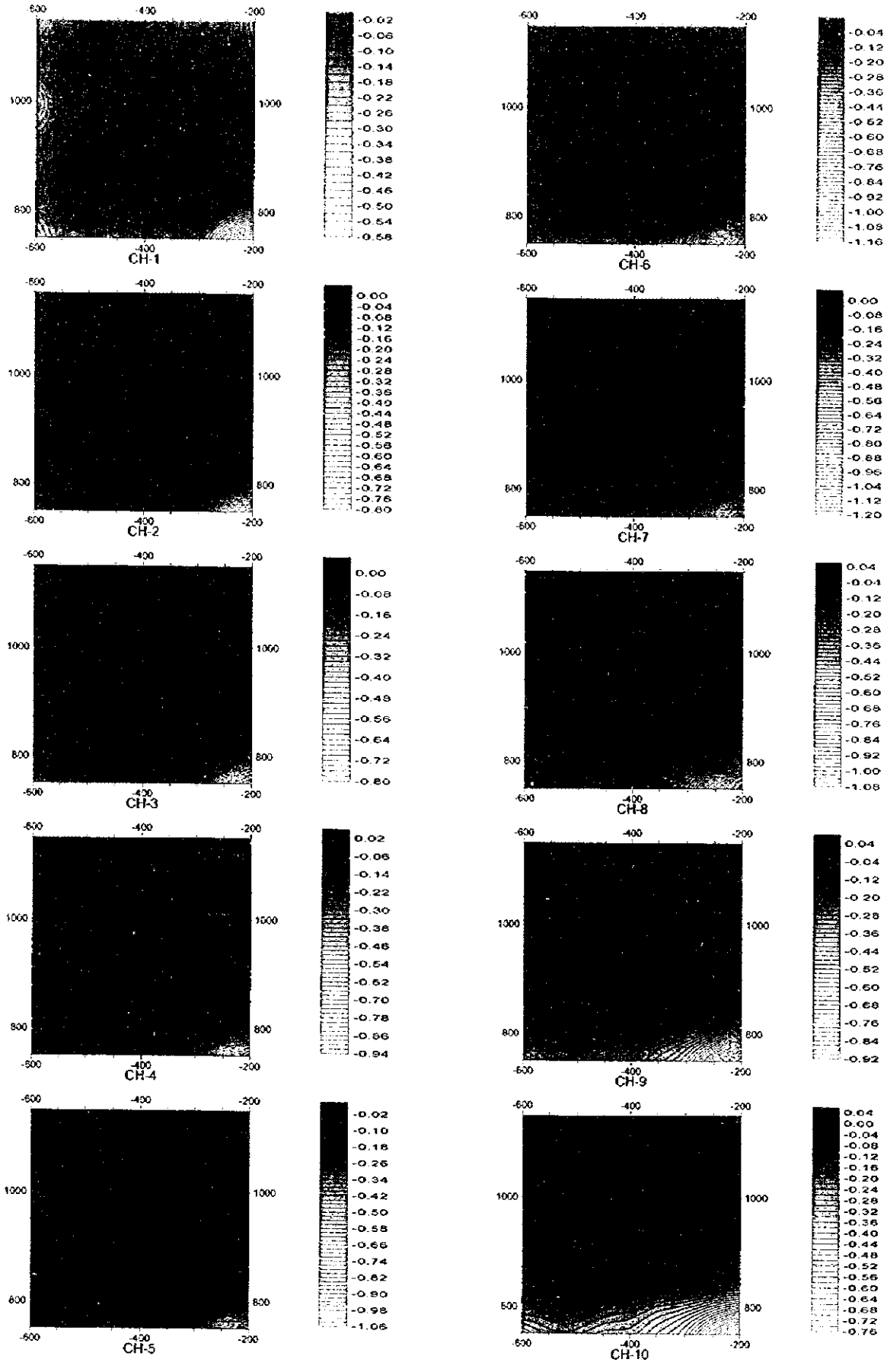


Fig. II-3-15(1) TEM response maps of Loop1 in Daris area(Ch1-Ch10)

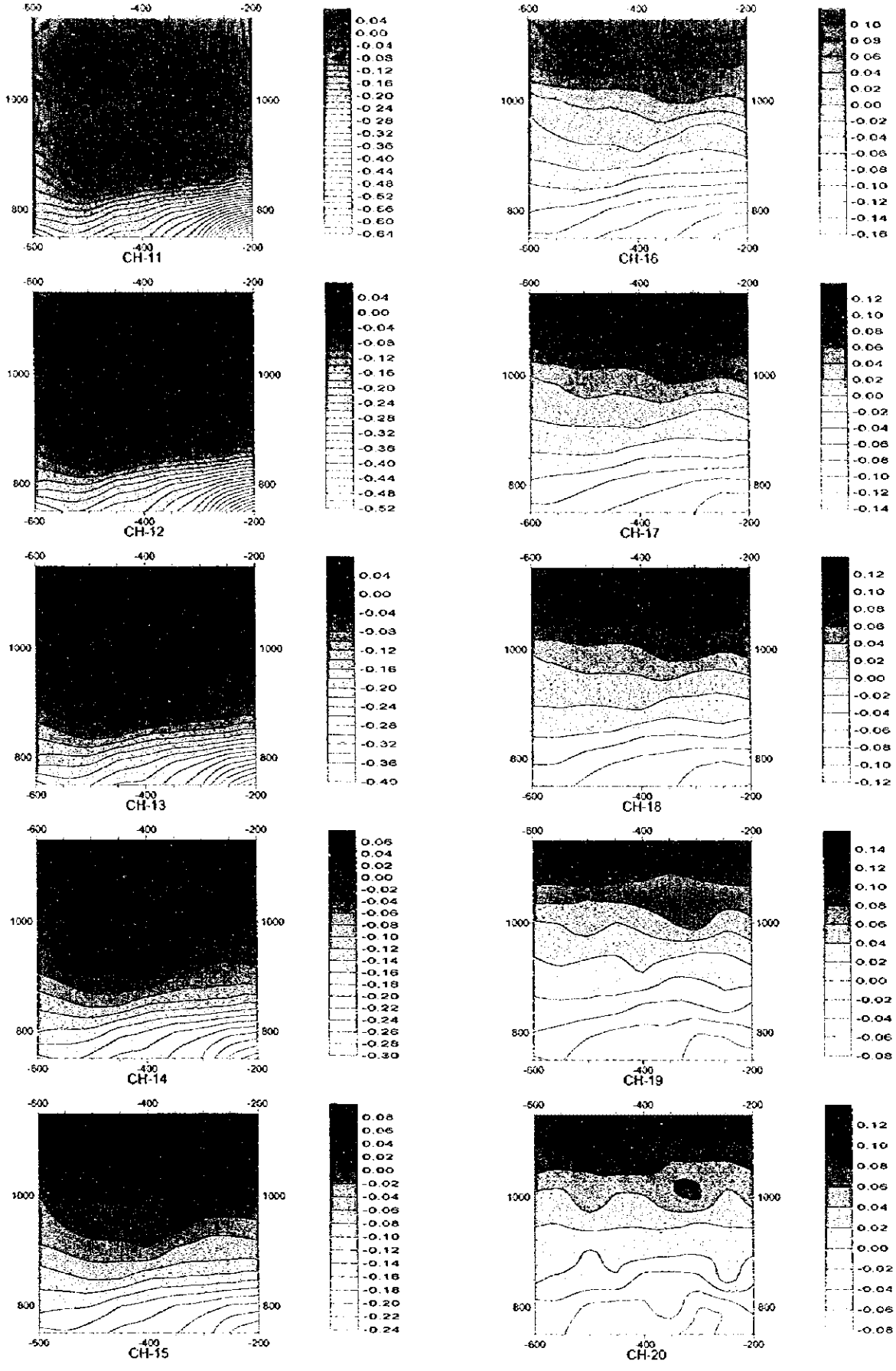


Fig. II-3-15(2) TEM response maps of Loop1 in Daris area(Ch11-Ch20)

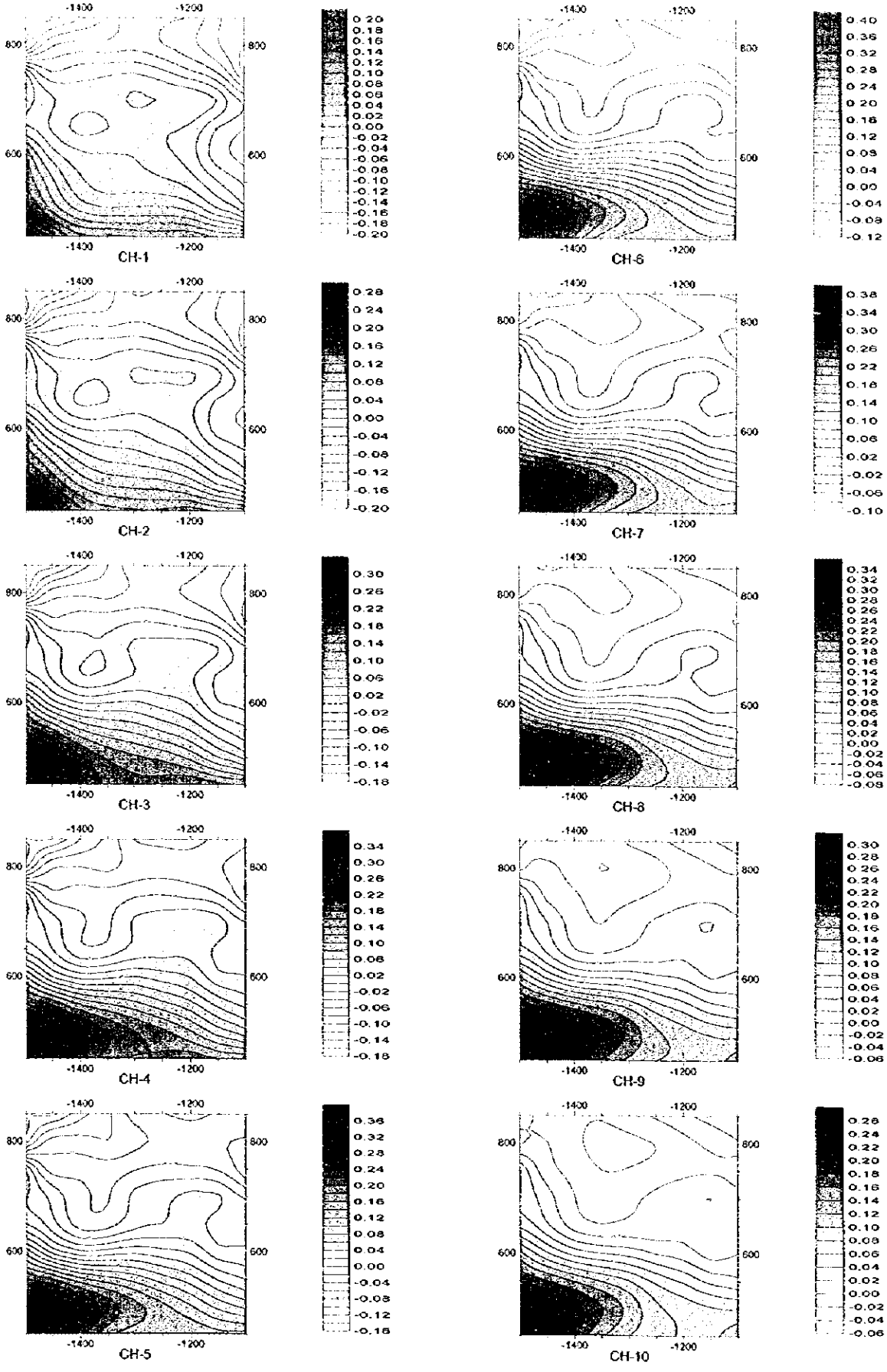


Fig. II-3-16(1) TEM response maps of Loop2 in Daris area(Ch1-Ch10)

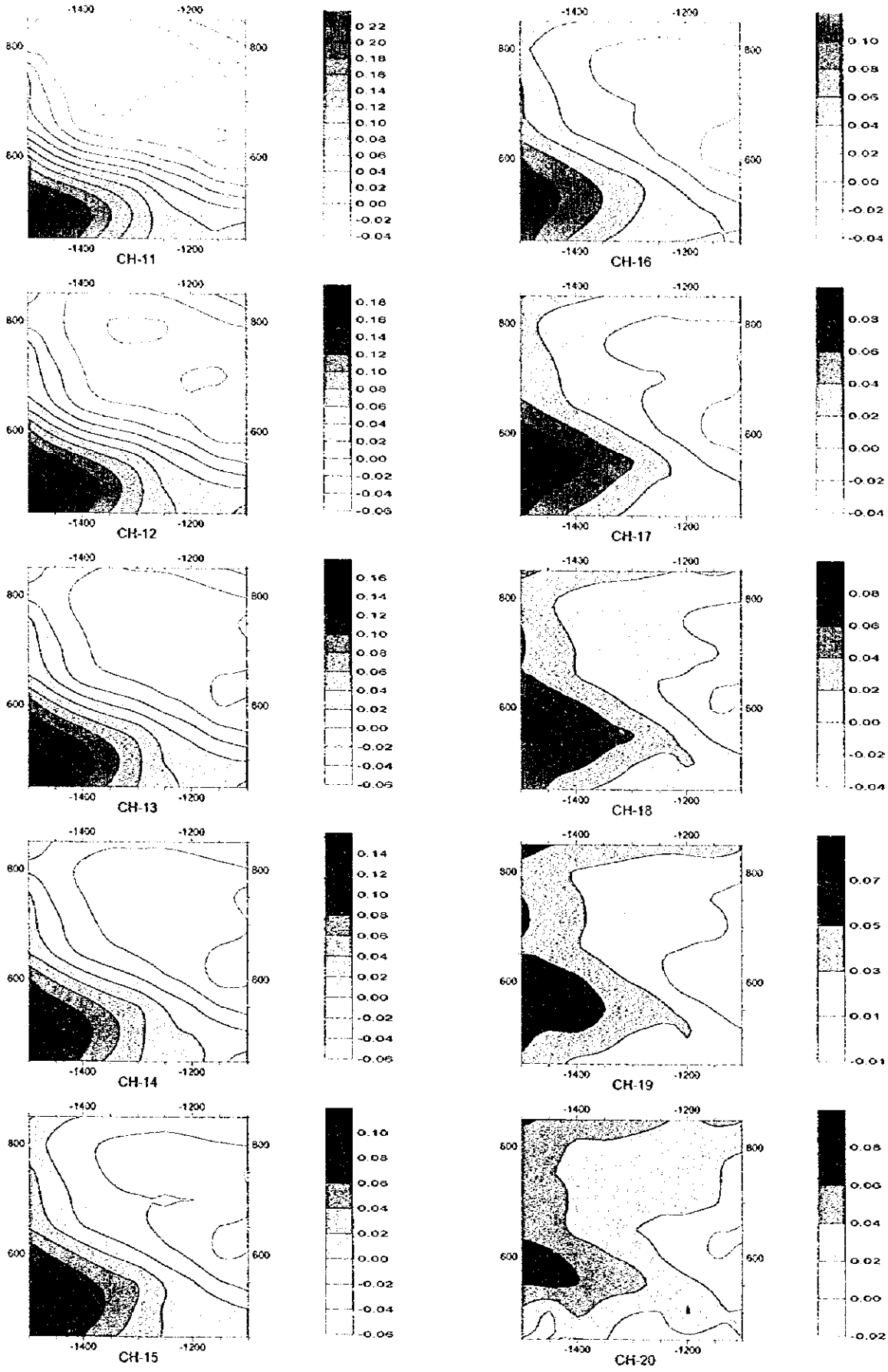


Fig. II-3-16(2) TEM response maps of Loop2 in Daris area(Ch11-Ch20)

east part of the area and distributed along the north-south direction.

During the 1996 field survey season, TEM method was conducted in areas covering the central part of the IP anomaly distributions located in the east central part of the area. During the 1997 field season, the TEM survey was continued along the north extension of the above mentioned anomalies. Fig. II-2-18 indicates the survey location by large loops in Doqal area.

(2) Results

Loop 1

Fig. II-3-17(1) and (2) presents the TEM responses in plan view obtained for each of the 20 channels. TEM anomaly in the central part of the loop is seen distributed along north-south direction, however a high anomaly indicative of massive sulphide could not be detected.

Loop 2

Fig. II-3-18(1) and (2) presents the TEM responses in plan view obtained for each of the 20 channels. Two high TEM anomalies are seen within this loop: one in the central part of the loop and another one in the east and north-east part of the loop. Since the first one is detected only in the channels 1 to 7, it can be inferred that the source of this anomaly is likely to be found at a shallow depth. Additionally, this anomaly indicates a conductive body not related to mineralization because it is located within a low chargeability zone.

Within the second group of anomalies, the one located in the east part is seen in the channels 1 to 10 and the other one in the north-east part is detected from channel 11. Based on the low chargeability values detected in this zone, it can be inferred that this anomaly is not indicative of massive sulphide.

3-6 Further Considerations

3-6-1 Ghuzayn Area

Fig. II-3-19 shows the compiled geophysical map obtained in Ghuzayn area. Fig.II-3-19(a) indicates the TDIP results, while Fig. II-3-19(b), the TEM results. Both of them present the geophysical information to a depth of about 150 ~ 200m.

The IP results of Fig.II-3-19(a) indicate high chargeability zones of more than 8 mV/V detected in three locations: west, central and central-east. High metal factor zones of more than 25 are seen in the west and central part overlapping the above mentioned high chargeability zones. It is worthy to mention

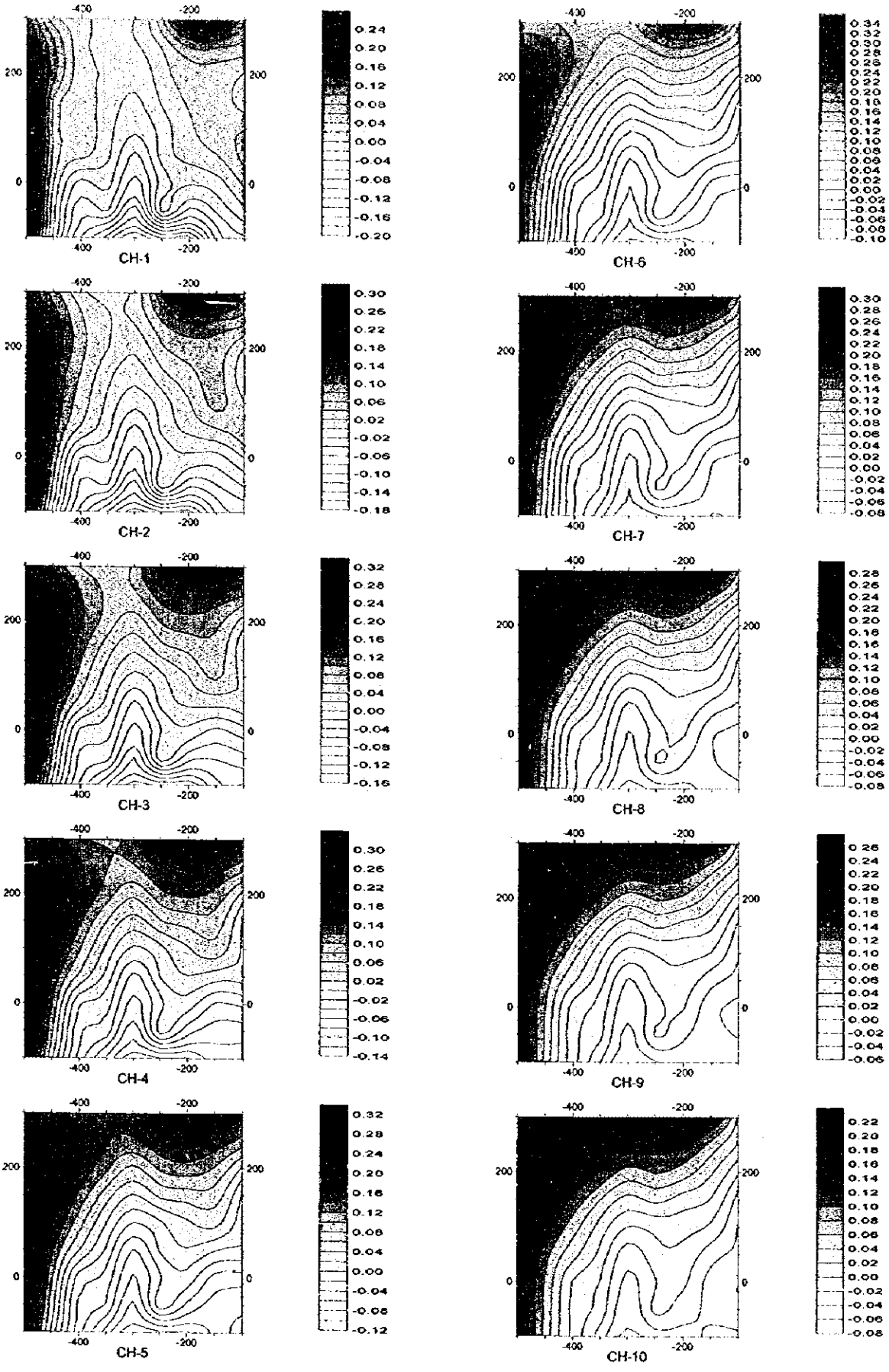


Fig. II-3-17(1) TEM response maps of Loop1 in Doqal area(Ch1-Ch10)

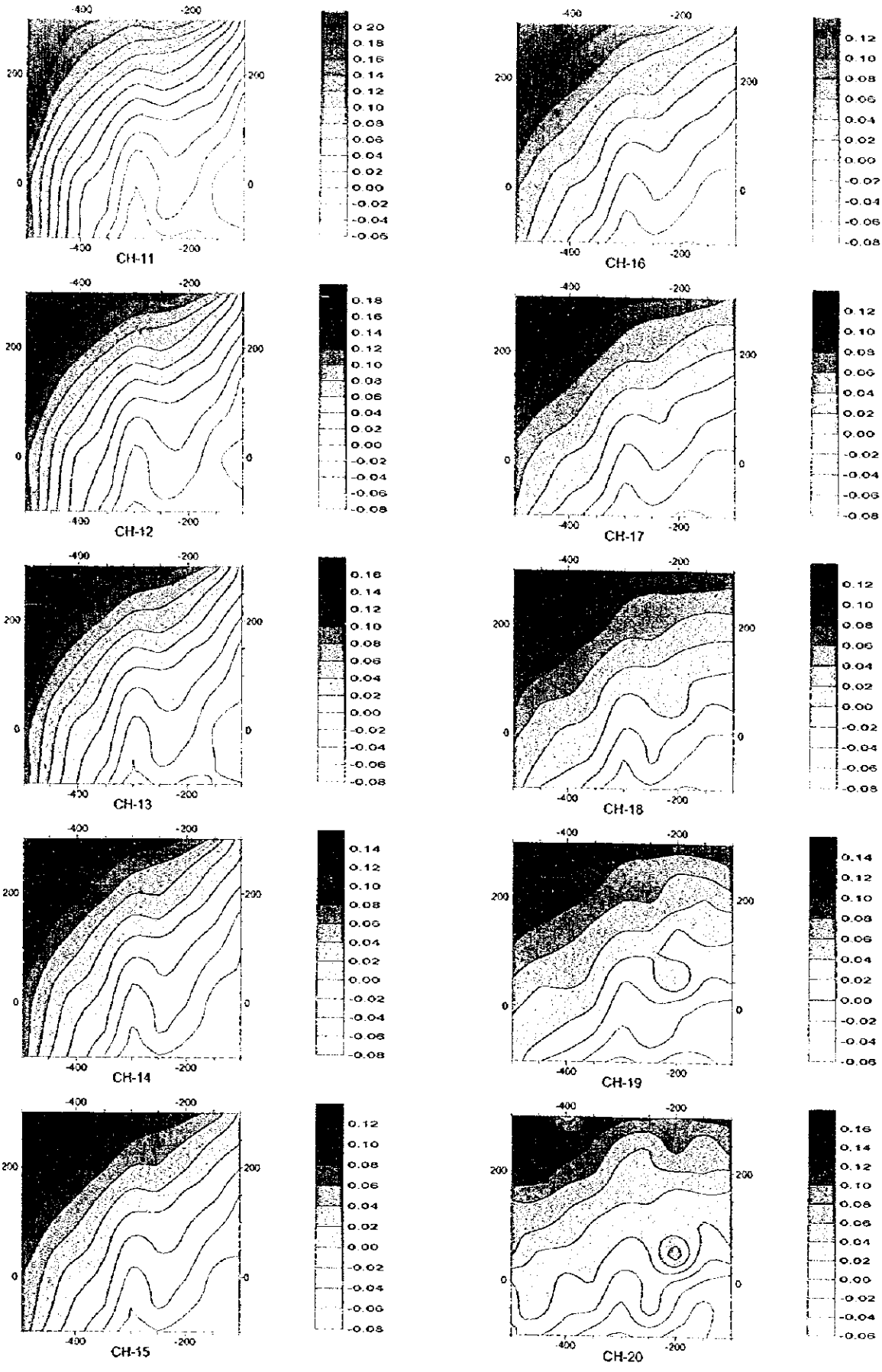


Fig. II -3-17(2) TEM response maps of Loop1 in Doqal area(Ch11-Ch20)

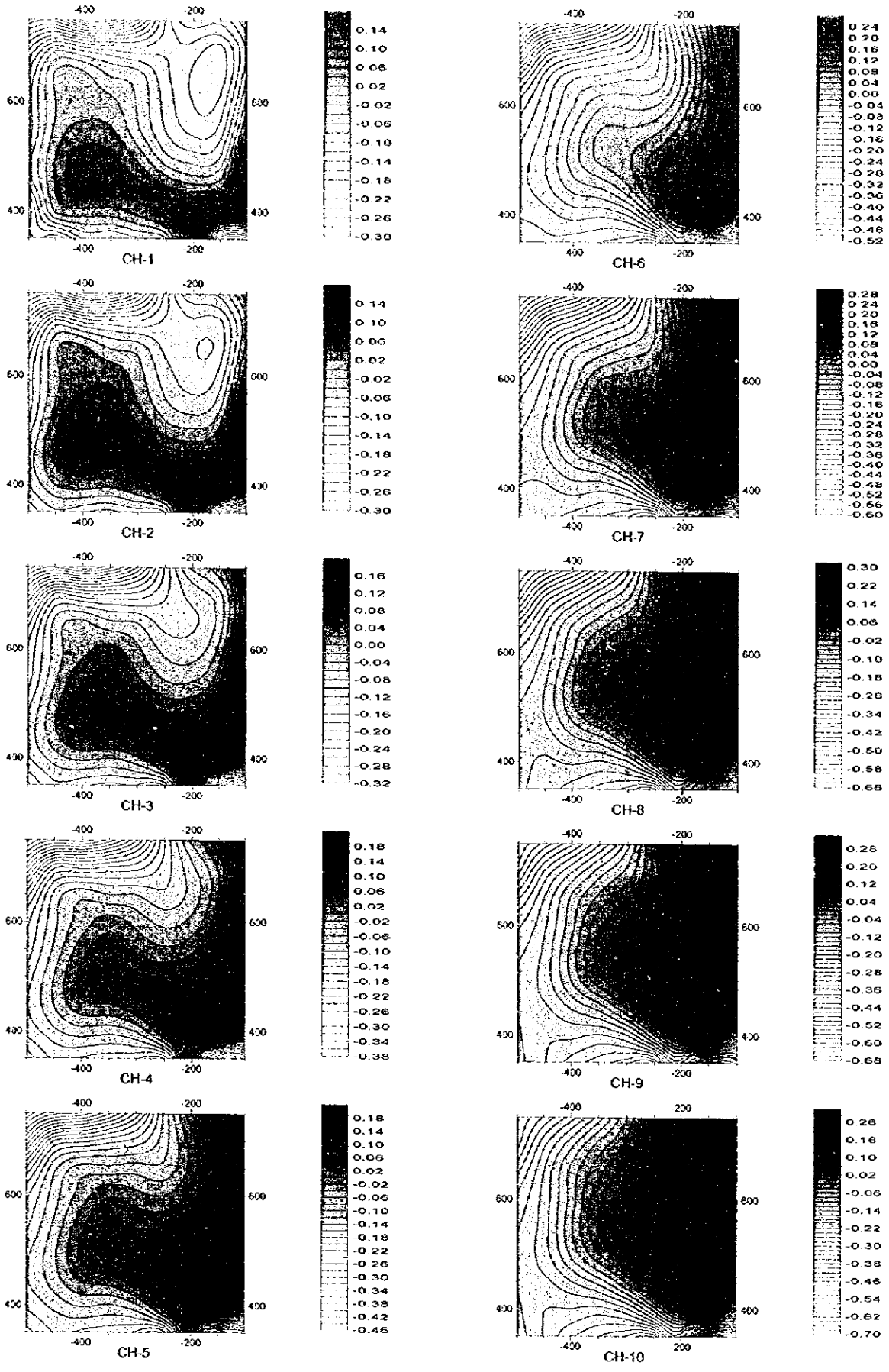


Fig. Ⅱ-3-18(1) TEM response maps of Loop2 in Doqal area(Ch1-Ch11)

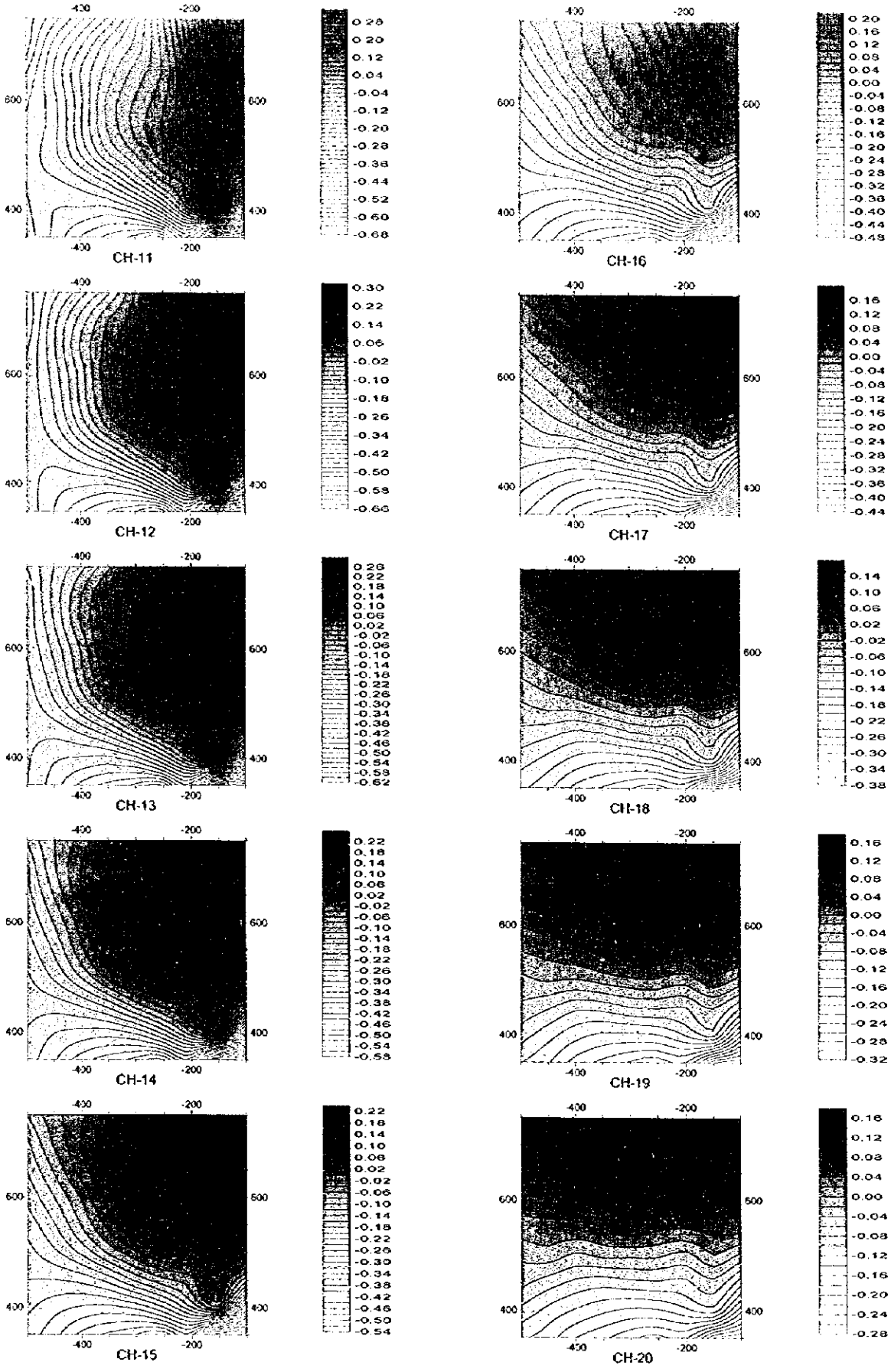
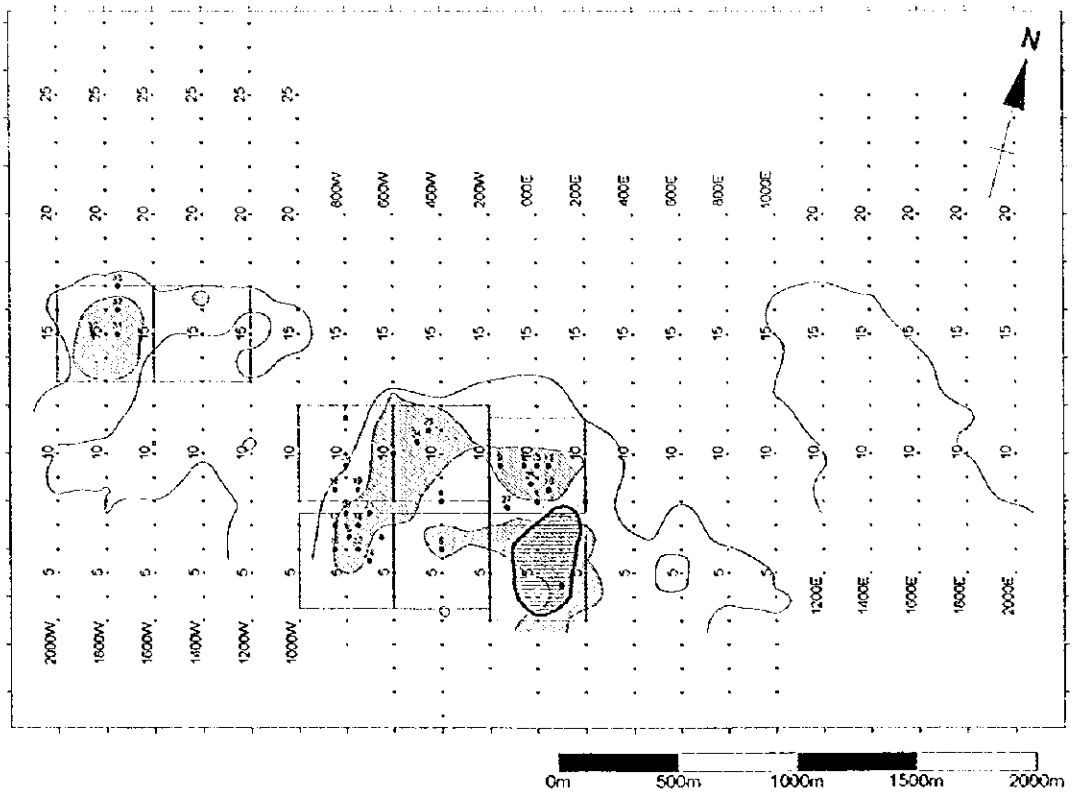


Fig. II-3-18(2) TEM response maps of Loop2 in Doqal area(Ch11-Ch20)



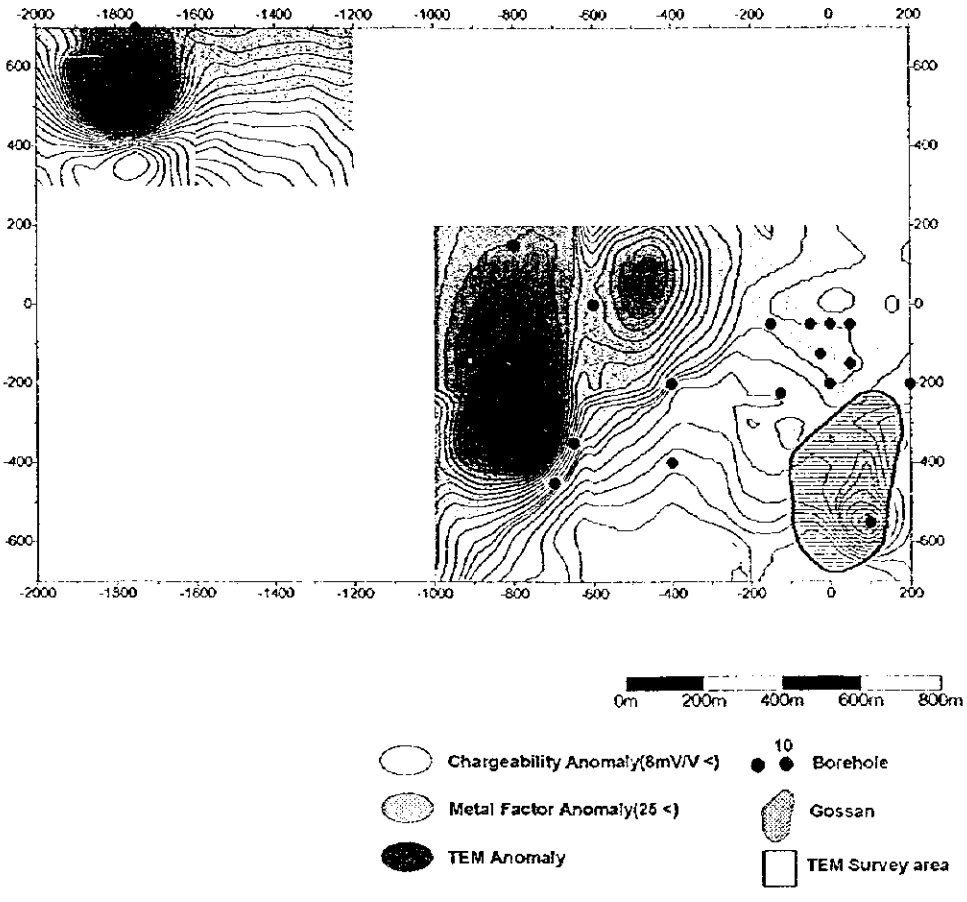


Fig. II -3-19 Compiled geophysical map in Ghuzayn area

here that high metal factors are very important parameter to be considered for the existence of this kind of deposits because it takes into account not only the high chargeability but also the low resistivity values. In this connection, the drillings carried out in the areas where the ore bodies Nos.1, 2 and 3 were discovered, were located in high metal factor zones.

The three massive sulphide orebodies discovered in Ghuzayn confirmed that this area presents a high potential for the exploitation of this kind of deposits.

Further south to the orebodies Nos.2 and 3 (not shown in the above mentioned figure), some indications suggest the existence of high metal factor distributions, for which it is recommended to carry out further TDIP surveys in this area and surroundings.

The compiled TEM results carried out in selected zones are presented in Fig. II-3-19(b). In this figure, the dark green parts represent high TEM responses which coincide in general, with the zones where the massive sulphide ore bodies were discovered. For the sake of clarity, the boreholes indicated by red points are the ones that intersected the ore bodies above mentioned.

The TEM results indicate also a possible extension to the north of the ore body No.3. Further TEM survey is then recommended to clarify this extension in order to better determine the locations of the boreholes to be drilled during the next phase.

3-6-2 Daris Area

Fig. II-3-20 shows the compiled geophysical map obtained in Daris area. Fig.II-3-20(a) indicates the TDIP results, while Fig. II-3-20(b), the TEM results. Both of them present the geophysical information to a depth of about 150 ~ 200m.

The TDIP survey carried during the 1995 field season, detected high chargeability distributions in the central and north-east part of the area.

Based on the results of high metal distributions, most of the large fixed loops were conducted within the north half part of the area. To verify the extracted TEM anomalies, the borehole D5 was drilled in the north part of the loop1 carried during the 1997 field survey. This borehole did not detect any massive sulphide but only a shared zone.

3-6-3 Doqal Area

Fig. II-3-21 shows the compiled geophysical map obtained in Doqal area. Fig.II-3-21(a) indicates the TDIP results, while Fig. II-3-21(b), the TEM results. Both of them present the geophysical information to a depth of about 150 ~ 200m.

As indicated in Fig. II-3-21(a), high chargeability values of above 8 mV/V are seen distributed in the east part of this area extended along north-south and north-west directions from the gossan and its surroundings. The distribution from the central part of the gossan to towards the north-west direction

overlaps the high metal factor distribution A high chargeability zone is also seen distributed in the south-west of the area,

As shown in Fig. II-3-21(b), both of the borcholes Q1 and Q2 were conducted within high chargeability zones, however only disseminated pyrite was intersected.

Additional TDIP survey is recommended in order to seek a possible south extension of the high chargeability zone detected in the south-west part of this area.

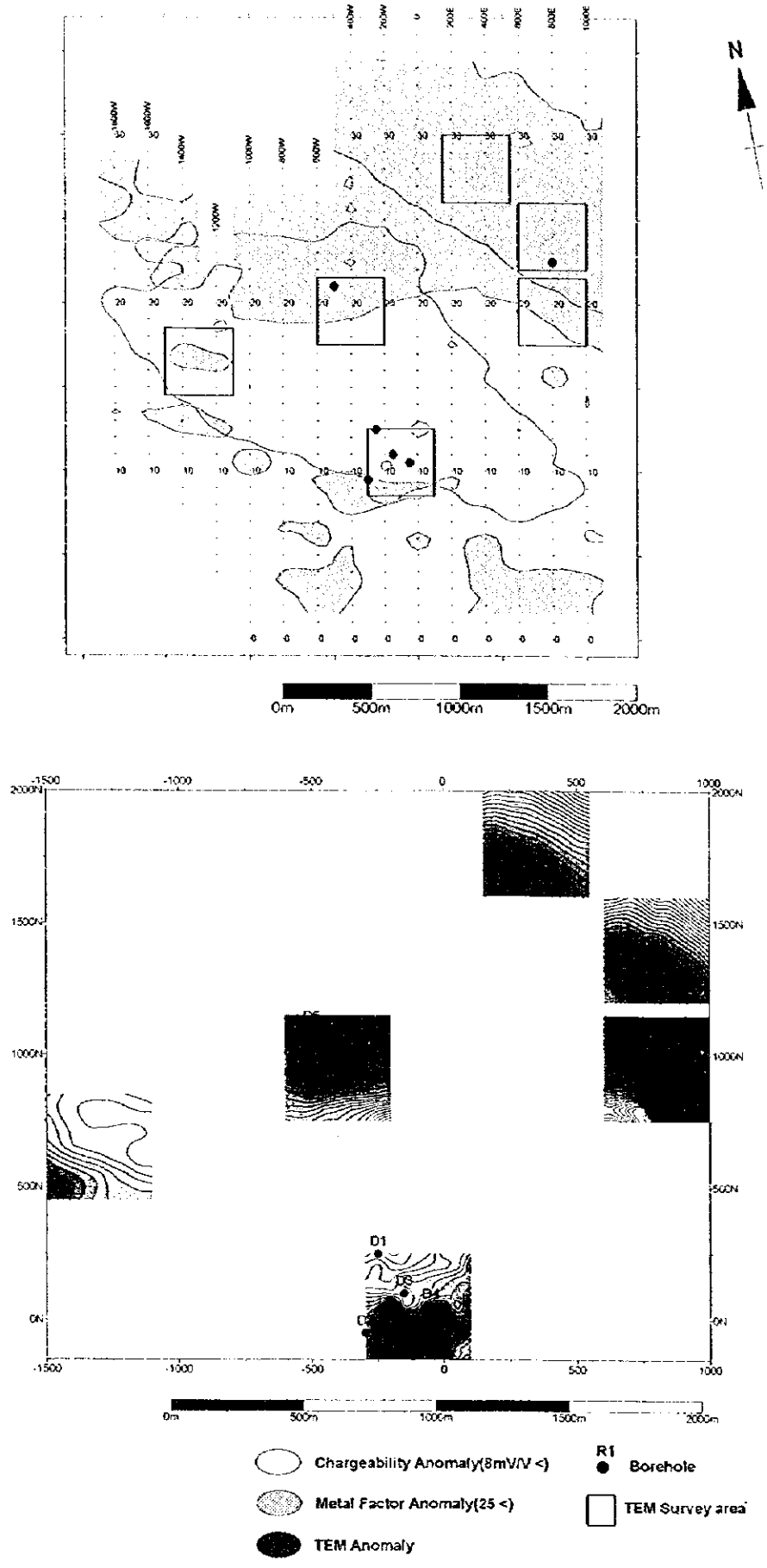
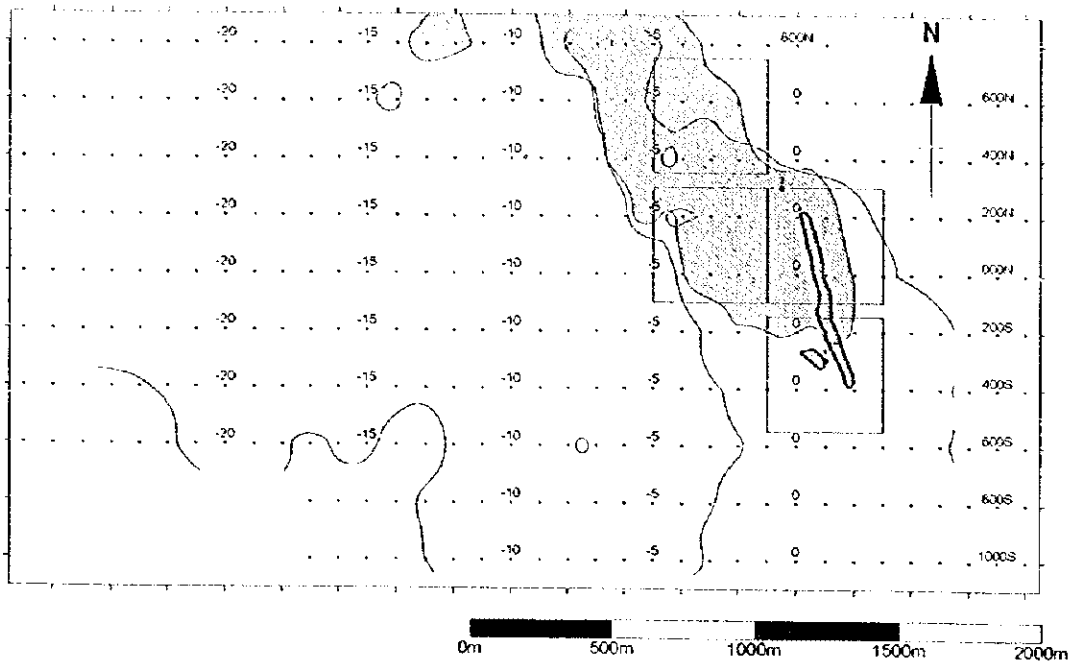


Fig. II -3-20 Compiled geophysical map in Daris area



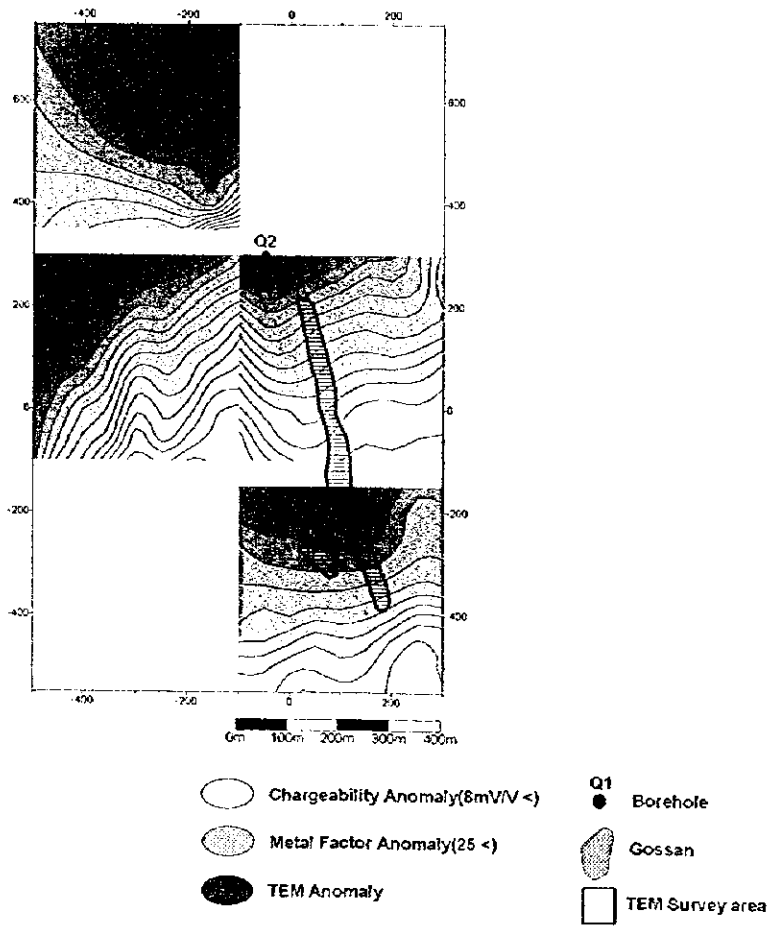


Fig. II-3-21 Compiled geophysical map in Doqal area

CHAPTER 4 DRILLING SURVEY

4-1 Background and Objectives

Drilling survey was carried out in order to investigate the extension of the ore bodies No.1 and No.3 discovered in Ghuzayn area in 1996, and to clarify the mineralization on anomalous zones detected by the geophysical surveys conducted during 1996 and during the Phase I of this project.

4-2 Survey Areas and Amounts

Drilling survey was conducted in the areas of Ghuzayn (central, eastern and western parts), Daris and Doqal. Figs. II-4-1 and II-4-3 show the location of the boreholes drilled during the Phase I. Total amount of survey consisted of 19 boreholes with a drilling length of 4,941.25m.

4-3 Survey Method

4-3-1 Drilling operations

The drilling operations were done by using four types of rigs mentioned in a table of Appendix 1. The wire line method was utilized.

4-3-2 Core logging

Description of the drill cores was conducted at the drilling site during drilling operations and compiled in a 1:200 log sheet. Core sampling was carried out concurrent to core logging activities. Amounts of laboratory works are indicated in Table I-1-2.

4-4 Results

Drilling logs are shown in Appendix 3. The results of the laboratory works are indicated in Table II-4-2 for thin sections, Table II-4-3 for polished sections, Table II-4-4 for X-ray diffraction analysis and Appendix 4 for chemical analysis of ore. The results of drilling survey are described for each of the surveyed areas as follows:

4-4-1 Ghuzayn Area – the Central Part

(1) MJOB-G18 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 (V1-2) of Lower volcanics, massive sulphide ore and Lower extrusives rocks 1 (V1-1).

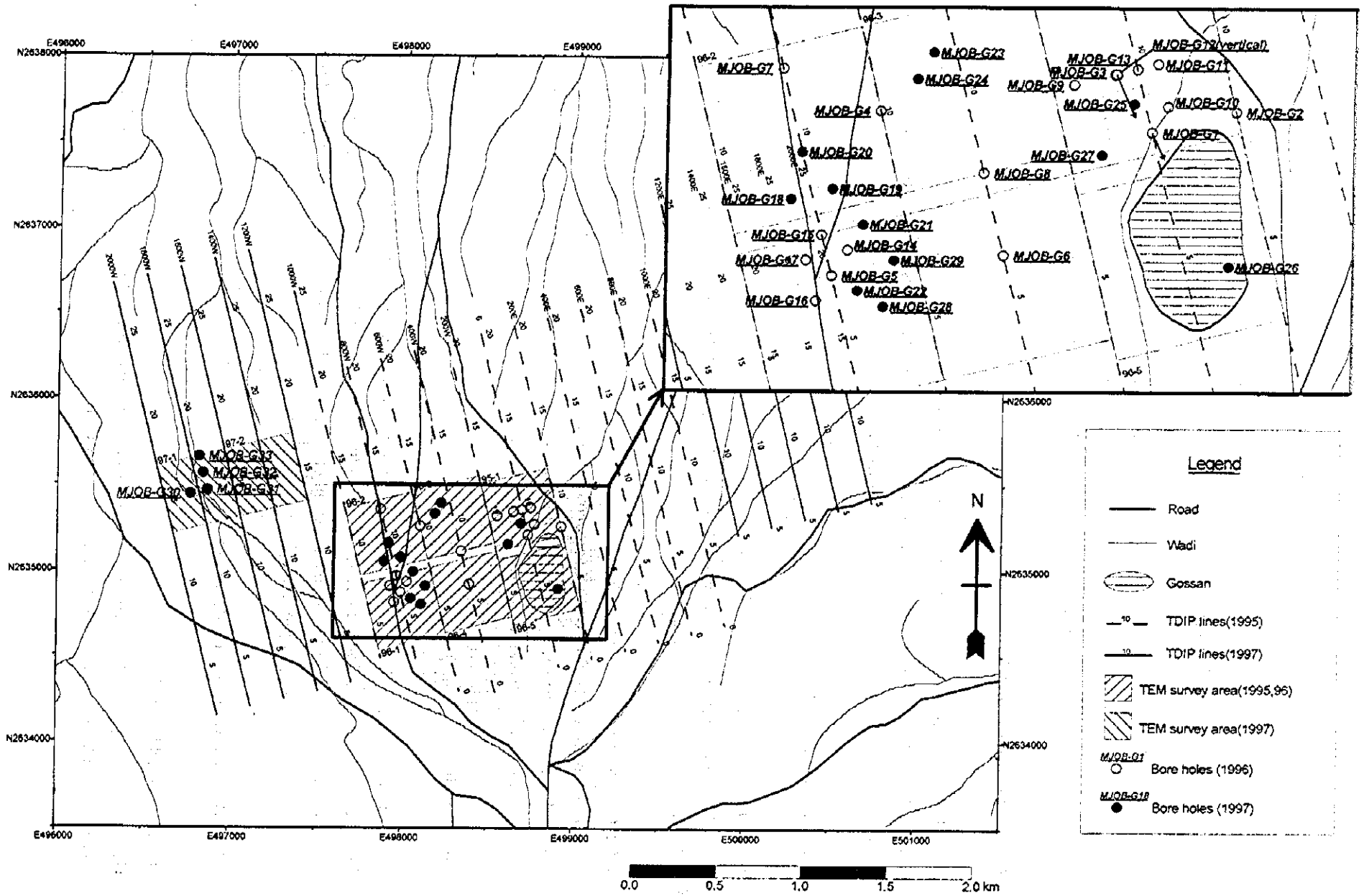


Fig. II-4-1 Location map of boreholes in Ghuzayn area

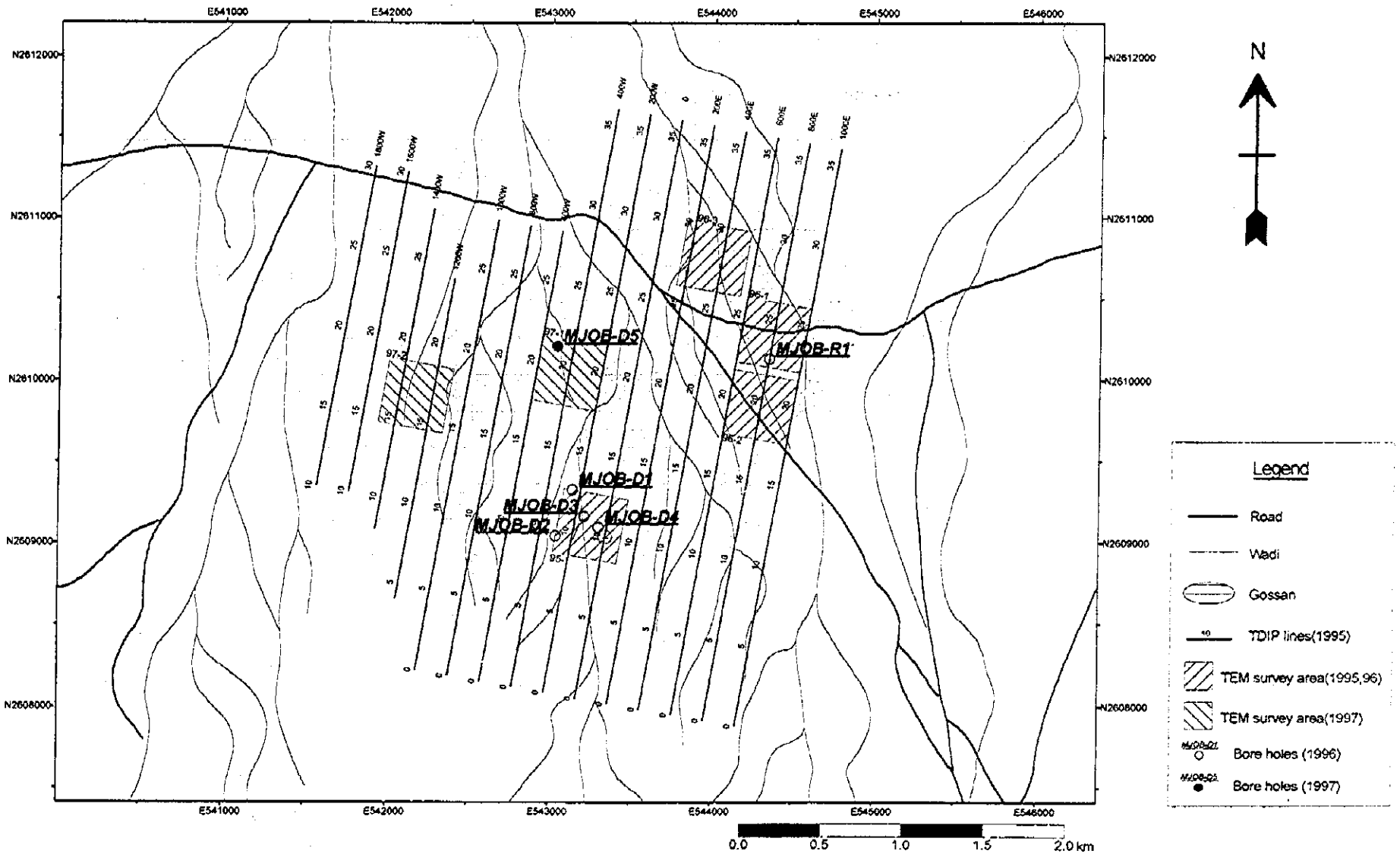


Fig. II -4-2 Location map of boreholes in Daris area

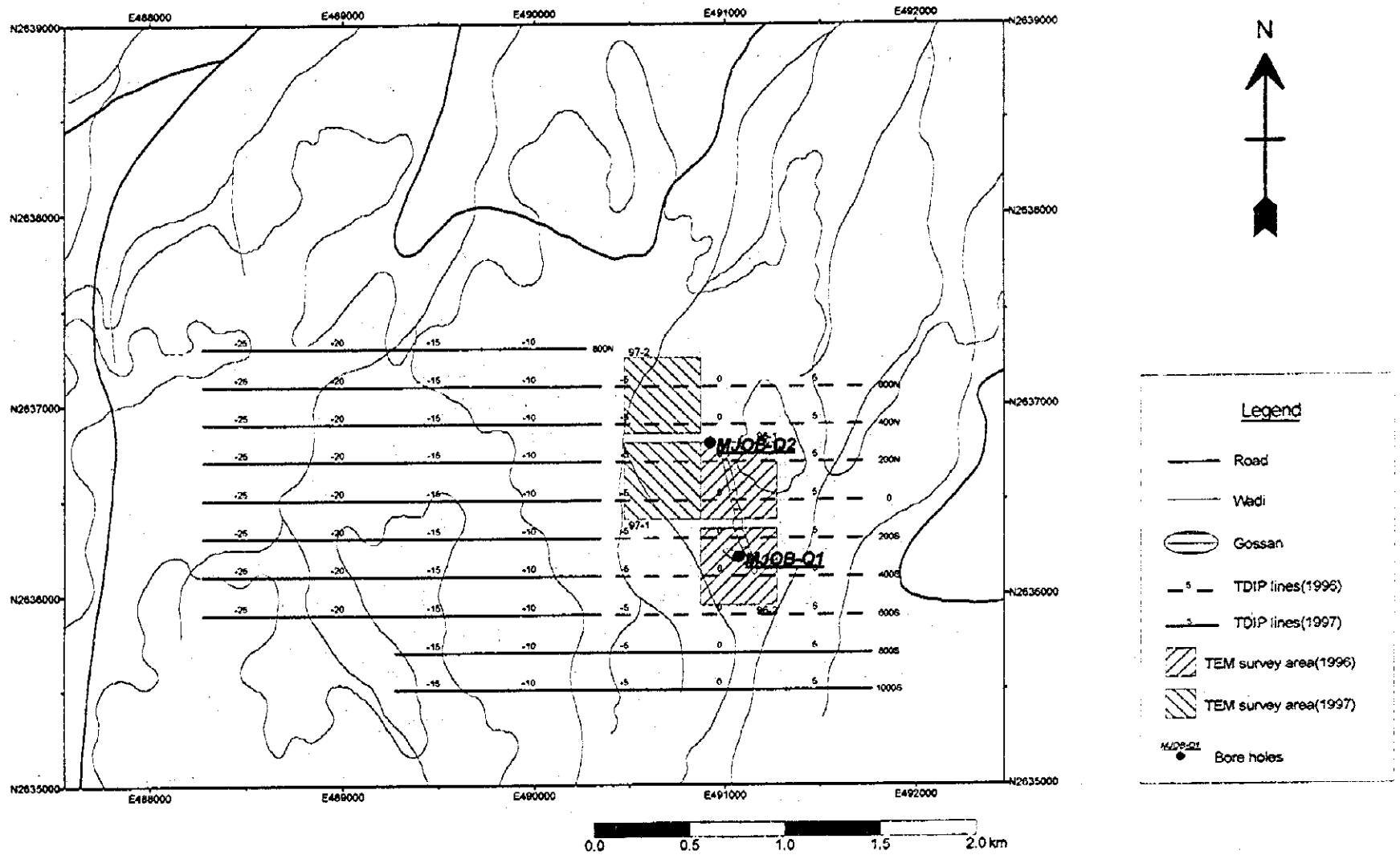


Fig. II-4-3 Location map of boreholes in Doqal area

Table II-4-1 Drilling survey conducted in Phase I

Area Name	Holes	Coordinate		Length planned	Length excuted	Inclination	Direction
		N (km)	E (km)	(m)	(m)	(deg.)	
(1) Ghuzayn Area	MJOB-G18	2,635.037	497.890	300	300.25	-90	
	MJOB-G19	2,635.057	497.988	300	300.40	-90	
	MJOB-G20	2,635.145	497.918	300	300.45	-90	
	MJOB-G21	2,634.970	498.057	250	250.25	-90	
	MJOB-G22	2,634.813	498.040	200	200.60	-90	
	MJOB-G23	2,635.364	498.229	350	350.10	-90	
	MJOB-G24	2,635.305	498.191	350	350.25	-90	
	MJOB-G25	2,635.233	498.692	200	200.10	-90	
	MJOB-G26	2,634.843	498.902	200	200.15	-90	
	MJOB-G27	2,635.114	498.615	200	201.05	-90	
	MJOB-G28	2 634.774	498.099	150	150.20	-90	
	MJOB-G29	2,634.883	498.127	200	200.15	-90	
	MJOB-G30	2,635.465	496.776	250	250.20	-90	
	MJOB-G31	2,635.485	496.874	235	235.45	-90	
	MJOB-G32	2,635.583	496.854	250	250.50	-90	
	MJOB-G33	2,635.681	496.833	300	300.00	-90	
	Total length			4,035	4,040.10		
(2) Daris Area	MJOB-D5	2,610.241	543.083	350	350.50	-90	
	Total length			350	350.50		
(3) Doqal Area	MJOB-Q1	2,637.332	490.749	300	300.05	-90	
	MJOB-Q2	2,636.732	490.899	250	250.60	-90	
	Total length			550	550.65		
Total length :				4,935	4,941.25		

Table Ⅱ-4-2 Description of thin sections of drilling cores

er No.	ample Location: Hole No.	ample Location: Depth	Rock Name	Texture	Primary Minerals: Qz	Pl	Cp	Op	Ol	Ap	Sp	OM	Secondary Minerals: Qz	Ab	Il	Ch	Ep	Ac	Pu	Pr	Cc	Sm	OM	PM	Remarks
1	G19	126.75 m	Basalt(V1-2)	Sub-ophitic		●	◎	·			●		·	○		○	○				●				
2	G19	187.25 m	Basalt(V1-2)	Intersertal		◎	○	·					○	●	·	○	○				○				Glass(○)
3	G19	229.40 m	Basalt(dyke)	Intergranular		◎	○						·	○		○	●				●		●		Glass(○)
4	G19	239.55 m	Basalt(dyke?)	Porphyritic		○	○						●	○		○	◎				●		●	○	Pet: Ep,Cp
5	G20	34.10 m	Basalt(V1-2)	Variolitic		●							●	●		●						◎	○		
6	G20	77.50 m	Basalt(V1-2)	Intersertal		◎	○							○		●	●					○	○		Ht(○)
7	G20	91.20 m	Basalt(V1-2?)	Intersertal		◎	○							○		○	○				●	○	○		Glass(○), Ht(●), Pv(●), Mg-Ch
8	G20	175.90 m	Basalt(V1-2?)	Intersertal		○	○						○	○		◎	◎				○		◎		Fe-Ch
9	G20	271.90 m	Dolerite(dyke?)	Porphyritic		◎	●						●	●		○	◎	·	○		○		○	◎	Pet: Ep
10	G20	288.75 m	Basalt(V1-1)	Intersertal		◎	·							○		○	○				○		○		Ht(○), Pet: Ab,Cc,Cp
11	G22	17.20 m	Basalt(V1-2)	Porphyritic		○	●				·		●	○		○	◎		·	●			●	○	Glass(○), Pet: Ep,Cp, Mg-Ch?
12	G22	88.70 m	Basalt(dyke)	Not clear		●	·				·		○	●		◎	○		○				●	●	Glass(·), Fe-Ch
13	G22	93.05 m	Basalt(V1-2)	Porphyritic		●	·						◎	●		◎	◎						○	◎	Ch》Pl, Fe-Ch, Pet: Ep,Qz
14	G22	200.00 m	Basalt(V1-1)	Not clear		●	●						◎	●		◎	◎						○		Qz,Ep rich, Ch》Pl
15	G23	218.00 m	Basalt(V1-2?)	Porphyritic		●							◎	○	·	◎	○						◎	○	Highly silicified, Pv(○), Fe-Ch
16	G23	226.10 m	Basalt(V1-2?)	Intersertal		○	●						○	◎		◎	○						◎		Glass(●), Pv(●), Cp: anhedral
17	G23	269.80 m	Dolerite(dyke?)	Ophitic		◎	◎						●	○		○	●		○	●	●		○	○	Fe-Ch
18	G23	281.20 m	Basalt(V1-2)	Variolitic		○	○						●	○		○	○			●	○		◎	○	Cp: anhedral, Mg-Ch
19	G24	289.00 m	Basalt(V1-2)	Variolitic		●							◎	●		◎	●						○	●	Highly silicified, Fe-Ch
20	G24	348.90 m	Basalt(V1-1)	Intersertal		○							○	◎		○	○						○		Qz in pore
21	G27	45.00 m	Basalt(V1-2)	Not clear		○	○						●	○		◎	◎				○		○	●	Glass(○), Mg-Ch?
22	G27	64.90 m	Basalt(V1-2)	Porphyritic		○	○						·	○		○	◎						○	○	Glass(○), Pet: Ep, Mg-Ch?
23	G27	86.00 m	Dolerite(V1-2?)	Porphyritic		●	●						●	○		○	◎				○		●	○	Glass(○), Pet: Ep
24	G27	120.20 m	Basalt(V1-1)	Intersertal		○							○	◎		○	○				●		○		Qz in pore
25	G27	160.00 m	Basalt(V1-1)	Intersertal		◎							○	○		○	○				○	●	◎		Glass(●)
26	G27	195.30 m	Basalt(V1-1)	Intersertal		◎							○	○		○	●				○		◎		Fe-Ch
27	Q1	52.50 m	Basalt(V1-2)	Intersertal		◎							●	○		○	●				●	●	○		Glass(●)
28	Q1	108.10 m	Basalt(V1-2)	Intersertal		◎							○	○		○	●				●		○		
29	Q1	261.30 m	Basalt(V1-2)	Intersertal		◎							○	◎		○	●				●	●	◎		Glass(●)
30	Q1	285.90 m	Basalt(V1-2)	Intersertal		◎							●	○		○	●				●		◎		

◎: abundant, ○: common, ●: rare, ·: very rare

Qz: Quartz, Pl: Plagioclase, Cp: Clinopyroxene, Op:Orthopyroxene, Ol: Olivine, Ap: Apatite, Sp: Spinel, Ab: Albite, Il: Illite, Ch: Chlorite, Ep: Epidote, Ac: Actinolite, Pu: Pumpellyite, Pr: Prehnite, Cc: Calcite, Sm: Smectite, OM: Opaque minerals, PM: Pseudomorph of Phenocryst, Ht: Hematite, Lm: Limonite
Py: Pyrite, Fe-Ch: Fe rich Chlorite, Mg-Ch: Mg rich Chlorite, Pet: Phenocryst

Table Ⅱ-4-3 Description of polished section of drilling cores

Ser. No.	Sample Location		Sample Description	Identified Minerals					
	Hole No.	Depth		Cp	Py	Sp	Mt	Ht	Gg
1	G18	254.70m	Massive sulphide ore	○	◯				○
2	G18	256.80m	Massive sulphide ore	○	◯				○
3	G18	259.30m	Massive sulphide ore	○	◯		◯	○	○
4	G22	98.40m	Massive sulphide ore	●	◯				○
5	G22	103.60m	Massive sulphide ore	○	◯		●		○
6	G26	82.00m	Massive magnetite ore	○	◯		◯	○	○
7	G26	85.80m	Massive magnetite ore		○		◯	○	○
8	G30	121.80m	Massive sulphide ore	◯	◯				○
9	G30	125.10m	Massive sulphide ore	◯	◯				○
10	G30	187.70m	Massive sulphide ore	○	◯				○
11	G33	241.40m	Massive sulphide ore	○	◯	○			○

◯ abundant
● common
○ rare

Cp: Chalcopyrite
Py: Pyrite
Sp: Sphalerite
Mt: Magnetite
Ht: Hematite
Gg: Gangue minerals

Table Ⅱ-4-4 Results of X-ray diffraction analyses of drilling cores

Ser. No.	Sample Location		Lithology(Formation)	Identified Minerals								
	Hole No.	Depth		Qz	Pl	Ch	Cc	Mm	Ep	La	Py	Mt
1	G20	175.90m	Basalt pillow lava(V1-2)	●	●	∘						
2	G20	271.90m	Basalt massive lava(V1-2)		●	●					∘	
3	G20	288.75m	Epidotized basalt pillow lava(V1-1)		●	●	∘		∘			
4	G22	17.20m	Basalt pillow lava(V1-2)		◎	○	∘		∘		●	
5	G22	93.05m	Basalt pillow lava(V1-2)	○		◎						
6	G22	200.00m	Epidotized basalt pillow lava(V1-1)	●	●	◎			●			
7	G23	218.00m	Basalt pillow lava(V1-2)		●	●					∘	
8	G23	223.70m	Basalt pillow lava(V1-2)		○	○						
9	G23	226.10m	Basalt pillow lava(V1-2)	●	●	●						
10	G23	235.40m	Basalt pillow lava(V1-2)	∘		◎						
11	G24	289.00m	Basalt massive lava(V1-2)	○	∘	◎						
12	G24	348.90m	Basalt pillow lava(V1-1)	○	◎	○						
13	G25	164.20m	Silicified and argillized part of V1-1	●		∘					●	
14	G25	195.90m	Intensely argillized part of V1-1	○		∘					○	
15	G25	198.90m	Intensely argillized part of V1-1	●		∘					○	
16	G27	45.00m	Basalt pillow lava(V1-2)		●	●						
17	G27	64.90m	Basalt pillow lava(V1-2)		◎	●			∘			
18	G27	86.00m	Basalt massive lava(V1-2)		●	●						
19	G30	218.20m	Silicified pillow lava(V1-1)	○		◎					∘	
20	G31	220.50m	Basalt massive lava(V1-1)	○		◎					∘	
21	G31	232.40m	Brecciated and arillized part of V1-1	○	○	○						

◎ abundant
○ common
● rare
∘ very rare

Qz: Quartz
Pl: Plagioclase
Ch: Chlorite
Cc: Calcite
Mm: Montmorillonate
Ep: Epidote
La: Laumontite
Py: Pyrite
Mt: Magnetite

0.00m ~ 10.00m Unconsolidated Quaternary sediments.

10.00m ~ 19.35m Consolidated Quaternary sediments (calcrete).

19.35m ~ 251.8m Lower extrusives rocks 2. Consisting mainly of basaltic pillow lava and massive lava. Thick massive lava is developed remarkably between 114.10m - 171.25m. Accompanied by many basaltic dikes of under 1.5m in width. Some metalliferous sediments of 5 to 20cm in thickness are intercalated between 244.40m ~ 251.55m.

251.80m ~ 267.00m Massive sulphide ore (core length: 15.2m). Accompanied by basaltic dike of about 2m in width.

267.00m ~ 300.25m(end of hole) Lower extrusives rocks 1. Consisting of basaltic pillow lava with interpillows of 4cm to 5cm in thickness and massive lava. Massive lava between 293.20m and 300.25m is considered as sheet flow because it is coarse-grained and doleritic.

Mineralization: Massive sulphide was intersected in the core between 251.80m and 267.00m. Average grade of this part (including basaltic dikes) is 0.96% Cu. Other mineralizations except massive sulphide are as follows. On the hanging wall side, pyrite dissemination is observed below 83.60m. This dissemination is weak between 83.60m and 171.25m, but in the deeper part, it becomes strong and continues to 233.60m. Chalcopyrite and sphalerite dissemination are observed partially between 214.70m and 233.60m. In the part close to massive sulphide ore, pyrite and chalcopyrite dissemination are observed slightly between 247.20m and 249.20m. On the footwall side, pyrite dissemination is observed in the interpillow between 284.50m and 289.85m.

Alteration: On the hanging wall side, weak silicification is recognized from 84.70m to 225.90m, and the deeper part down to massive sulphide ore is strongly silicified. Epidotization is recognized below 185.45m. Sparse epidote-calcite veinlets between 185.45m ~ 189.60m and massive epidote in the interpillow between 205.00m ~ 208.00m are observed. Between 237.90m ~ 251.80m, just above massive sulphide ore, strong epidotization consist of epidote stockwork and intensely disseminated epidote are recognized. On the footwall side, slight silicification is observed in all part, and epidote networks are observed in parts.

(2) MJOB-G19 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 (V1-2) of Lower volcanics, massive sulphide ore and Lower extrusives rocks 1 (V1-1).

0.00m ~ 3.60m Unconsolidated Quaternary sediments.

3.60m ~ 24.80m Consolidated Quaternary sediments (calcrete).

24.80m ~194.10m Lower extrusives rocks 2. Consisting mainly of basaltic pillow lava and accompanied by massive lava partially. Many basaltic or doleritic dikes of under 2m in width are recognized. Strongly silicified shear zone is recognized between 89.00m ~ 97.20m.

194.10m ~ 227.5m Massive sulphide ore (core length: 33.4m). Accompanied by basaltic dikes of

80cm to 220cm in width.

227.50m ~ 300.4m(end of hole) Lower extrusives rocks 1. Consisting mainly of basaltic pillow lava and massive lava, and accompanied by many basaltic dikes.

Mineralization: Massive sulphide was intersected in the core between 194.10m ~ 227.50m. Average grade of this part (including basaltic dikes) is 1.15% Cu. Other mineralization except massive sulphide is as follows. On the hanging wall side, there are quarts veinlets network including chalcopyrite between 93.50m ~ 96.55m in the silicified shear zone, weak pyrite dissemination between 96.55m ~ 196.40m and 129.60m ~ 130.00m, pyrite dissemination accompanied partially by pyrite-epidote-calcite veinlets between 144.70m ~ 165.95m and epidote-calcite veinlets accompanied by chalcopyrite, sphalerite and pyrite between 168.25m ~ 184.90m. Between 190.10m and 194.10m, just above massive sulphide, considerably strong pyrite dissemination accompanied by chalcopyrite dissemination is recognized. On the footwall side, weak pyrite dissemination accompanied by chalcopyrite dissemination is recognized all the way to the bottom, and epidote veinlets including pyrite and chalcopyrite are observed between 265.30m ~ 285.40m.

Alteration: On the hanging wall side, silicification is recognized below 89.00m. The section from 89.00m to 154.20m is weakly silicified, and the deeper part is silicified strongly. Epidotization recognized below 158.00m consists of epidote-calcite-quarts veinlets network. On the foot wall side, silicification is observed continuously all the way to the bottom. Especially, dense epidote veinlets are recognized between 231.20m ~ 245.00m and 276.50m ~ 285.45m.

(3) MJOB-G20 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 (V1-2) of Lower volcanics, massive sulphide ore and Lower extrusives rocks 1 (V1-1).

0.00m ~ 7.75m Unconsolidated Quaternary sediments.

7.75m ~ 16.00m Consolidated Quaternary sediments (calcrete).

16.00m ~ 273.90m Lower extrusives rocks 2. Consisting mainly of basaltic pillow lava, massive lava and many intruded basaltic or doleritic dikes. Intensely silicified shear zone is recognized between 148.80m and 156.60m.

273.90m ~ 279.30m Bedded and laminated massive sulphide ore (core length: 5.40m). Intercalating many thin beds of magnetite and hematite. Accompanied by basaltic dikes.

279.30m ~ 300.45m(end of hole) Lower extrusives rocks 1. Consisting mainly of basaltic pillow lava and accompanied partially by massive lava.

Mineralization: Massive sulphide showing marginal facies was intersected in the core between 273.90m ~ 279.30m. Average grade of this part (including basaltic dikes) is 0.69% Cu. On the hanging wall side, weak pyrite dissemination is recognized continuously from 140.60m to the ore body (accompanied by strong dissemination in parts), pyrite-calcite veinlets accompanied by chalcopyrite and sphalerite partially between 179.60m ~ 208.40m and chalcopyrite dissemination between 228.55m ~ 248.80m are also recognized. On the footwall side, pyrite dissemination is recognized very slightly in parts.

Alteration: On the hanging wall side, weak silicification is recognized below 140.60m. Epidote veinlets and lenticular epidote in the interpillow are recognized below 188.60m, and remarkable epidotization is observed in the interpillow between 257.30m and 266.70m. On the foot wall side, between 280.60m ~ 284.3m, just beneath ore body, strong epidotization is observed and intensely disseminated epidote and epidote-quarts veinlets network are recognized. In the deeper part to bottom, epidotization in the interpillow is strong and epidote veinlets are recognized in lava.

(4) MJOB-G21 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 (V1-2) of Lower volcanics, massive sulphide ore and Lower extrusives rocks 1 (V1-1).

0.00m ~ 8.90m Unconsolidated Quaternary sediments.

8.90m ~ 126.1m Lower extrusives rocks 2. Consisting mainly of basaltic pillow lava and massive lava. Between 60.10m ~ 100.85m, thick coarse-grained massive lava (sheet flow) is remarkably developed. Between 57.05m ~ 57.30m, 106.40m ~ 106.65m and 108.30m ~ 108.40m, reddish-brown metalliferous sediments are intercalated. Between 114.10m ~ 116.85m and 120.60m ~ 123.90m, consolidated fracture zone is recognized. Basaltic dikes are slightly intruded. Between 123.90m ~ 126.10m, just above ore body, strong silicification is recognized.

126.10m ~ 138.75m Silicified massive sulphide ore including about 40% siliceous matrix (core length: 12.65m).

138.75m ~ 250.25m(end of hole) Lower extrusives rocks 1. Consisting mainly of basaltic pillow lava, massive lava and fracture zone, and intercalating partially hialoclastite and metalliferous sediments. Between 138.75m ~ 145.30m, just beneath ore body, strong silicification is recognized. Metalliferous sediments are recognized in three part below 223.55m with thickness from 30cm to 215cm.

Mineralization: Massive sulphide was intersected in the core between 126.10m ~ 138.75m. Average grade of this part is 1.15% Cu. On the hanging wall side, weak pyrite dissemination is recognized all around, and chalcopyrite dissemination is recognized between 112.75m ~ 126.10m. On the footwall side, strong pyrite dissemination is recognized all around, and chalcopyrite dissemination is recognized in parts.

Alteration: On the hanging wall side, the upper side of thick massive lava between 60.10m and 100.85m is slightly silicified and the lower side shows middle silicification. Epidotization is recognized everywhere except for a thick massive lava zone. On the foot wall side, the part from just beneath ore body to 181.70m consisting mainly of fracture zone is silicified. The deeper part (219m ~ bottom) shows weak silicification. Epidotization consisting of dense epidote veinlets and disseminated epidote is recognized between just beneath ore body and 219.80m except for fracture zone.

(5) MJOB-G22 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 (V1-2) of Lower volcanics, massive sulphide ore and Lower extrusives rocks 1 (V1-1).

0.00m ~ 8.70m Unconsolidated Quaternary sediments.

8.70m ~ 96.55m Lower extrusives rocks 2. Consisting mainly of basaltic pillow lava, intercalating massive lava in parts. Accompanied by many basaltic dikes. Two thin beds of metalliferous sediments are recognized at lowest part (just above massive sulphide ore).

96.55m ~ 110.20m Massive sulphide ore (core length: 13.65m).

110.20m ~ 300.20m(end of hole) Lower extrusives rocks 1. Between 110.20m ~ 127.85m, just beneath massive sulphide ore, strong silicification is recognized. This silicified part and lower part to 170.80m form stockwork ore. The section below silicified part consists of only basaltic pillow lava.

Mineralization: Massive sulphide was intersected in the core between 96.55m ~ 110.20m. Average grade of this part is 2.7% Cu, which is the highest value in ore body No.1. On the foot wall side, high grade stockwork ore is developed between 110.20m ~ 170.80m. Average grade between 110.20m ~ 144.85m is 1.33% Cu, and especially between 117.85m ~ 127.85m is 3.56% Cu. On the hanging wall side, pyrite dissemination is recognized between 14.60m ~ 57.05m and 84.40m ~ 93.65m, and coarse-grained chalcopyrite dissemination is recognized between 90.50m ~ 93.05m. Quarts-epidote veinlets including pyrite and chalcopyrite are recognized partially between 57.05m ~ 84.40m. At the lower part of stockwork ore on the footwall side, network of pyrite-chalcopyrite-quarts-epidote veinlets and dissemination of pyrite and chalcopyrite are recognized through 180.50m. Small massive pyrite and chalcopyrite are observed in the interpillow between 180.50m and the bottom of hole.

Alteration: On the hanging wall side, all part is silicified, epidotization is recognized all around except for 12m just above ore body. On the footwall side, below the intense silicification part between 110.20m and 127.80m, strong silicification continue to 190.90m and lower part down to the bottom shows weak silicification. Epidotization is recognized between 180.40m and the bottom of hole.

(6) MJOB-G28 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 (V1-2) of Lower volcanics and Lower extrusives rocks 1 (V1-1).

0.00m ~ 7.50m Unconsolidated Quaternary sediments.

7.50m ~ 80.75m Lower extrusives rocks 2. Consisting mainly of basaltic pillow lava and massive lava, intercalating many metalliferous sediments of under 2m in thickness. Accompanied by little basaltic dikes.

80.75m ~ 150.20m(end of hole) Lower extrusives rocks 1. Consisting of basaltic pillow lava with thick interpillow (10cm ~ 30cm) and massive lava. Accompanied partially by hialoclastite.

Mineralization: On the V1-2, pyrite dissemination is recognized only in the shallow part(7.50m ~ 49.00m). Dissemination of sphalerite and chalcopyrite is recognized partially between 40.05m ~ 47.65m. Metalliferous sediments in lower part of V1-2 consist mainly of magnetite, and in the lowest part intercalate thin magnetite beds. These are marginal facies of massive sulphide ore. On the V1-1, slight to middle pyrite dissemination is recognized continuously down to the bottom of the hole. Chalcopyrite dissemination is recognized slightly in parts.

Alteration: On the V1-2, slight silicification and epidote veinlets are recognized all around. Below 36.05m, epidote veinlets are well developed and very dense. Very intense epidotization is recognized between 72.15m and 80.15m. On the V1-1, weak silicification is recognized below 119.60m, and epidote veinlets are well developed between 80.45m ~ 93.40m, 107.10m ~ 110.60m and 135.80m – to the bottom of the hole.

(7) MJOB-G29 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 (V1-2) of Lower volcanics and Lower extrusives rocks 1 (V1-1).

0.00m ~ 3.30m Unconsolidated Quaternary sediments.

3.30m ~ 15.15m Consolidated Quaternary sediments (calcrete).

15.15m ~ 116.05m Lower extrusives rocks 2. Consisting mainly of basaltic pillow lava, and accompanied slightly by basaltic massive lava. Six beds of metalliferous sediments are intercalated below 67.10m. Basaltic dikes are recognized in parts.

116.05m ~ 200.15m(end of hole) Lower extrusives rocks 1. Consisting of basaltic pillow lava, basaltic massive lava and hialoclastite. The section between 132.75m ~ 142.85m forms stockwork ore.

Mineralization: On the V1-2, dissemination of pyrite or chalcopyrite and sphalerite-calcite veinlets are recognized slightly in parts. In the metalliferous sediments between 67.10m and 80.50m, intense pyrite dissemination is recognized. Lowest metalliferous sediments includes a lot of magnetite. V1-1 shows strong pyrite dissemination all around and is accompanied by chalcopyrite dissemination. In the section between 132.75m ~ 142.85m, chalcopyrite-pyrite-quarts veinlets are developed, and high copper grade stockwork ore is formed. Average grade in this section is 1.16% Cu.

Alteration: On the V1-2, epidote-calcite veinlets are developed below 38.40m, and becoming more dense when going deeper. The section between 105.00m ~ 114.20m is strongly epidotized. On the V1-1, the section below 151.10m is slightly silicified. Intense epidotization is recognized between 116.05m ~ 124.65m. Epidote-calcite veinlets are recognized slightly between 142.70m and the bottom of hole.

4-4-2 Ghuzayn Area – the Eastern Part

Drilling survey was carried out at five boreholes. The boreholes were located at the high

magnetic field anomaly zone detected by big loop TEM survey in Phase II and above the No.1 ore body detected at MJOB-G3 and G13 boreholes in Phase II. Before drilling survey, small loop TEM survey was carried out. And its result contributed to decide the location of boreholes.

(1) MJOB-G23 borehole

Geology: Consisting of Quaternary sediments and Lower extrusives rocks 2 (V1-2) of Lower volcanics.

0.00m ~ 3.15m Unconsolidated Quaternary sediments.

3.15m ~ 12.10m Slightly consolidated Quaternary sediments (calcrete).

12.10m ~ 350.20m(end of hole) Lower extrusives rocks 2. Consisting of basaltic pillow lava between 12.10m ~ 235.85m, and of basaltic-doleritic dikes at deeper levels. Dike between 235.8m and 312.9m is considered as feeder dike because it is large scale, coarse-grained and partially gabbroic. The section between 143.05m ~ 149.15m intercalates metalliferous sediments including many magnetite. The depth interval between 339.15m ~ 340.0m intercalates silicified metalliferous sediments.

Mineralization: Weak pyrite dissemination is recognized between 94.20m ~ 149.15m. This dissemination zone is accompanied by sphalerite dissemination and sphalerite-chalcopyrite-quartz veinlets between 121.10m ~ 133.90m and by strong chalcopyrite dissemination and chalcopyrite-quarts veinlets between 134.5m ~ 149.15m. Weak pyrite dissemination between 179.45m ~ 312.95m and intense pyrite dissemination at deeper levels down to the bottom of hole are recognized. This dissemination zone is accompanied by sphalerite and chalcopyrite dissemination and sphalerite-chalcopyrite-quarts veinlets between 241.30m ~ 259.00m and by chalcopyrite-quarts veinlets and chalcopyrite dissemination in parts.

Alteration: Weak silicification is recognized between 85.50m ~ 212.50m and below 312.9m. Epidotization is recognized in veinlets between 133.00m ~ 223.10m.

(2) MJOB-G24 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 (V1-2) of Lower volcanics and Lower extrusives rocks 1 (V1-1).

0.00m ~ 7.80m Unconsolidated Quaternary sediments.

7.80m ~ 12.10m Consolidated Quaternary sediments (calcrete).

12.10m ~ 331.60m Lower extrusives rocks 2. The section between 12.10m ~ 233.65m consists mainly of basaltic pillow lava and is accompanied partially by massive lava and metalliferous sediments. The lower section consists mainly of basaltic massive lava and is accompanied by pillow lava and thin metalliferous sediments. Pillow lava dominant part is accompanied by many basaltic dikes.

331.60m ~ 350.25m(end of hole) Lower extrusives rocks 1. Consisting mainly of basaltic pillow lava with thick (20cm ~ 50cm) interpillows. Accompanied by massive lava

and hialoclastite.

Mineralization: Weak pyrite dissemination is recognized between 93.20m ~ 150.90m. This dissemination zone is accompanied by sphalerite and pyrite dissemination between 131.00m ~ 150.25m. Pyrite veinlets and network of pyrite-quarts veinlets are recognized between 162.40m ~ 214.70m, and chalcopyrite is included between 206.65m ~ 214.70m. Slight-middle pyrite dissemination accompanied by chalcopyrite dissemination is recognized between 214.70m ~ 292.00m. In the deeper section, weak pyrite dissemination is recognized in parts.

Alteration: Weak silicification is recognized between 58.50m ~ 246.80m. Epidote is observed sparsely as veinlets between 179.15m ~ 272.05m.

(3) MJOB-G25 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 (V1-2) of Lower volcanics, massive sulphide ore and Lower extrusives rocks 1 (V1-1).

0.00m ~ 4.05m Unconsolidated Quaternary sediments.

4.05m ~ 13.00m Consolidated Quaternary sediments (calcrete).

13.00m ~ 115.60m Lower extrusives rocks 2. Consisting of basaltic pillow lava between 13.00m and 21.75m, of gabbroic dolerite considered as feeder dike between 21.75m ~ 85.00m and of pillow lava and massive lava below 85.00m.

115.60m ~ 123.05m Massive sulphide ore (core length:7.45m)

123.05m ~ 200.10m(end of hole) Intense silicified and slight argillized Lower extrusives rocks 1. Stockwork ore is formed between 123.05m ~ 182.00m.

Mineralization: Massive sulphide was intersected in the core between 115.60m ~ 123.05m. Average grade of this part is 3.51% Cu. On the foot wall side, stockwork ore which consists mainly of very strong pyrite dissemination is developed. But its grade is low, and average grade between 123.05m ~ 148.05m is 0.19% Cu. On the hanging wall side it is recognized pyrite dissemination and veinlets between 26.90m ~ 45.90m, pyrite dissemination between 82.80m ~ 96.60m and pyrite dissemination with chalcopyrite and sphalerite dissemination between 102.90m ~ 115.60m. Below the stockwork ore on the footwall side, intense pyrite dissemination accompanied sparsely by chalcopyrite dissemination is recognized between 182.00m ~ bottom of hole.

Alteration: On the hanging wall side, the interval between 21.75m ~ 115.60m is silicified, and especially between 110.70m ~ 115.60m, just above ore body, intense silicification is recognized. On the footwall side, very strong silicification and argillization is recognized all around.

(4) MJOB-G26 borehole

Geology: Consisting of Lower extrusives rocks 2 of Lower volcanics (V1-2), massive magnetite and Lower extrusives rocks 1 (V1-1).

0.00m ~ 37.55m Lower extrusives rocks 2. Consisting of basaltic pillow lava, massive lava and metalliferous sediments at the lowest part.

37.55 ~ 79.05m Lower extrusives rocks 1. Consisting mainly of basaltic pillow lava. Accompanied sparsely by hialoclastite.

79.05m ~ 80.05m Fracture zone (thrust).

80.05m ~ 86.80m Massive magnetite (core length: 6.75m). Accompanied by a little chalcopyrite and pyrite.

86.80m ~ 200.15m(end of hole) Lower extrusives rocks 1. Consisting mainly of basaltic pillow lava. Accompanied sparsely by massive lava and basaltic dikes.

Mineralization: Massive magnetite including chalcopyrite and pyrite was intersected in the core between 80.05m ~ 86.80m, but its grade is not high and average grade is 0.14% Cu. On the V1-1 above the fault, sparse pyrite dissemination is recognized near the fault. On the V1-1 under the fault, stockwork ore consisting mainly of very strong pyrite dissemination accompanied by chalcopyrite dissemination and sphalerite-chalcopyrite-pyrite-quarts veinlets is recognized from massive magnetite to 141.05m. At the lower part, from 141.05m to 167.05m it is recognized middle pyrite dissemination accompanied sparsely by sphalerite and magnetite dissemination and chalcopyrite-quarts veinlets.

Alteration: In the upper side of the thrust fault, V1-2 shows weak silicification all around, but in V1-1 silicification is recognized only in interpillow near the fault between 70.40m ~ 79.05m. Below massive magnetite, very strong silicification with argillization is recognized and continues to 167.05m. No alteration is recognized below 167.05m.

(5) MJOB-G27 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 of Lower volcanics (V1-2) and Lower extrusives rocks 1 (V1-1).

0.00m ~ 4.55m Unconsolidated Quaternary sediments.

4.55m ~ 13.60m Consolidated Quaternary sediments (calcrete).

13.60m ~ 101.25m Lower extrusives rocks 2. Consisting of basaltic pillow lava, massive lava and intruded basaltic dikes. The lowest part is magnetite-rich Metalliferous sediments intersected by fault.

101.25m ~ 201.05m(end of hole) Lower extrusives rocks 1. Consisting mainly of basaltic pillow lava. Accompanied by massive lava at the upper part and near the bottom.

Mineralization: Mineralization is weak on both V1-2 and V1-1. Only sparse pyrite dissemination is recognized. It is characteristic that chalcopyrite dissemination is recognized at the interpillow in many pillow lava.

Alteration: On the V1-2, silicification is observed all around. Epidote veinlets are recognized sparsely below 38.35m. On the V1-1, no alteration is observed by the naked eye.

4-4-3 Ghuzayn Area – the Western Part

High chargeability with low resistivity was detected by TDIP survey this year. TEM survey was carried out within this IP anomaly zone, thereafter drilling survey was carried out at four boreholes

within the TEM anomaly zone.

(1) MJOB-G30 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 of Lower extrusives rocks 1 (V1-2), massive sulphide ore and Lower extrusives rocks 1 (V1-1).

0.00m ~ 14.95m unconsolidated Quaternary sediments.

14.95m ~ 110.40m Lower extrusives rocks 2. Consisting of basaltic pillow lava, massive lava and intruded basaltic dikes.

110.40m ~ 201.80m Massive sulphide ore (core length: 91.40m).

201.80m ~ 250.20m(end of hole) Lower extrusives rocks 1. The section between 201.80m ~ 204.05m, just beneath ore body, is basaltic dike. The lower part between 204.05m ~ 217.30m is strongly silicified and forming stockwork ore. Below 217.30m it is recognized of only basaltic pillow lava.

Mineralization: High grade massive sulphide was intersected as indicated in the core between 110.40m ~ 201.80m. Average grade of this part (core length: 91.40m) is 2.68% Cu. The grade of the section between 114.40m ~ 126.40m is especially high, and average grade is 7.71% Cu. On the hanging wall side, weak pyrite dissemination is recognized between 53.20m ~ 110.40m. In this interval, sphalerite-pyrite-calcite veinlets and sphalerite dissemination are recognized between 75.70m ~ 97.20m, and chalcopyrite dissemination and veinlets is recognized between 99.60m ~ 110.40m. On the footwall side, between 204.25m ~ 217.30m, stockwork ore is formed which consists of intense pyrite dissemination and veinlets and brecciated pyrite. Upper part of this stockwork ore between 204.25m ~ 208.05m is accompanied by chalcopyrite dissemination. Below 217.30m, network of pyrite-quarts veinlets and intense pyrite dissemination in the interpillow is recognized.

Alteration: On the hanging wall side, weak silicification is recognized between 51.05m ~ 102.75m. Sparse epidote veinlets are recognized between 66.15m ~ 70.70m and 105.25m ~ 110.40m. Relatively dense epidote veinlets are recognized between 86.20m ~ 102.75m. Between 104.10m ~ 110.40m, just above ore body, epidote dissemination is recognized. On the footwall side, very strong silicification is recognized between 204.25m ~ 217.30m. And at the lower part, it is recognized considerable strong silicification.

(2) MJOB-G31 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 of Lower volcanics (V1-2), massive sulphide ore and Lower extrusives rocks 1 (V1-1).

0.00m ~ 15.10m Unconsolidated Quaternary sediments.

15.10m ~ 109.30m Lower extrusives rocks 2. Consisting mainly of basaltic pillow lava. Intercalating partially massive lava. Accompanied by many basaltic dikes.

109.30m ~ 181.30m Massive sulphide ore (core length: 72m). Accompanied by many basaltic dikes below 151.05m.

181.30m ~ 235.45m(end of hole) Lower extrusives rocks 1. Consisting of basaltic pillow lava

between 181.30m ~ 212.75m, and of basaltic massive lava below 212.75m. Fracture zone is recognized below 226.35m.

Mineralization: Massive sulphide was intersected in the core between 109.30m ~ 181.30m. Average grade of this part is 1.66% Cu. On the hanging wall side, pyrite dissemination along the network of silicification between 32.15m ~ 47.90m, pyrite dissemination and veinlets (accompanied by sphalerite-calcite veinlets and dissemination of sphalerite and pyrite) between 47.90m ~ 96.80m and weak pyrite dissemination between 105.60m ~ 109.30m are recognized. On the footwall side, pyrite veinlets network, pyrite-chalcopyrite-quarts veinlets network, intense pyrite dissemination and chalcopyrite dissemination are recognized and form stockwork ore between 181.30m ~ 213.25m. In this interval, brecciated massive pyrite is intercalated. Below 213.25m to 227.30m, pyrite-chalcopyrite-quarts veinlets and weak pyrite dissemination are recognized.

Alteration: On the hanging wall side, weak silicification is recognized between 28.50m ~ 109.30m. Epidote veinlets are recognized intermittently from 6.80m to the top of ore body. Disseminated epidote is recognized just above the ore body. On the footwall side, intense silicification and argillization are recognized between 181.30m ~ 212.70m.

(3) MJOB-G32 borehole

Geology: Quaternary sediments, Lower extrusives rocks 2 of Lower volcanics (V1-2), massive sulphide and Lower extrusives rocks 1 (V1-1).

0.00m ~ 3.90m Consolidated Quaternary sediments (calcrete).

3.90m ~ 169.35m Lower extrusives rocks 2. Consisting of basaltic pillow lava and massive lava. Accompanied by many intruded basaltic dikes.

169.35m ~ 209.00m Massive sulphide (core length: 39.65m). Accompanied by intrusive basaltic dikes.

209.00m ~ 250.50m(end of hole) Lower extrusives rocks 1. Consisting mainly of basaltic pillow lava. Intercalating partially basaltic massive lava. Accompanied by many basaltic dikes.

Mineralization: Massive sulphide was intersected as indicated in the core between 169.35m ~ 209.00m. Average grade of this part is 1.13% Cu. On the hanging wall side, pyrite dissemination is recognized between 71.80m and ore body. Dissemination becomes strong around 100m and above ore body. And this pyrite dissemination zone is accompanied by sphalerite dissemination between 117.20m ~ 129.00m and by sphalerite-epidote-calcite veinlets between 129.00m ~ 141.30m. On the footwall side, pyrite dissemination is recognized intermittently from 214.70m to 234.60m. Chalcopyrite dissemination and chalcopyrite-calcite-epidote veinlets are partially recognized.

Alteration: On the hanging wall side, weak silicification is recognized between 76.25m and ore body. Epidote veinlets are recognized between 123.25m and ore body. This epidotization is more developed when it gets close to ore body. On the footwall side, weak silicification and epidotization are recognized all around. As like on the hanging wall side, epidotization becomes more intense as

coming close to ore body.

(4) MJOB-G33 borehole

Geology: Consisting of Quaternary sediments, Lower extrusives rocks 2 of Lower volcanics (V1-2), massive sulphide and Lower extrusives rocks 1 (V1-1).

0.00m ~ 7.30m Consolidated Quaternary sediments

7.30m ~ 230.95m Lower extrusives rocks 2. Consisting mainly of basaltic pillow lava. Interleaving basaltic massive lava. Accompanied by basaltic dikes. Interleaving many thin beds of metalliferous sediments between 210.30m ~ 228.80m.

230.95m ~ 247.40m Massive sulphide ore (core length:16.45m). Accompanied by basaltic dikes. Boundary between ore body and Lower extrusives rocks 1 is fault.

247.40m ~ 300.00m(end of hole) Lower extrusives rocks 1. Consisting of basaltic pillow lava and massive lava. Accompanied by basaltic dikes.

Mineralization: Massive sulphide was intersected in the core between 230.95m ~ 247.40m. Average grade of this part is 0.83% Cu. On the hanging wall side, pyrite dissemination is recognized intermittently from 113.65m to ore body. Just above the ore body, between 232.20m - 230.95m, this pyrite dissemination is strong and accompanied by intense chalcopyrite dissemination. Average grade in the interval (core length:7.75m) is 0.70% Cu. The interval between 139.10m ~ 168.50m is accompanied by calcite-quarts veinlets including sphalerite and sphalerite dissemination. On the footwall side, weak pyrite dissemination is recognized from the ore body to 285.90m. In this section, quarts-epidote veinlets including chalcopyrite and pyrite are observed partially. Below 285.90m, pyrite, quarts and epidote are recognized partially.

Alteration: On the hanging wall side, silicification is recognized between 105.90m ~ 219.30m. In this section, intensity of silicification become a little strong between 146.80m ~ 182.90m. Epidote veinlets and epidote dissemination are recognized continuously between 159.37m ~ 225.90m. On the footwall side, densely distributed epidote veinlets and epidote dissemination are recognized between 261.10 and bottom of hole. The interpillow is strongly silicified and epidotized.

4-4-4 Daris area

High chargeability was widely detected at the center of this area by the TDIP survey in Phase I of the previous Cooperative Mineral Exploration project. Based on the IP anomalies, a TEM survey was carried out in Phase II of the above mentioned project and in Phase I of the present project. Drilling survey was carried out in this area by taking into account the results of the TEM survey.

(1) MJOB-D5 borehole

Geology: Consisting of Quaternary sediments and Lower extrusives rocks 2 of Lower volcanics(V1-2)

0.00m ~ 1.50m Unconsolidated Quaternary sediments.

1.50m ~ 350.50m(end of hole) Lower extrusives rocks 2. Consisting of basaltic pillow lava and

intercalating partially basaltic massive lava at the upper part between 1.50m ~ 256.00m. Consisting mainly of basaltic massive lava and intercalating partially basaltic pillow lava at the lower part below 256.00m. In this lower part, faults and cracks are developed and many basaltic dikes are recognized.

Mineralization: Weak dissemination of fine-grained chalcopyrite between 130.10m ~ 142.70m and weak pyrite dissemination between 147.65m ~ 240.80m are recognized.

Alteration: Very weak silicification is recognized between 120.90m and bottom of hole. Epidote veinlets are recognized slightly between the intervals of 77.70m ~ 81.65m, 231.10m ~ 238.50m and 258.50m ~ 267.30m.

4-4-5 Doqal area

High chargeability was detected beneath the gossan by TDIP survey in Phase II of previous project. TEM survey was carried out during above mentioned Phase II and continued during Phase I of this project on the zones where IP anomalies were detected. On the basis of TEM results, drilling survey was carried out by drilling two boreholes within high TEM anomaly zone. In this area, the object of drilling survey is not only massive sulphide but also stockwork ore, because some gold contents of gold detected in the gossan by the geological survey in Phase I of previous project.

(1)MJOB-Q1 borehole

Geology: Consisting of Lower extrusives rocks 2 of Lower volcanics (V1-2).

0.00m ~ 300.05m(end of hole) Lower extrusives rocks 2. Consisting of basaltic pillow lava and massive lava. Accompanied by many intruded basaltic-doleritic dikes.

Mineralization: Pyrite dissemination is recognized throughout the core. Intensity is generally weak, but intense dissemination is recognized between the intervals of 114.55m ~ 123.80m, 148.30m ~ 154.00m and 191.95m ~ 245.20m. Sphalerite dissemination accompanied by chalcopyrite dissemination is recognized partially between 16.80m ~ 67.30m. Weak dissemination of chalcopyrite and quarts-calcite veinlets including chalcopyrite and pyrite are recognized between 255.00m ~ 297.50m.

Alteration: Slight silicification is recognized sparsely around 60m and 130m, and continuously between 196.50m ~ 232.40m and below 257.50m. Epidotization is recognized partially in the interpillow between 14.95m ~ 86.35m.

(2) MJOB-Q2 borehole

Geology: Consisting of Lower extrusives rocks 2 of Lower volcanics (V1-2).

0.00m ~ 250.60m(end of hole) Lower extrusives rocks 2. Consisting of basaltic pillow lava and basaltic massive lava. Accompanied by many basaltic-doleritic dikes.

Mineralization: Weak pyrite dissemination is recognized continuously from 43.30m to bottom of hole. Intense dissemination is observed in parts. Chalcopyrite dissemination is recognized in parts

throughout the core. Sphalerite dissemination and chalcopyrite-sphalerite-calcite veinlets are recognized between 35.25m ~ 81.35m.

Alteration: Silicification and epidotization are recognized in parts. Epidotization is recognized mainly in the interpillow.

4-5 Further Considerations

4-5-1 Ghuzayn Area - the Central Part

The ore body No.2 in Ghuzayn area was intersected by 5 boreholes in 1996: MJOB-G5, G14, G15, G16 and G17, and another 5 boreholes in this phase: MJOB-G18, G19, G20, G21 and G22. Drilling results of this phase are shown in Table II-4-5.

Geologic cross sections across boreholes are shown in Figs.II-4-4(1) and (2). Figs.II-4-5~II-4-8 shows the isopacks, the average copper assay distribution, the distribution of the top surface and the distribution of the bottom surface of the ore body, respectively. It is clear from these maps, that the ore body No.2 strikes northeast to southwest and dips northwest by 20° to 40° . The high angle fault confirmed by the borehole G21 is thought to form the eastern boundary of the ore body and to be the main pass of hydrothermal solution which generated the ore body. This fault probably extends to the place in between the boreholes of G22 and G28 because of the change of dipping and the discontinuity of ore body between these two boreholes.

As shown in Fig. II-4-6, the biggest thickness of the ore body No. 2 is detected around the borehole G14, tending to decrease gradually in thickness towards north and northwest, and decreasing quickly at the southern side. The average assays of the ore body show the highest value around the borehole G22 and it tend to be gradually lower towards north. The ore body No.2, in the boreholes of G22 and G14, consists not only of massive sulphide ore, but also of stockwork ore.

Alteration related to mineralization consists of silicification, cloritization (Mg rich chlorite: Clinochlore) and epidotization. These are observed in both sides of the foot wall and hanging wall, however, they are more intense in the foot wall side. In addition, their intensities are increasing as approaching towards the ore body. At the center of the ore body, an intense silicification and chloritization can be found such as the foot wall side of boreholes of G14 and G22. Epidotization is very slight in the center, which can not be seen at the foot wall side, however it is most remarkable at the foot wall side in the margin of the ore body. Silicification and epidotization show a relatively wide distribution around the ore body and silicification covers slightly larger extension. These are accompanied with pyritization and the extents coincide almost with the area delineated from the TDIP survey as a high chargeability zone. Epidote associated with mineralization is mainly forming veinlets together with quartz or calcite, which is accompanied by pyrite, chalcopyrite and rarely sphalerite. A disseminated and massive epidote can be observed in the vicinity of the ore body.

The fact described above suggests the idea that the center of generation of the ore body No.2

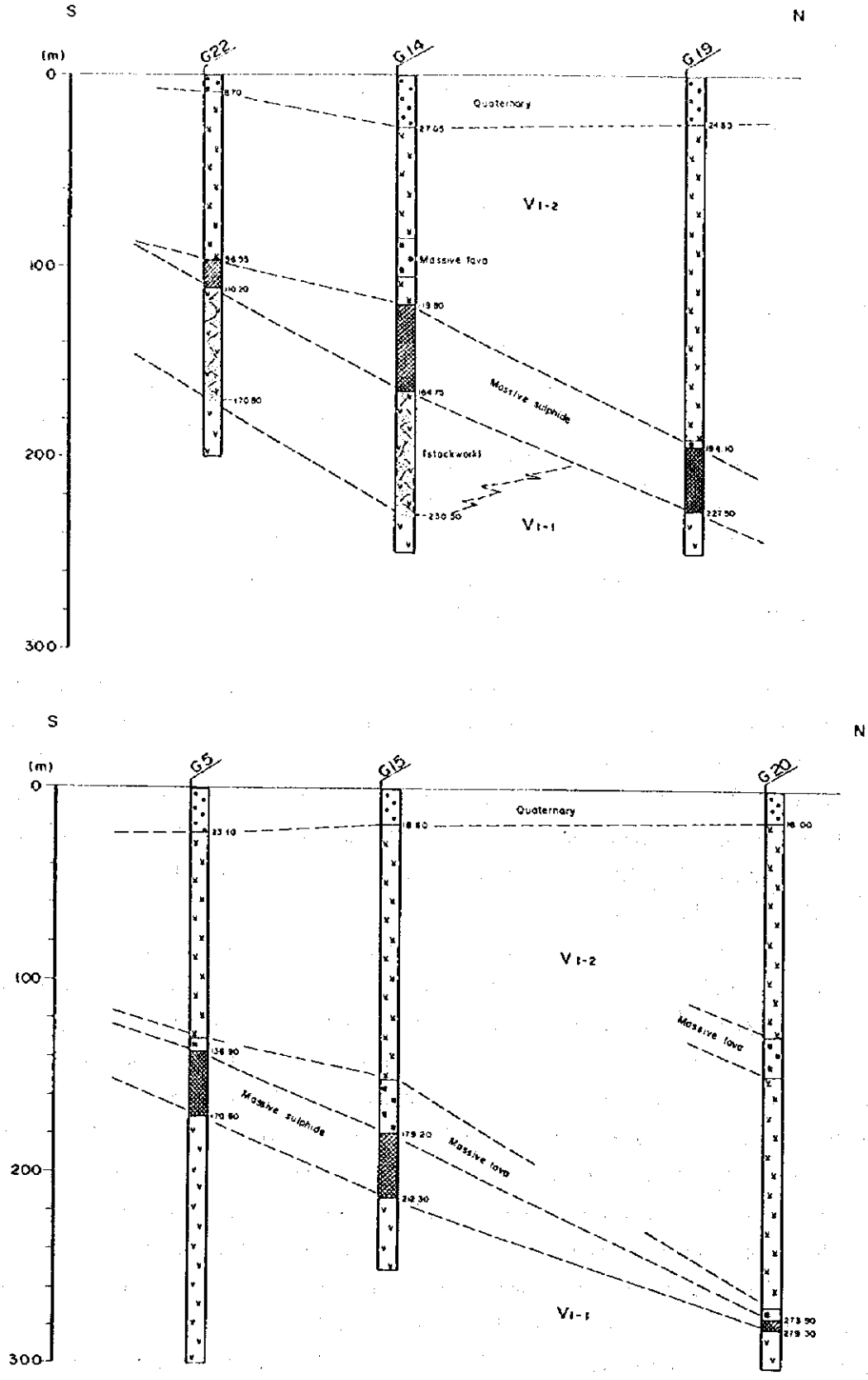


Fig. II -4-4(1) Cross section of borehole site of ore body No.2 in Ghuzayn area

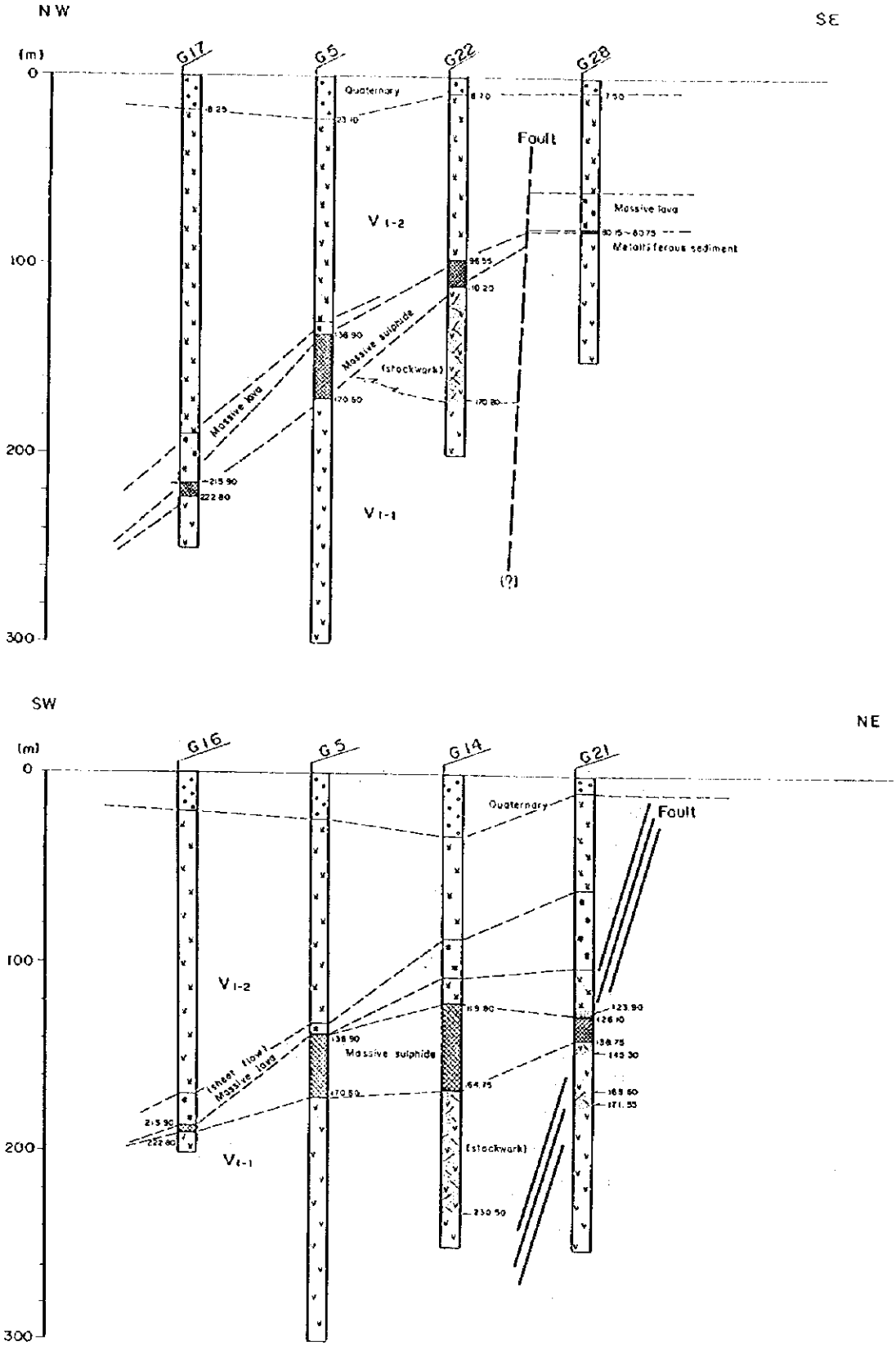


Fig. II -4-4(2) Cross section of borehole site of ore body No.2 in Ghuzayn area

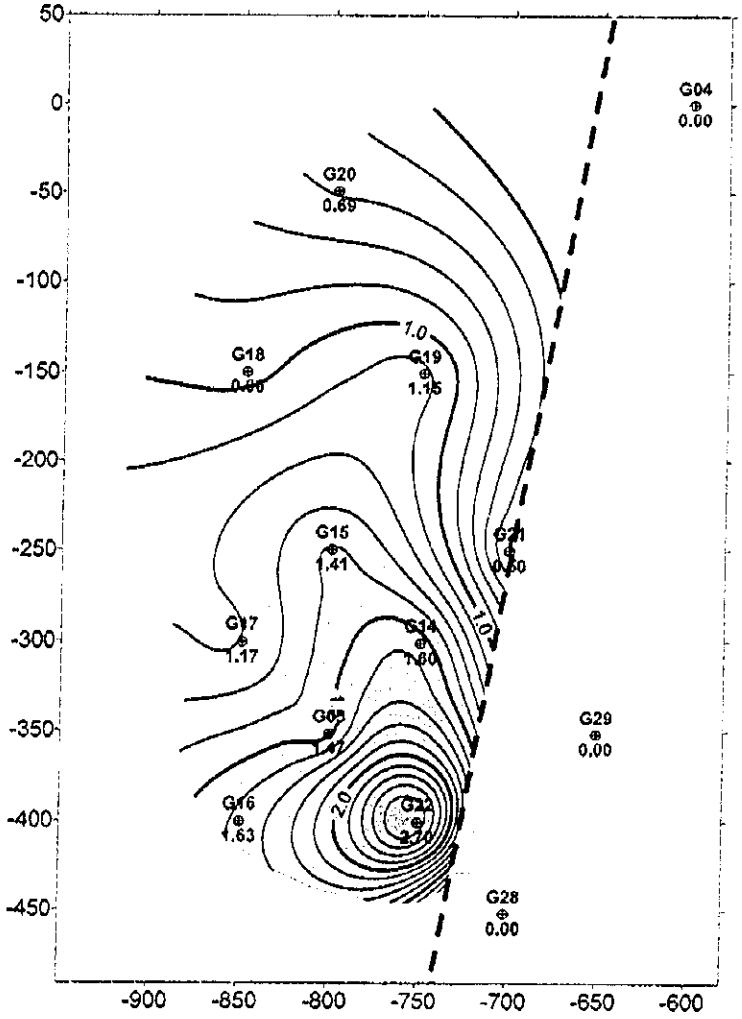


Fig. II-4-5 Copper assay distribution of ore body No.2 in Ghuzayn area

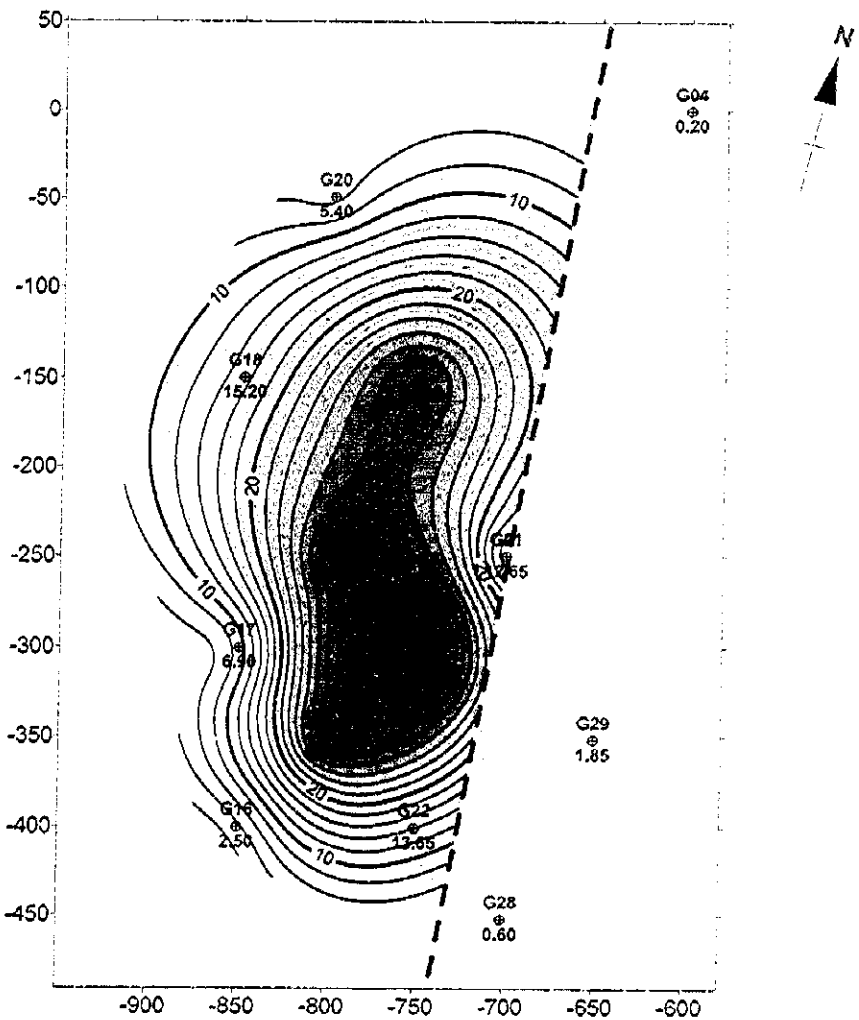


Fig. II-4-6 Isopack map of ore body No.2 in Ghuzayn area

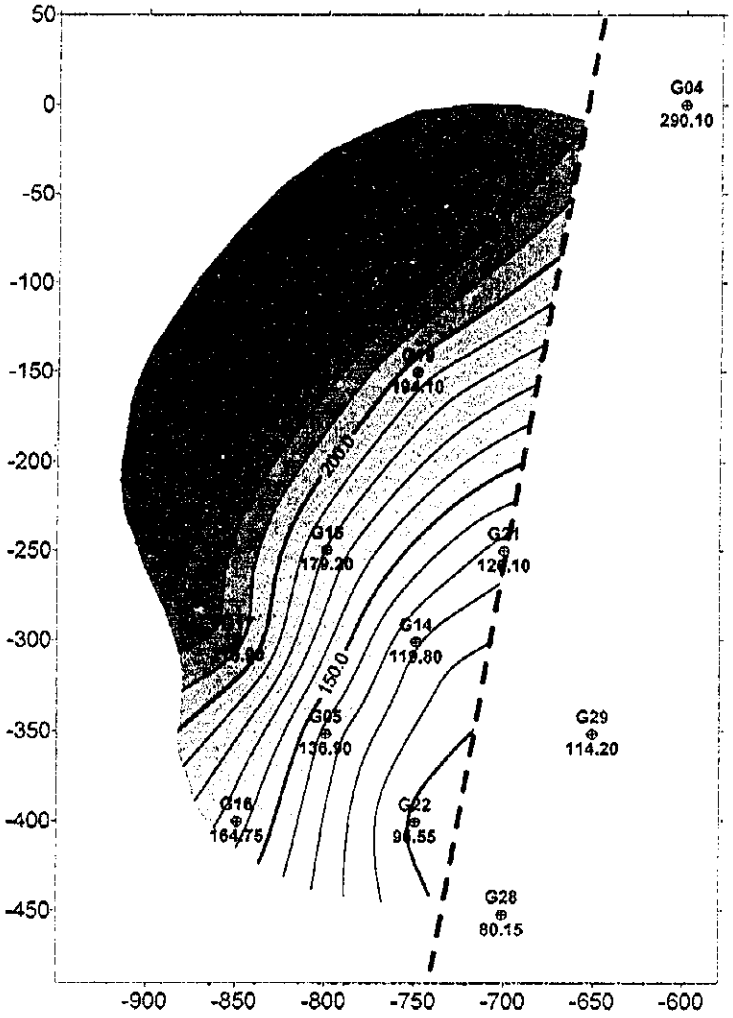


Fig. II -4-7 Contours of the top surface of ore body No.2 in Ghuzayn

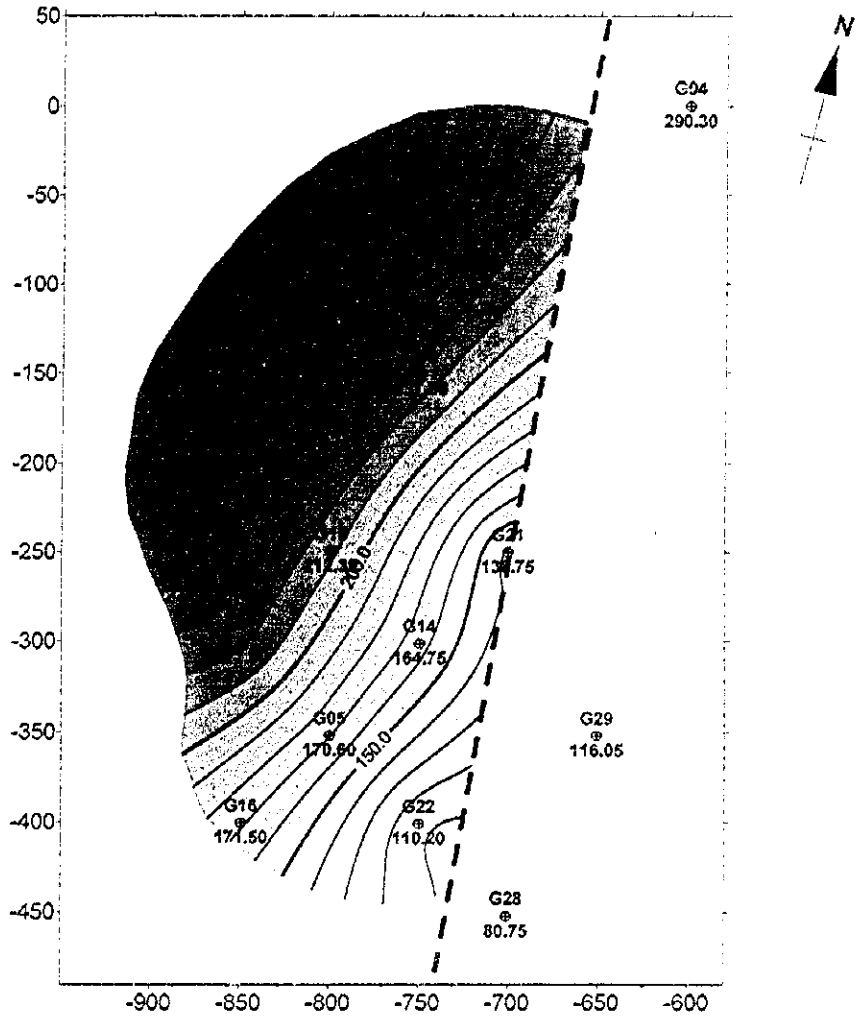


Fig. II -4-8 Contours of the bottom surface of ore body No.2 in Ghuzayn

was located around the boreholes G22 and G14. On the other hand, the site of the borehole G20 is situated at the margin of the ore body No.2, where the ore body shows a sedimentary structure (lamination and bedding) and consists of manganese, hematite and pyrite layers.
Geological ore reserves of the ore body No.2 are estimated in 5 million tons with an average assay of 1.2%Cu.

4-5-2 Ghuzayn Area - the Eastern Part

The ore body No.1 was intersected by MJOB-G3 and G13 in 1996 and by MJOB-G25 in this Phase I. Intersected ore in borehole G25 was quite similar in core length and assays to the ore in G3, being this with higher grade in spite of short core length, as shown in Table II-4-5. The alteration is also as same as the case of G3 and consists of intense silicification and chloritization (Clinochlore) in the foot wall side and only silicification in the hanging wall side.

The borehole MJOB-G26 intersected the massive magnetite body (reported by Prospection Ltd. in 1976) accompanied with a small amount of chalcopyrite. However the results of assay show a very low grade of copper. As shown in Fig.II-4-9, the thrust fault was also found in this borehole and V1-1 was repeated in the core log.

The other boreholes of MJOB-G23, G24, G27 did not intersect any massive sulphide body. The remarkable weathering of V1-2 near the surface was found at the boreholes G23 and G24 and forming a good aquifer. Many small scaled fractures were found in the middle depth of borehole G23. The anomaly detected by TEM survey around the boreholes G23 and G24 can be considered to reflect the underground water and fractures. About the borehole G27, a fault was confirmed at the boundaries between V1-1 and V1-2, which is probably the extension of the N-S trending fault outcropping on the south of Ghuzayn gossan. The TEM anomaly around the borehole G27 might reflect the fault breccia zone

4-5-3 Ghuzayn Area - the Western Part

A remarkable geophysical anomaly was detected in this phase along the Wadi Hawasinah and investigated by the drilling survey of 4 boreholes. All of these boreholes intersected a large scaled massive sulphide ore body (ore body No.3). The massive sulphide ore intersected by MJOB-G30 indicated a core length of 91.40m and an average assay of 2.68 %Cu. In the boreholes G31, G32 and G33, core lengths and average assays of ore were respectively, 72m with 1.66%Cu, 39.65m with 1.13%Cu and 16.45m with 0.83%Cu.

Geologic cross sections across boreholes are shown in Fig.II-4-10. From this cross section, the ore body No.3 is seen to strike northeast to southwest and dips northwest by about 20° . About 50m to the south of borehole G30, V1-1 is exposed and contacts with V1-2 by a E-W trending fault. The vertical displacement of this fault can be estimated in more than 100m on the basis of drilling results. The above mentioned fault is inferred to be the main passage of the hydrothermal solutions which

Table II-4-5 Summary of drilling results in Ghuzayn area

Ore Body Name	Bore Hole NO.	Type of Ore	Depth (m)		Thickness (m)	Average Grade	
			from	to		Cu%	Zn(%)
GHUZAYN No.1 Body	MJOB-G25	massive sulphide	**115.60**	**123.05**	**7.45**	**3.51**	**0.03**
		stockwork	123.05	148.95	25.90	0.19	0.04
GHUZAYN No.2 Body	MJOB-G18	massive sulphide	**251.80**	**267.00**	**15.20**	**0.96**	**0.08**
	MJOB-G19	massive sulphide	**194.10**	**227.50**	**33.40**	**1.15**	**0.05**
	MJOB-G20	massive sulphide	**273.90**	**279.30**	**5.40**	**0.69**	**0.02**
	MJOB-G21	massive sulphide	**126.10**	**138.75**	**12.65**	**0.50**	**0.01**
	MJOB-G22	stockwork(upper)	90.50	96.55	6.05	0.33	0.01
		massive sulphide	**96.55**	**110.20**	**13.65**	**2.70**	**0.03**
		stockwork(lower)	110.20	144.85	34.65	1.33	0.14
		stockwork(high grade)	117.85	127.85	10.00	3.56	0.10
	MJOB-G29	stockwork	132.75	142.85	10.10	1.16	0.05
GHUZAYN No.3 Body	MJOB-G30	massive sulphide	**110.40**	**201.80**	**91.40**	**2.68**	**0.01**
		massive sulphide (high grade part)	114.40	126.40	12.00	7.71	0.01
	MJOB-G31	massive sulphide	**109.30**	**181.30**	**72.00**	**1.66**	**0.04**
		stockwork	181.30	213.25	31.95	0.27	0.01
	MJOB-G32	massive sulphide	**169.35**	**209.00**	**39.65**	**1.13**	**0.05**
	MJOB-G33	stockwork	223.20	230.95	7.75	0.70	0.04
		massive sulphide	**230.95**	**247.40**	**16.45**	**0.83**	**0.06**

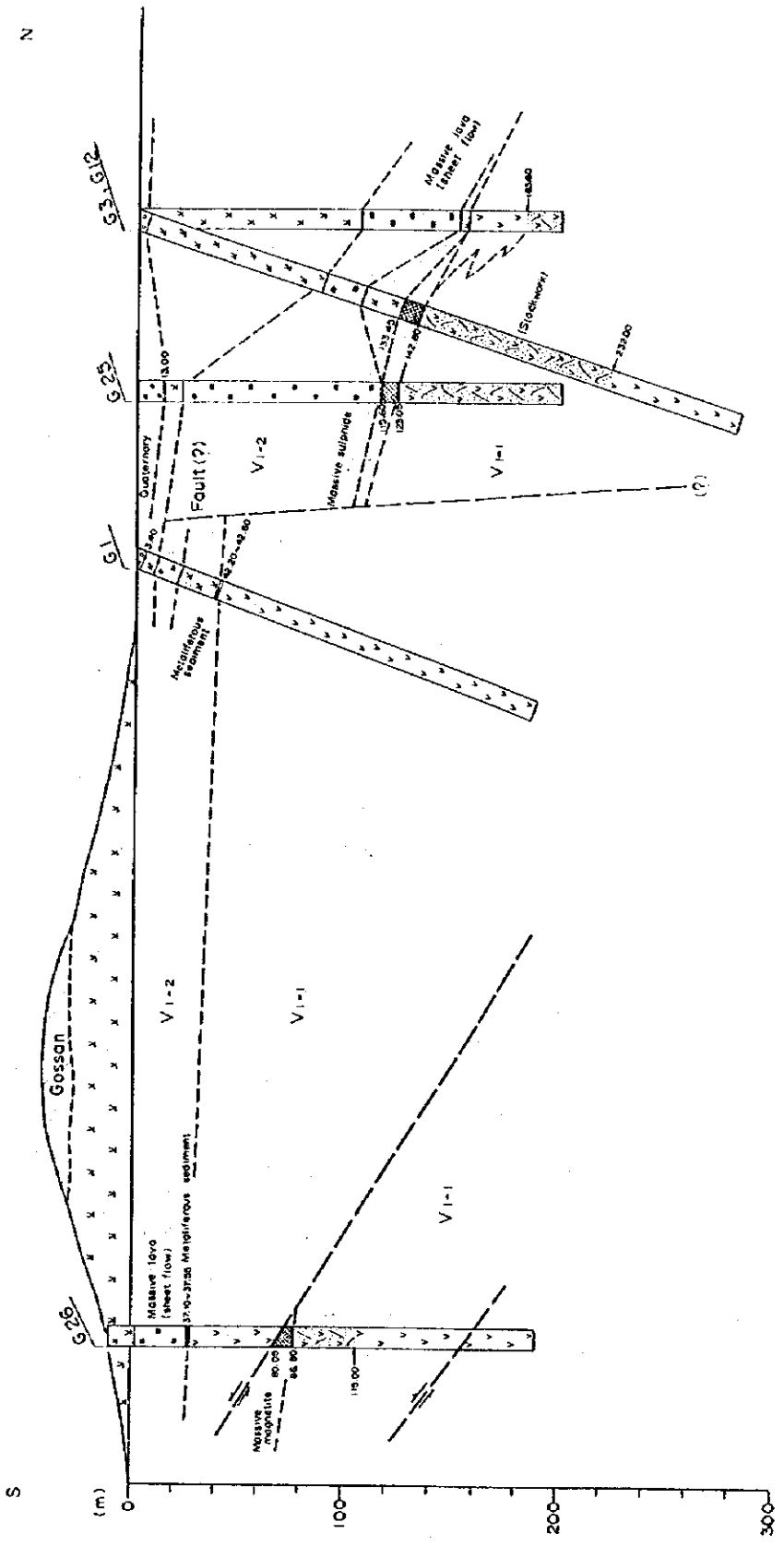


Fig. II-4-9 Cross section of borehole sites in ore body No.1 of Ghuzayn area

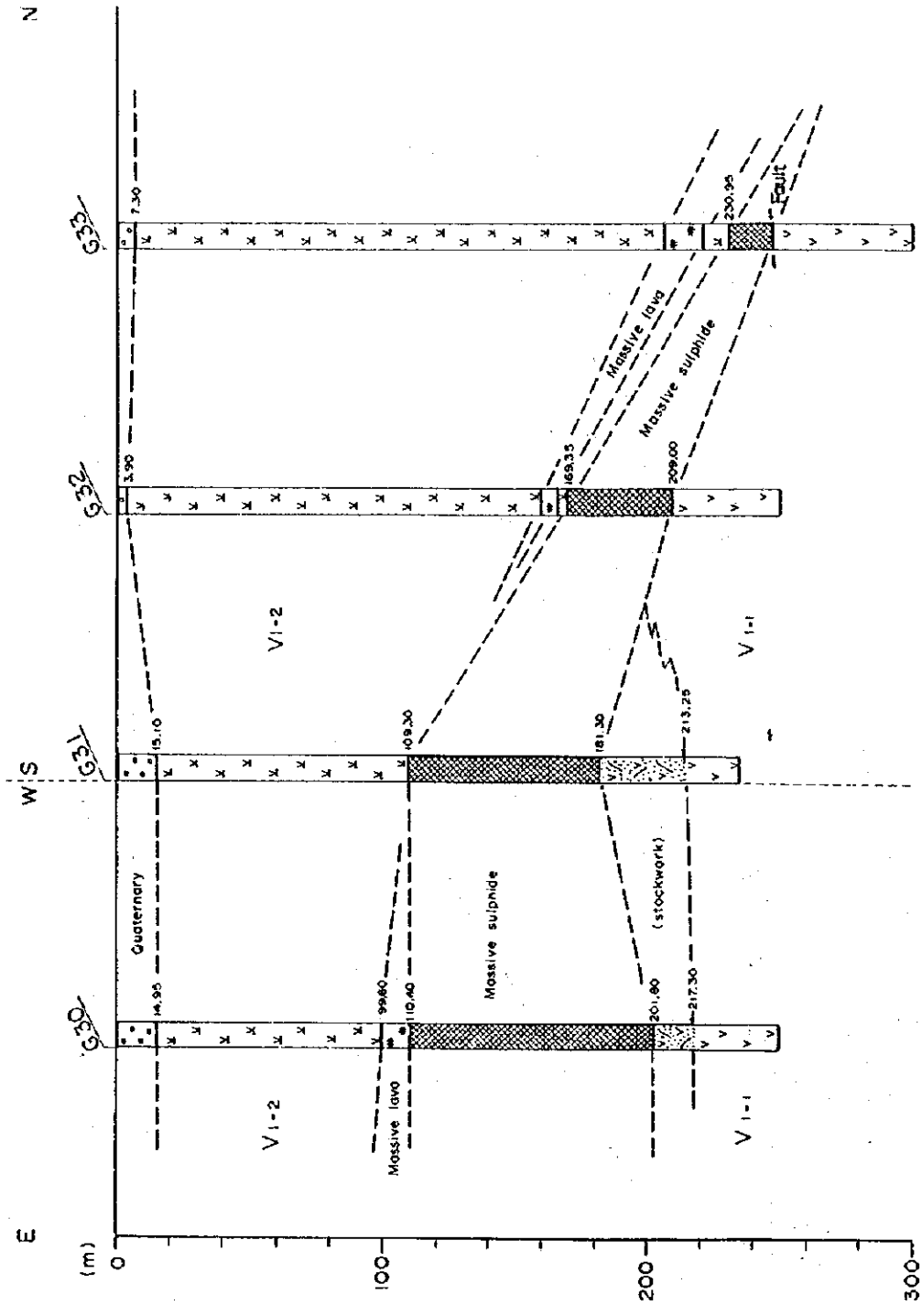


Fig. II-4-10 Cross section of borehole sites in ore body No.3 of Ghuzayn area

generated the ore body, because of the intense alteration observed at the foot wall side of the boreholes G30 and G31 which are close to the above mentioned fault. Alteration related to mineralization around the ore body No.3, which is almost same as the ore body No.2, consists of silicification, cloritization(Mg rich chlorite: Clinochlore) and epidotization. These are observed in both sides of the foot wall and hanging wall , however they are more intense in the foot wall side. In addition, their intensities are increasing as approaching towards the ore body. An intense silicification and chloritization can be found at the foot wall side of boreholes G30 and G31 considered to be a center of the ore body. In the hanging wall side, the silicification covers slightly larger extension than the epidotization. Epidote associated with mineralization is mainly forming veinlets, however, a disseminated epidote and massive epidote can be observed in the vicinity of ore body. The epidotization in the foot wall side is well observed on the V1-1 outcrop to the south of borehole G30.

4-5-4 Daris area

In order to investigate a relatively high TEM response detected in Daris area, drilling survey was conducted by drilling the borehole MJOB-D5, however, no massive sulphide was detected. According to the core analysis, the TEM anomaly may have been reflected not by mineralization, but instead by the fracture zone. Fig. II-4-11 illustrates the IP pseudo-section including the borehole location.

The wide high chargeability zone being detected in Daris area, may reflect indications of a blind massive sulphide mineralization. However, if any massive sulphide is found, it should not be a big scale deposit because significant low resistivity zones were not detected on the above mentioned high chargeability zone.

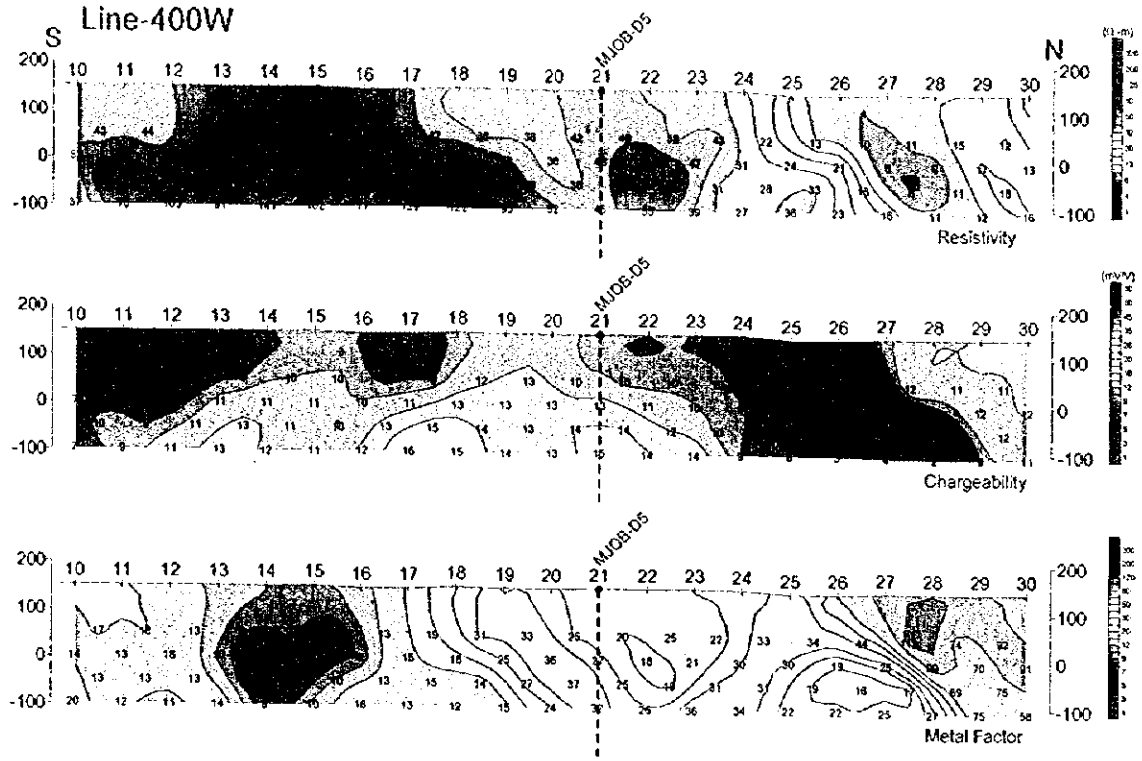
Furthermore, the several faults and fractures recognized by previous drillings including MJOB-D5, suggest that Daris area is situated in an area of a complicated geological structure and as such, the orebody may be fractured and of small scale.

4-5-5 Doqal area

In this area the TEM survey was conducted in 1996 and again in 1997, to examine the remarkable chargeability zones associated with the low resistivity detected previously by the TDIP method. To investigate the nature of these geophysical anomalies, two boreholes were drilled on the site selected from the TEM anomalies.

The two mentioned boreholes confirmed extensive sulphide mineralization and veinlets, but failed to find any economically interesting sulphide mineralization. The high chargeability anomaly is considered to reflect the sulphide dissemination.

The facts that in Doqal, the sulphide veinlets are borne in V1-2, presenting partial alteration with lack in continuity and with many veinlets intruding in V1-2, lead us to assume that the



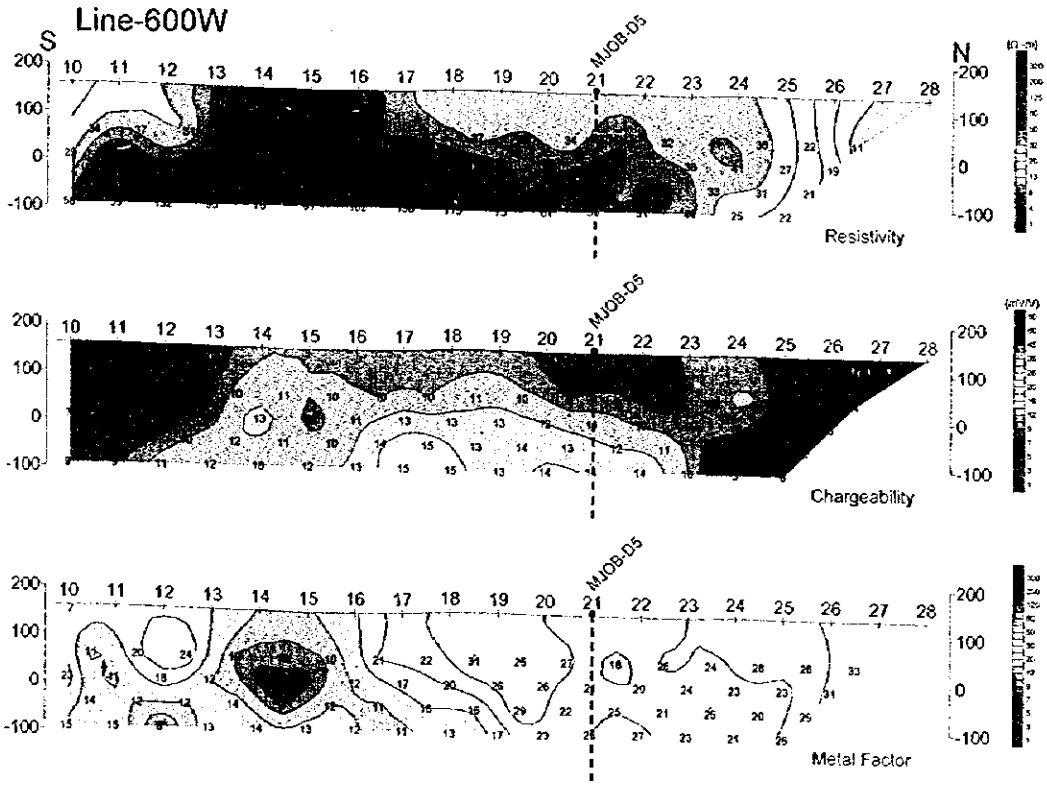


Fig. II-4-11 IP pseudo-section around boreholes in Daris area

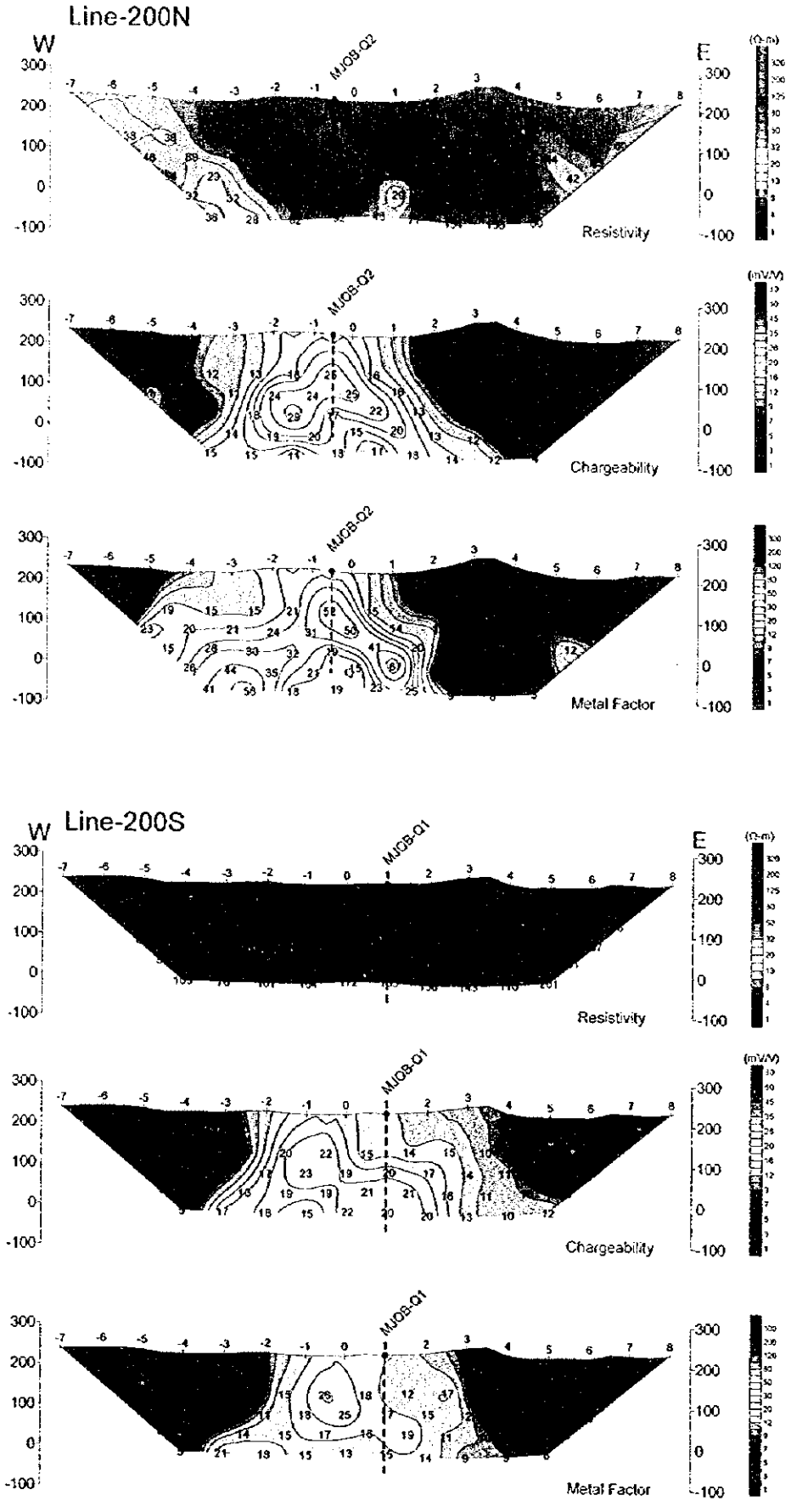


Fig. II -4-12 IP pseudo-section around boreholes in Doqal area

(i)

(ii)

(i)

mineralization and associated alteration occurred by volcanic intrusive activity.

4-5-6 Discussion of survey hypothesis

An exploration hypothesis was mentioned in previous chapter regarding the application of the results of the drilling survey conducted in Ghuzayn area in the search of massive sulphide deposits in the Batinah Coast area. These exploration hypothesis are as follows:

The massive sulphide deposit shows a stratigraphic control and occurs in the contact between V1-1 and V1-2.

The alteration associated with mineralization consists of silicification, chloritization (Mg-rich chlorite) and epidotization. Silicification and epidotization are remarkable even in the margin of the massive sulphide ore body.

The generation of massive sulphide deposit is closely related with faults.

There exists the possibility that metalliferous sediment grade laterally into massive sulphide in the case that the sediment contains many magnetic layers with clear stratification and copper mineralization.

PART III CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 1 CONCLUSIONS

The survey results can be summarized as follows:

(1) A prominent IP anomaly was extracted in the western part of Ghuzayn area. This anomaly is associated to the massive sulphide detected in this part.

(2) To investigate further the above mentioned IP anomaly, a TEM survey was carried out. The TEM data taken within the large loop, supplied general information about the extension of the massive sulphide ore body. The small loops data reflected a more detailed extension as well as a probably depth and dip of the ore body.

(3) The borehole MJOB-G25 drilled for the investigation of ore body No.1, intersected massive sulphide with a core length of 7.45m and an average assay of 3.51% Cu.

(4) Seven boreholes were drilling within the area of ore body No.2. Massive sulphide was intersected in five of them, revealing that the ore body No.2 has an extension of 400m along the north-south direction and 200m along east-west. Geological ore reserves are estimated in 5 million tons with an average assay of 1.2% Cu.

(5) All of the 4 boreholes drilled to investigate the IP and TEM anomalies detected in the western part of Ghuzayn area, intersected massive sulphide (ore body No.3). The ore intersected in the borehole MJOB-G30 indicated a core length of 91.40m and an average assay of 2.68% Cu. The boreholes G31, G32 and G33 indicated core lengths of 72m, 39.65m and 16.45m, respectively.

(6) From the core analysis, it is concluded that the alteration associated with mineralization consists of silicification, chloritization (Mg-rich chlorite) and epidotization. Important indications not only for the surface geological survey, but also for the drilling survey, are the remarkable features of silicification and epidotization detected even in the margins of the ore body.

(7) As a result of the geological survey conducted around 14 mineral showings in the north-western part of the project area, the area between Hara Kilab and Mahab was selected as a promising area for massive sulphide deposits.

(8) Interesting features of alteration and copper mineralization, that may lead to the discovery of a massive sulphide ore body, have been observed to the north and west of the TDIP surveyed area in Ghuzayn.

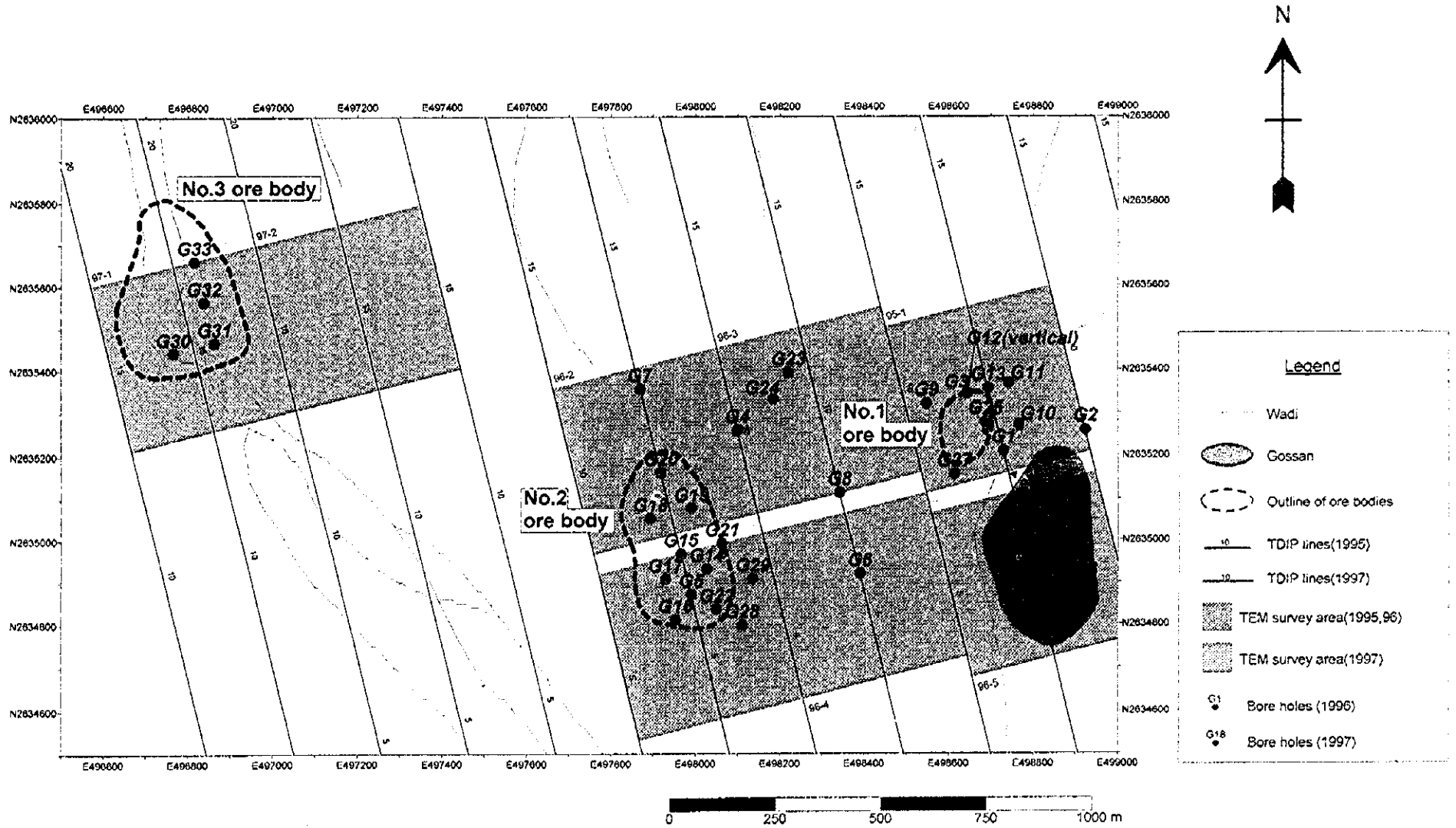


Fig.Ⅲ-1 Location map of ore bodies, TEM anomalies and boreholes in Ghuzayn area

CHAPTER 2 RECOMMENDATIONS

The discovery of 3 ore bodies in Ghuzayn area, leads to the opinion that not only Ghuzayn area but also the Batinah Coast area presents a high potential for massive sulphide deposits. Therefore, on the basis of the Phase I results, geophysical and drilling surveys are recommended in the following areas:

(1) Ghuzayn Area

1. Drilling survey to obtain more details of ore body No.3, along with TEM survey to delineate the northern extension of the body.

2. TDIP survey to the west and south extension of the previously TDIP surveyed area to evaluate the potentiality for massive sulphide.

3. TEM and drilling surveys based on possible IP anomalies extracted from the above mentioned zone.

(2) Doqal Area

1. TDIP survey in the south-western extension of the previously surveyed area to evaluate the potential of mineralization of this area.

2. TEM and drilling surveys based on possible IP anomalies extracted by the TDIP survey..

(3) Hara Kilab – Mahab area

1. TDIP survey in and around Hara Kilab and Mahab mineral showings considered to be promising in order to evaluate the potentiality for massive sulphide.

2. TEM and drilling surveys to evaluate possible IP anomalies extracted by the TDIP survey.

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