°




WELL ABOU ASH-SHAMAT (4)
POINT (12)
DESCRIPTION OF ROCKS
SECTON
GAMMA RAY
RESISTIVITE OF FORMATION
-SPONTANCOUA POLARIZATION
RESISTIVIMETRY
Dolomite limestone
Limestone
50
100
150
200
250
300

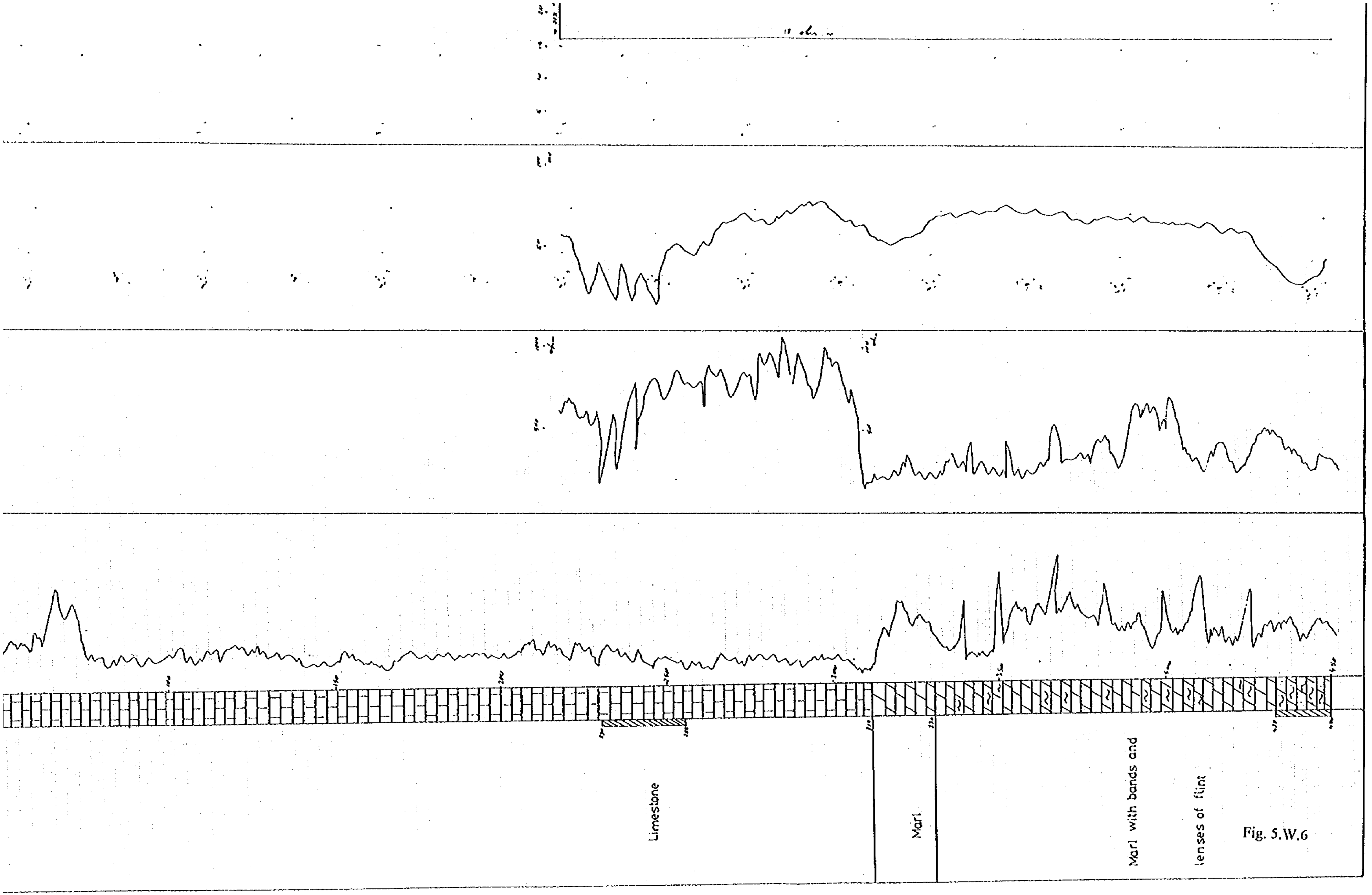
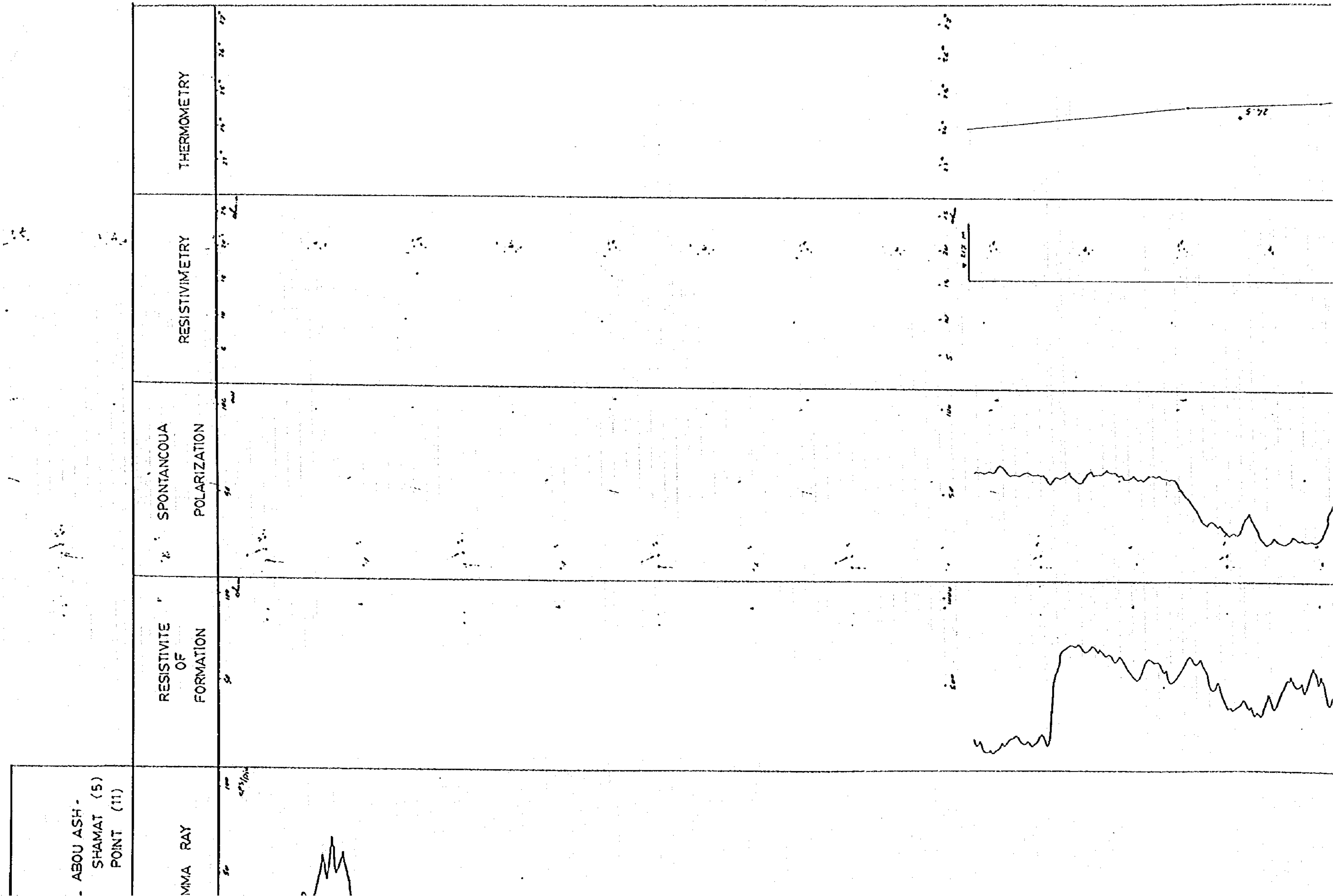
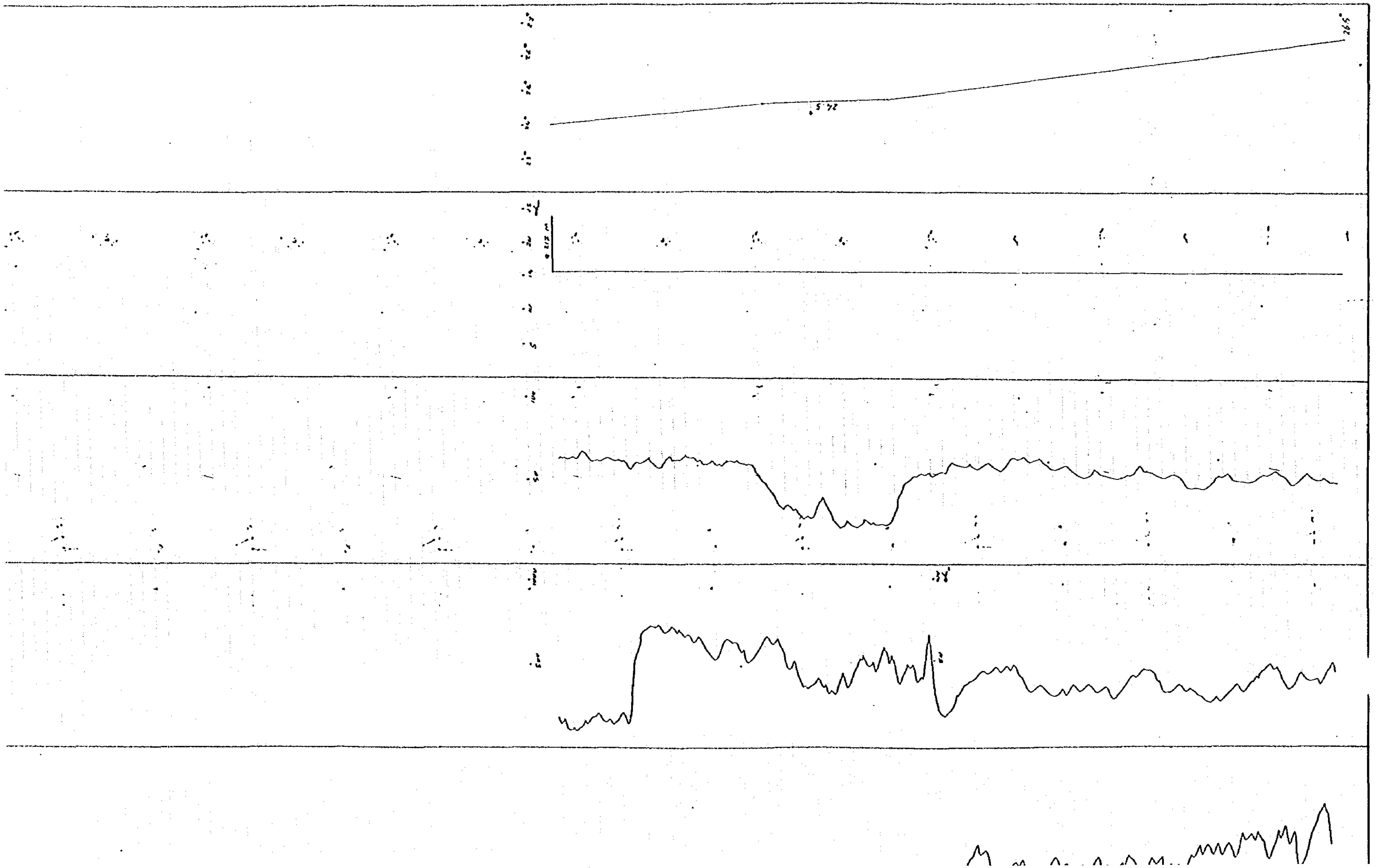
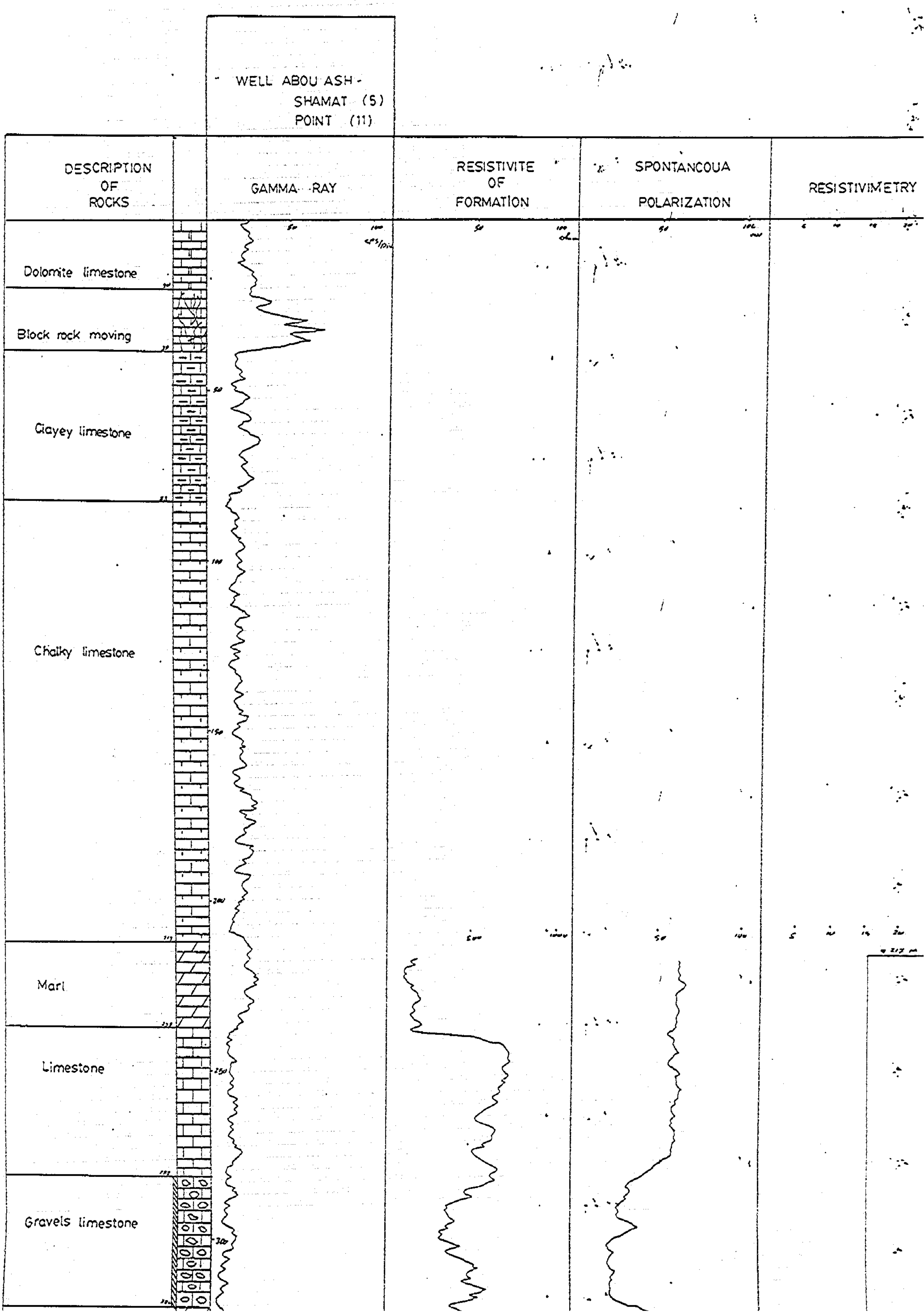


Fig. 5.W.6



ABOU ASH-SHAMAT (5)
POINT (11)
THERMOMETRY
RESISTIVIMETRY
SPONTANCOUA POLARIZATION
RESISTIVITE OF FORMATION
MMA RAY
24.5


24.5°
26.5°


WELL ABOU ASH-
SHAMAT (5)
POINT (11)
DESCRIPTION OF ROCKS
GAMMA RAY
RESISTIVITE OF FORMATION
SPONTANCOUA POLARIZATION
RESISTIVIMETRY
50
100
cps/Div
50
100
ohm
50
100
mv
5
10
15
20
500
1000
50
100
5
10
15
20
217 m
50
100
150
200
250
300
Dolomite limestone
Block rock moving
Clayey limestone
Chalky limestone
Marl
Limestone
Gravels limestone

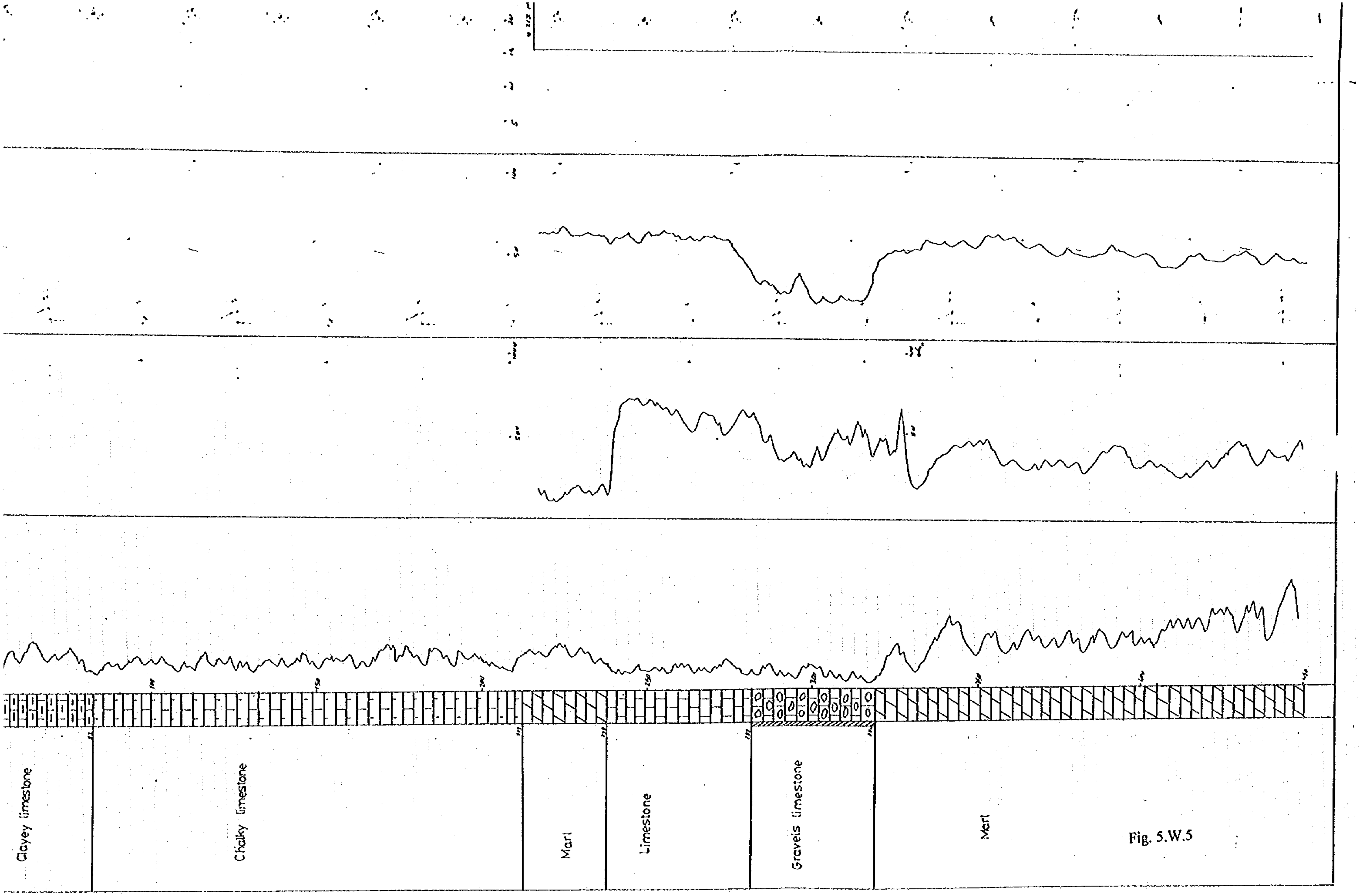

Clayey limestone
Chalky limestone
Marl
Limestone
Gravels limestone
Marl

Fig. 5.W.5

6. RAW MATERIALS

6.1 GENERAL

6.1.1 Remarks on Topography and Stratigraphy of Abu Al Shamat Region

According to the "Report on the First Stage of the Study of the Raw Materials for Cement Manufacture (Abu Al Shamat Region)" made by the Director of Exploration of GEGMR, the following facts have been proved:

1) Topography and stratigraphy in Abu Al Shamat region (Fig. 6.1 ~ 6.3). The proposed limestone deposit, distributed in flatlands with the height of about 700 m, belongs to the Eocene Series (Pg_2^3), outcrops of which can rarely be found on the surface.

2) Sedimentary rocks underlying the Eocene limestone form the hills situated to the north of the flatlands, with the height of 900~1,400 m. They mainly consist of the Cretaceous System such as Albian limestone (Cr_1al), Cenomanian limestone and marl (Cr_2cm) and Mastrichian marl (Cr_2m).

3) Lower flatlands between the hills of the Messozoic rocks and the flatlands of Eocene limestone are covered by Quaternary sediments (Q_3 and Q_4).

4) On the south of Eocene limestone there can be found the basaltic eruptions and lavas of the Holocene Series (β_1Q_4) which are the proposed basalt deposit. They have two cones, the summits of which are 791 m and 801 m above the sea level.

6.1.2 Outline of Geological Investigation on the Limestone and Basalt Quarries

Exploration works on the proposed limestone and basalt deposits have been conducted by GEGMR at the request of GOC since last year. They consist of topographic survey of the explored site, network boring of the limestone deposit, boring and cross sectional sampling from the surface outcrop of the basalt deposit and chemical analysis of samples.

Number of boreholes, number of samples collected therefrom and number of cross sections are shown below:

1) Limestone deposit:	637 samples (from 62 boreholes)
2) Basalt deposit:	42 samples (from 8 boreholes)
	125 samples (from 12 cross sections)

6.1.3 Other Materials

Compared with the basalt deposits used by other cement factories, the iron content in the proposed basalt in Abu Al Shamat is so high that it is difficult to secure a sufficient quality of cement without silica sand and clay as corrective materials.

In addition to these main materials (limestone, basalt) and corrective materials (silica sand, clay), the following materials will be used for the new cement factory.

1) Ferro clay for producing SR (sulphate resisting portlant cement)
2) Gypsum
3) Pozzolan as an additive

6.2 LIMESTONE

6.2.1 Lithofacies of the Limestone Deposit

- The proposed limestone deposit can be classified into two facies: crystallized limestone in the upper part and marly limestone in the lower part.
- The crystallized limestone is hard and light gray colored. Whereas the marly limestone is light gray to yellowish gray colored and slightly softer than the crystallized limestone.
- Based on the result of the boring prospecting, the boundary between them is around 30 m below surface in the northwestern boreholes, and becomes shallower to 10 m below surface southeastwards.

6.2.2 Limestone Quarry

- Topographic survey

  Field survey and drawing of map have been completed; results have been submitted to JST.

- Network boring (refer to Fig. 6.4)

  Drilling all of prescribed boreholes and making lithological description have been completed.

- Additional deeper boring requested by JST during their first site survey

  Drilling and making of the lithological description (refer to Table 6.1) have been completed.

- Chemical analysis

  Chemical analysis of 637 samples collected from 62 boreholes has been completed; the results are attached at the end of this chapter. The average chemical composition of each borehole sample is shown in Table 6.A.

  The result of X-ray diffraction test and microscopic observation of limestone samples collected by JST are attached at the end of this chapter.

6.2.3 Quality

The proposed limestone deposit, in general, has a sufficient quality and quantity for manufacturing cement.

The deposit in this area is composed of two types of limestone: crystallized limestone and marly limestone.

The crystallized limestone is very pure. Its CaO content is 53~55%. On the other hand, the marly limestone contains generally 50~53% of CaO, and sometimes intercalates the marl layers whose SiO_2 content is 5~12%.

Therefore, it would be better that high silica layers intercalated in the marly limestone could be quarried selectively not only for the purpose of controlling material quality stability but also to reduce consumption of silica sand from Al Qaryatin.

The possible quality control methods for utilizing the high-silica quarry site limestone, however, depends on more detailed information acquired by further investigation.

As an example of geological setting of the limestone deposit in this area, the columnar section of borehole No. H-8 is shown in Table 6.1.

The figures in the following table, which was suggested by GEGMR in the course of JST's first survey, are used as chemical composition used for raw mix calculation since there are no large differences from the new data.

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	LOI
3.35	0.32	0.32	53.09	0.07	0.09	41.59

Volume metric weight estimated by GEGMR:

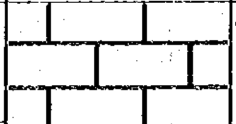
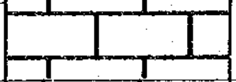
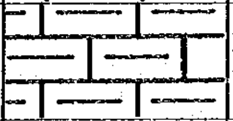
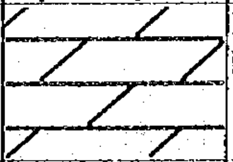
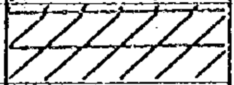
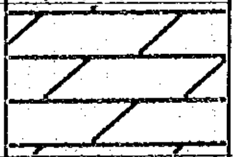
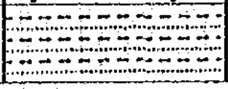
Crystallized limestone	2.46
Marly limestone	2.22
Whole limestone	2.25

(lighter than VMW of common limestone in Syria)

Moisture content estimated by GEGMR:

Minimum	1.0%
Average	2.0%

Table 6.1 Stratigraphy around the Proposed Limestone Deposit (based on the boring core data from Borehole No. H-8)

Depth (m)	Columnar Section	Lithofacies	Characteristics
0.00 - 7.25		Crystallized limestone	Hard, marbly, light brown-gray, including small cavities and cracks
7.25 - 22.50			Hard, white, including small cracks filled with soft marl
22.50 - 49.95		Limestone-marly limestone	Medium hard, white-light gray, intercalating some sandy parts, including small cracks
49.95 - 53.00		Marly limestone - limey marl	Medium hard, light gray-light brown, intercalating some sandy parts, including cracks and organic matters
53.00 - 53.75		(High-phosphate zone)	
53.75 - 97.75		Marly limestone-limey marl	medium hard, light gray-light brown, intercalating some sandy parts, including cracks and organic matters
97.75 - 100.0		Clay	Bentonitic, gray, including organic matter and plant fossils

6.3 BASALT

6.3.1 Lithofacies of the Basalt Deposit

The proposed basalt deposit is composed of volcanic eruptions and lavas of the Holocene Series. They are subalkaline, hard ~ medium hard and dark gray in color. They consist of scoria or agglomerate.

6.3.2 Basalt Quarry

- Topographic survey

Finished field survey and the map drawing is received by JST.

- Boring and cross sectional sampling from the surface outcrop (refer to Fig. 6.5)

Finished drilling; all samples of boreholes from all prescribed sections were suitable; made lithological descriptions.

- Chemical analysis

Chemical analysis of 42 samples from 8 boreholes and 125 samples from 12 cross sections has been completed by GOC. The average chemical composition of each borehole sample is shown in Table 6.B.

The results of X-ray diffraction tests and microscopic observation of basalt samples collected by JST are attached at the end of this chapter, together with results for limestone.

6.3.3 Quality

Iron content in the proposed basalt is almost the same as alumina content. Thus mixing ratio for basalt should be limited.

The analysis data for samples indicate that alkaline (Na_2O, K_2O) content is higher than expected before exploration. This is inferred to originate from feldspar, judging from X-ray diffraction tests and microscopic observation; therefore, there is a possibility of fresh parts of the quarry having a higher alkali content than weathered parts.

There are, however, too few data to prove the above inference. Hence, further exploration, especially relating to alklalinity should be carried out to grasp quality of the basalt.

Representative geological setting of this area is shown in Fig. 6.2 to Fig. 6.4

The figures in the following table, which was estimated by GEGMR, are used as chemical composition for raw mix calculation, since there are no large differences from the new data.

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	Cl	LOI
39.89	11.71	12.52	15.00	7.47	0.24	0.04	6.93

Volume metric weight estimated by GEGMR:	2.3
Moisture content estimated by GEGMR:	
Maximum	4.0%
Minimum	0.5%
Average	2.0%

Table 6.2 Description of Lithology in Borehole No. G3

Depth (m)	Columnar Section	Lithofacies	Characteristics
0.00 - 5.25	• • • • O O O O	Surface soil	Soil weathered from basalt, which is used for agriculture
5.25 - 16.45	V V V V V	Olivine basalt	Hard, gray-black, including cavity filled with calcite
16.45 - 25.00	V V		Hard, gray-black, including small cavities

Table 6.3 Description of Lithology in Borehole No. G5

Depth (m)	Columnar Section	Lithofacies	Characteristics
0.00 - 7.00	• • • • O O O O	Surface soil	Soil weathered from basalt, including scoria
7.00 - 15.40	V V	Olivine basalt	Medium hard, gray-black, including cavities (porous)
15.40 - 18.50	V V V V V		Hard, gray-black, including few cavities
18.50 - 22.00	V V V V V		Medium hard-weak, gray-black, porous

Table 6.4 Description of Lithology in Borehole No. G6

Depth (m)	Columnar Section	Lithofacies	Characteristics
0.00 - 7.30	V V V	Olivine basalt	Hard, gray-black, porous
7.30 - 23.50	V V		Hard, gray-blackish, porous

6.4 CORRECTIVE MATERIALS

The following data and information have been acquired from GEGMR and GOC in the course of JST's first and second site survey.

6.4.1 Silica Sand

Most silica sand deposits in Syria were heaped in the lower Cretaceous Period, the lower Oligocene Epoch and the lower Miocene Epoch. They were originated from the granitic rocks distributed in the Arabio-Nubian Shield.

Among them, the lower Miocene Series (N_1^1) bears the best quality ores, some of which can be found in Al Qaryatin, Bishri Mountains and Palmyride Mountains. The results of exploration of these ore deposits were compiled in a report named "General Study on Quartz Sand Resources & their Possibilities of Industrialization" (1995) by E. Katmeh and W. Viraneh.

According to the report, the Al Qaryatin Sand, which is the closest deposit to Abu Al Shamat region, contains 86-99% SiO_2. It is fine to medium grained and pure enough to be used for producing glass, cement and building materials.

Typical chemical composition of the Al Qaryatin Sand used for existing cement factories are as follows:

Table 6.5.a Typical Chemical Composition of Al Qaryatin Sand

Name of factory	Chemical Composition (%)					
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	LOI
Tartous	95.02	0.50	0.35	1.05	0.41	0.94
Hama (Syrian Cement)	93.71	0.83	0.20	2.52	0.20	0.71
Aleppo (Arabian?)	92.40	1.36	0.96	2.70	0.45	1.70
Al Chahba Cement	92.35	1.03	0.78	3.04	0.74	1.70

At present, glass factories in Damascus and Aleppo consume approximately 120 thousand t/year of the sand, while all cement factories in Syria make use of a few thousand t/year. On the other hand, the ore reserves are estimated at 190~200 million tons, which will be sufficient to suppy the new cement factory in Abu Al Shamat for a long time in addition to the existing factories mentioned above.

As for mining method, the open-pit method is applied for the present.

With respect to quality, GOC has amended the expected chemical composition as follows:

Table 6.5.b Chemical Composition of Al Qaryatin Sand

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	LOI	Moisture Content
93.86	0.63	0.47	1.90	0.60	1.77	2.0~6.0 (Avg. 4.0)

Furthermore, there is also a large silica sand deposit surrounding Bishri Mountains. Although it is sometimes contaminated by iron, the quality is thought to be still suitable for producing cement. Thus, the nation is, in general, capable of supplying the silica source for the cement industry.

6.4.2 Clay

GEGMR suggested that clay deposits distributed in the central region of Syria could be used as an alumina source for the new cement factory.

GEGMR is, at present, carrying out an exploration of the clay deposits in Rukheimeh, Marrau and Mkemen, for the purpose of securing raw materials for the ceramic industry.

All of the deposits belong to the upper Oligocene Series (Pg_3). They consist of alternated beds of mudstone and sandstone, and the mudstone is predominant. Their bedding planes are 7-9° dipped and easily quarried by ripping with bulldozer.

Among the above clay deposits, the Rukheimeh Clay Deposit is located around 200 km from Abu Al Shamat; it has been explored by boring three holes and trenching more than 20 lines resulting in confirmation of 2.7 million tons of ore reserves. Boring prospecting is now extended to the southwest toward the Marran Deposit.

The lithofacies of the deposit are characterized by predominant mudstone whose color is greenish to yellowish gray with intercalations of calcareous hard layers which are 2~10 cm thick and greenish gray colored. It is almost horizontally laid. The thickness of overburden is 0~2 m. From the topographical point of view, the deposit forms a flat desert with several 10 m of undulation.

Meanwhile, trenching and boring of the Marran Clay Deposit have just started. The surface of the deposit is covered with calcareous soil, iron nodules, thin layer of gypsum and so on.

GEGMR has amended the estimated properties of the Rukheimeh-Marran Clay Deposits as follows (however, previous values of chemical composition of the Rukheimeh Clay mentioned in the interim report are still valid for raw mix calculation for the time being, because it has not yet be decided whether only the Rukheimeh Clay will be used for the new cement factory or the Marran Clay will also be mixed together):

Table 6.6 Typical Properties of Rukeheimeh & Marran Clay

SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O	K_2O	TiO_2	SO_3	LOI
51.43~53.06	17.68~19.63	4.96~6.01	5.44~7.36	0.05~0.09	2.87~3.36	0.88~0.92	0.33~0.58	10.69~11.49

Table 6.7 Averaged Chemical Composition of Rukeheimeh & Marran Clay

SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O	K_2O	TiO_2	SO_3	LOI
47.69	19.58	7.29	6.17	1.29	1.97	1.11	1.34	12.38

(Source: GOC)

6.4.3 Ferro Clay from Rajo

As a new kind of raw material, ferric materials are needed for manufacturing sulphate resisting portland cement (SR). Currently two cement factories in Hama and Cheik Said which produce SR by wet kiln system consume ferro clay from Rajo.

The ferro clay deposit is distributed near the boundary between Syria and Turkey. It belongs to the Aptian Stage, and mainly consists of hematite with small amount of limonite. The appearance of ore is similar to sandy clay. The average Fe_2O_3 content is about 30~32%, while small amounts of TiO_2 and Al_2O_3 are also contained.

The thickness is 10~20 m and the ore reserves are estimated around 62 million tons. It is quarried by open-pit method and used not only for cement but also for the glass industry.

Chemical composition in this report applies the following data:

Table 6.8 Chemical Composition of Ferro Clay from Rajo

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	Cl	LOI
24.70	13.67	44.60	2.07	1.45	0.00	1.30	0.003	10.85

(Source: GOC)

6.4.4 Gypsum

As mentioned in 8.4.1 of the interim report by JST, the Jeirud Gypsum Deposit, which is now used by Adra Cement Co., is located 60 km from Abu Al Shamat, but its ore reserves are very limited. Therefore, GOC is thinking of using other gypsum deposits for the new cement factory.

The Ar'raqqa Gypsum Deposit, belonging to the Tortonian Stage (N_1^2t), is widely distributed on the south of Euphrates River. It forms a little mountain extending to Deir-ez-Zor. The ore reserves seem to be unlimited.

It is composed of a large amount of gypsum ($CaSO_4 \cdot 2H_2O$) and a small amount of anhydrite ($CaSO_4$) , both of which are very pure.

It is not covered with overburden, and easily quarried by the open-pit method. The quarried ore is consumed by cement factories in Aleppo.

The Latakia Gypsum Deposit, which was intensively surveyed in 1976,is also large, amounting to 37 million tons; it has transpor roads in good condition and is close to the railway.

It can be divided into the following two areas:

1) Zobar-Karkit Area, 20 km east of Latakia, where building materials such as plaster block are produced.

2) Latakia-Huffa Area, around 20 km from Latakia along the road connecting Latakia and Huffa, where raw materials for cement production are mined.

These two areas are, however, thought to belong to the same formation due to the similarity in lithofacies and geological structures.

For instance, the Karkit Gypsum Ore can be described as follows:

Table 6.9 Stratigraphy of Karkit Gypsum

No.	Lithological features	$CaSO_4$ content	Occurrence rate
①	Coarse crystallized, transparent, massive, cemented by calcite	80~90%	65%
②	Very fine crystallized, translucent, sometimes intercalating low-grade zone	>90%	19%
③	Intercalation of marly layer including cracks and cavities filled with limy materials	-	9%
④	Mixture of the above two kinds	Similar to ①	7%

* The whole strata gently dip westwards with no tectonic structures.

Transport cost must be increased in case of using the Latakia Gypsum or the Ar'raqqa Gypsum, compared with using the Jeirud Gypsum. However, there are no other problems in quality or quantity.

Chemical composition in this report applies the following data:

Table 6.10 Chemical Composition of Latakia Gypsum

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	LOI
1.79	0.25	0.20	31.68	1.81	42.50	-

(Source: GOC)

6.4.5 Pozzolan

Most of the cement factories in Syria are using pozzolan from Shahba as an additive. The Shahba Pozzolan Deposit is originated form the Telshihan Volcanic Products that are basaltic.

The deposit, mainly consisting of vitric tuff, has several layers of different geologic ages in Quaternary Period ($\beta\ _4Q_6$). It is scoriaceous, porous and medium grade in hardness.

Some examples of chemical composition of the Shahba Pozzolan used for existing cement factories are as follows:

Table 6.11.a Chemical Composition of Shahba Pozzolan

Name of factory	Chemical Composition (%)								
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	SO_3	LOI
Adra Cement Co.	44.54	15.42	13.97	9.53	9.07	0.00	0.00		0.00
Syrian Cement Co.	44.67	14.67	14.14	8.95	8.35	1.70	0.00	<0.05	0.71
Al Chahba Max.	48.00	10.90	15.20	11.00	15.90			0.30	1.00
Cement Co. Min.	38.00	9.50	10.00	9.00	12.50			0.00	0.00

(Source: Reply to questionnaire)

Chemical composition in this report applies the following data:

Table 6.11.b Chemical Composition of Shahba Pozzolan

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	LOI
44.54	15.42	13.97	9.53	9.07	-

(Source: GOC)

6.4.6 Summary of Reference Data

List of Rock Samples from Syria

Date	Locality	Number	Name	X-ray dfr.	Thin sect.	Remarks
Nov.14 '95	Adra [Adra Cement]	111401	Crystallized limestone	◎	◎	Taken at limestone quarry of Adra Cement
		111402	Marly limestone			
		111403	Chalk			
		111404	Weathered basalt (soft)	◎		Taken at basalt quarry (1) of Adra Cement
		111405	Fresh basalt (hard)	◎	◎	
		111406	Pelidotite	◎	◎	
		111407	Marl (mixed with each other mining face	◎		Taken at marl quarry of Adra Cement
	(Shahba)	111408	Pozzolan	◎		Taken at stockyard of Adra Cement
	(Jeirud)	111409	Gypsum	◎		
Nov. 15	Abu Al Shamat	111501	Crystallized limestone	◎	◎	Core sample from network boring
		111502	Marly limestone	◎	◎	
Nov. 17	Hama [Syrian C.]	111701	Micrite ~ cryptocrystal limestone			Taken at limestone quarry of Syrian Cement
Nov. 18	Aleppo [Arabian C.]	111801	Biomicrite	◎		Taken at quarry (A) of Arabian Cement
		111802	Basalt (intrusive)	◎		
Nov. 19	Hama	111901	Surface soil (reddis brown colored)			Used for agriculture
Nov. 21	Tias	112101	Mudstone (yellowish green)			Massive
		112102	Sandstone (yellow ~ brown)			Fine grained, soft
		112103	Sandstone (yellow ~ reddish)	◎	◎	Fine grained, hard
		112104	Mudstone (yellowish green)			Massive
	Rukheimeh	112105	Mudstone (yellow ~ brown)	◎	◎	Shaly
		112106	Mudstone (greenish gray)	◎	◎	Hard, calcareous
	Extension area of Rukheimeh	112107	Mudstone (greenish gray)			
		112108	Har bed (reddish brown)			Fe-rich?
		112109	Gypsum			Surface thin layer
	Marran	112110	Mudstone (greenish gray)			Massive
Nov. 23	Abu Al Shamat	112301	Basalt (lava flow)	◎	◎	Poreous, very hard
		112302	Basalt (lava flow)			Poreous, very hard
		112303	Basalt			Weathered
		112304	Basalt	◎	◎	Massive
Mar. 11 '96	Rajo	31101	Ferro clay	◎	◎	Including clayly part
	Al Qaryatin	31102-1	Silica Sand	◎	◎	
	Al Qaryatin	31102-2	Silica Sand	◎	◎	Partly cementil by calcite

Test Result

No.	Name	Microscopic Observation												X-ray Diffraction Test													
		Fd	Px	Qt	Cc	Fo	Mu	Ch	Cl	Op	Sk	Go	He	Fd	Px	Qt	Cc	Fo	Mu	Ch	Cl	He	Pa	Gy	Sk	Go	He
111401	Crystallized limestone		○	△	◎												◎										
111404	Weathered basalt				×									×							○	△					
111405	Fresh basalt	◎	○		△				△	△				◎			○				×	×					
111406	Pelidotite	◎	○					○		×				◎	○					○							
111407	Marl															△	◎										
111408	Pozzolan														○			○					tr				
111409	Gypsum																							◎			
111501	Crystallized limestone				◎												◎										
111502	Marly limestone				◎												◎										
111801	Biomicrite															△	◎										
111802	Basalt													◎	○						tr						
112103	Sandstone	×		◎	◎		tr							tr		◎	◎										
112105	Mudstone	△		△	◎		△		○	×				tr		○	△		tr			○					
112106	Mudstone			△	◎		△		○	×						○	○		×			○					
112301	Basalt	◎	△		△					△				○	○		○										
112304	Basalt	◎			△	○									◎		○	○									
31101	Ferro clay			△								△	△			○									△	○	△
31102-1	Silica Sand			◎	△											◎	△										
31102-2	Silica Sand			△	◎											△	◎										

◎ : Abundant ○ : Common △ : Few × : Rare tr : Trace

Legend

Fd:	Feldspar	
	Al: Albite	4 or 8 $[(Na, Ca) (Si, Al)_4 O_8]$
	An: Anorthite	8 $[CaAl_2 Si_2 O_2]$
	Mi: Microcline	4 $[(K, Na) AlSi_3 O_8]$
Px:	Pyroxene	
	Au: Augite	4 $[(Ca, Mg, Fe^{3+}, Ti, Al_2) (Si, Al)_2 O_6]$
Qt:	Quartz	3 $[SiO_2]$
Cc:	Calcite	2 $[CaCO_3]$
Do:	Dolomite	$(Ca, Mg) CO_3$
Fo:	Forsterite	4 $[(Mg, Fe^{2+}) SiO_4]$
Mc:	Mica	
	Mu: Muscovite	4 $[(KAl_2 (AlSi_3 O_{10}) (OH)_2]$
Ch:	Chlorite	$(Mg, Fe, Al)_6 (Si, Al)_4 O_{10} O(OH)_8$
Cl:	Clay minerals	
	Mo: Montmorillonite	$[(1/2Ca, Na)_{0.86} (Al, Mg, Fe^{3+})_4 (Si, Al)_8 O_{20} (OH)_4 \cdot 2H_2O]$
	No: Nontronite	$[(1/2Ca, Na)_{0.86} Fe^{3+} 4(Si, Al)_8 O_{20} (OH)_4 \cdot nH_2O]$
Pa:	Palygorskite	2 $[Mg_5 Si_8 O_2 O(OH)_2 (OH_2)_4 \cdot 4H_2O]$
	Ka: Kaolinite	2 $[Al_2 (Si_2 O_5) (OH)_4]$
He:	Hematite	2 $[Fe_2 O_3]$
Gy:	Gypsum	4 $[CaSO_4 \cdot 2H_2O]$
Op:	Opaque minerals	
Go:	Goethite	4 $[FeO (OH)]$

Results of Microscopic Observation

Spl. 111401 (Adra):	Biomicritic limestone, including large quantity of organic remains.
Spl. 111405 (Adra):	Fresh part of basalt, mainly composed of feldspar, pyroxine and chlorite, other than which hematite, opaque mineral and clay minerals such as montmorillionite can be seen.
Spl. 111406 (Adra):	Basalt (called "periodotite" as field name in Adra), mainly composed of feldspar, pyroxene and chlorite, other than which opaque mineral can be seen.
Spl. 111501 (Abu Al Shamat):	Micritic limestone.
Spl. 111502 (Abu Al Shamat):	Marly limestone, including organic remains.
Spl. 112103 (Tias):	Calcareous sandstone, mainly composed of the quartz grains which are 60μ at maximum size and subangular to subrounded shaped, cemented by calcite, and also including small quantity of feldspar and mica.
Spl. 112105 (Rukheimeh):	Calcareous mudstone or marl, mainly composed of quartz and microfossils, abundant in the needle-shaped mica which is less than 50μ in length.
Spl. 112106 (Rukheimeh):	Calcareous mudstone or marl, mainly composed of microfossils and the quartz grains which are less than tens of μ in diameter, and also including small-sized mica and clay minerals.
Spl. 112301 (Abu Al Shamat):	Basalt lava, mainly composed of the feldspar which is needle-shaped and the pyroxene which is automorphic and approximately less than 0.01 mm in diameter, with glassy matrix and the dolomite with which weathered porous part are filled.
Spl. 112304 (Abu Al Shamat):	Basalt, mainly composed of feldspar, other than which forsterite, calcite and opaque mineral can be seen.
Spl. 31101 (Rajo):	Ferro clay, originated from igneous rocks, including quartz grains and small quantity of xenolith of sedimentary rocks.
Spl. 31102-1 (AlQaryatin):	Silica sand, composed of quartz grains which are 500 to 800μ in diameter, subangular to subrounded in roundness, and partly cemented with secondary deposited calcite.
Spl. 31102-2 (Al Qaryatin):	Calcareous part of silica sand.