1-5-1 Central Shebenik District

This district includes three target areas, namely Ahu i Vetem, Lugu i Batres and Buzgare. Drill hole locations are shown in Figure 2-1-11.

(1) Ahu i Vetem (Appendixes 1(1) and (2))

- Holes Drilled: MJAS-23, -24, -25, -26 and -27
- Target: northern extension of the ore body identified by surface indications and exploratory tunnels
- Hole Geology: dunite with thickness of several to several tens of meters within harzburgite
- Ore Intersections: All five holes have encountered chromium mineralization of the deep ore body at the depths deeper than 100m from their collars.

  MJAS-23; chromitite with thickness of 2.75m and Cr_2O_3 grade of 26.10% within dunite with thickness of 12m.

  MJAS-24; chromitite with thickness of 2.45m and Cr_2O_3 grade of about 15% within dunite with thickness of 48m.

  MJAS-25; chromitite with thickness of 1.60m and Cr_2O_3 grade of 16~19% within dunite with thickness of more than 23m.

  MJAS-26; chromitite with thickness of 4.60m and Cr_2O_3 grade of 17.42% within dunite with thickness of more than 44m.

  MJAS-27; chromitite with thickness of 1.98m and Cr_2O_3 grade of 21.51% within dunite with thickness of 24m.

  MJAS-25 and-26 have also intersected massive chromitite of the shallow ore body, with very thin thickness less than several centimeters and Cr_2O_3 grade of 35.41% in MJAS-26.
- Ore Body Characteristics: There are two ore bodies, the deep ore body and the shallow ore body ; the former is lower in elevation than the latter.

  The deep ore body strikes in the NNE-SSW direction with dips of 40~50° to the west and plunges gently to the north. It consists of banded or disseminated ores with thickness of 1 to 2m, reaching the maximum of 4.6m, and with relatively low Cr_2O_3 grade ranging from 14 to 26%.

  The shallow ore body strikes in the NNW-SSE direction with dips of 20~30° to the east and plunges gently to the north. It consists of massive ores with appreciably high Cr_2O_3 grade ranging from 35 to 51% though its thickness is very thin and much less than 1m.
- Reasons for No Ore Intersection: MJAS-23, -24 and-27 have failed to intersect the

shallow ore body, which would suggest the shallow ore body to be shifted to the west, with its strike being oblique to that of the deep ore body.

(2) Lugu i Batres (Appendix 2)

- Holes Drilled: MJAS-28 and -29
- Target: down-dip extension of the ore body identified by surface indications and exploratory pits
- Hole Geology: dunite with thickness of several meters within harzburgite
- Ore Intersections: MJAS-28 has intersected massive chromitite with thickness of 0.3m and Cr_2O_3 grade of 39.75%. MJAS-29 has failed to intersect chromitite.
- Ore Body Characteristics: The ore body strikes in the WNW-ESE direction with dips of 40~70° to the south and plunges gently to the west, being cross-cut by a number of faults.
- Reasons for No Ore Intersection: The down-dip extension of the ore body may be dislocated by a fault in the vicinity of MJAS-29, or may thin out to the depth.

(3) Buzgare (Appendix 3)

- Holes Drilled: MJAS-30 and -31
- Target: down-dip and northwestern extensions of the ore body identified by exploratory tunnels and EPMA anomaly
- Hole Geology: essentially harzburgite in MJAS-30 and dunite with thickness of several meters within harzburgite in MJAS-31, often highly fractured or brecciated.
- Ore Intersections: no ore intersection.
- Ore Body Characteristics: The ore body strikes in the NW-SE direction with dips of 50~80° to the south.
- Reasons for No Ore Intersection: The down-dip extension of the ore body may be dislocated by a fault for a substantial distance because a fault with a thick sheared zone is located in its vicinity at depth.

1-5-2 Southern Shebenik District

This district includes four target areas, namely Qarri i Zi, Mbi Skroske, Pishkash South and Pishkash-5. Drill hole locations are shown in Figure 2-1-12.

(1) Qarri i Zi (Appendixes 4(1)~(3))

- Holes Drilled: MJAS-8, -9 and -10
- Target: southern down-dip extension of the Qarri i Zi ore body and EPMA anomaly
- Hole Geology: dunite in the shallower parts and harzburgite in the deeper parts of

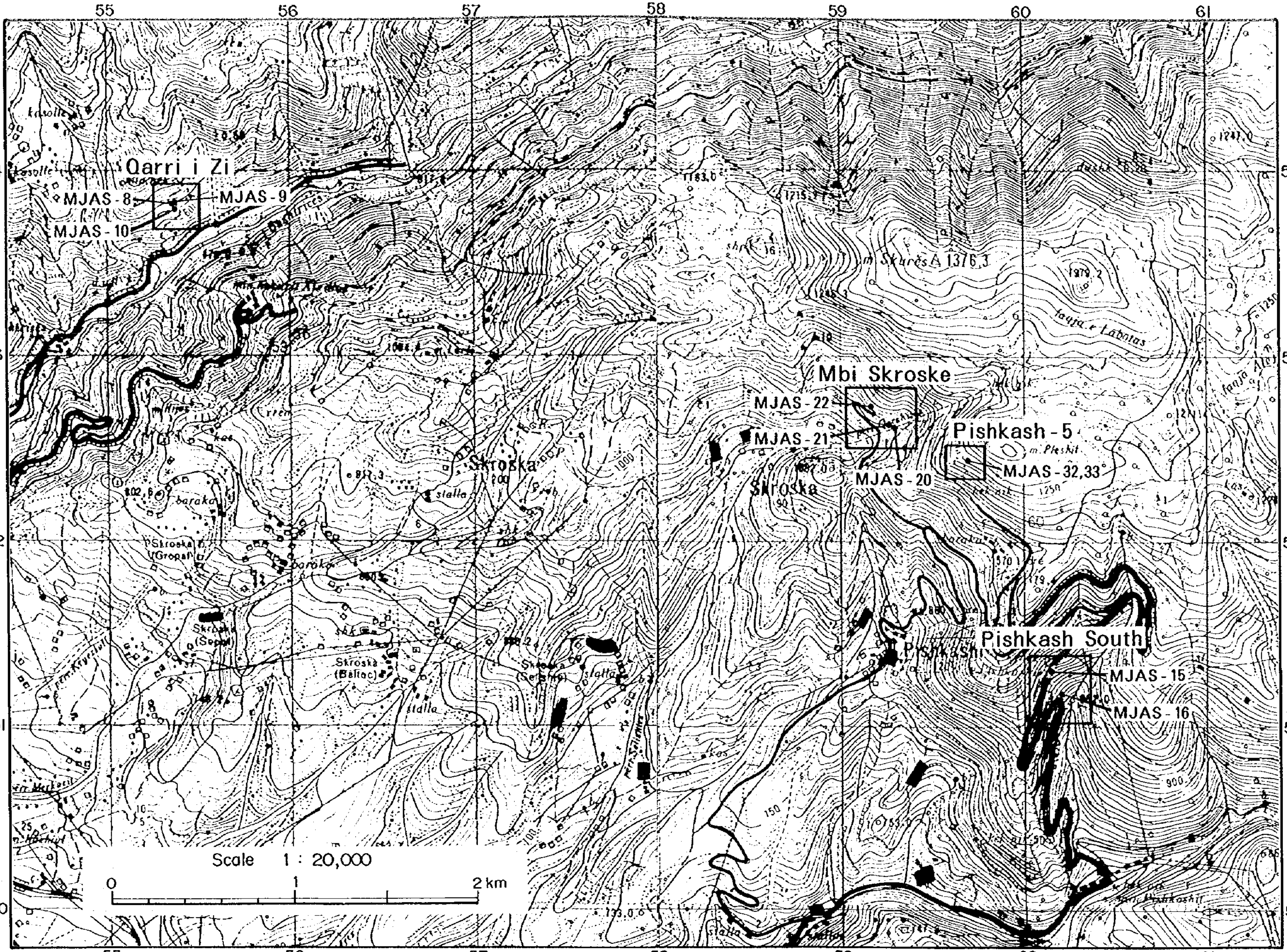

Figure 2-1-12 Location map of drilling survey in Southern Shebenik District

MJAS-8 and-9. Essentially harzburgite with minor dunite near the hole collar in MJAS-10.

- Ore Intersections: MJAS-8 and-9 have intersected disseminated chromitite with variable thickness ranging from several centimeters to less than 1m within dunite more than 10m thick. The number of chromitite layers thicker than 0.1m is 4 in MJAS-8 and 2 in MJAS-9. While the only chromitite layer, the shallowest in MJAS-8, has indicated Cr_2O_3 grade of 39.61%, grades of others are in the order of 20% (21~27%) Cr_2O_3. No chromitite has been intersected by MJAS-10
- Ore Body Characteristics: The ore body strikes in the NW-SE direction with dips of 80~90° to the east and is broken into a number of blocks with variable displacement by faults.
- Reasons for No Ore Intersection: The dunite occurrence in MJAS-10 is minimal. The dunite containing chromitite may have been dislocated with substantial displacement by the ENE-WSW trending fault.

(2) Mbi Skroske (Appendix 5)

- Holes Drilled: MJAS-20, -21 and -22
- Target: the causative body of the magnetic anomaly PM-1 at depth for MJAS-20, the surface indication No.49 at depth for MJAS-22 and verification of the relationship between the anomaly PM-1 and the indication No.49.
- Hole Geology: principally harzburgite with rare occurrences of thin dunite in all three holes. No dunite occurs in MJAS-22.
- Ore Intersections: no ore intersection.
- Reasons for No Ore Intersection: Minor occurrences of dunite indicate that no chromium mineralization has been formed in this area.
- Magnetic Anomaly: No facies change, which may adequately explain the cause of the magnetic anomaly, has been observed.

(3) Pishkash South (Appendix 6)

- Holes Drilled: MJAS-15 and -16
- Target: the causative body of the magnetic anomaly PM-5
- Hole Geology: principally harzburgite with subordinate pyroxinite and dunite. notable development of zones of brecciation and faults.
- Ore Intersections: no ore intersection.
- Magnetic Anomaly: No facies change is observed corresponding to the magnetic anomaly. In MJAS-16, dunite is predominated in the deeper part than the estimated depth of the anomaly PM-5. It may be implied for the cause of the

magnetic anomaly that two rock masses bounded by a major fault have different remnant magnetization to each other.

(4) Pishkash-5 (Appendix 7)

- Holes Drilled: MJAS-32 and -33
- Target: northern extension of the fault-dislocated portion of the ore body which has been identified by exploratory tunnels.
- Hole Geology: harzburgite accompanying minor dunite. notable development of zones of brecciation and faults.
- Ore Intersections: no ore intersection.
- Ore Body Characteristics: The ore body strikes in the NW-SE to NNW-SSE direction with dips of 50~80° to the south and plunges gently to the north. However, the relative position of the ore body is stepped up northwards by a number of cross-cutting faults.
- Reasons for No Ore Intersection: It is implied that the ore body may be dislocated for a displacement of more than several tens of meters by the major fault trending in the NNW-SSE direction parallel to the ore body.

1-5-3 Northern Pogradec District

This district includes six target areas, namely Bregu i Pishes, Fusha e Madhe, Gjorduke, Shesh Bush No.1, Murriq and Hija e Zeze. Drill hole locations are shown in Figure 2-1-13.

(1) Bregu i Pishes (Appendixes 8(1)~(4))

- Holes Drilled: MJAS-1, -2, -3, -34 and -36
- Target: northwestern extension of the ore body which has been identified by mineralized outcrops and exploratory pits.
- Hole Geology: harzburgite accompanying dunite with thickness less than 1m. notable development of zones of brecciation and faults.
- Ore Intersections: While the two holes, MJAS-1 and -2, have intersected chromitite enveloped by dunite, the other three holes, located to the north of these two holes, have failed to encounter any chrome mineralization. MJAS-1 has intersected disseminated chromitite with thickness of 1.03m and Cr_2O_3 grade of 34.46% within dunite with thickness of 2m. MJAS-2 has intersected disseminated and massive ore zones with thickness of 0.25 and 0.85m and Cr_2O_3 grades of 38.60% and 49.70% respectively within dunite with thickness of 2m. The foot wall of the latter ore zone is bounded by a fault directly to harzburgite.

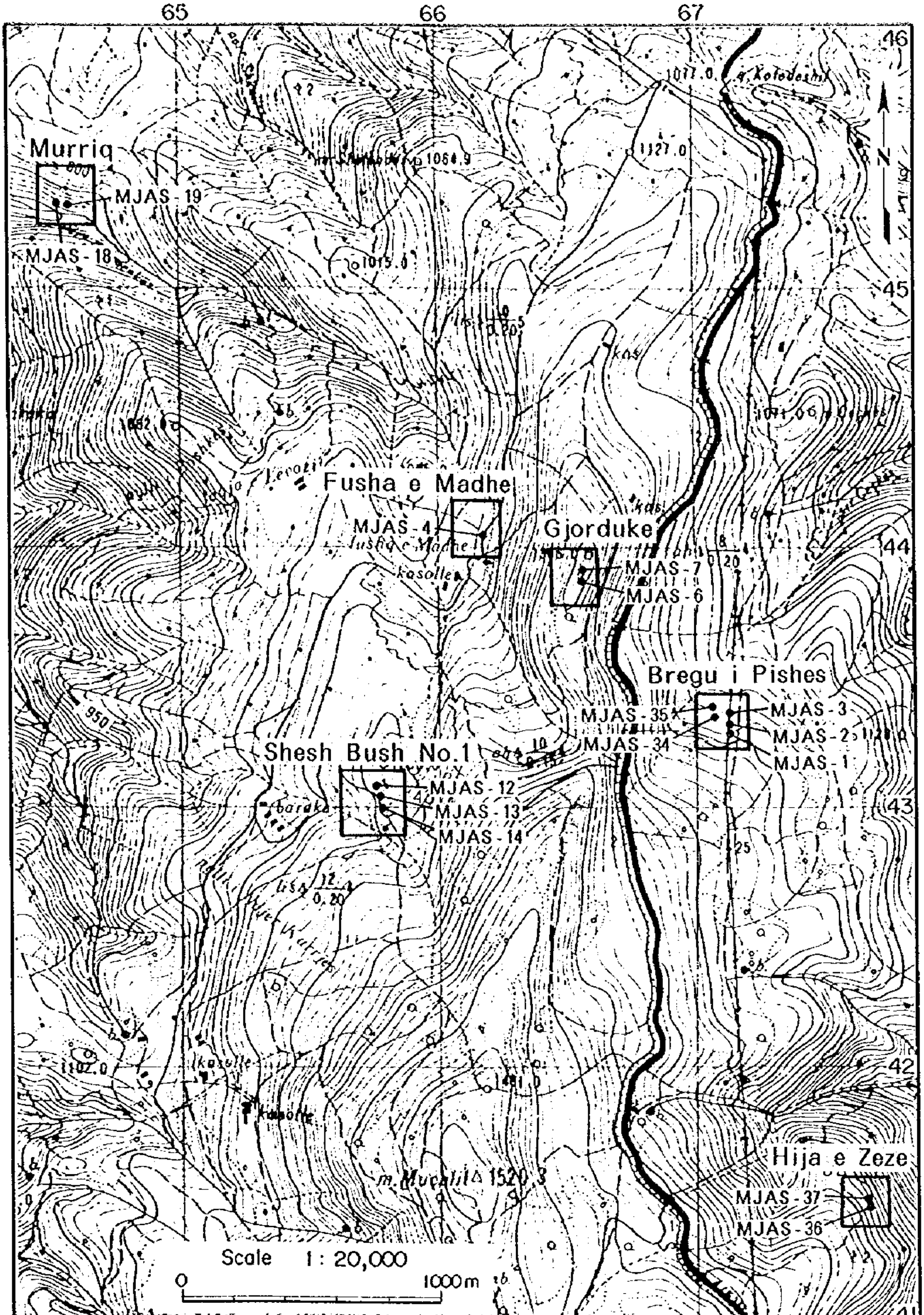

Figure 2-1-13 Location map of drilling survey in Northern Pogradec District

- Ore Body Characteristics: The ore body strikes in the NW-SE direction with dips of 80~90° to the east and is crosscut by a number of faults, with faulted segments being arranged en echelon.
- Reasons for No Ore Intersection: It is implied that the ore body may be dislocated further to the west by faults or that its down-dip extension may be very limited.

(2) Fusha e Madhe (Appendix 9)

- Holes Drilled: MJAS-4
- Target: the causative body of the magnetic anomaly KM-4 at depth
- Hole Geology: harzburgite with dunite. notable development of iron oxide stains. Zones of brecciation or shearing are highly developed at the estimated depth of the anomaly KM-4, below which dunite is predominated.
- Ore Intersections: no ore intersection.
- Magnetic Anomaly: It may be implied for the cause of the magnetic anomaly that two rock masses bounded by the zones of brecciation and shearing have different remnant magnetization to each other.

(3) Gjorduke (Appendix 10)

- Holes Drilled: MJAS-6 and -7
- Target: northern extension of the Gjorduke ore body
- Hole Geology: harzburgite accompanying dunite. The harzburgite deeper than the zone of brecciation has a fresh appearance.
- Ore Intersections: No ore has been intersected, except for a 2cm thick lens of chromespinel concentrations within 0.5m thick dunite in the hole, MJAS-6.
- Ore Body Characteristics: The ore body strikes in the NNW-SSE direction with dips of 45~65° to the east and plunges 20° to the north. It is broken into a number of blocks by two sets of normal faults; one striking in the NW-SE direction with dips of 10~30° to the east and the other, in the WNW-ESE direction with dips of 40~50° to the south.
- Reasons for No Ore Intersection: The two holes may have passed through the foot wall side of the ore body, because it has a gentle plunge of about 10° and is stepped up northward by a number of crosscutting normal faults.

(4) Shesh Bush No.1 (Appendix 11)

- Holes Drilled: MJAS-12, -13 and -14
- Target: northern extension of the ore body which has been identified by mineralized outcrops and exploratory tunnels.

- Hole Geology: harzburgite accompanying dunite. notable development of zones of brecciation and faults
- Ore Intersections: No ore has been intersected, except for sporadic spots of chromespinel concentrations in the Hole, MJAS-14, drilled in the vicinity of the known ore body.
- Ore Body Characteristics: The ore body strikes in the NNW-SSE direction with dips of 80~90° to the east and plunges 20° to the north and plunges 12° to the north.
- Reasons for No Ore Intersection: The down-dip extension of the ore body may have been dislocated by a shallow-dip fault which has been identified at a depth of some 10m. Meanwhile, the exploration to date has been unsuccessful in locating its down-dip extension within an extent of 100m square centering the ore body.

(5) Murriq (Appendix 12)

- Holes Drilled: MJAS-18 and -19
- Target: down-dip extension of the ore body which has been identified by exploratory trenches and pits.
- Hole Geology: harzburgite accompanying minor dunite. notable development of zones of brecciation and faults.
- Ore Intersections: No ore has been intersected.
- Ore Body Characteristics: The ore body strikes in the N60° W direction with a dip of 48° to the north.
- Reasons for No Ore Intersection: The ore body is extremely limited in its continuation, with the associated dunite envelope being very small in its scale.

(6) Hija e Zeze (Appendixes 13(1)~(3))

- Holes Drilled: MJAS-36 and -37
- Target: north northwest extension of the ore body which has been identified by exploratory tunnels and pits.
- Hole Geology: harzburgite accompanying dunite. notable development of zones of brecciation and faults.
- Ore Intersections: MJAS-37 has intersected a zone of massive ores with thickness of 1.1m and Cr_2O_3 grade of 36.41% within dunite with thickness of about 3m. MJAS-38 has intersected a zone of massive chromitite with thickness of 0.2m and Cr_2O_3 grade of 41.62% within dunite with thickness of 0.7m.
- Ore Body Characteristics: The ore body strikes in the NW-SE to NNW-SSE direction with a dip of 80~90° to the east and plunges gently to the north.

1-6 Laboratory Tests

Laboratory tests, such as microscopic observation of thin and polished sections of rocks and ores, chemical analysis of rock and ore samples and EPMA analysis of chromespinel, were carried out.

1-6-1 Microscopic Observation

The ultramafic rocks of the Project Area are generally serpentinized to a certain degree. Some of them, however, have been subjected to minimal deformation and serpentinization, and preserve primary mineralogical features. Some chromitite contains unaltered olivine and spinel including fresh hornblende inclusions, which will provide significant information on conditions for spinel concentration.

(1) Harzburgite

Harzburgite consists mainly of olivine and orthopyroxene with small amounts of chromespinel and clinopyroxene. It generally indicates a proto-granular texture but is occasionally porphyroclastic with notable development of foliation. Olivine and pyroxenes are entirely or partly replaced by serpentine (chrysotile or lizardite), in general.

(2) Dunite

Dunite consists principally of olivine, with minor chromespinel and ortho- or clino-pyroxene. Its texture is generally proto-granular. Intense serpentinization is common for this type of rocks, as the case for harzburgite. The content of chromespinel varies considerably, very minor in some parts or significant in other parts forming chromitite.

(3) Chromitite

Chromitite consists principally of olivine and chromespinel. Olivine is mostly serpentinized (chrysotile, lizardite and antigorite). The proportion of chromespinel to olivine is extremely variable.

Chromespinel is reddish brown to opaque, and is mostly euhedral. Its rims and cleavages are often replaced by magnetite (ferritchromite in part). Chlorite commonly fills up grain spaces of chromespinel. Most inclusions within chromespinel are replaced by chlorite and/or serpentine, though fresh hornblende is occasionally observed.

(4) Pyroxenite

Pyroxenite consists mainly of clino- and ortho-pyroxene and indicates a coarse granular texture. The ratio of clinopyroxene to orthopyroxene is about 8 to 2. There are two types; one contains minor olivine and hornblende, and the other, minor plagioclase and opaques.

1-6-2 Chemical Analysis

The results of whole rock analysis, of rock and ore analysis and analysis for platinum group metals are indicated in Appendix 15, 16 and 17 respectively.

Harzburgite is higher in Al_2O_3, Fe_2O_3, SiO_2 and CaO, and lower in Cr_2O_3 and MgO, than dunite. K_2O, Na_2O, MnO, P_2O_5 and TiO_2 are low for both rock types. The average contents of Cr_2O_3 are 0.40% for harzburgite, 0.74% for dunite and 30% or more for chromitite.

Of the all elements in Appendix 16, the statistics of Al, Ca, Co, Fe, Mn, Ni, V and Zn, which have indicated values greater than their detection limits in most of the samples, are summarized in Table 2-1-4 for each rock type.

Table 2-1-4 Basic statistics of major elements in different rock facies

Rock		Al (%)	Ca (%)	Co (ppm)	Fe (%)	Mn (ppm)	Ni (ppm)	V (ppm)	Zn (ppm)	Cr (ppm)
Chromitite	Max.	4.51	4.2	195	10.05	1140	3710	899	276	–
	Min.	0.05	0.01	10	0.65	110	300	4	12	–
	Ave.	0.49	0.28	47	2.49	379	1424	72	43	–
	sample	112	91	109	112	112	112	110	80	–
Dunite	Max.	0.30	0.65	130	5.90	950	2840	50	58	5060
	Min.	0.05	0.02	66	3.94	530	1940	1	18	233
	Ave.	0.12	0.12	90	4.61	696	2310	19	29	1062
	sample	32	32	32	32	32	32	32	32	29
Hartzburgite	Max.	1.37	5.5	123	5.79	910	2770	55	54	8270
	Min.	0.09	0.03	52	3.70	650	1250	7	20	366
	Ave.	0.24	0.40	88	4.93	787	1986	32	33	1645
	sample	38	38	38	38	38	38	38	38	35

Note: The statistical calculation was done for data excepting over and under detection limit value.

Chromitite tends to indicate higher values in V, Al and Zn and lower values in Ni, Co, Fe and Mn than dunite and harzburgite. The chromium content in chromitite, with chromium being the major element of chromespinel, is much higher than that in dunite and harzburgite, and has exceeded its detection limit in the adopted procedure for the multi-element analysis (therefore, excluded from Table 2-1-4).

Comparing dunite with harzburgite, dunite is high in Ni content and low in Al, Ca, Mn, V and Cr contents. This is because Ni is partitioned more in olivine than in orthopyroxene and vice versa for the other elements.

Chemical analysis for platinum group elements (PGE) has been made for chromitite or chromium ore samples collected from outcrops in the general area, drill cores, the Bulqiza mine in the eastern zone and Korce in the western zone. The result appears to suggest that the potential of the Project Area is not necessarily high for the PGE mineralization, although the PGE content of chromitite is generally higher in the western zone than in the eastern zone (Appendix 17).

The chondrite-normalized PGE diagram for the chromitite in the Project Area indicates a pattern similar to that of ophiolite (high in iridium group elements and low in platinum group elements).

1-6-3 EPMA Analysis

(1) Conditions of Analysis

The target mineral for the EPMA analysis was chromespinel contained in chromitite, its hosts, dunite and harzburgite. Unaltered portions of chromespinel crystals, near their cores, were carefully chosen for analysis, because magnetite (or ferritchromite) was often formed along their peripheries or cleavages. The analytical result is tabulated in Appendix 18.

The conditions of analysis, the same as in the first and second year Campaigns, are as follows;

- Instrument: JEOL, JAX-733 (Wavelength Dispersion Type),
- Accelerating Voltage: 15kV
- X-ray Take-off Angle: 40degrees
- Probe Current: 12nA
- Element for Analysis: Cr, Al, Fe, Mg, Ti, Mn, V

(2) Definition of EPMA Anomaly

The following four geochemical standards have been established for defining EPMA anomaly with respect to chromium mineralization based on the results of the research studies on chromespinel in ultramafic rocks associated with world sizable chromium ore deposits (e.g. Matsumoto 1996 and others);

- harzburgite indicating relatively low Cr # (0.4~0.6): Cr # of chromespinel in harzburgite generally ranges between 0.4 and 0.5, at most low 0.6s, in association with large scale of deposits in the world.
- harzburgite indicating high TiO_2 wt% (0.05 or higher): TiO_2 wt% of chromespinel in dunite and harzburgite indicates a medium range value close to that of chromespinel in chromitite.
- dunite and harzburgite indicating high Fe^{3+} # (0.030 or higher for dunite and 0.150 or higher for harzburgite): Fe^{+3} # of chromespinel in dunite and harzburgite indicates a medium range value close to that of chromespinel in chromitite.

• dunite and harzburgite indicating high Cr # and low V_2O_3 wt% (0.7 or higher in Cr # and 0.2 or lower in V_2O_3 wt% for both dunite and harzburgite): chromespinel in dunite and harzburgite is relatively low in V2O3 wt% and relatively high in Cr #, which is resulted from selective melting of orthopyroxene in harzburgite.

Note: Cr # = Cr/(Cr+Al), Mg # = Mg/(Mg+Fe^{2+}), Fe 3+ # = Fe^{3+}/(Cr+Al+Fe^{3+})

It is expected that the podiform type of sizable chromium ore deposits is associated with dunite and harzburgite containing chromespinel which has the chemical compositions with the above four characteristics.

The chromium content of orthopyroxene is higher in rocks (harzburgite) less depleted of primary (mantle) constituents. Where magmas are brought up from mantle into harzburgite less depleted of primary constituents, interaction between the magmas and the harzburgite takes place and forms a melt in which chromium, derived from orthopyroxene in the harzburgite by preferential melting, is enriched. Chromespinel is crystallized from the chromium enriched melt and is concentrated in various forms of chromitite. This is a brief introduction of the hypothesis that has been proposed for genesis of the chromium mineralization of podiform type (Arai, 1995 and 1996).

The scale of chromitite created by the interaction would be decided by the ratio of Cr/Al and the amount of Cr+Al in the orthopyroxene contained in the wall rock (hartzburgite). As the amount of Cr (ratio of Cr/Al and amount of Cr+Al) in the orthopyroxene in the mantle peridotite is related to the Cr # of chromespinel coexisted, hartzburgite containing chromespinel indicating 0.4~0.6 in Cr # must have the high potentiality that Cr should be concentrated.

Among other indices, TiO_2 wt% and Fe^{+3} # of chromespinel can be also used as indicators for the interaction zone where preferential melting of orthopyroxene takes place and concentrates chromium in melts. In the interaction zone, these indices should present values of intermediate ranges, representing a intermediate facies, between those of chromespinel in the wall rock harzburgite and in the magmas originated from mantle (Matsumoto et al., 1995 and 1996). Therefore, if the area where TiO_2 wt% and Fe^{+3} # of chromespinel present values of intermediate ranges is widen, it is expected that orthopyroxene would be resolved in a large range and much amount of Cr would be concentrated.

Cr # of chromespinel is higher in dunite and chromitite than in harzburgite and vice versa for V_2O_3 wt%. This relationship between V_2O_3 wt% and Cr # with respect to rock species suggests that chromium has been depleted from harzburgite (wall rocks), specifically by preferential melting of orthopyroxene, and concentrated into dunite and chromitite (melts), while vanadium has remained in harzburgite.

(3) Result of EPMA Analysis

A number of outcrop samples have indicate EPMA anomaly in various indices as above explained in the central to southern part of the Shebenik Complex and in the Pogradec Complex (Appendix 14). In particular, notable concentrations of such samples are associated with ore deposits and indications such as Bushtrice, Menik, Qarri i Zi, and Mbi Shtepite e Celes in the southern part of the Shebenik Complex, and with those such as Qeshori Pojske, Bregu i Pishes, Shrolli i Koprit, Guri i Pellumbit, Cervenake and Krai i Farkuar in the northern to central part of the Pogradec Complex. It must be noted that all of these are located in the western half of the Shebenik-Pogradec Ultramafic Complex.

Cr # of chromespinel in harzburgite in the Project Area widely ranges from 0.40 to 0.85. However, most samples indicate Cr # ranging between 0.60 and 0.80, with only 12 samples yielding the values less than 0.60 (Figure 2-1-14). Of the 12 samples, 7 outcrop samples have been collected in the vicinities of Librazhd-Katundi (2 samples), Ahu i Vetem (2 samples) and Skenderbeu (1 sample) in the northwestern, central and central-eastern parts of the Shebenik Complex respectively, and also in the vicinities of Gjorduke (1 sample) and Mt. Fushes Madhe (1 sample) in the northern and central parts of the Pogradec Complex. The remaining 5 samples have been obtained from drill cores in Qarri i Zi (MJAS-8; 1 sample) and Mbi Skroske (MJAS-20 and-22; 1 sample each) in the southern part of the Shebenik Complex, and also in Murriq (MJAS-18; 2 samples) in the northern part of the Pogradec Complex.

As above mentioned, the number of samples indicating Cr # less than 0.60 is very small, which may imply that the potential for a large scale chromium ore deposit, equal to or larger than the Bulqiza, may be not high in the Project Area. In reality, however, a number of small ore deposits have been identified and exploited to date. Therefore, it may still be possible to identify constellations of small ore bodies with some economic significance or to specify an area for sizable ore deposits by more detailed investigation on the areas where the EPMA anomaly has been indicated.

Most chromespinel in chromitite indicates 0.2 or less in V_2O_3 wt% and values higher than 0.7 in Cr #, as shown in the V_2O_3-Cr # Correlation Diagram (Figure 2-1-14). Dunite which contains chromespinel indicating the composition within this range, is regarded as EPMA anomaly in V_2O_3 –Cr #. Most outcrop samples have been collected as sets of chromitite-dunite-harzburgite. Of the total of 48 sets, dunite samples of 29 sets have shown EPMA anomaly in V_2O_3 –Cr #. The chromespinel in dunite of this type has common nature in its chemical composition, high in TiO_2 wt% and low in V_2O_3 wt% and Mg #. The dunite indicating EPMA anomaly in V_2O_3 –Cr # has been also observed in drill cores of Qarri i Zi (MJAS-8), Ahu i Vetem (MJAS-26) and Hija e Zeze (MJAS-36).

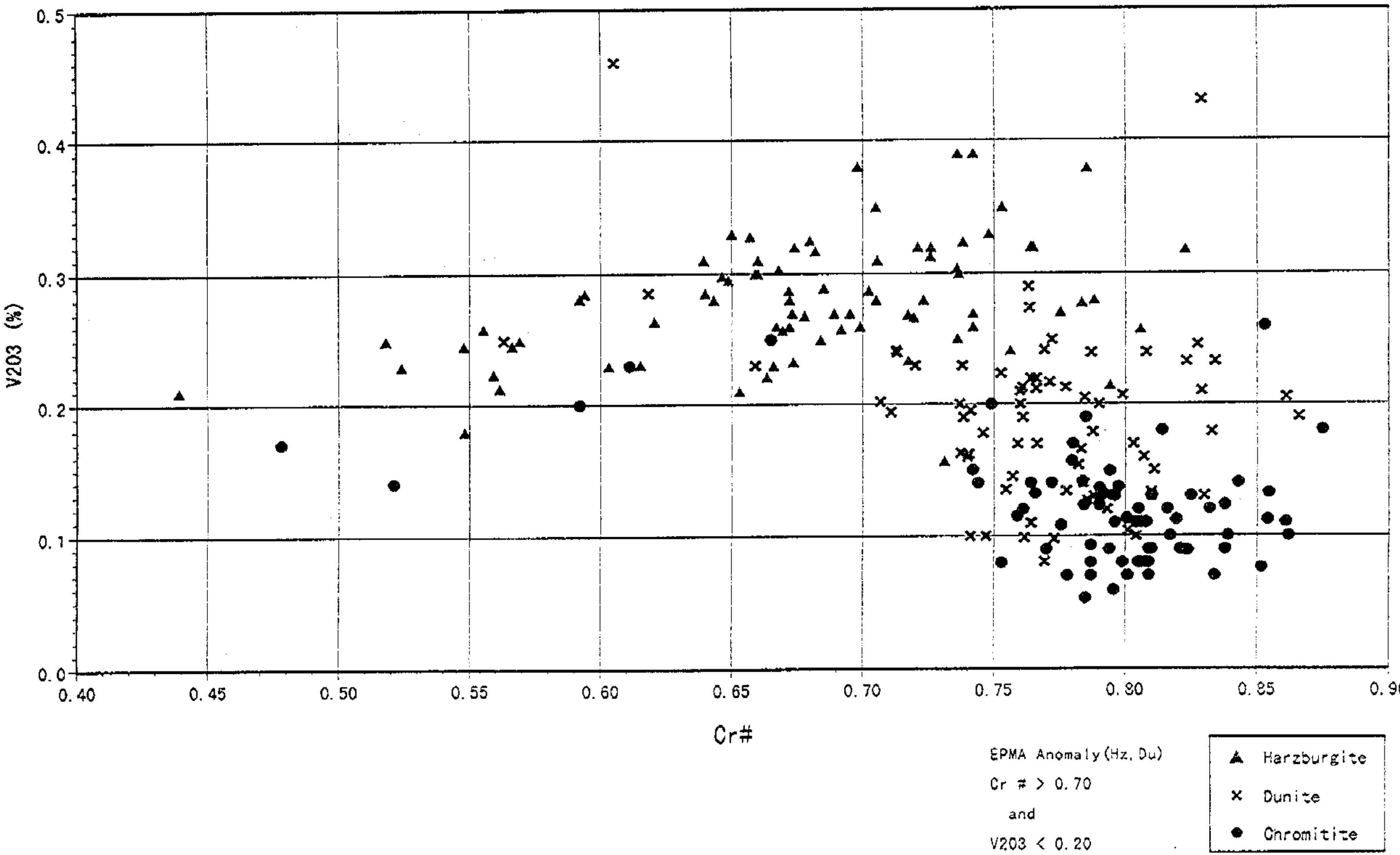

Figure 2-1-14 EPMA analysis : Correlation diagram between V_2O_3 and Cr #

Chapter 2 Evaluation of the Exploration Result

The drilling exploration, comprising a total of 34 holes, was carried out for the 13 target areas in the Central Shebenik, Southern Shebenik and Northern Pogradec Districts, selected on the basis of the results of the geological investigation, the magnetic survey and the EPMA analysis. Its objectives were to identify strike and down-dip continuations of known ore bodies or indications, to specify their modes of occurrences and to verify causative bodies of magnetic anomalies. Of the 34 holes, 12 holes for the 5 target areas, namely Bregu i Pishes, Qarri i Zi, Ahu i Vetem, Lugu i Batres and Hija e Zeze, intersected chromitite. The ore bodies, which have been successfully intersected by the drilling, are valuated on their viability for future exploitation and possibility for further extension or upgrading as described below.

2-1 Occurrence of Chromitite

(1) Bregu i Pishes

Three holes were drilled to the north northwestern extension of the ore body known by the past exploration and two of them intersected ores in the second Year Campaign. On the basis of the result of these holes, two holes were drilled in the third Year Campaign but failed to intersect ores.

The ore body strikes in the NW-SE to NNW-SSE direction with dips of 80~90° to the east and plunges gently to the north. It is crosscut by a number of faults, with faulted segments being arranged en echelon and extending in the NNW-SSE direction. The ore body configuration is generally conformable with the regional structure of the ultramafic rocks in the surrounding area.

The ore body comprises massive ores and has a strike and dip lengths of 200m and 30m respectively with thickness of 0.1 to 2.0m. The two holes have intersected ores for lengths of 1.0m and 1.1m with Cr_2O_3 grades of 34% and 49% respectively within about 2m thick dunite. Assuming the average grade of 41% Cr_2O_3, the average thickness at 1.0m for the length of 200m and the width of 30m, and the average specific gravity of 3.0, the ore resources can be estimated at approximately 18,000 tons containing 5,000 tons of chromium metal.

The two holes, which have intersected ores, are located much closer to the known ore body than those which have failed. The ore body may have been dislocated for a significant distance by a fault in the vicinity of the other three holes which have failed to intersect ores.

(2) Qarri i Zi

Three holes have been drilled, targeting the strike and down-dip extensions of the known ore body. Two of the three holes have intersected ores of the down-dip extension but the one, targeting the strike extension, has failed.

The ore body strikes in the NNW-SSE direction with dips of 80~90° to the east and plunges gently to the south. This occurrence is generally conformable with the regional structure of the ultramafic rocks in the surrounding area. The two holes have intersected disseminated chromitite with variable thickness ranging from several centimeters to less than 1m.

The hole, MJAS-8, includes 4 chromitite layers with thickness ranging from 0.25 to 0.55m and the hole, MJAS-9, 2 layers with thickness of 0.50 and 0.91m. In addition, several layers of chromitite with thickness less than 5cm are observed in these holes. The thickness of dunite envelope ranges from 2 to 23m. The analytical result to date, including the past data, indicates that Cr_2O_3 grades are 39% at the highest and 19% at the lowest, and mostly range between 23 and 27%. Judging from the modes of occurrence in the two holes, the ore body comprises several thin layers of chromitite. Because the hole drilled to the strike extension have failed to intersect ores, the ore body may be dislocated for some distance by a fault at its south end.

(3) Ahu i Vetem

This target area includes the deep ore body comprising mainly disseminated ores with relatively low Cr_2O_3 grades and the shallow ore body comprising massive ores with high Cr_2O_3 grades. All the 5 holes drilled have intersected the deep ore body and 2 of them have encountered the shallow ore body.

1) Deep Ore Body

The deep ore body is characterized by its appreciable thickness, being enveloped within a thick dunite, and by its relatively low Cr_2O_3 grade. The ores consist mainly of banded or disseminated chromitite with a cumulative texture, including high chromespinel concentrations in part. It strikes in the NNE-SSW direction and dips westwards with a moderate angle, elongating to the north with a gentle plunge. Its dimension is more than 200m in length, more than 70m in width and 0.5 to 4m, averaging at 1.5 to 2.5m, in thickness. In the southeastern topographic depression, where a part of the deep ore body is exposed, the layered structure of ultramafic rocks trends in the NNE-SSW direction and is conformable with the strike of the deep ore body. This trend is, however, oblique to the strike of the shallow ore deposit, which will be explained later in this section.

According to the existing data, the Cr_2O_3 grade of this ore body ranges from the maximum of 29.70% to the minimum of 14.55%, mostly between 19 and 24%. The average grade of ore sections in the holes drilled in the current project ranges from the maximum of 26.10% to the minimum of 15.39%, with an arithmetic mean of 19.76%. The maximum and the minimum grades of single assay runs are 39.53 and 8.64% Cr_2O_3 respectively.

Assuming the average grade of 20% Cr_2O_3, the average thickness at 2m for the length of 200m and the width of 70m, and the average specific gravity of 2.5, the ore resources can be estimated at approximately 70,000 tons containing 9,600 tons of chromium metal.

There will be a good possibility for the deep ore body to extend north northeastwards and to widen its width towards the down-dip side, because all the five hole have intersected the ore bodies with the appreciable thickness exceeding some 2m.

2) Shallow Ore Body

The shallow ore body is characterized by its thin thickness, being enveloped with in a thin dunite, and its appreciably high Cr_2O_3 grade, consisting of massive chromitite with very limited continuity. It strikes in the NNW-SSE direction and gently dips to the northeast, elongating northwards with a gentle plunge. The dimension of the ore body is more than 80m in length and more than 30m in width, with thickness ranging from 0.5 to 1.0m. In the northwestern topographic high where a part of the shallow ore body is exposed, the layered structure of ultramafic rocks trends in the NW-SW direction and is conformable with the shallow ore body. This trend is, however, oblique to the strike of the deep ore body. Its continuation to the north-northwest may be limited, because three out of five holes have failed to intersect the ore body and the ore sections in the two holes, MJAS-25 and-26, are very thin, having the thickness of 0.01 and 0.05m respectively.

According to the existing data, the Cr_2O_3 grade of ore ranges between the maximum of 51.94% and the minimum of 19.31%, with most of ore samples indicating around 50% Cr_2O_3. The analytical result of the ore section of MJAS-26, which is the only sample of the shallow ore body analyzed in the current Project, indicates the Cr_2O_3 grade of 35.41%. Assuming the average grade of 40% Cr_2O_3, the average thickness of 0.8m for the length of 80m and the width of 30m and the average specific gravity of 3.0, the ore resources can be estimated at approximately 5,700 tons containing 1,600 tons of chromium metal.

3) Relationship between the Deep and Shallow Ore Bodies

The occurrence of the deep and shallow ore bodies are conformable with the structure of the ultramafic host for each of them but are disharmonious to each other.

The host ultramafics for the deep ore body, exposing in the southeastern part, show the layered structure trending in the NNE-SSW direction, which is disharmonious with the regional structure in the Central Shebenik District. On the other hand, those for the shallow ore body, exposing in the northwestern part, show the layered structure trending in the NW-SE direction, which is harmonious with the regional structure.

The structural difference between the ultramafics hosting for the deep and shallow ore bodies has not been well interpreted to date, whether related to the genesis of ultramafic complexes or caused by later tectonic movements. Regardless of the causes of the structural difference, it would be inconceivable that the two ore bodies, showing different modes of occurrence, had originally formed one ore body and were later dislocated to the present positions by faulting and folding. The ore bodies may have been formed through different mineralization processes, judging from their structures, modes of occurrence, locations and also the regional structure of the Shebenik Ultramafic Complexes.

(4) Lugu i Batres

The ore body identified by outcrops and trenches strikes in the E-W to WNW-ESE direction and dips moderately to steeply to the south, elongating in the WNW-ESE direction with a gentle plunge to the west. It is gradually shifted by a number of minor crosscutting faults and is terminated by a fault at the east end, forming a hook shape. The geometrical relationship between the surface indications and the ore section in the hole, MJAS-28, suggests its overall inclination of 55 degrees to the south.

The ore body consists mainly of massive ores, containing bands or clots of chromespinel concentrations in part. Its size is rather small, with the strike length of 80m, the dip length exceeding 20m and the thickness ranging between 0.1 and 2.0m. The length of ore section in MJAS-28 is 0.3m.

The chemical analysis of five samples has shown 38.0 to 52.5% Cr_2O_3 and 28.0% Cr_2O_3 respectively for the massive and banded ores in surface indications, and 39.75% Cr_2O_3 for the massive ore section in the hole, MJAS-28. The arithmetic mean of the five samples is estimated at 41.49% Cr_2O_3.

No past exploration has confirmed the continuation of the ore body , neither to the east nor to the depth. The third year's drilling intended to explore its continuation to the west and to the down-dip in its central and western parts. However, MJAS-29, which had been projected to pass through the down-dip continuation at the west end of the ore body, failed to intersect chromitite. In addition, the ore body tends to become less massive westwards and hence low in Cr_2O_3 grade. Therefore, its potential westwards is judged to be insignificant.

(5) Hija e Zeze

Two holes were drilled in order to explore the north northwestern continuation of the ore body identified by the past exploration, and both intersected chromium ores.

The ore body strikes in the NW-SE to NNW-SSE direction with a sub-vertical dip and elongates in the NNW-SSE direction with a plunge of about 10 degrees to the north northwest. It is crosscut by a number of faults, some of which are observed in the drill holes as crushed or sheared zones, and, as a whole, continues horizontally to the plunge direction, being stepped up by these faults.

The ore deposit, comprising mainly massive ore, is more than 100m in strike length and more than 15m in dip length (width) with thickness ranging between 0.7 and 2.2m. The average thickness may be estimated at around one meter, taking account of the ore sections in MJAS-36 and-37 which are measured at 1.1 and 0.2m respectively. The Cr_2O_3 grade ranges between 35.05 and 51.53% for the surface massive ore samples, and is averaged at 36.41 and 41.90% respectively for the massive ore sections in MJAS-36 and-37, with the arithmetic mean of 41.90% for the analyzed six samples.

Assuming the average grade of 42% Cr_2O_3, the average thickness of 1.0m for the length of 100m and the width of 20m and the average specific gravity of 3.0, the ore resources can be estimated at approximately 6,000 tons containing 1,700 tons of chromium metal.

The drilling exploration in the current program is the first instance carried out for this target area and has successfully confirmed the strike extension of the known ore body. The ore body, with an appreciable average thickness of about 1m and a relatively high average grade at around 42% Cr_2O_3, is still open for the strike and dip extensions and is expected to substantially increase its resources by further drilling exploration.

2-2 Chromium Ore Deposits in the Shebenik Area

(1) Genesis of Chromium Ore Deposits and Exploration Method

Chromium ore deposits in the world, excluding alluvial deposits, can be divided into those of the stratiform type occurring in platform regions and of the podiform (Alpine) type occurring in mobile belts. While volcano-stratigraphy can be utilized as an effective tool for exploration of the stratiform type (e.g. Bushveld and Great Dyke), no exploration indicator has been established for specifically locating ore deposits of the podiform type.

The exploration strategy for this Project has been set up based on the most recent theory for the chromite genesis (the magma mixing model; Arai and Yurimoto, 1994, 1995, Zhou et al., 1994, Matsumoto, 1996), incorporating field observations, characteristics of variable rock facies and chemical compositions of chromespinel (EPMA analysis), and reviewing the past exploration data.

The result of the Project has proved validity of the above genetic model that argues significance of interaction between harzburgite and magmas and of magmas mixing with melts formed by the interaction for formation of chromium ore deposits of the podiform type (Figure 2-2-1). Interaction between wall rocks, harzburgite, and ascending magma forms melts relatively enriched in silica, which are further mixed with magmas continuously supplied from mantle. In the course of the process, chromespinel is independently crystallized and concentrated to form chromium ore deposits. The harzburgite wall rocks less depleted of primary (mantle) constituents are more favorable for chromespinel concentration which takes place in the melts through selective melting of pyroxenes by the interaction. Mechanism of chromespinel crystallization can be explained by the Irving (1977) model.

Assuming that chromespinel is crystallized and concentrated in the process as above described, interaction zones must be formed along the contacts between the wall rocks and magmas. In this Project, chemical compositions of chromespinel, relatively resistant to alteration and metamorphism, are used as 'sensors' to characterize interaction zones and to identify potential areas for chromium mineralization, based on examples in the Sangun Metamorphic Belt, Japan (Figure 2-2-2, Ministry of Trade and Industry, Japan, 1992, 1993, Matsumoto, 1995, etc.). The result has proved that chemical compositions of chromespinel are useful for exploration of chromium ore deposits of the podiform type in Shebenik Area and are generally applicable, as 'sensors', to the same type of ore deposits elsewhere in the world.

EPMA anomaly is defined for 'sensors' indicating values apart from ordinary ranges of chemical compositions of chromespinel contained in each rock facies (dunite, harzburgite or chromitite). Thresholds of 'sensors' should be determined specifically for regions under investigations, because they are likely dependent on characteristics of characteristics of harzburgite wall rocks and magmas in the relevant regions.

The thresholds for the Project Areas are determined as follows;

<1> harzburgite containing chromespinel with Cr # equal to or less than 0.6

<2> harzburgite containing chromespinel with TiO_2 wt% equal to or higher than 0.05

<3> dunite containing chromespinel with Fe^{3+} # equal to or more than 0.030,
harzburgite containing chromespinel with Fe^{3+} # equal to or higher than 0.015

<4> correlation between V_2O_3 wt% and Cr # of chromespinel in dunite and harzburgite: equal to or lower than 0.20 in V_2O_3 wt% and equal to or higher than 0.70 in Cr #.

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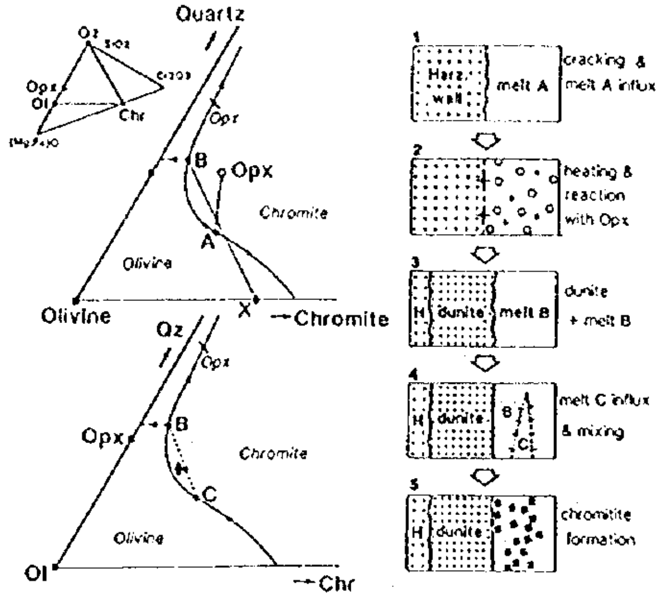

FIG. 6. A magma-mixing model for the genesis of podiform chromitite. At the first stage a melt (A) of deep origin is intruded into shallow mantle harzburgite (stage 1). Melt A reacts with orthopyroxene (open squares) in the harzburgite (stages 2 and 3) to produce olivine (+ spinel) and a secondary Si-rich melt (B), which may precipitate spinel only if mixed with successively supplied relatively primitive melt (C) (stages 4 and 5). Thin straight lines in the upper left panel indicate pairs of reactants (Opx and melt A) and products (crystal mixture X—olivine + spinel—and melt B) of the interaction. The thin dotted line in the lower left panel denotes the mixing of B (secondary silica-rich melt) and C (primitive melt). Primary liquidus fields are indicated by italicized minerals. Chr = chromite, Ol = olivine, Opx = orthopyroxene, Qz = quartz. Phase diagrams modified from Irvine (1977).

Figure 2-2-1 Genetic mechanism of podiform chromitite (magma-mixing model)

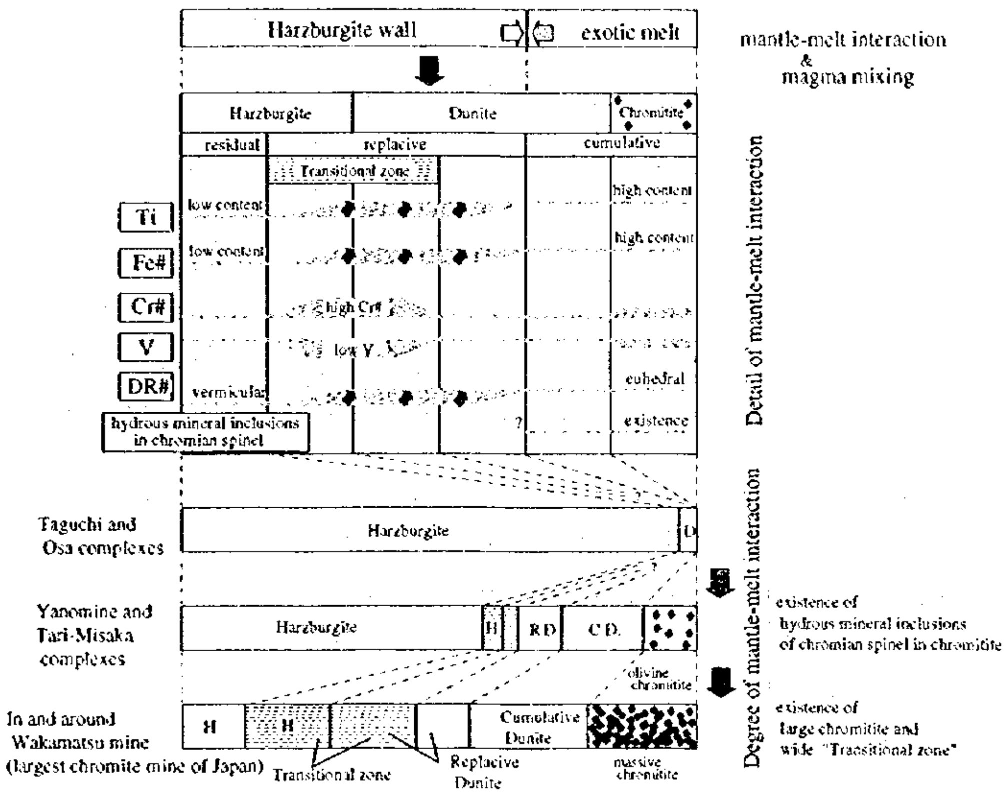

Figure 2-2-2 Correlation between degree of mantle-melt interaction and chromitite concentration

The index <1> is related to the potential chromium content of harzburgite and its relatively low value indicates more chromium concentrations in melts derived from pyroxenes in harzburgite(chromium in harzburgite is more partitioned in pyroxenes than in chromitite). The indices <2>, <3> and <4> are related to degrees of wall rock-magma interaction according to the magma mixing model.

(2) Potential of the Chromium Mineralization in Shebenik Area

The ultramafic rocks in Albania can be divided into the moderately to highly dunite and harzburgite in the eastern zone and the very much less depleted harzburgite and lherzolite in the western zone (e.g. Aina et al.). The difference in degrees of the depletion between the ultramafic rocks in the eastern and western zones are well demonstrated in chemical compositions of contained chromespinel (Figure 2-2-3). Chemical compositions of chromespinel in ultramafic rocks associated with world major chromium ore deposits are also incorporated in Figure 2-2-3 for comparison.

The Kempirsai complex in Kazakhstan, which contains podiform chromium ore deposits of outstanding scales in the world standard, comprises harzburgite of a less depleted type with Cr # of contained chromespinel ranging between 0.4 and 0.6. On the other hand, the harzburgite in the northern Kamuikotan in Japan is a highly depleted type with Cr # of contained chromespinel ranging between 0.8 and 0.9, and rarely yields chromitite. Also, no chromitite occurs in lherzolite which is extremely low in depletion indicating Cr # equal to or less than 0.4 in contained chromespinel (not shown in Figure 2-2-3). The chemical compositions of chromespinel in harzburgite in the eastern zone can be plotted between those in Kazakhstan and Kamuikotan, while those in the western zone are much lower in Cr #, indicating lower degrees of depletion than those for the ultramafic rocks in the Sangun metamorphic belt in Japan and in the Coto block in Philippines.

According to the chemical compositions of chromespinel in harzburgite as above described, the eastern zone in which the Bulqiza mine is situated may still have a potential for chromium ore deposits of similar orders to the Bulqiza. However, there will be a very little chance to locate chromespinel concentrations of economically viable sizes and grades in the western zone.

The harzburgite in the Project Area appears to be relatively high in its degree of depletion in comparison with that in the proximity of the Bulqiza mine. Therefore, possibility may be low for future prospecting to locate significantly superior chromium ore deposits to the Bulqiza. Nevertheless, there will be still chances to delineate ore deposits in order of several tens to several hundreds tons of ores, as indicated by the drilling exploration to date, where interaction zones are identified according to the

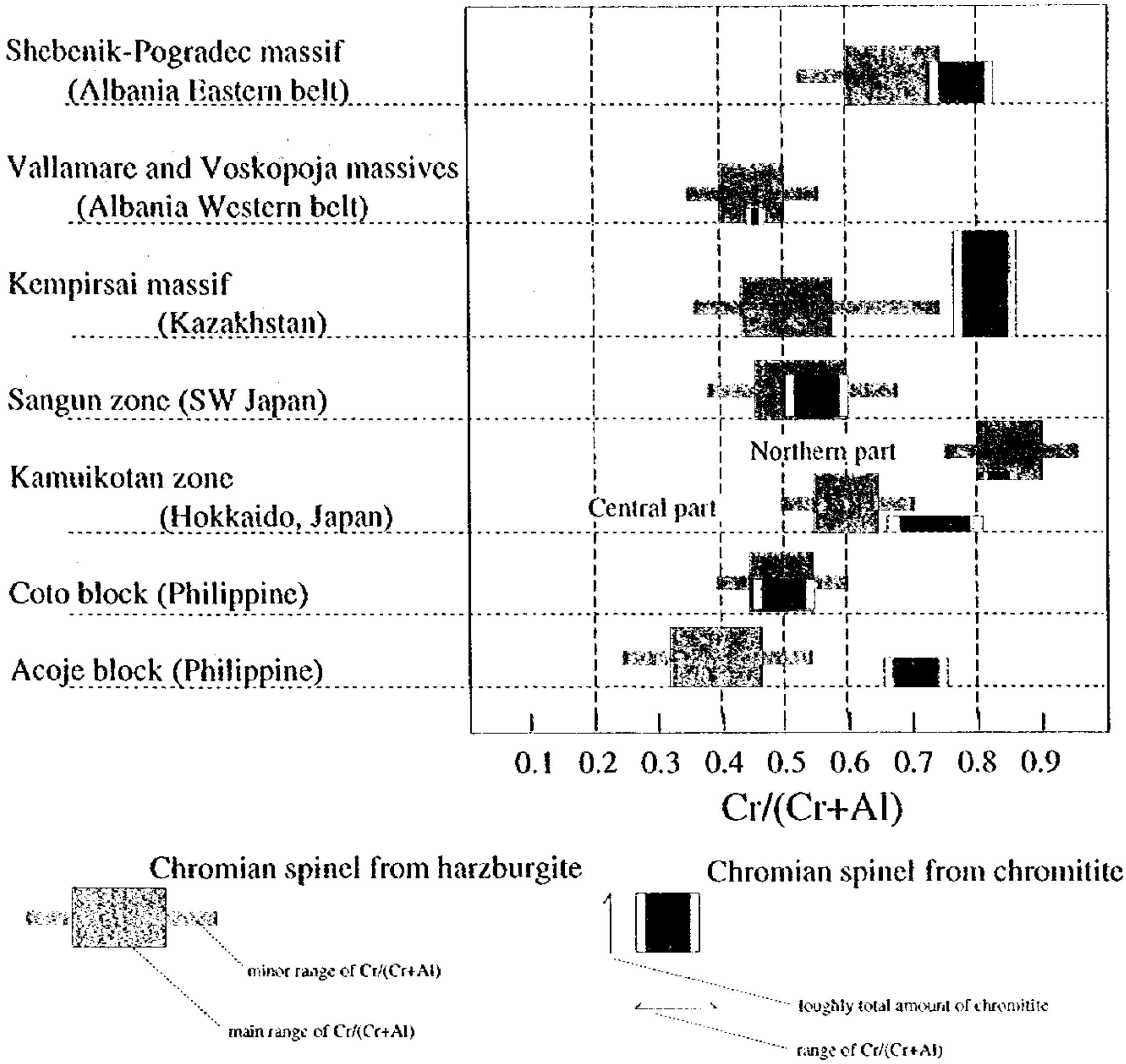

Figure 2-2-3 Comparison of Cr # in chromium deposit in the world

Data sources;
Shebenik-Pogradec, Vallamare and Voskopoja massives: This survey.
Kempisai massif: Kravchenko and Grigoryeva (1986), Melcher et al. (1994).
Sangun zone: Arai (1980), MITI(1993), Matsumoto et al., (1995).
Kamuikotan zone: Arai (1978), MITI(1994).
Coto and Acoje blocks: Leblanc (1983), Yumul (1994) .

chemical compositions of chromespinel.

(3) Appraisal of the Potential for Economically Viable Ore Resource

The chromium ore deposits in the Shebenik Area are generally small in their scales and limited in their continuity, being often crosscut by a number of faults, according to the existing data and the result of the current Project. The ore deposits that have been exploited in this Area have dimensions of several tens of meters by more than one hundred meters with thickness of 1m or more and contains resources of several tens of thousand tons. Among the target areas of this Project, those which may have a possibility for resources comparable to this order are Ahu i Vetem, Bregu i Pishes and Hija e Zeze.

PART III

Part Ⅲ Conclusion and Recommendation

Chapter 1 Conclusion

1-1 Geological and Geochemical Investigation

The most part of the Project Area is underlain by ultramafic rocks, named the Shebenik-Pogradec Ultramafic Complex as a whole, which are grouped into the Shebenik Complex in the northern half and the Pogradec Complex in the southern half. Although chromium ore deposits and indications are distributed in the entire Ultramafic Complex except in the northeastern part of the Shebenik Complex, a majority of them are located in the southwestern part of the Shebenik Complex and in the Pogradec Complex.

The Ultramafic Complex comprises mostly harzburgite, accompanying subordinate dunite, lherzolite, pyroxinite and gabbro. Harzburgite, lherzolite and dunite are mostly serpentinized. Fresh harzburgite and dunite are found only in the northern part of the Pogradec Complex and in the southeastern margin of the Shebenik Complex, and possibly represent the lower part of the Ultramafic Complex.

All of the chromium ore deposits in the Project Area are categorized into a podiform or Alpine type, and consist of chromespinel concentrations, in forms of dissemination, band, mass or nodule, within dunite envelopes in harzburgite.

Sizes of unit ore bodies range from 0.1 to 2m in thickness, from several tens to hundreds of meters both in strike and down-dip lengths. Thickness of dunite envelopes containing chromium ore bodies ranges from several tens of centimeters to several tens of meters. The mines being presently operated produce mainly massive ores with average grades ranging between 25 and 30% Cr_2O_3.

Important indicators for chromium ore deposit exploration are as follows;

- chromium ore bodies occur in dunite envelopes in serpentinized harzburgite
- all chromium ore bodies are enveloped by dunite
- textures of chromespinel arrangement are often parallel to inclinations of relevant chromium ore bodies
- chromium ore bodies continue in their plunge directions for appreciable distances.

1-2 Ground Magnetic Survey

Magnetic survey was carried out in 4 target areas of Pishkash, Kotodesh, Katjel and Central Shebenik.

A test magnetic survey, which was carried out over the chromitite outcrops of Katjel ore body, has identified a low magnetic anomaly in association with the ore body and the dunite envelope containing the ore body. The known ore indications in each area were recognized as " a group of anomalies " where a lot of high and low anomalies located together or a pair of high and low anomaly which continued well. These anomalies are presumed to indicate the blocks of ultramafic rocks with different orientations in remnant magnetization or dunite envelopes inversely magnetized.

According to the result of the magnetic survey, drilling survey was carried out in three magnetic anomalous areas of Pishkash South (Pishkash), Mbi Skroske (Pishkash), Fusha e Madhe (Kotodesh). However no chromitite was intersected in drill holes of these area. These magnetic anomaly is thought to be caused by the fault contact of blocks with different orientations in remnant magnetization.

1-3 Drilling Exploration

The drilling exploration, comprising a total of 34 holes, was carried out for the 13 selected target areas in the Central Shebenik, Southern Shebenik and Northern Pogradec Districts. Of the 34 holes, 12 holes for the 5 target areas, namely Bregu i Pishes, Qarri i Zi, Ahu i Vetem, Lugu i Batres and Hija e Zeze, intersected chromitite. The sections directly above and below chromitite consist of dunite in every hole. The thickness of dunite envelopes varies considerably from hole to hole. However, the dunite envelope in association with the low grade chromium ore in Ahu i Vetem is apparently thicker than those in other target areas.

(1) Bregu i Pishes

Of the 5 holes drilled (MJAS-1, 2 3, 34, 35), 2 holes (MJAS-1 and -2) have intersected disseminated and massive ores with thickness of about 1m. The Cr_2O_3 grades are 34 to 38% for the disseminated ores and 50% for the massive ores. It is observed in one hole (MJAS-2) that the chromitite contacts foot-wall harzburgite bounded by a fault.

The 2 holes are located closer to the known ore body than other 3 holes which have failed to intersect ore body. The ore body, being cross-cut by a number of faults, consists of a number of faulted segments which are arranged en echelon, and may have been dislocated for a distance greater than anticipated in the proximity of the drill location of the other 3 holes.

(2) Qarri i Zi

Of the 3 holes drilled (MJAS-8, -9 and -10), 2 holes (MJAS-8 and -9) have intersected several layers of disseminated ores with thickness ranging from a few centimeters to less than one meter. The ore grades generally range between 21 and 27% Cr_2O_3 except for one layer having indicated 39% Cr_2O_3. The thickness of the dunite envelope is estimated at 10m or more.

The 2 holes having intersected the ores were targeted to the down-dip extension almost directly below the known ore body, while the hole having missed ores was drilled to its strike extension at depth. The continuation of the known ore body has been identified to some extent by the drilling. However, its strike extension which has been missed by the hole, may have been dislocated by faults for a certain distance.

(3) Ahu i Vetem

All the 5 holes (MJAS-23 through -27) drilled have intersected the deep ore body and 2 of them (MJAS-25 and -26) have encountered the shallow ore body. The deep ore body consists of disseminated or banded ores with thickness ranging from about 1m to 5m indicating Cr_2O_3 grades ranging from 15 to 26%. The shallow ore body consists of thin massive ores with thickness less than 5 centimeters indicating Cr_2O_3 grades of about 35%. The thickness of the dunite envelope for the deep ore body varies from more than10m to about 50m for the deep ore body, while that for the shallow ore body is estimated at 3m or less.

The ores intersected by the 5 holes indicate similar modes of occurrence and Cr_2O_3 grades to those known for the deep ore body by the past exploration and are correlated to its strike extension, judging from their positions of intersections. Because all the 5 holes have intersected ores for appreciable lengths exceeding 2m, it is expected that the deep ore body extends to its strike direction for a substantial distance.

On the other hand, only two of the 5 holes which were targeted to the down-dip extension of the shallow ore body, have intersected very thin ores at the correlative positions. Accordingly, the down-dip continuation of the shallow ore body is considered to be insignificant.

(4) Lugu i Batres

One (MJAS-28) of the two drill holes (MJAS-28 and -29) have intersected ores for a length of 0.3m with a Cr_2O_3 grade of 39%. The thickness of dunite envelope is estimated at about one meter. The hole was intended to confirm the down-dip continuation of the central part of known ore body, while the other hole was targeted to its western strike extension. Although the down-dip continuation has been confirmed, the extent of the ore body appears to be very limited because its eastern strike extension has not been indicated by the past exploration.

(5) Hija e Zeze

Both of the two holes (MJAS-36 and -37) drilled in this target area have intersected massive ores for lengths of 0.2 and 1.1m with respective Cr_2O_3 grades of 36 to 42%, within a dunite envelope of one to three meter thick. The ores indicate similar modes of occurrence and Cr_2O_3 grades to those known for the ore body by the past exploration and are correlated to its strike extension, judging from their positions of intersections.

The drilling result suggests that the ore body continues further in its strike direction for an appreciable distance, which will lead to substantial increase in ore resources.

(6) Other Target Areas

One to three holes each for other eight target areas (Buzgare, Mbi Skroske, Pishkash South, Pishkash-5, Fusha e Madhe, Gjorduke, Shesh Bush No.1 and Murriq) were drilled in order to identify down-dip or strike extensions of the known ore bodies or to verify causative bodies for surface magnetic anomalies. None of the drill holes, however, have encountered any chromitite.

The reasons why the holes located in the neighbors of the known ore bodies have failed to intersect chromitite may be attributed either to greater dislocation of the ore bodies by faults than anticipated or to their limited extensions. Numerous faults are developed in extremely complicated patterns, affecting positions of faulted segments of the ore bodies. Therefore, it is often very difficult to estimate the amount and direction of dislocation of ore bodies by faults.

One or two holes each for three target areas (Pishkash South, Mbi Skroske and Fusha e Madhe) were drilled with intention to pass through below surface magnetic anomalies. However, none of the holes was successful to verify their causative bodies.

1-4 EPMA Analysis

EPMA analysis were made for chromespinel in samples of drilled cores and outcrops. The aim of the examination for chemical composition of chromespinel by EPMA analysis is to determine the wall rock containing chromium ore deposit by its chemical characteristic. The following four indices indicate the existence of large scale chromium ore deposit (MITI 1994; 1995, Matsumoto 1996, Arai 1994, and so on). The threshold value used in this Project are shown within the parentheses. The formulas of atomic number are as follows; Cr # =Cr/(Cr+Al), Mg # =Mg/(Mg+Fe^{2+}), Fe^{3+} # =Fe^{3+} /(Cr+Al+ Fe^{3+}).

- harzburgite indicating relatively low Cr # (0.4~0.6)
- harzburgite indicating high TiO_2 wt% (0.05 or higher)
- dunite and harzburgite indicating high Fe^{3+} # (0.030 or higher for dunite and 0.15 or higher for harzburgite)
- dunite and harzburgite indicating high Cr # and low V_2O_3 wt% (0.7 or higher in Cr # and 0.2 or lower in V_2O_3 wt% for both dunite and harzburgite).

Especially EPMA anomaly in high Cr # and low V_2O_3 wt% (hereinafter described as V_2O_3 − Cr #) is presumed to reflect the composition of the melt which is created as a result of the alternative reaction between melt and mantle to occur the podiform type chromium ore deposit. The V_2O_3 − Cr # anomaly is a common feature to the dunite containing chromitite (or intermediate rock facies between dunite and hartzburgite). Surface rock samples indicating V_2O_3 − Cr # anomaly distribute in the ore indications of the Central Shebenik District as Ahu i Vetem, Lugu i Batres, Gobille, Buzgare and so on, of the South Shebenik District as Qarri i Zi and so on, and of the North Pogradec District as Bregu i Pishes and so on.

As a result of drilling survey which had been recommended by EPMA analysis for the surface samples, chromitite was intersected in holes drilled in some target areas. The drill core samples in Qarri i Zi, Bregu i Pishes, Ahu i Vetem and Hija e Zeze where chromitite was encountered also indicated V_2O_3 − Cr # anomaly. Therefore, the chemical composition of chromespinel will be one of the effective indicators for chromium ore deposit exploration in the Project Area. As the same anomaly was detected in Pishkash South and Mbi Shkroske, there is the possibility that the chromium ore deposit would exist around these target areas.

Hartzburgite and dunite indicating high Fe^{3+} # and hartzburgite indicating high TiO_2 wt% are possibly received the reflection of the melt. These samples distribute in the region from the Central Shebenik to the South Shebenik District.

Cr # of chromespinel in harzburgite ranges between 0.4 and 0.5 (up to mid-0.6s in the highest case) in the vicinity of sizable chromium ore deposits. It is, however, generally high in the Project Area and exceeds 0.6 in most harzburgite samples. Only a few samples with Cr # less than 0.6 are sporadically distributed. Therefore, the possibility to locate large scale chromium ore deposit comparable to those of the Bulqiza Mines appears to be rather limited based on the result of the EPMA analysis to date. Nevertheless, it may still be possible to locate the ore deposit, which contains resources of several tens thousands to several hundreds thousands tons as estimated by the drilling survey, in the region where a lot of samples indicating EPMA anomaly are located.

Chapter 2 Recommendation

The following target areas are recommended for the follow-up drilling exploration;

- Hija e Zeze: the down-dip and northern extensions of the drill-indicated ore body
- Ahu i Vetem: the north northeastern extension of the drill-indicated part of the deep ore body and the northwestern extension of the shallow ore body
- Bregu i Pishes: the down-dip and western extensions of the drill-indicated part of the known ore body

In these target areas, lateral and down-dip extensions will be drilling targets since the drilling exploration of the current Project has confirmed the ore bodies with thickness exceeding 1m.

As for Hija e Zeze, the drilling exploration of the current Project is the first instance of this kind and has successfully identified the ore body with an appreciable size and grade, in spite of the scarce existing information. This area is well located for its accessibility and topography, and is economically advantageous for exploitation where promising results are obtained by the future exploration.

The deep ore body of Ahu i Vetem is rather low in its overall Cr_2O_3 grade but is superior in its size to those in other target areas. The ore body drill-indicated in the current Project is highly probable to continue further to the north. Since it includes higher grade portions in part, its economic value may improve depending on the result of future exploration.

The third Year drilling operation in Bregu i Pishes failed to prove the strike extension of the ore body further to the north of the portion drill-indicated in the second Year operation. However, the result is inconclusive for the continuation of the ore body in the strike direction. There remains a possibility to locate a fault-dislocated portion of the ore body by the follow-up drilling exploration.

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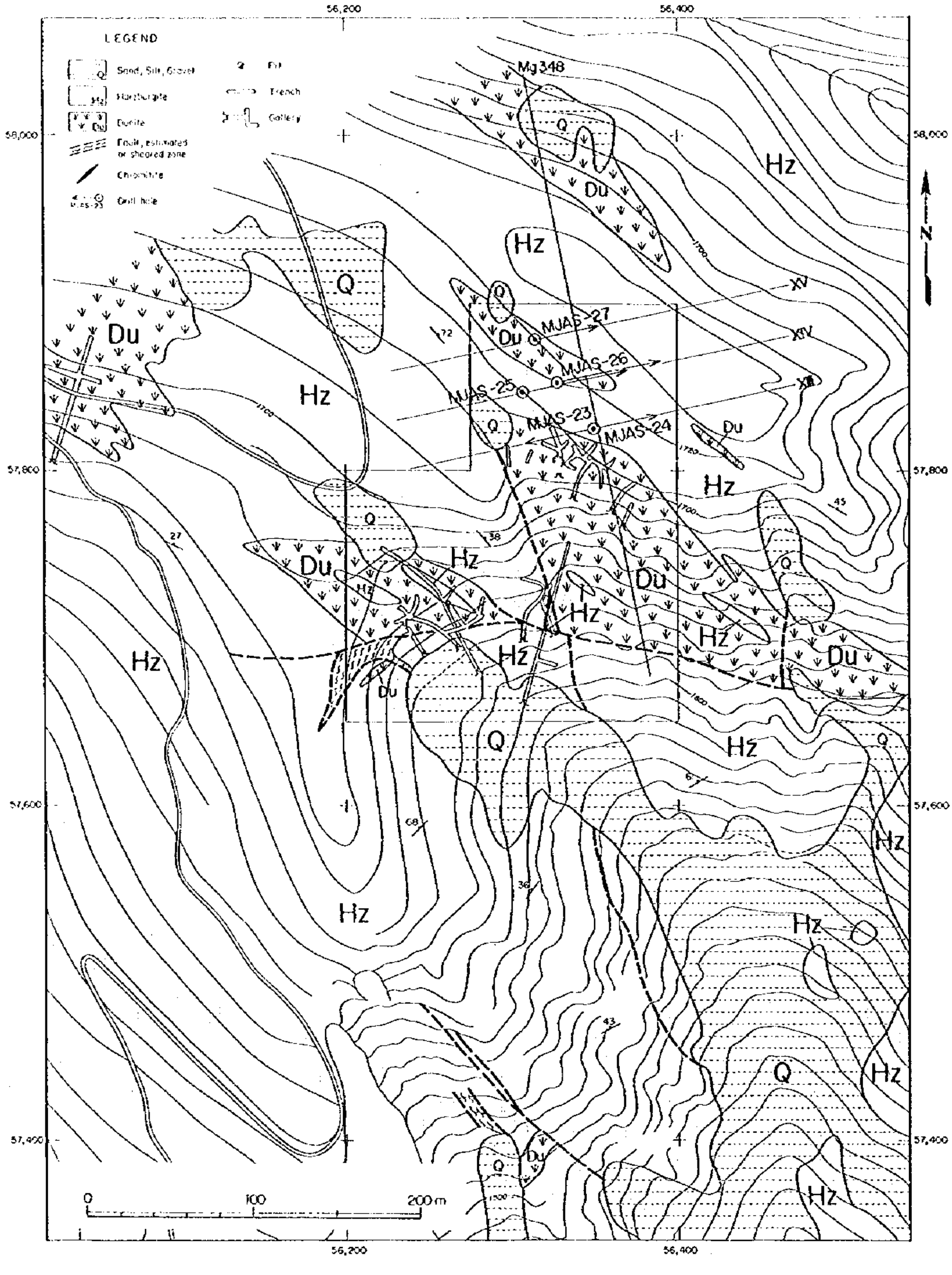
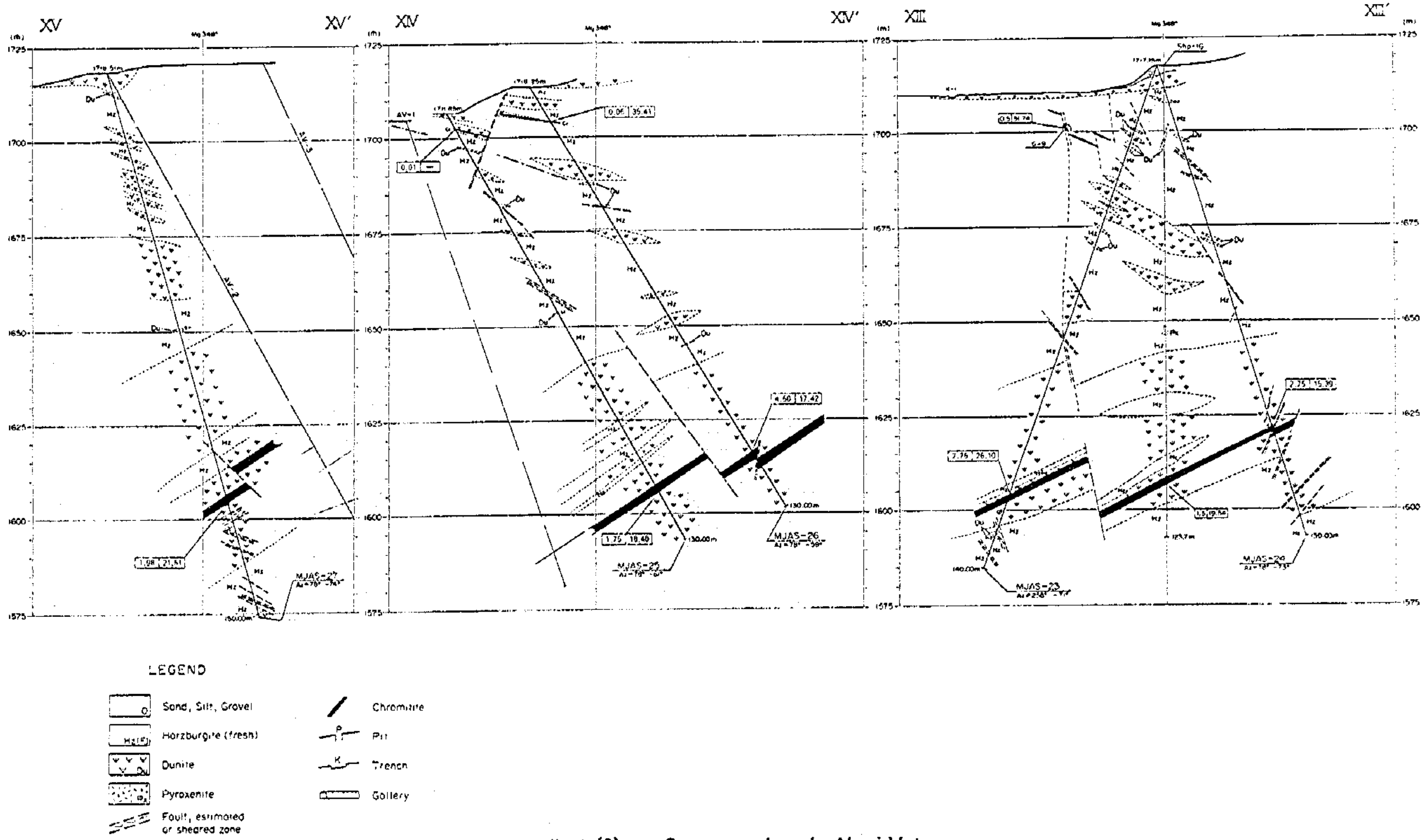
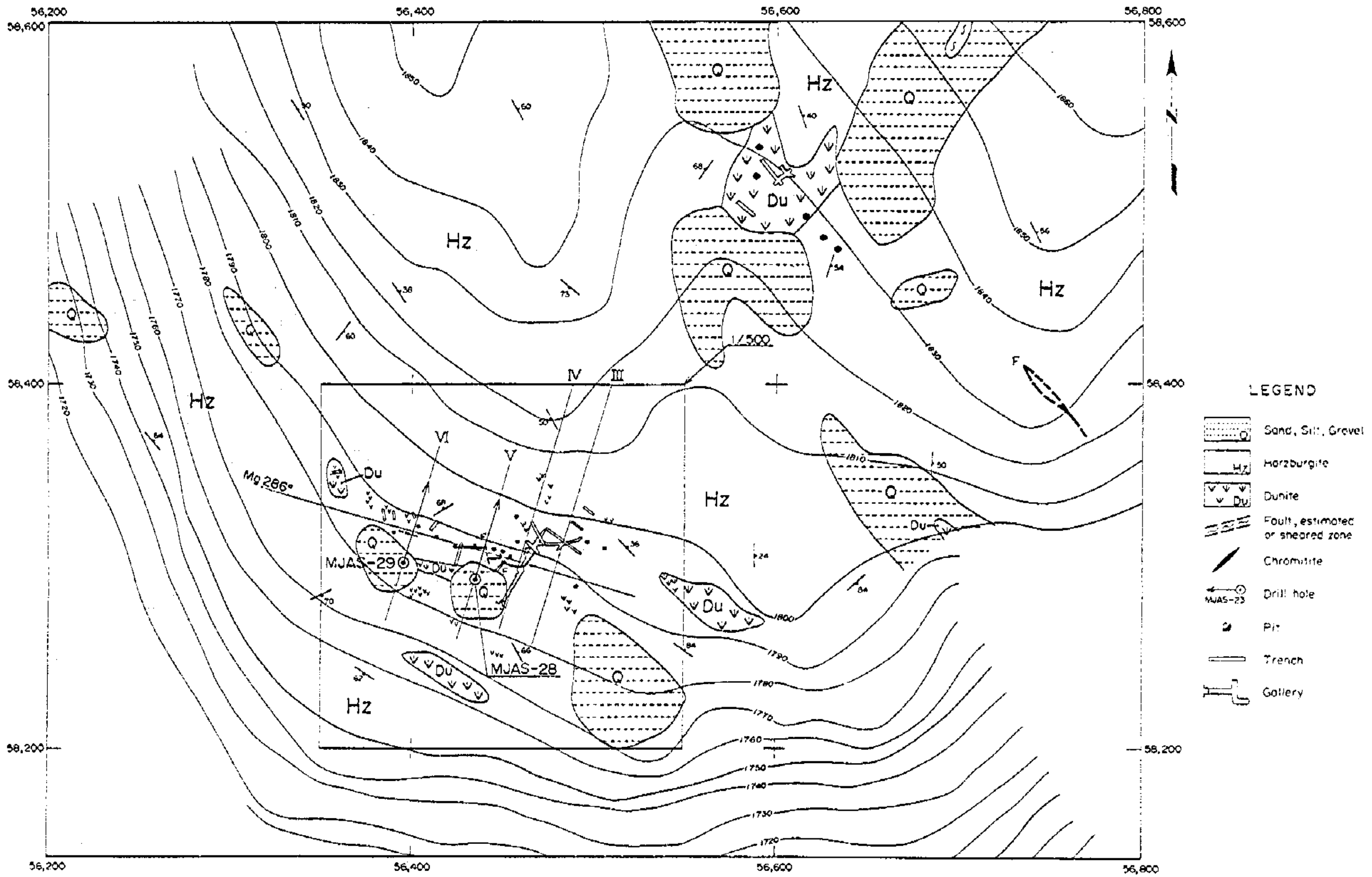
APPENDIXES



Appendix 1 (1) Geological fact map in Ahu i Vetem

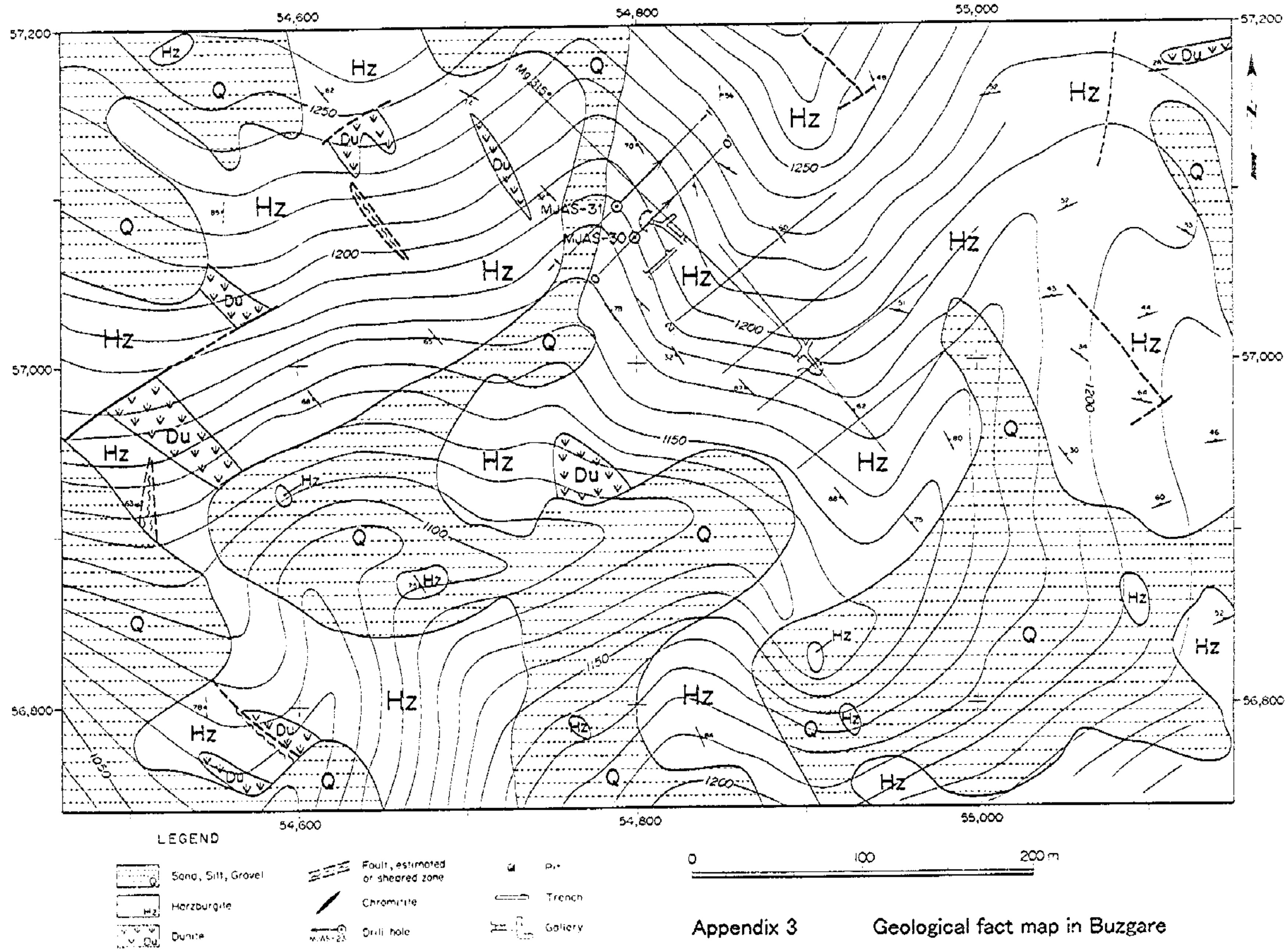


Appendix 1 (2)　Cross sections in Ahu i Vetem

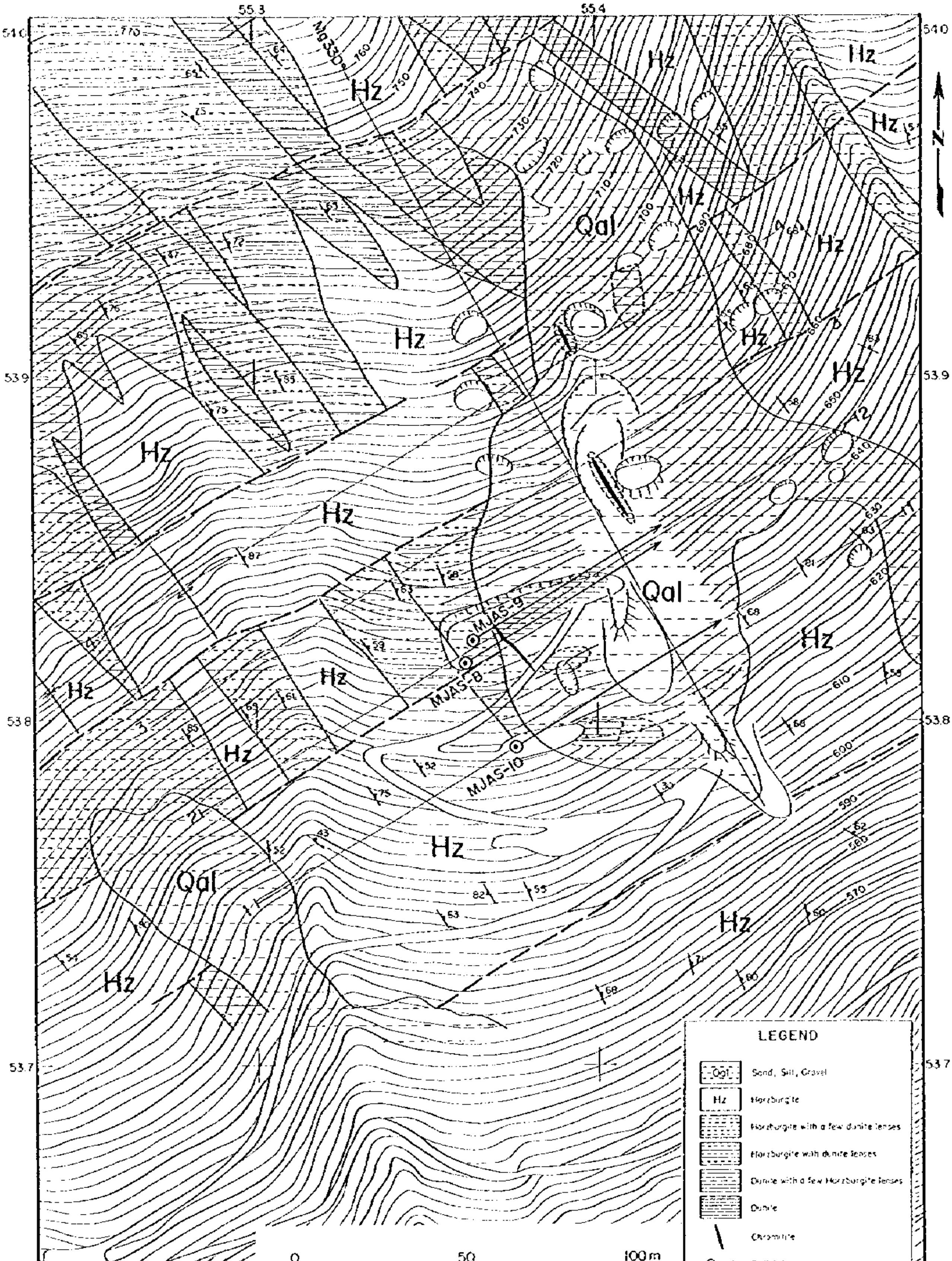


0 100 200 m

Appendix 2 Geological fact map in Lugu i Batres

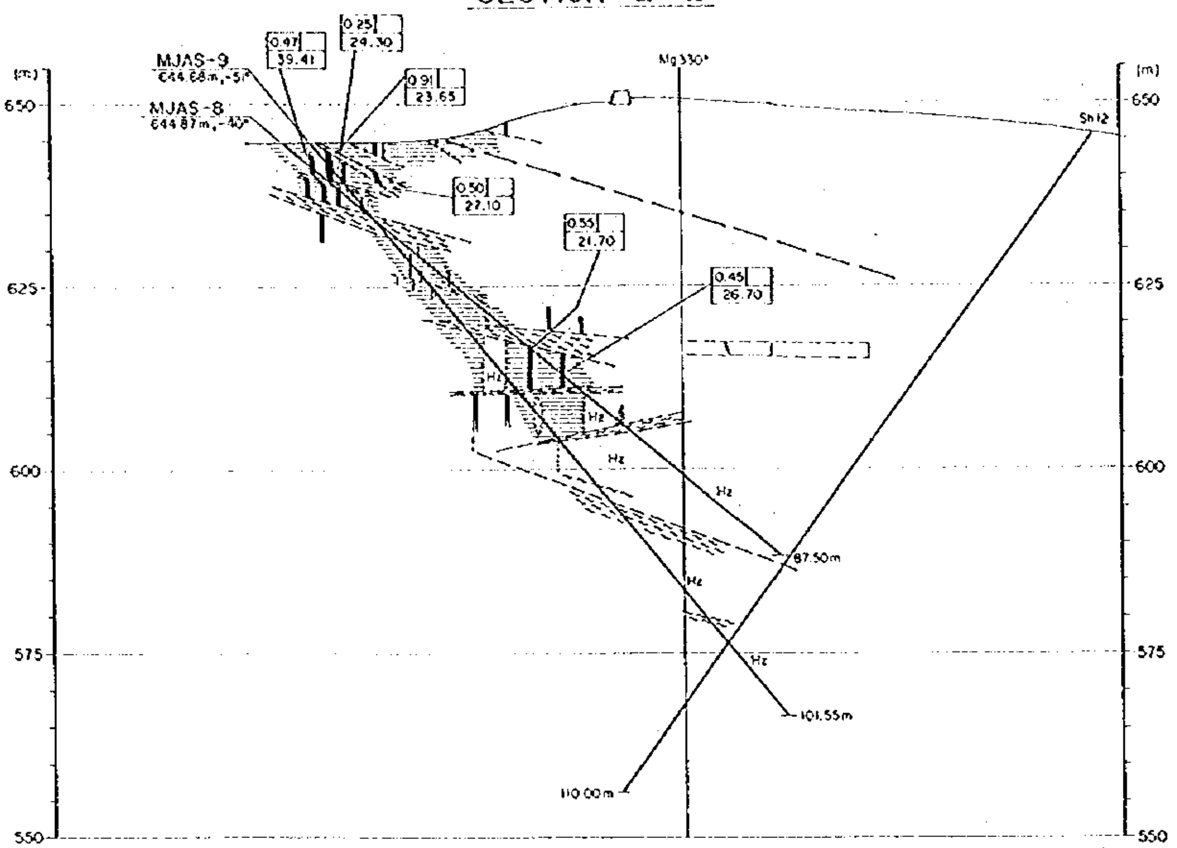


Appendix 3 Geological fact map in Buzgare

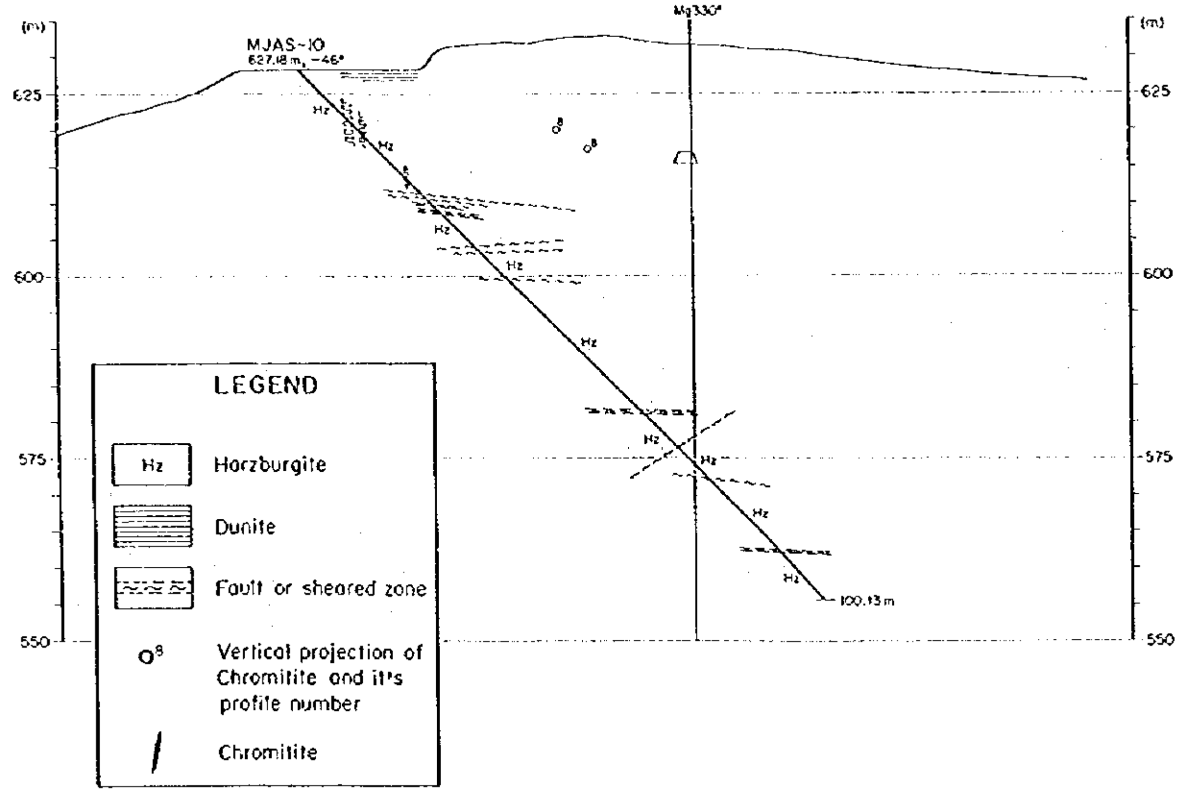


Appendix 4 (1) Geological fact map in Qarri i Zi

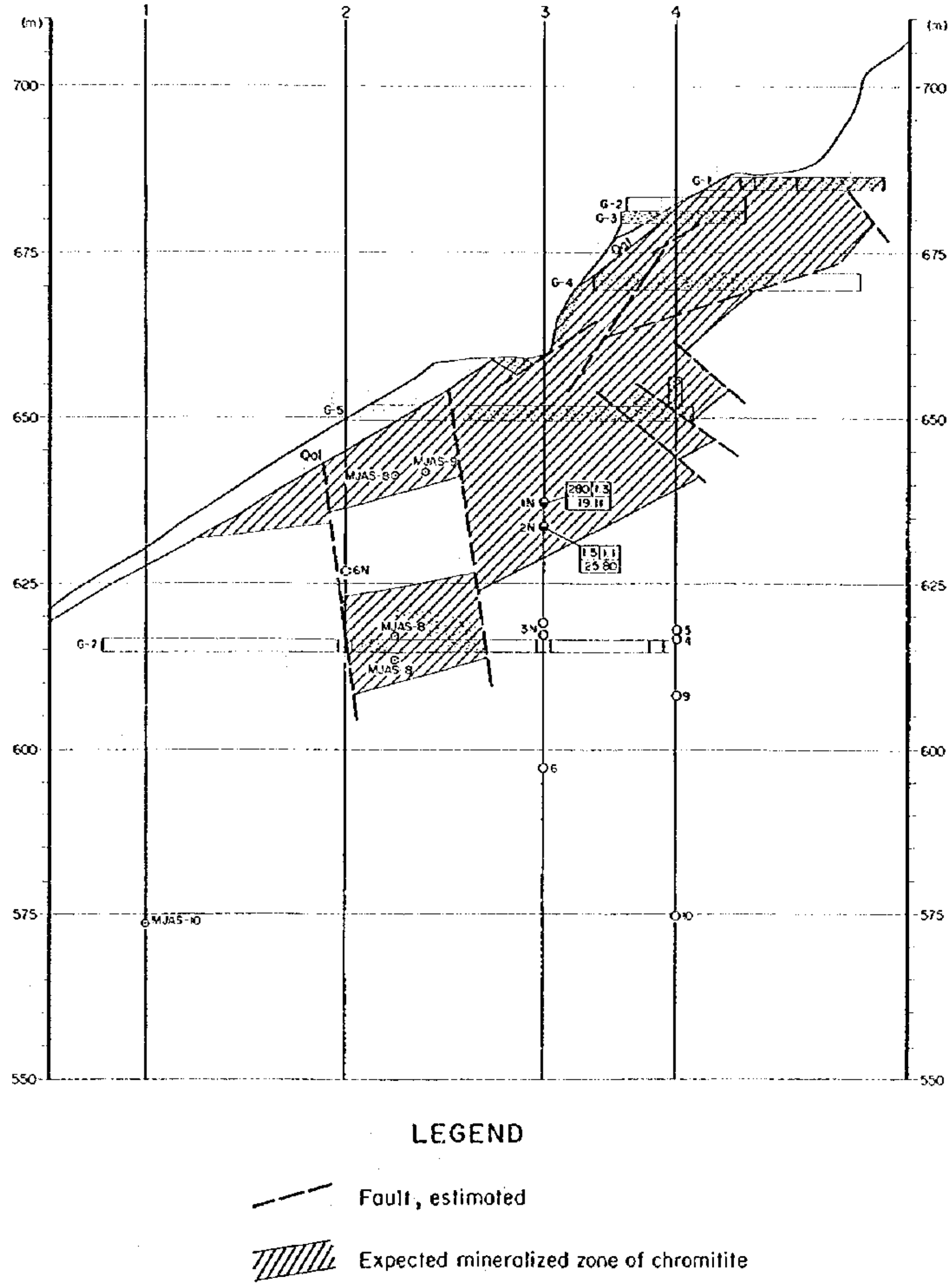
SECTION 2-2



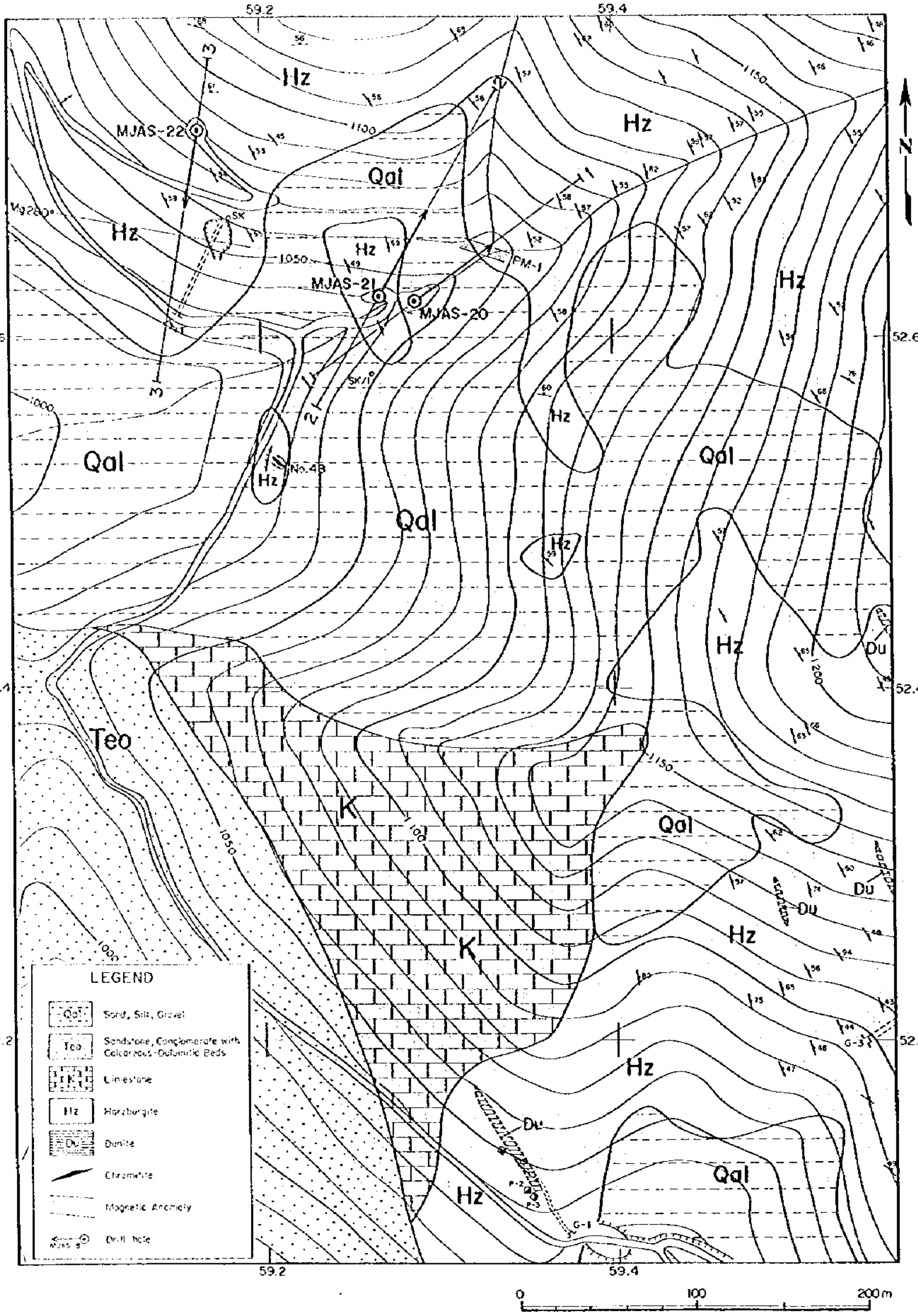
SECTION 1-1



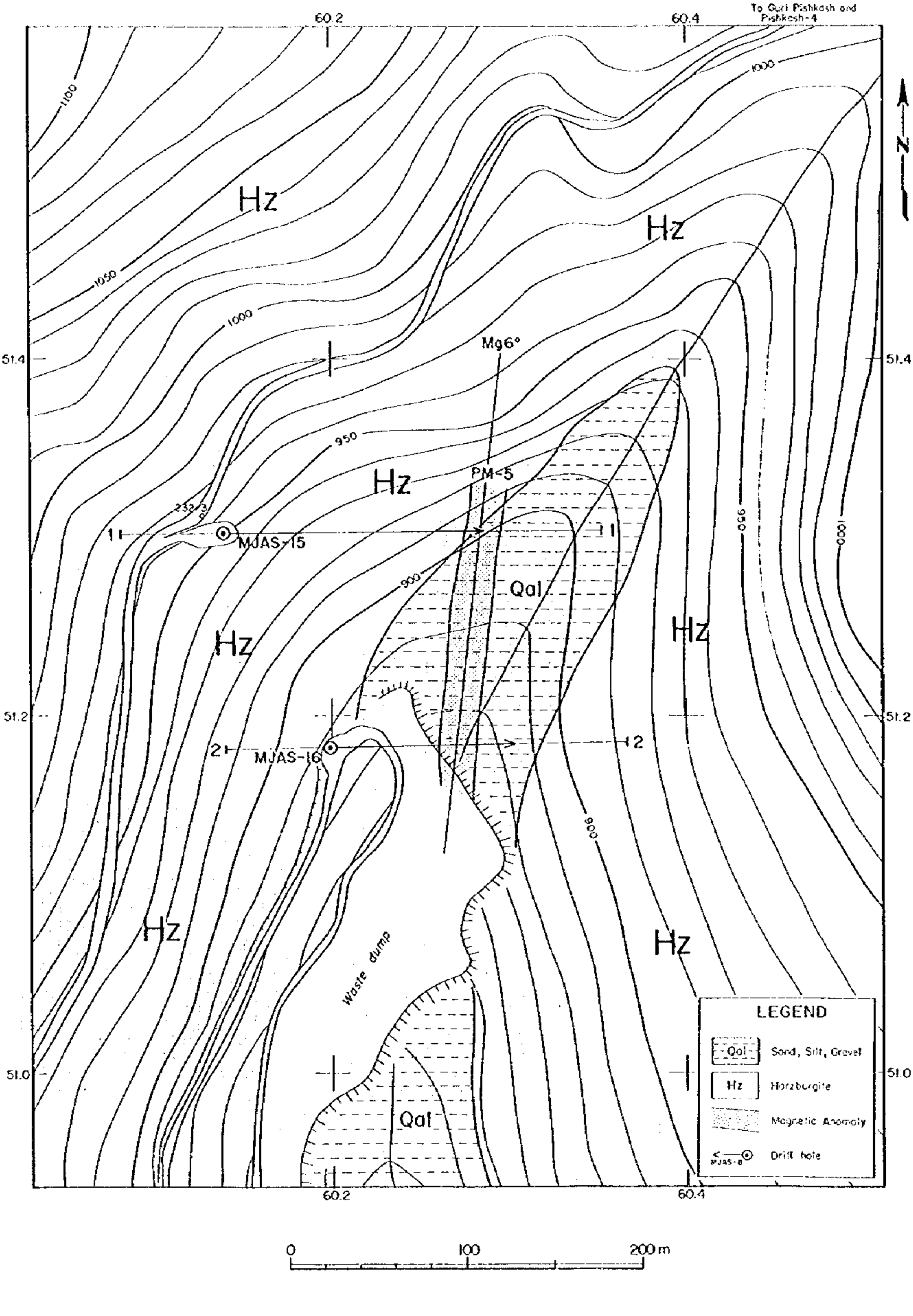
Appendix 4 (2) Cross sections in Qarri i Zi



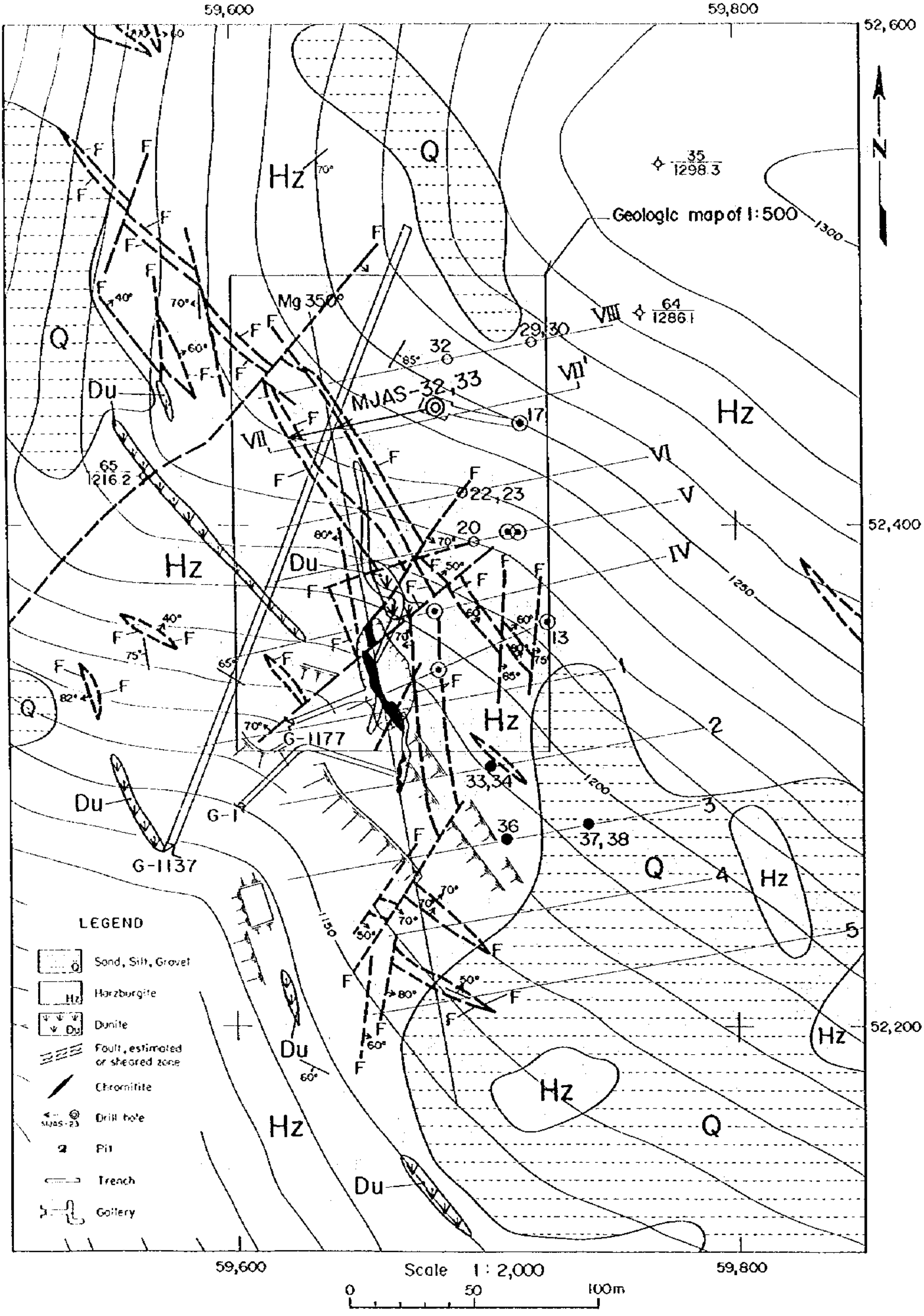
Appendix 4 (3) Longitudinal section in Qarri i Zi



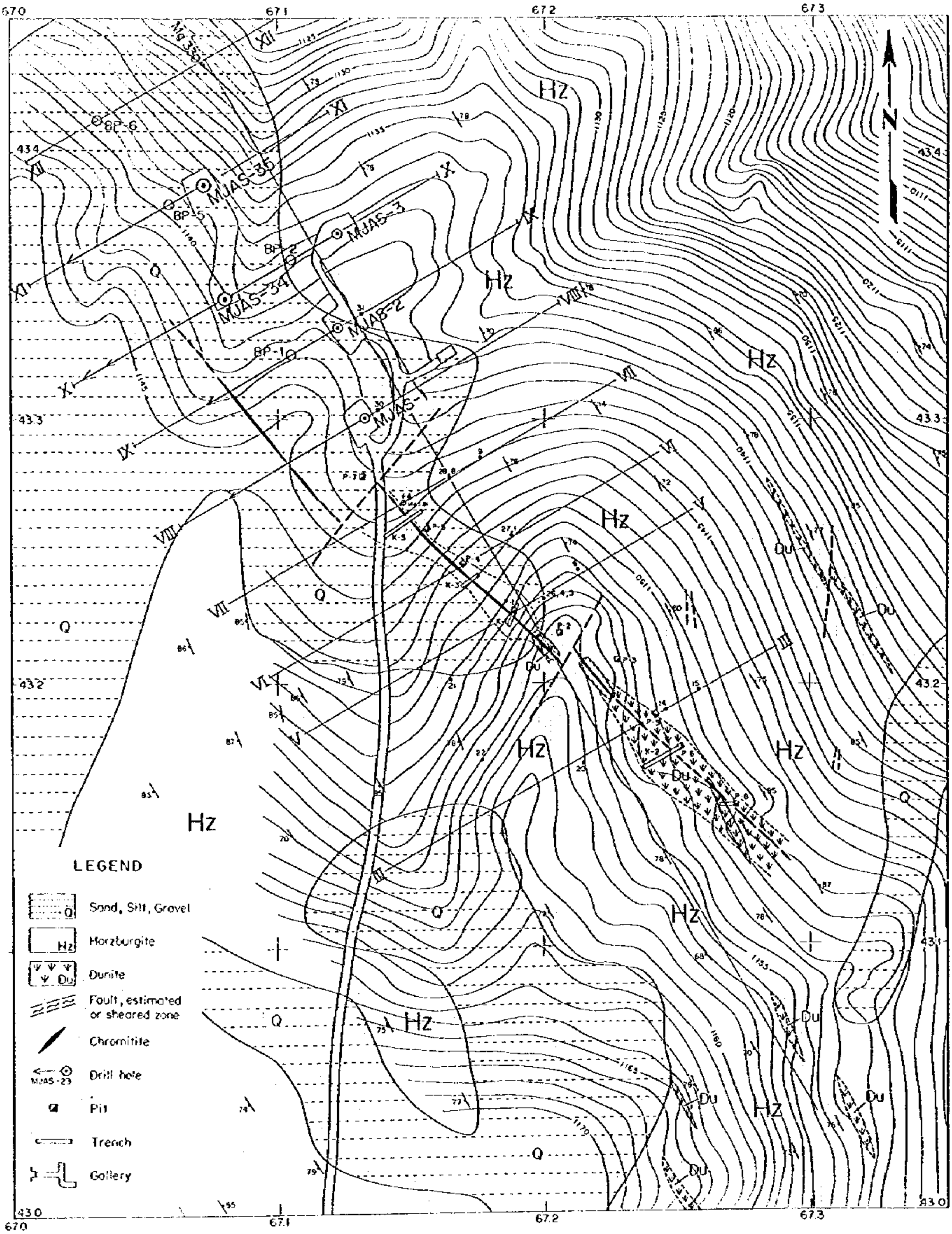
Appendix 5 Geological fact map in Mbi Skroske



Appendix 6　　Geological fact map in Pishkash South



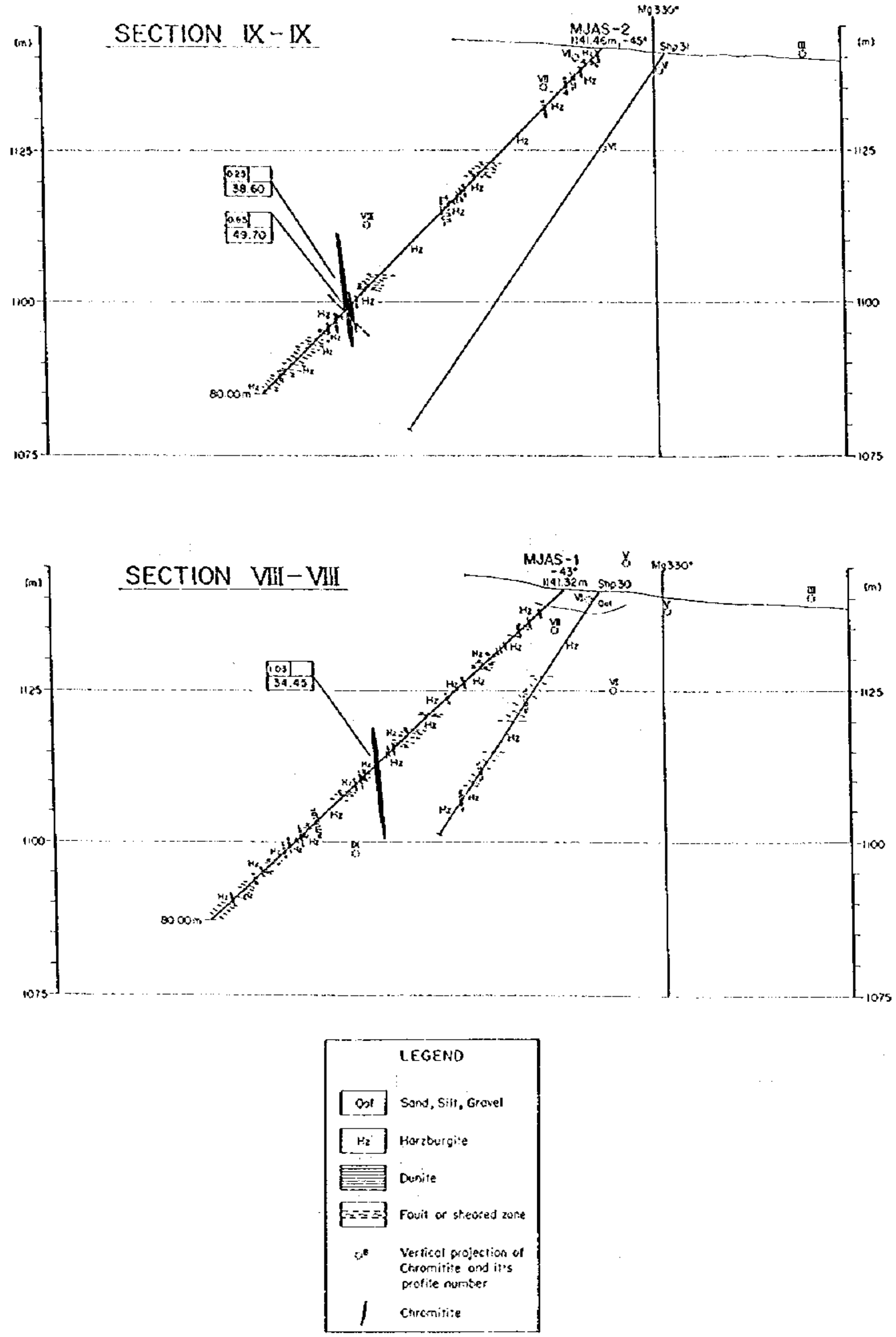
Appendix 7 Geological fact map in Pishkash-5



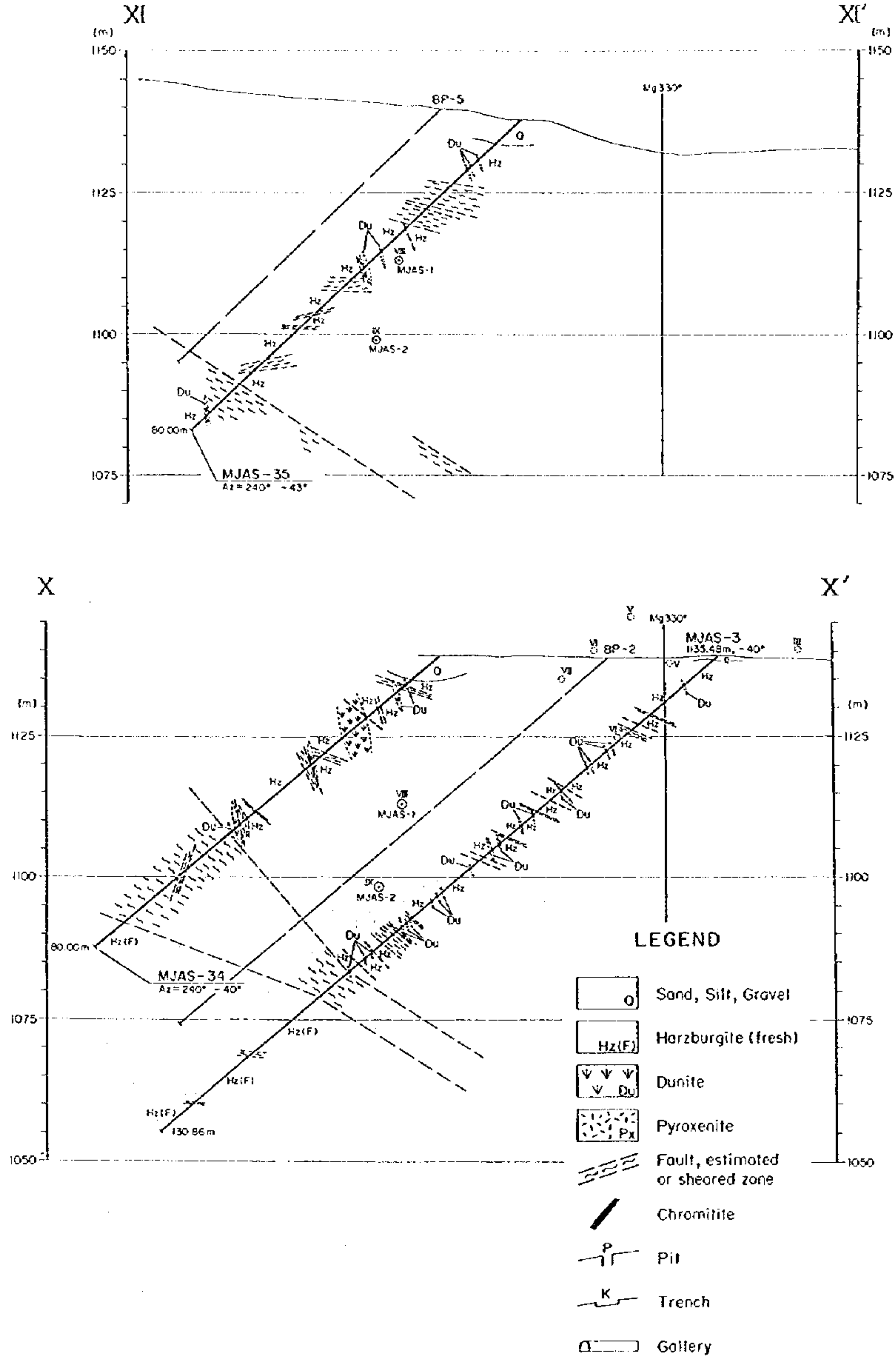
Scale 1 : 2,000

0 50 100m

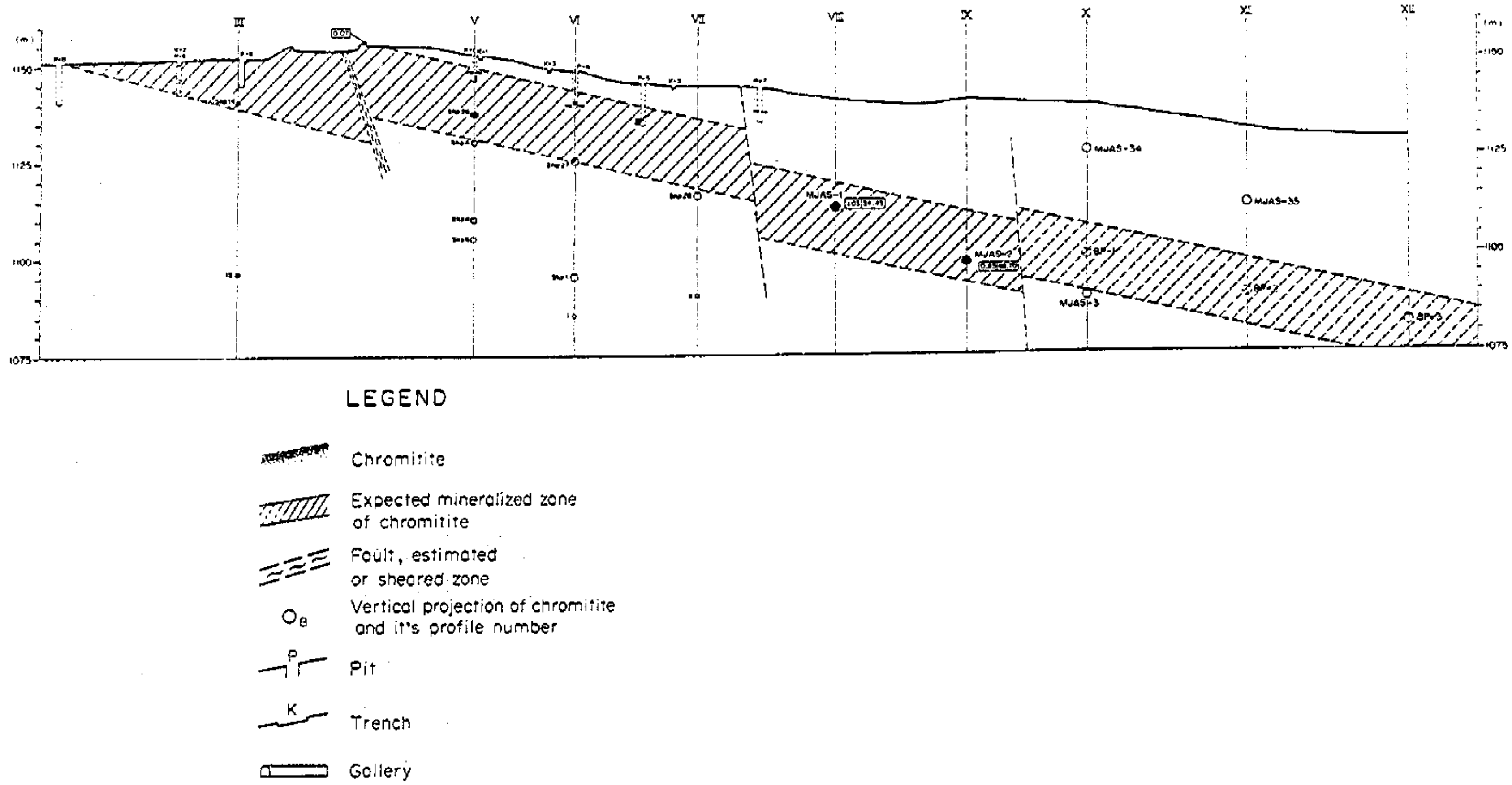
Appendix 8 (1) Geological fact map in Bregu i Pishes



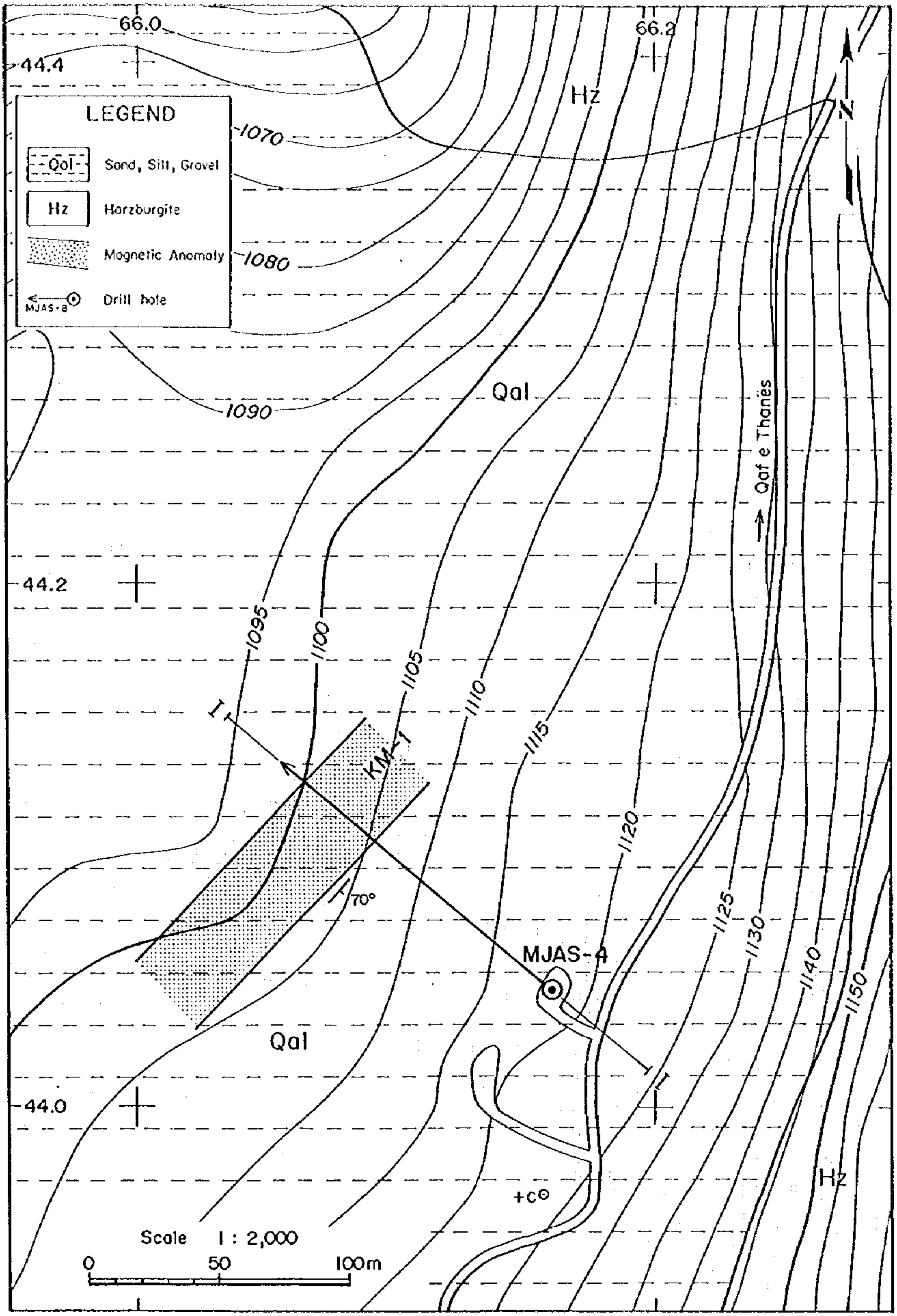
Appendix 8 (2) Cross sections in Bregu i Pishes



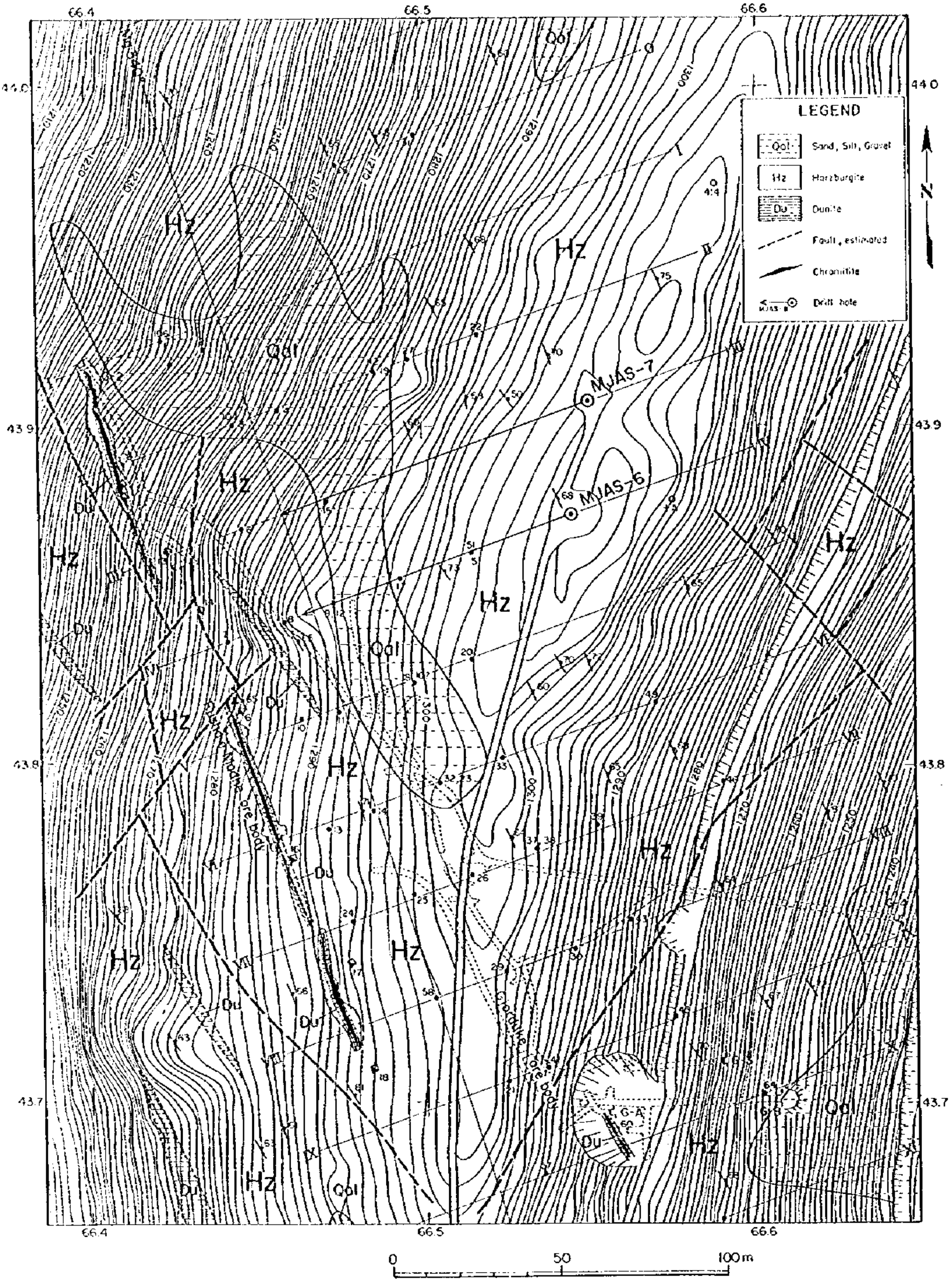
Appendix 8 (3) Cross sections in Bregu i Pishes



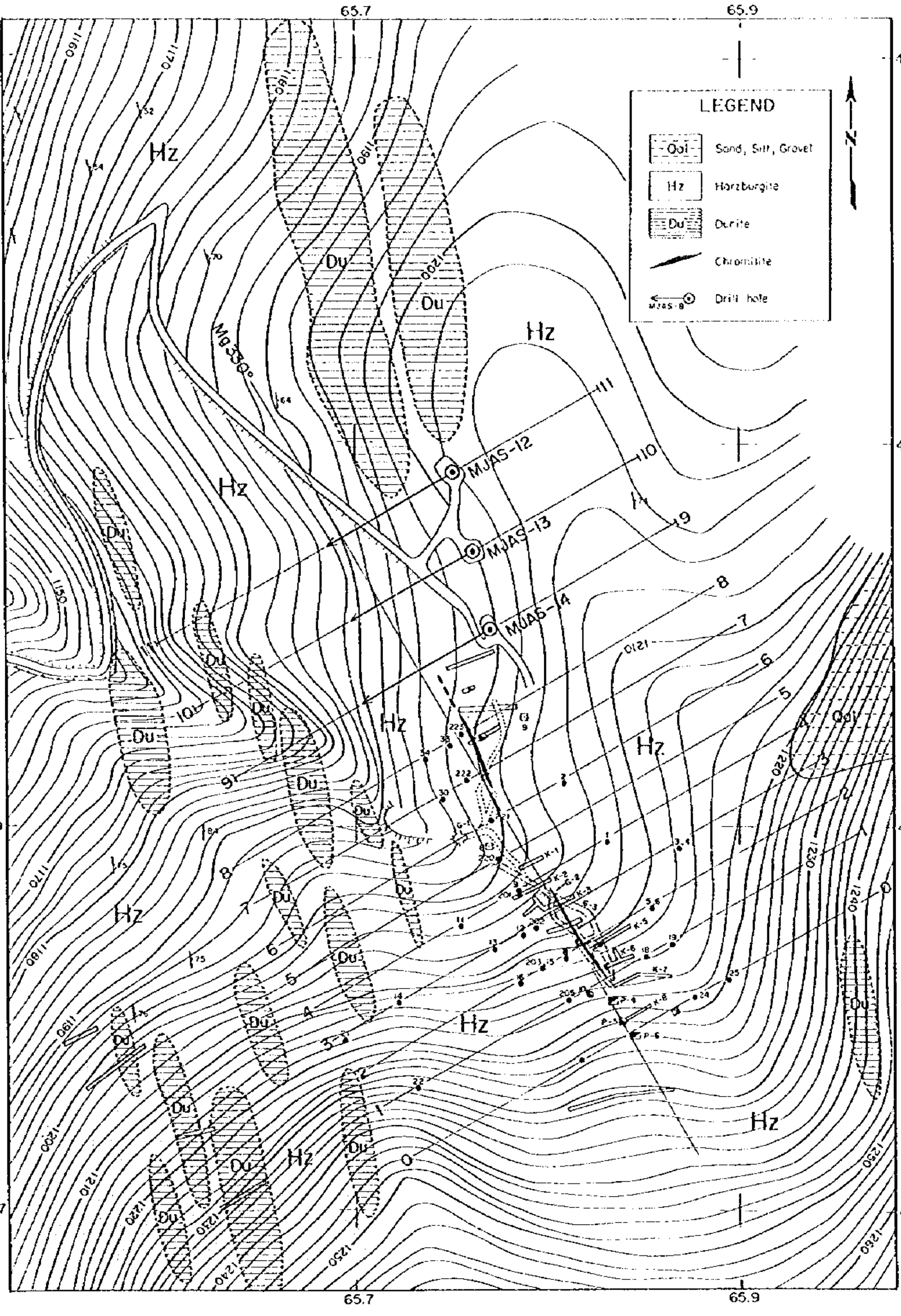
Appendix 8 (4) Longitudinal section in Bregu i Pishes



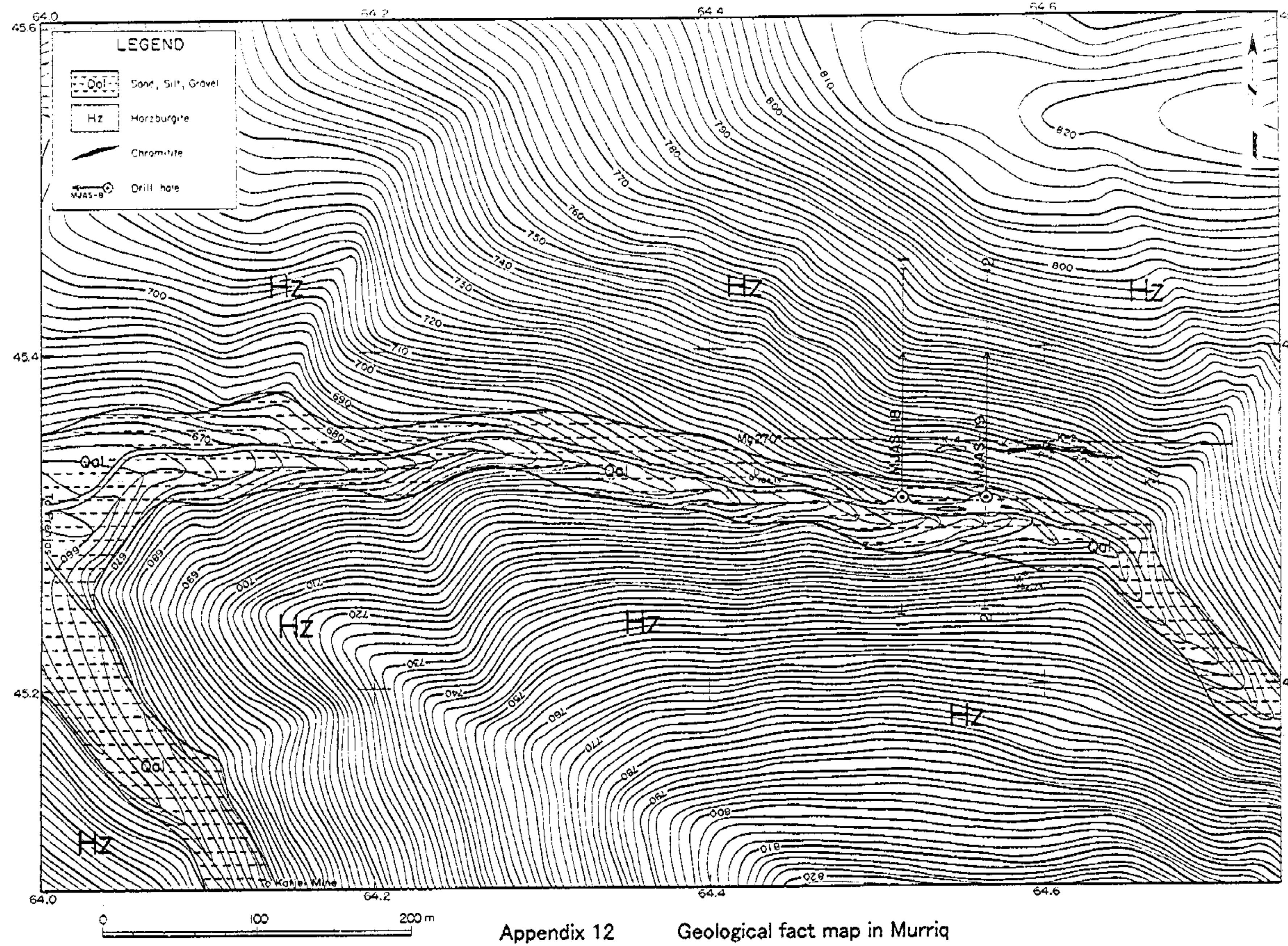
Appendix 9 Geological fact map in Fusha e Madhe



Appendix 10 Geological fact map in Gjorduke



Appendix 11 Geological fact map in Shesh Bush No.1



Appendix 12 Geological fact map in Murriq