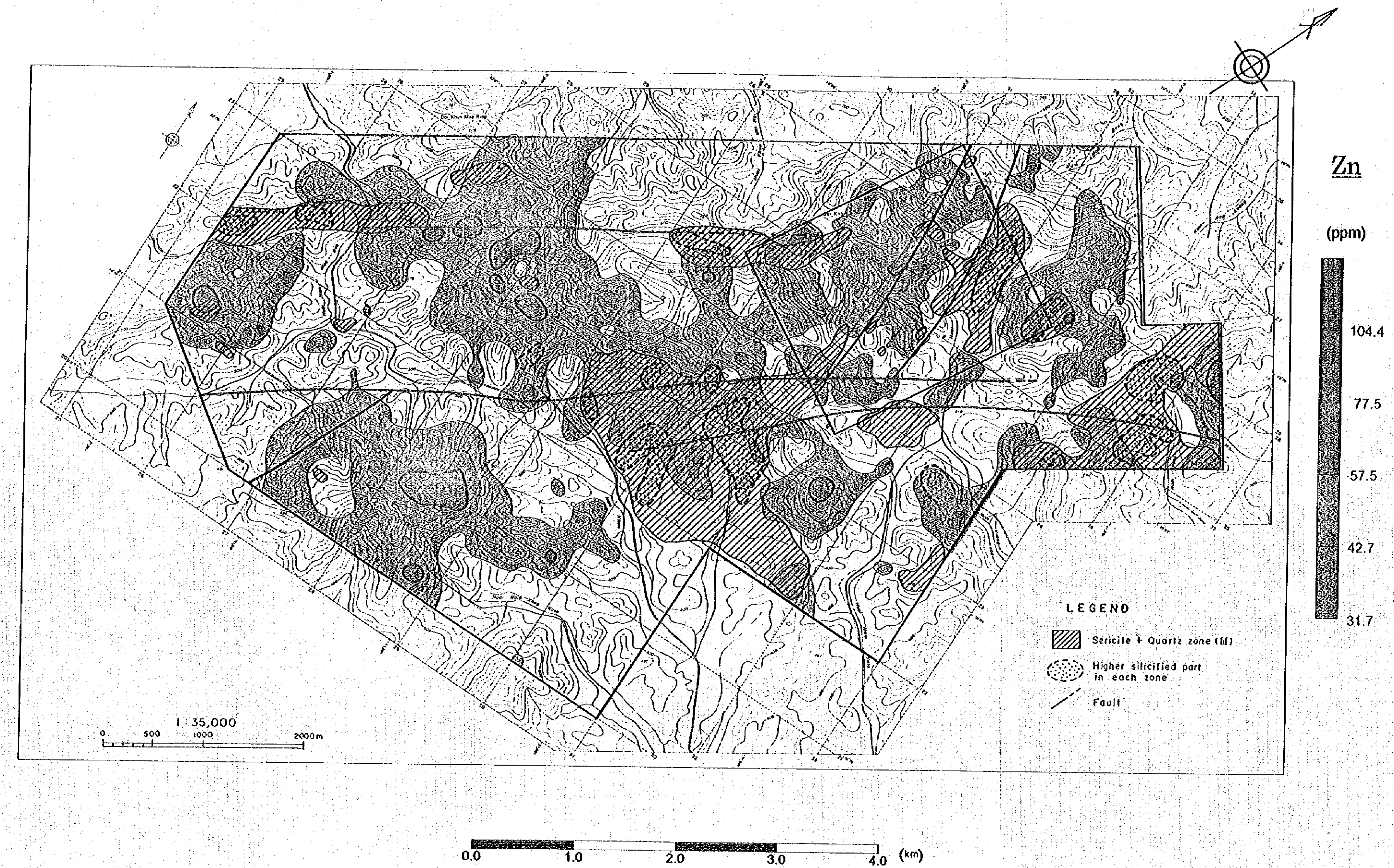


Fig. II-1-10.15 Geochemical Anomaly Map in Whole Area (Zn)

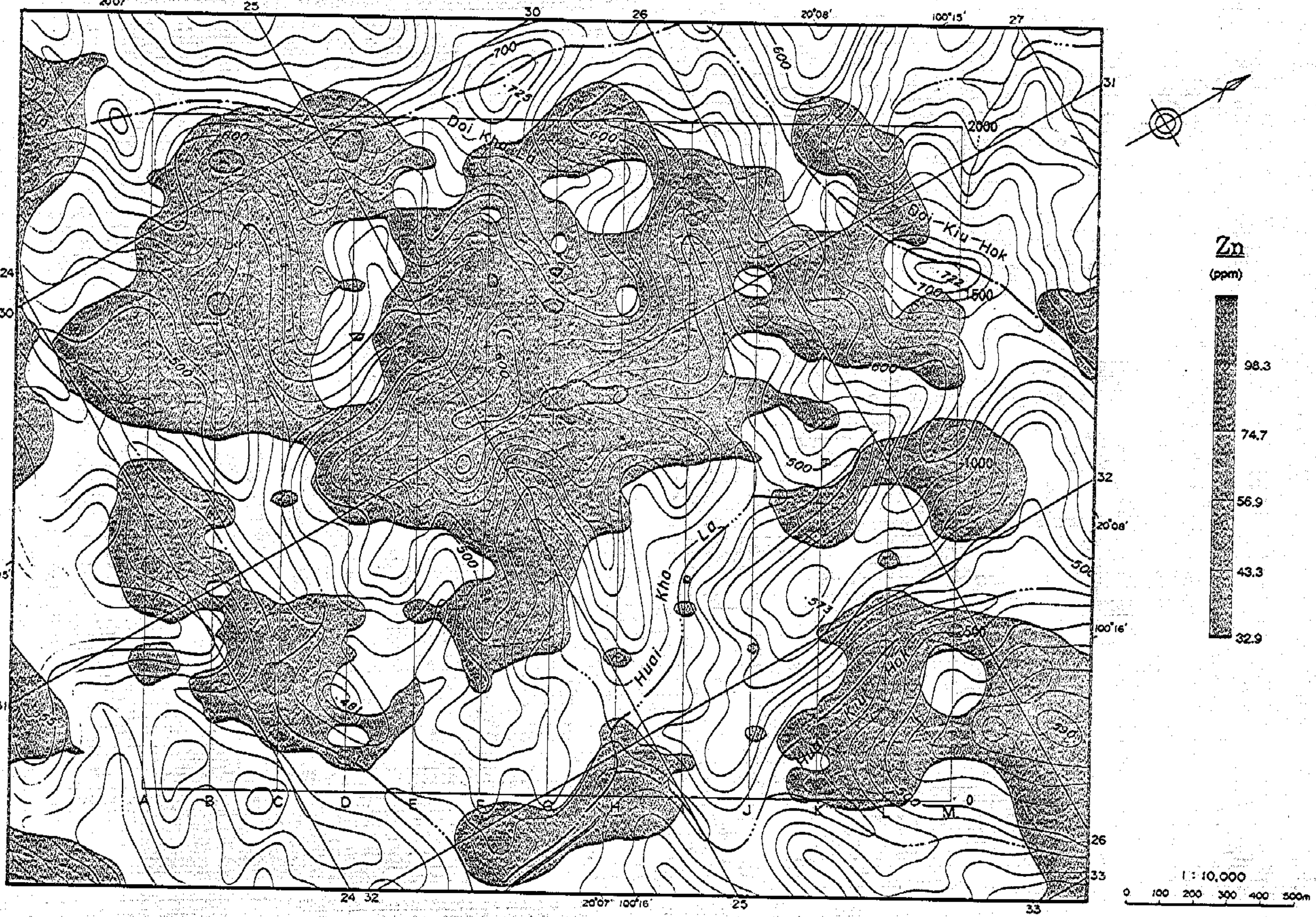


Fig. II-1-10.16 Geochemical Anomaly Map in Detailed Survey Zone (Zn)

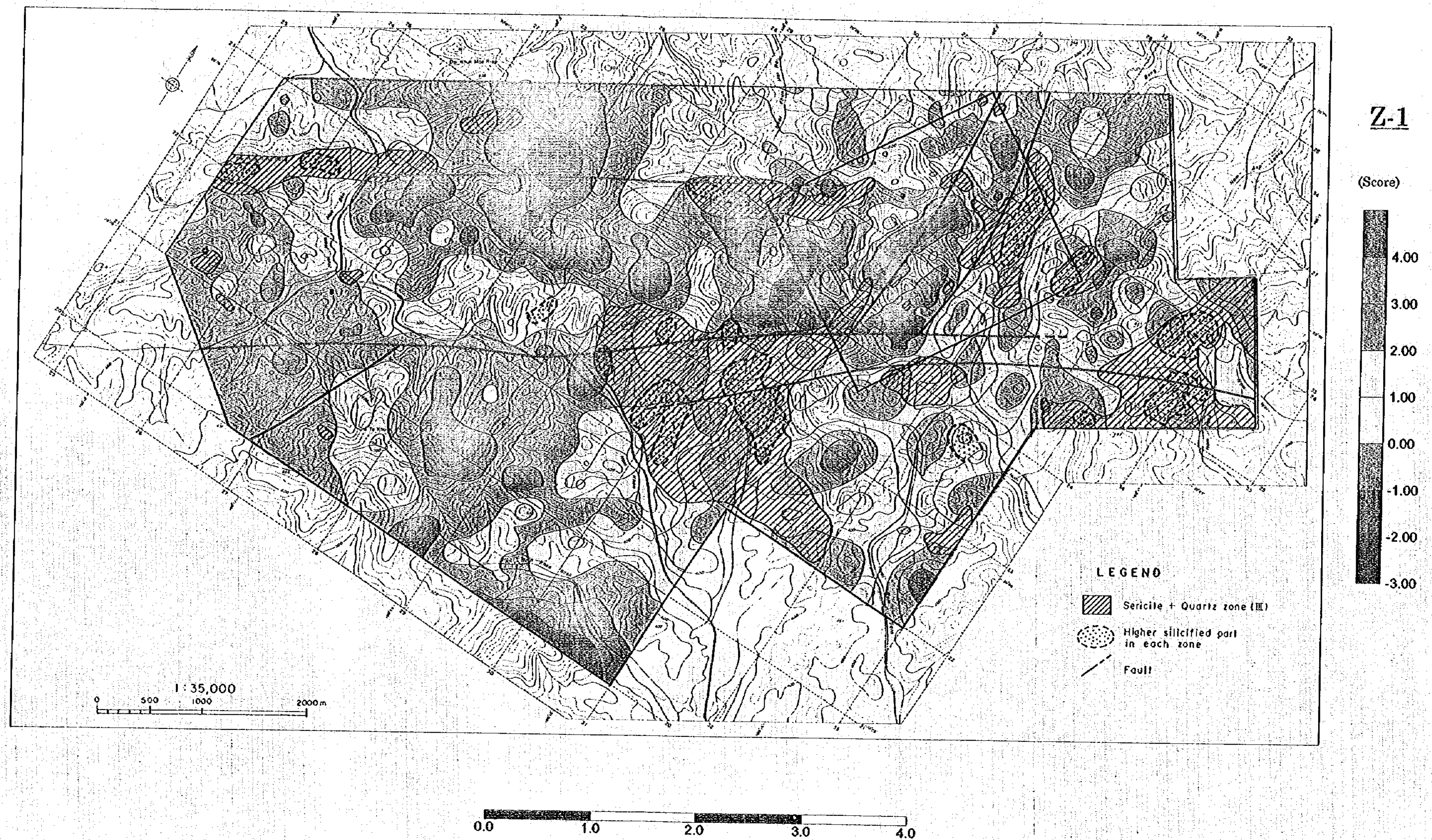


Fig. II-1-11.1 Z-1 Scores of principal Components Analysis in Whole Area

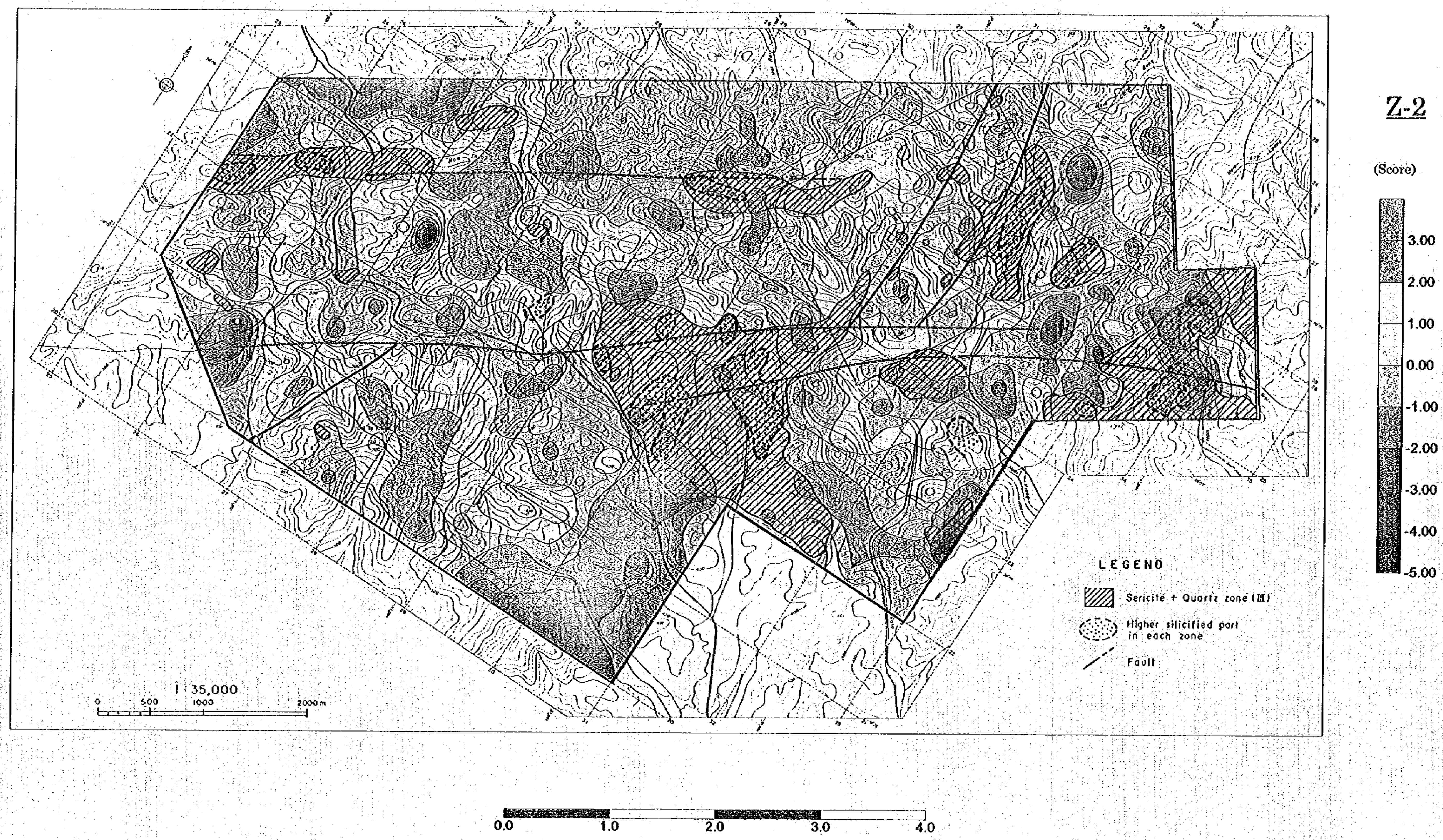
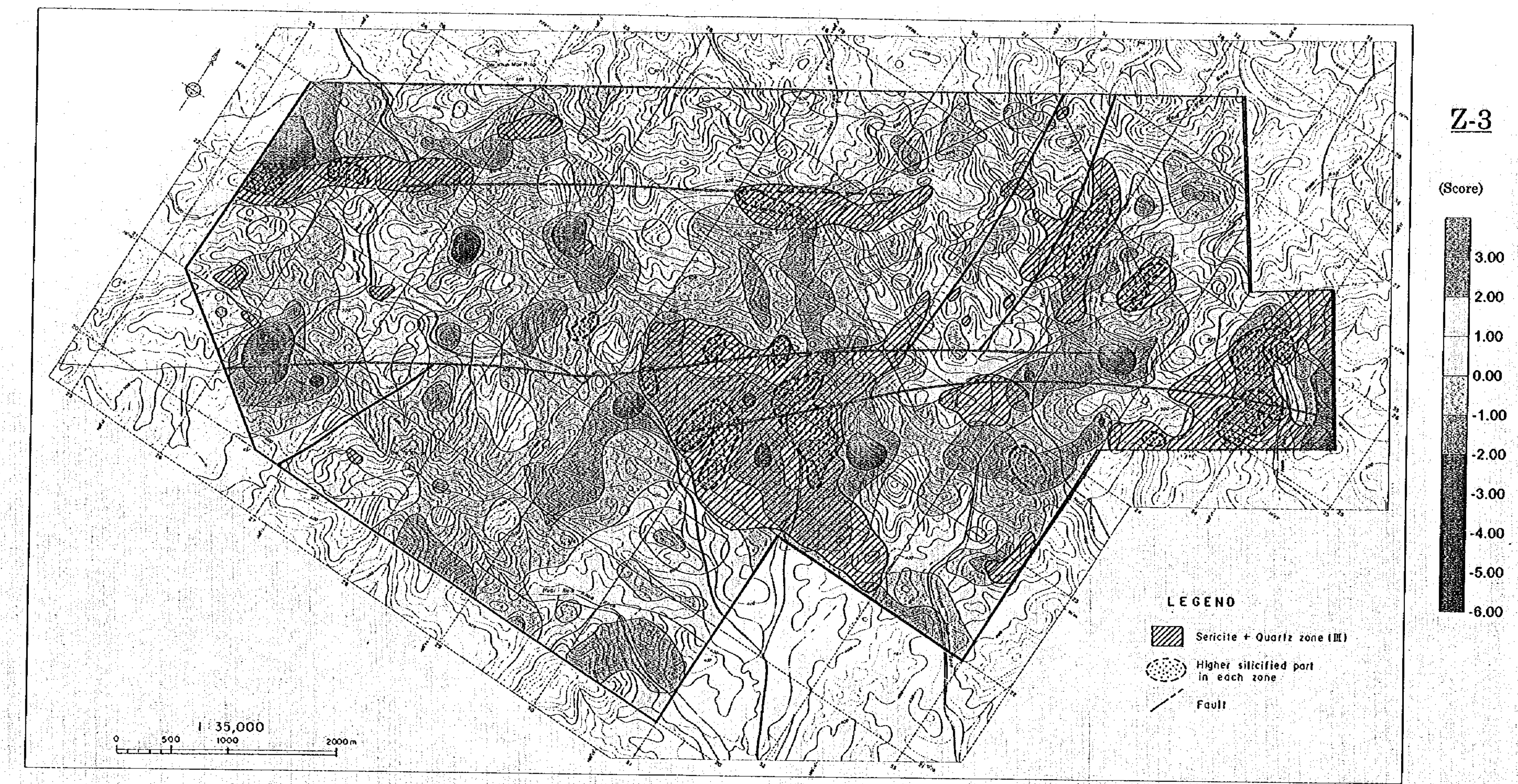


Fig. II-1-11.2 Z-2 Scores of principal Components Analysis in Whole Area



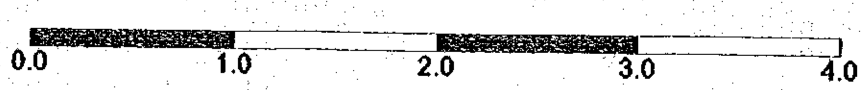


Fig. II-1-11.3 Z-3 Scores of principal Components Analysis in Whole Area

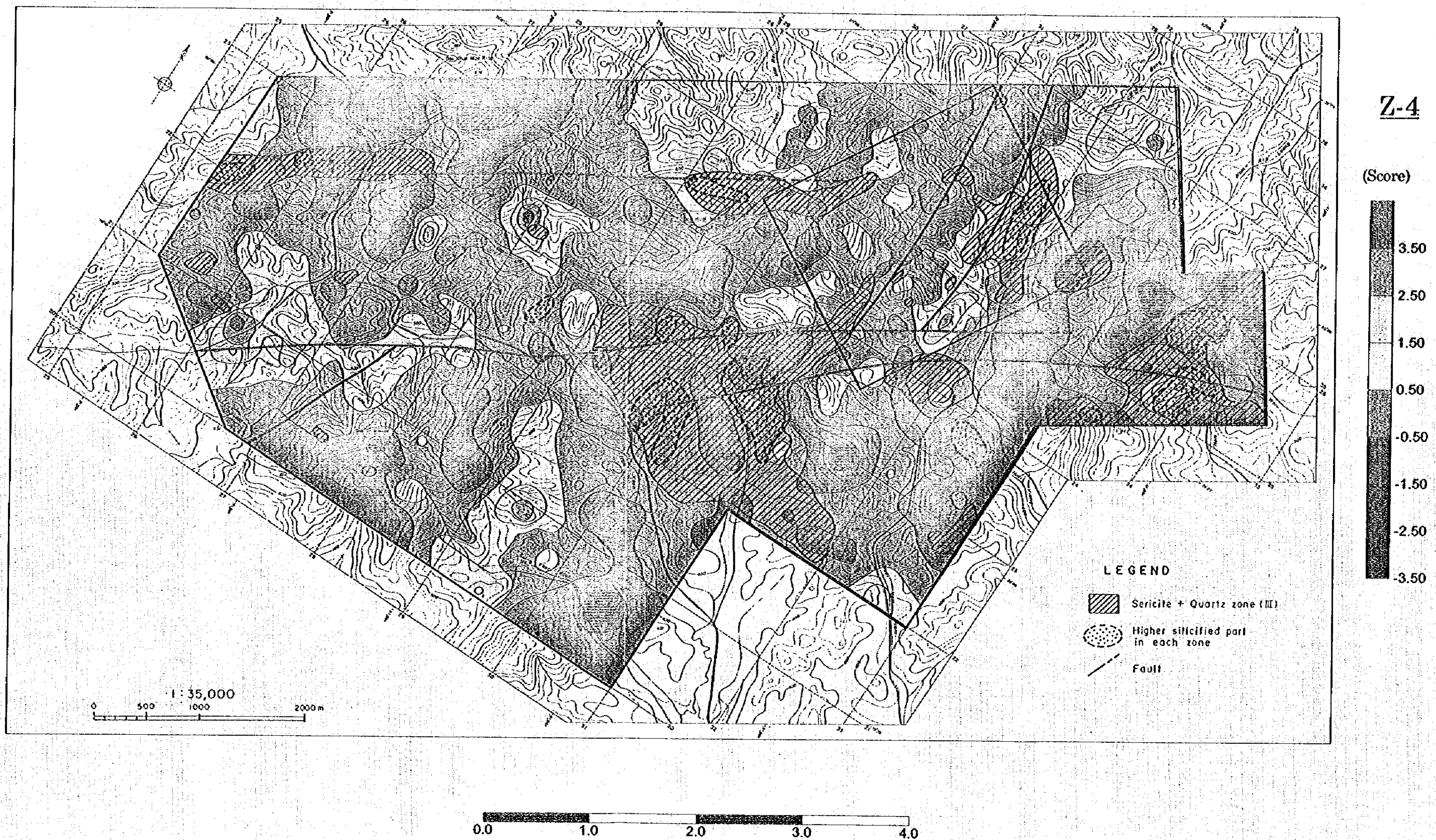


Fig. II-1-11.4 Z-4 Scores of principal Components Analysis in Whole Area

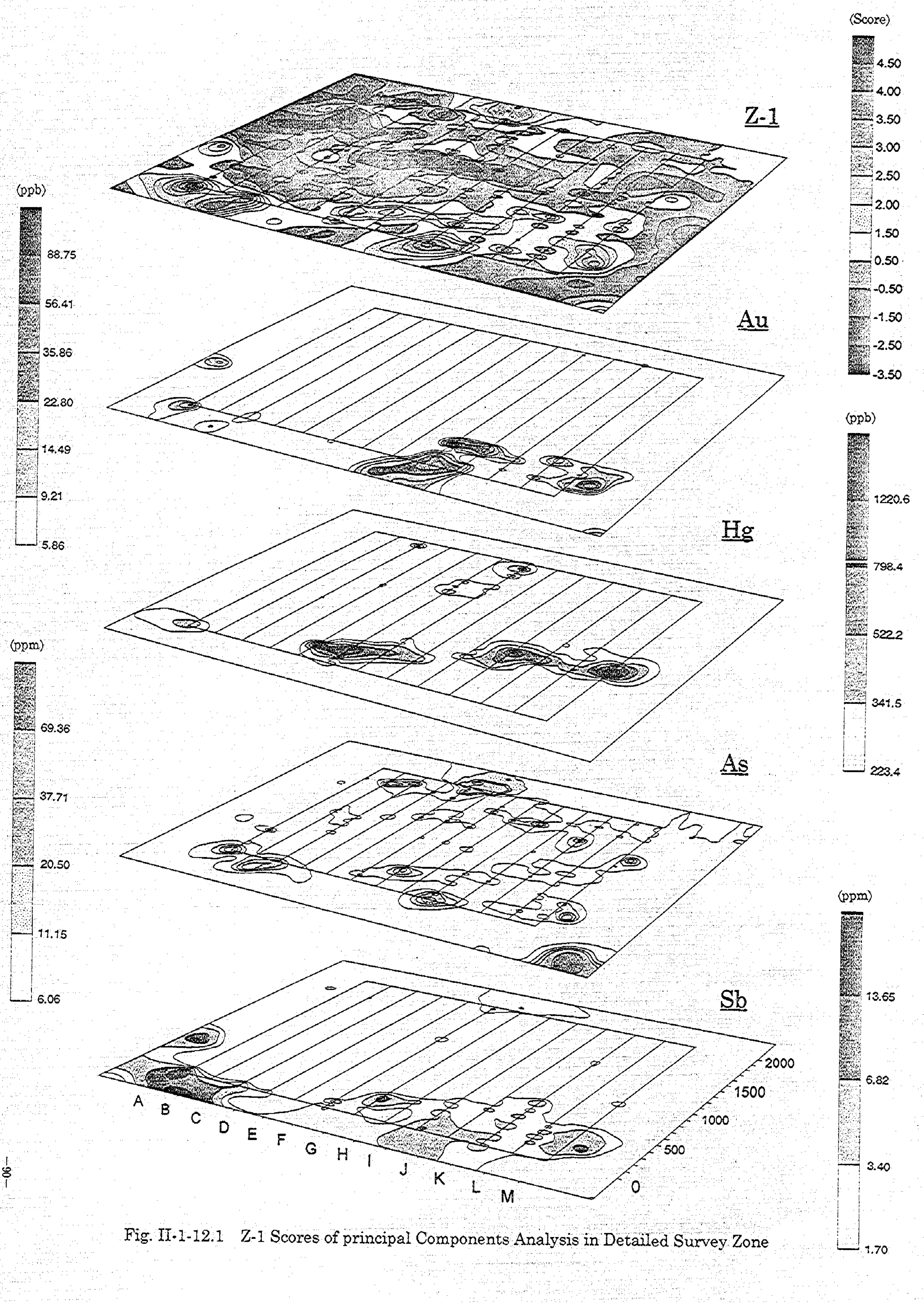


Fig. II-1-12.1 Z-1 Scores of principal Components Analysis in Detailed Survey Zone

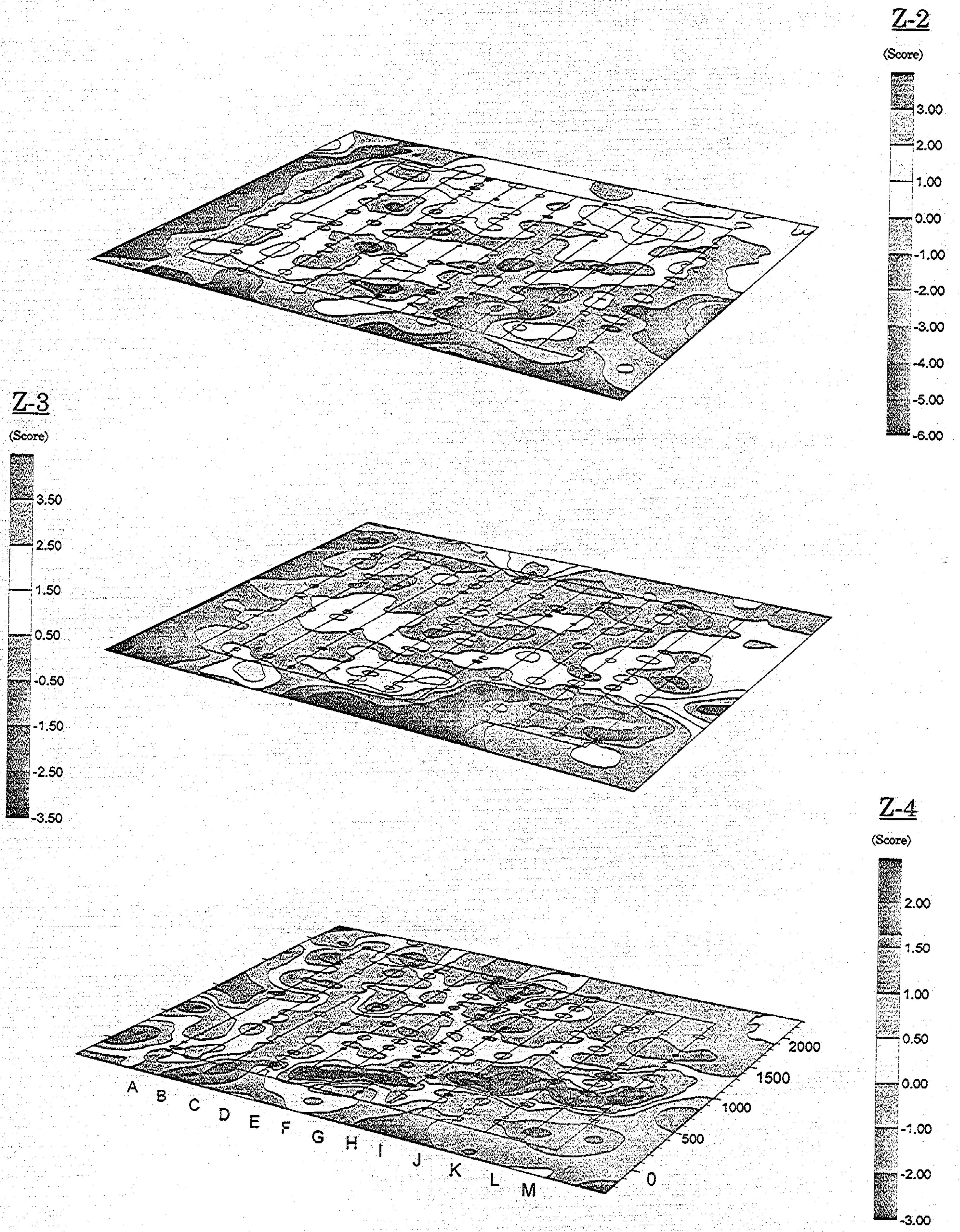


Fig. II-1-12.2 Z-2～Z-4 Scores of principal Components Analysis in Detailed Survey Zone presence of hydrothermal veins deeper down here.

1-6 Considerations

1-6-1 Consolidation of the Geochemical Survey

1) Geology and Geological Structure

The Chiang Khong Area is underlaib by the Permian sedimentary rocks; Permo-Triassic rhyolitic volcanic rocks, andesitic volcanic rocks; Triassic granite; Jurassic andesite; red sandstone and mudstones of Jurassic age; siltstone of Pliocene age; Plio-Pleistocene basalt.

Of these, in the area around the Upper Huai Nam Sala Area, which is the area covered by the Survey, Permian rocks (mainly slate (PRm), interleaved with sandstone and conglomerate (PRc)) and volcanic rocks of Permio-Triassic age (mainly rhyolitic volcanic rocks (PTr): welded tuff/lapilli tuff, andesitic volcanic rocks: tuff and tuff brecchia (PTt), interleaved with andesitic lava (PTa): plagioclase-porphoritic basalt (PTp), hornblende andesite (PTh)) occur; within these, throughout virtually the whole of the Survey Area, basaltic to dacitic intrusive rocks of Jurassic age (I) occur scattered in a NE-SW direction.

The mountainous regions and valleys in and around the Survey Area extend in a NE-SW to NNE-SSW direction, and a tendency was observed for the strata to continue in harmony with this direction. The respective strata generally occur arranged in bands in the structural direction described above.

That is to say, near the crest line and to the west of it sedimentary rocks of Permian age distribute, and on the slope on the eastern side of the crest line occur andesitic volcanic rocks of the Permo-Triassic age. The rhyolitic volcanic rocks of Permo-Triassic age underlay further east and are scattered on the eastern edge of the mountain mass, near the boundary with the basin.

Within the Survey Area two fault systems were observed, a N-S fault and a NE-SW fault. It is estimated that both fault systems have a perpendicular displacement, with the western or northwestern block relatively raised. The NE-SW fault is developed on the synclinal axis of the Permian rocks, and continues to the southwest part of the Survey Area. The N-E fault converges with the NE-SW fault, and is thought to be derived from this fault.

2)Alteration and Mineral Occurence

In addition to the widespread distribution of a white argillized zone accompanying silicification from the central part of the Survey Area to the northeastern part, the same kind of alteration zone occurs on both the western and eastern edges of the Survey Area. These zones of alteration are distributed in harmony with the NNE-SSW and NE-SW faults that are developed in the same areas.

While there is some difference in the strength of silicification, the alteration zooning are classified from the centre outwards into zones of weak acidic to neutral alteration and display a progressive structure, ie., sericite + quartz zone; sericite + kaolinite ±quartz zone; sericite + montmorillonite ±kaolinite ±quartz zone; montmorillonite zone; zone of weak or no alteration. The Permo-Triassic tuffs is undergone by alteration, but also extends to the lavas of the same age and the Permian sedimentary rocks.

In the Survey Area there are no ore mines in operation nor any areas with mineral prospects ready to be mined; but silicified rocks accompanying quartz veins, quartz vein floats and pyrite dissemination were observed together with the zones of alteration mentioned above.

The alteration and mineral occurence are mainly distributed around the Huai Kiu Hok to Huai Kha La and Nam Pong Ngao to Huai Kiang on the eastern edge of the Survey Area; Nam Khon Kaen to Huai Nam Sala in the central part; on and around Mt. Doi Huai Nam Sala, in the northern part; and on and around Mt. Doi Huai Rong Bong in the western part. The above-mentioned alteration zoning was observed in each case, although there were varying degrees of strength and weakness.

The alteration around the Huai Kiu Hok to Huai Kha La develop along the NNE-SSW fault, and are developed mainly on the eastern side of the fault. On the eastern ridge of Huai Kiu Hok and the eastern ridge of Huai Kha La there is a sericite+quartz zone accompanied by a not very large area of strong silicification, and around that a zone of sericite+kaolinite ±quartz, and this continues through a zone of sericite+montmorillonite ±kaolinite ±quartz to the zones of alteration of the Nam Khon Kaen/Huai Nam Sala rivers. The altered country rocks are mainly tuff of Permo- Triassic age, but silicification and pyrite mineralization replacing hornblende were also observed in the hornblende andesitic lava of the top part. In this area, in a N10 to 25° E direction, a quartz vein accompanied by druse with a width of 10-30cm occurs as outcrops and floats. Ore assay produced no significant values for Au, but in the brecciaed limonite-quartz vein in the small creek near Line J/700m on the east bank of the Huai Kha La values were As=2,610ppm, Hg=8,440ppb, Sb=20ppm. Values for As and Hg were high, as in the samples with high concentrations of Au from the Nam Khon Kaen area, which will be described later; and it is anticipated that there is gold in the lower part of this vein.

The alteration on the Nam Khon Kaent to Huai Nam Sala are developed along the main NE-SW fault, and in the eastern part of the zone of alteration they spread N-S along the convergent NNE-SSW fault. The sericite+quartz zone occurs over a wide area, and a large strongly silicified part was observed. In the centre of the strongly silicified part there is a zone of strong silicification made up almost entirely of quartz, and in and around this area pyrite dissemination was observed. On the outside of that is a sericite+kaolinite±quartz zone. There are no outcrops of quartz vein, but many quartz veins with a width of 20 to 50cm, and silicified floats reaching up to 1m, were observed. The ore ssay results of the quartz veins and the floats of silicified rock in and around the zone of strong silicification in the upper reaches of a tributary of the Nam Khon Kaen river, produced the following values respectively: Au=5.63g/t, Ag=3.6g/t,As=5530ppm, Hg=10630ppb, Sb=120ppm:

Au=0.995g/t, Ag=1.8g/t, As=96ppm, Hg=70ppb, Sb=22ppm.

In the alteration zones in the Nam Pong Ngao to Huai Kiang area, rhyolitic welded tuff has undergone alteration. In the center is a strongly silicified sericite+quartz zone, and there is a gradual shift in order towards the outside, to a sericite + kaolinite±quartz zone then a sericite + montmorillonite ±kaolinite ±quartz zone, but the two outside zones have a narrow distribution. There are lots of floats of quartz vein and silicified rock. Two samples of strongly silicified rock taken from the ridge at the eastern edge of the Survey Area produced ore assay values in both cases of Au=0.02g/t, Ag=0.4g/t, and As=80ppm, 52ppm, Hg=160ppb, 10ppb respectively.

The alteration from Mt. Doi Huai Nam Sala to Mt. Doi Kha La spread in a long narrow strip along the NE-SW fault: there is a sericite+quartz zone in the northern part of Mt. Doi Huai Nam Sala, and encasing that a sericite+montmorillonite ±kaolinite ±quartz zone distributes as far as the environs of Mt. Doi Kiu Hok. Alteration has affected the Permian sedimentary rocks to the Permo-Triassic volcanic rocks. Many quartz veins with a width of 20 to 50cm and silicified floats50 to 150 cm in diameter were observed.

The alteration zone on and around Mt. Doi Huai Rong Bong lies on a southwestern extension of the fault that regulates the zone of alteration around Mt. Doi Huai Nam Sala, and extends along the fault. Andesite of the Permmo-Triassic age is strongly silicified and is frequently subject to massive pyrite dissemination.

3)Homogenization Temperature of Fluid Inclusion

The homogenization temperature of fluid inclusion for quartz veins occuring in the Survey Area has a mode value of 125℃ to 150℃, with little variation according to the location from which the samples were taken. The homogenization temperatures for quartz with the highest gold contentsample are also within this range.

In the quartz veins distributed on the border between Permian sedimentary rocks and andesitic rocks of Permo-Triassic age the evidence of boiling in hydrothermal solution was observed.

The quartz veins in the areas where rhyolitic welded tuff occurs had a mode value of close to 200℃.

4)Geochemical Survey

The soil geochemical survey carried out using the rectangular grid method in the detailed zone and the Ridge and Spur random method over the whole of the Survey Area made it clear that geochemical anomalies in Au and its intimate elements As, Sb and Hg occur in the eastern half of the Survey Area, and that there is a strong possibility of the existence of hydrothermal vein-type deposits containing gold.

The results of the principle component analysis show that Z-1, which is a factor related to gold mineralization, occurs in the upper reaches of the Nam Pong Ngao and the Nam Wai in the northeast part of the Survey Area, and also continues N-S from the eastern edge of the Survey Area to the southeast edge. It branches to the southwest along the NE-SW fault from near the upper reaches of the Huai Nam Sala, and once more continues in a N-S direction from near the zone of strong silicification on the tributary of the Nam Khon Kaen river. Also principle Z-4, which is a factor indicating a halo of the upper part of hydrothermal deposits, in the detailed zone occurs adjacent to the fault on the western side of Z-1. Apart from the places where it overlaps Z-4, Z- 1 is distributed along the streams and on ridges of a lower altitude than the ridges on which Z-4 occurs. There is a possibility that this reflects a vertical zonal structure of indicator elements suggesting gold mineralization.

If we look at the relationship of the distribution of the four elements Au, As, Sb and Hg, the relationship between altitude and the state of alteration shows that Hg is the element representing the uppermost halo, As is between Hg and Au, and Sb is below Au or shows a high temperature halo.

1-6-2 Considerations

Comprehensive map relating to the geochemical survey of the area of the Upper Huai Nam Sala are shown in Fig. II -1-13.1 and 13.2.

From the geochemical survey, geochemical anomaly zones showing the possibilty of the existence of gold ore deposits in the area were educed in the eastern half of the Survey Area. Principle component 1, which is thought to directly represent the presence or otherwise of a gold mineralization effect, and Z-4, which is thought to represent the upper halo of the hydrothermal effect, distribute regulated by the fault and fractures of the NE-SW system and the NNE-SSW fault deriving from it.

Z-1, which is a factor related to the gold mineralization effect, occurs in the upper reaches of the Nam Pong Ngao and the Nam Wai in the northeast part of the Survey Area, and also continues N-S from the eastern edge of the Survey Area to the southeast edge. It branches to the southwest along the NE-SW fault from near the Upper Huai Nam Sala, and once more continues in a N-S direction from near the strong silicification zone on the tributary of the Nam Khon Kaen. This distribution does not match along the fault in the geological survey but is shifted to the eastern sidematching basic directionality. As for its relationship with the alteration zone, in and around the detailed zone there is wider distribution corresponding to weaker alteration zone than the sericite+quartz zone where the alteration is stronger than in any other part of the Survey Area.

If we look at the distribution of anomalous values for the single element Au, they develop in and around the strongly silicified sericite-quartz zone. In the Khon Kaen alteration zone where the highest values in ore assay were obtained and a strong silicified sericite+quartz zone develops, the distribution of Z-1 is narrow, and the geochemical concentration of gold is also low.

The geochemical anomalous values that spread out corresponding to this alteration zone are those of Sb; and it is thought that the geochemical anomalies of Sb alone indicate the distribution of silicified zone rather than the gold mineralization effect itself. Near to the highest grade of quartz vein, geochemical anomalies in As are found, and it is deduced that the zones of anomaly in As and Au show areas of gold mineralization originating in comparatively shallow parts.

Hg is a volatile component and easily sublimated, and is an indicator element representing the upper halo of subsurface hydrothermal deposits. Z-4, which has a large factor loading in Hg, is distributed adjacent to the fault on the western side of the distribution area for Z-1 in the detailed zone. Topographically it occurs at higher altitudes than the distribution area for Z-1, and while there are no anomalous values for Au, geochemical anomalies in As belong here. The limonite-quartz vein showing the brecciaed structure of the creek near Line J/700m has a low Au content, but same as the highest grade quartz vein the values of As and Hg are high.There is a strong possibility that gold is concentrated under the ground. From these observations it is anticipated that in the lower parts of the areas of distribution of Z-4 lie subsurface hydrothermal veins containing gold.

The homogenization temperature of fluid inclusion in the quartz veins has a mode value of 125 to 150℃, showing that there was boiling around these temperatures. The above-mentioned temperatures are lower than the average deposition temperatures for gold, and there is also a strong possibility of gold deposition at lower part under theground. The quartz veins that are thought to have boiled have deposits of the Permian sedimentary rocks in the area bordering the upper layer of volcanic rocks, and it is thought that the temperature at which boiling took place was around 150℃. This means that there is also a strong possibility of gold deposits in quartz veins in fissures within the sedimentary rocks.

Taken together, these results narrow down the promising prospecting sites from this phase of the geochemical survey to six sites thought to have mineral prospects in gold in comparatively shallow locations, and four sites where it is expected mineral prospects in gold lie subsurface.

The prospective sites may be arranged as below:

Prospective Site	Reasons for Selection	Unfavourable Conditions
S-A	Presence of maximum grade quartz veins, state of alteration good. The homogenization temperature is low. Anomalies in As, distribution of Z-4.	The closeness of the base rock means there is a strong possibility that the underground quartz veins are narrow.
S-B	Distribution of maximum values in soil samples, located in the border area with parts of strong silicification.	
S-C	Overlapping of anomalous values for Au, As; border area with strongly silicified sericite-quartz; extension of quartz veins	
S-D	Overlapping of anomalous values for Au, As; extended area of zone of strongly silicified sericite-quartz	State of alteration, geology oscure Prospective Site

Prospective Site	Reasons for Selection	Unfavourable Conditions
S-E	Overlapping of anomalous values for Au, As, Sb; many fine quartz vein floats	State of alteration, geology obscure Prospective Site
S-F	Overlapping of anomalous values for Au, As, Sb; extended area of S-B, S-C	
D-A	Zone of strongly silicified sericite-quartz; distribution of quartz veins, brecchia-type limonite quartz veins; anomalous values in Hg; veins with high Hg, As; homogenization temperature in surrounding area is low.	
D-B	Distribution of anomalous values in Hg, As	State of alteration, geology obscure Prospective Site
D-C	Anomalous values in Hg; border area with zone of strongly silicified sericite-quartz	
D-D	Strong anomalous values for Hg in border area with zone of strongly silicified sericite-quartz; anomalous values in As in surrounding area	Distribution of high concentrations of base metal; possibility of high homogenization temperatures

Apart from these prospective sites, there are high anomalous values for Au and As on the right bank of the Nam Wai river on the eastern edge of the Survey Area, and with regard to the state of alteration too, there is widespread distribution of zones of sericite-quartz. The greater part of the zone of mineralization appears to be eastwards outside the Survey Area, and there is a need for a further survey to be carried out here.

As can be seen in Fig. II-1-13.2, in the detailed zone principle component 1, principle compoment 4 and anomalous values in Hg and As occur in the area from Line A/1000m to the end of Line H and at the ends of Lines B and C. This is an area of Permian base rock, and it is thought that the anomalous values here represent the existence of fractures within the base rock. Since it was shown by the measurement of the homogenization temperature of fluid inclusion that ore solution boiling has taken place in the border area between the base rock and the overlying volcanic rocks, there is a strong possibility that gold deposition has occurred in quartz veins within the base rock. It is considered unlikely that quartz veins within the base rock would be of any great width, but they would be well worth prospecting.

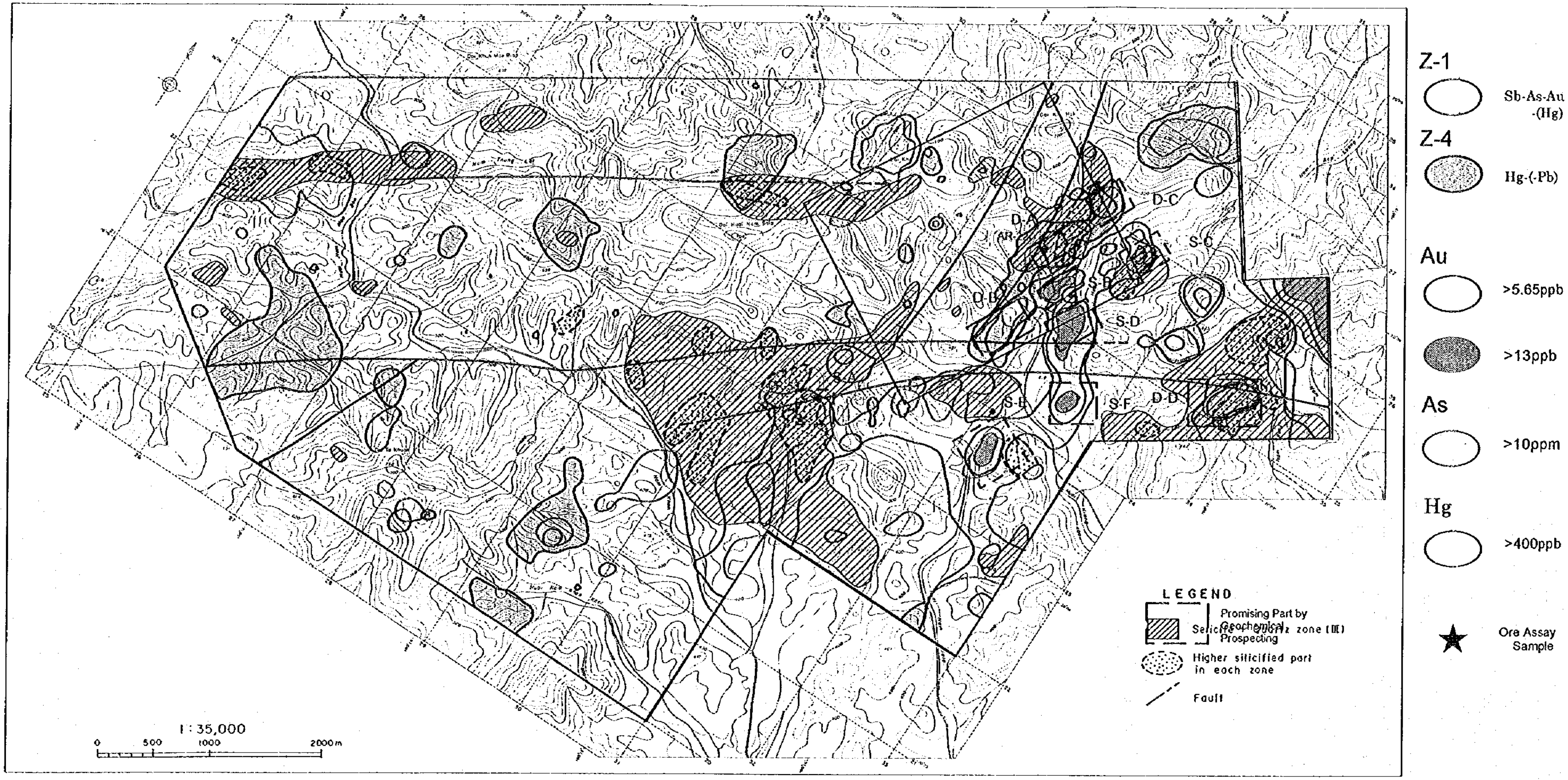


Fig. II-1-13.1 Geochemical Comprehensive Map of Whole Area

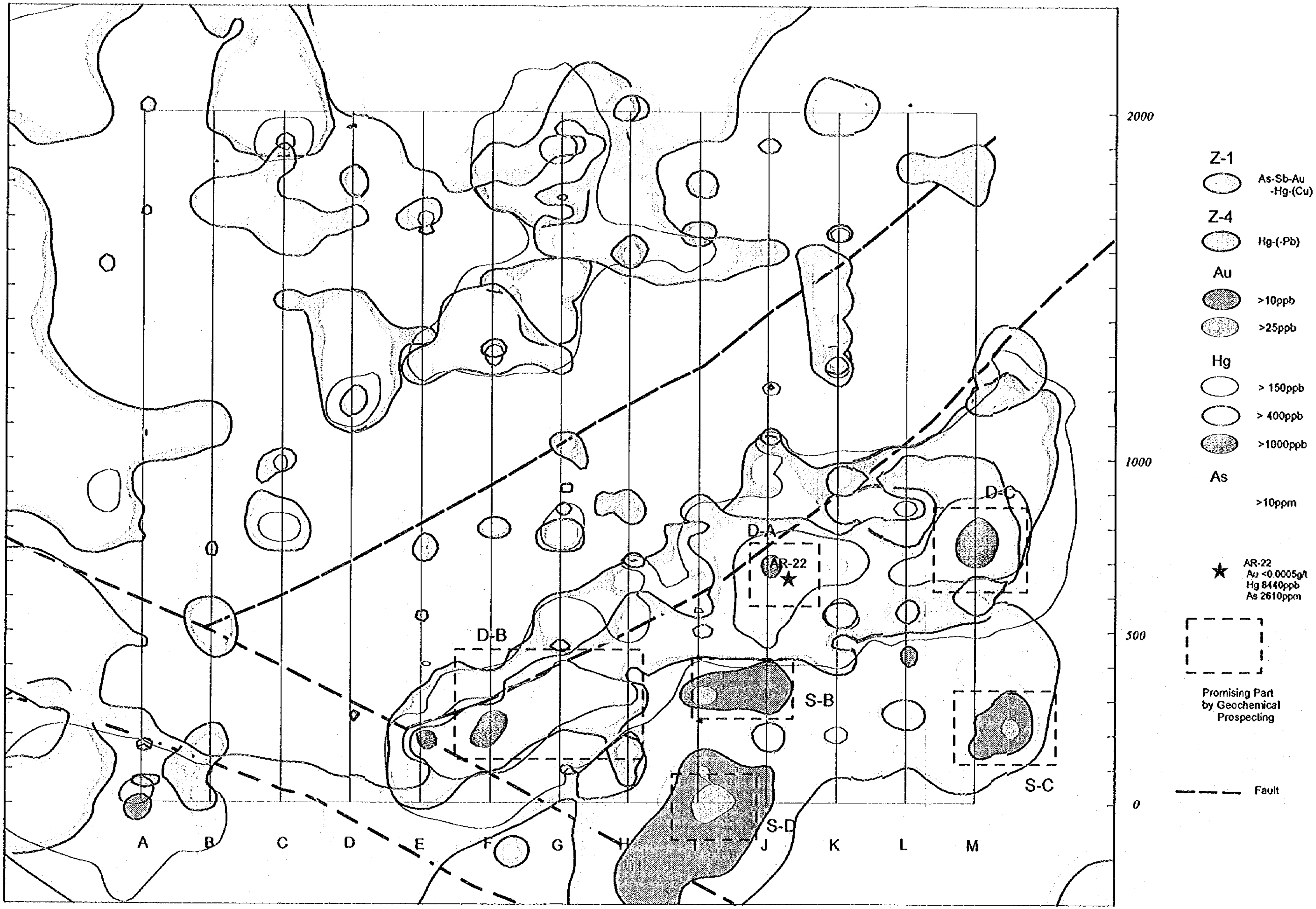


Fig. II-1-13.2 Geochemical Comprehensive Map of Detailed Survey Zone

CHAPTER 2 GEOPHYSICAL SURVEY

2-1 Method of Survey

2-1-1 Method of Measurement

As shown in the map indicating the location of survey area in Fig.II-2-1, 13 of the geophysical survey lines extending 2.0 km length and drawn at intervals of 200m were established. The direction of the survey lines is N6° W. A total of 21 measurement points at intervals of 100 m was also set up on the survey line. The measurement points and survey lines are shown in the map in Fig.II-2-2.

The array CSAMT method (Controlled source audio-frequency magneto-telluric method) was carried out in the survey area. The CSAMT method works on the same measuring principle as MT method(Magneto-telluric method) and AMT method (Audio-frequency magneto-telluric method). Electromagnetic waves in the atmosphere penetrate into the subterranean and produce the phenomena of electromagnetic induction correspond to the subterranean resistivity structure. The manner of the electromagnetic method is that constructs of the resistivity structure of the subterranean by measuring the changes of electromagnetic fields on the subterranean.

It is known that the electromagnetic wave signals in low frequency zones have high permeability even though with low resolving power and in high frequency zones have low permeability with high resolving power. That measuring the electromagnetic waves in both high and low frequency zones, taking advantage of these essential qualities, enable to investigate the resistivity structure of subterranean from the shallow to deep zones.

In the case of the subterranean resistivity structure is a homogeneous or horizontally multi-layered structure, the following relation between the horizontal electric field and horizontal magnetic field which crosses it perpendicularly is effected, thus, the subterranean resistivity structure can be obtained by measuring the electromagnetic field in various frequency at each survey point.(Cagniard, 1953)

$$\rho_{XY} = \frac{1}{\mu\omega}\left|\frac{E_X}{H_Y}\right|^2 \quad \cdots\cdots\cdots\cdots\cdots \quad (1)$$

Where,

ρ_{xy}: apparent resistivity(Ωm)

μ : free air magnetic permeability ($4\pi \times 10^{-7}$ H/m)

ω : angular frequency (rad/s) $\omega = 2\pi f$

Ex: electric field intensity (mV/km)

H_Y: magnetic field intensity which crosses perpendicularly in the direction of electric field measurement (γ)

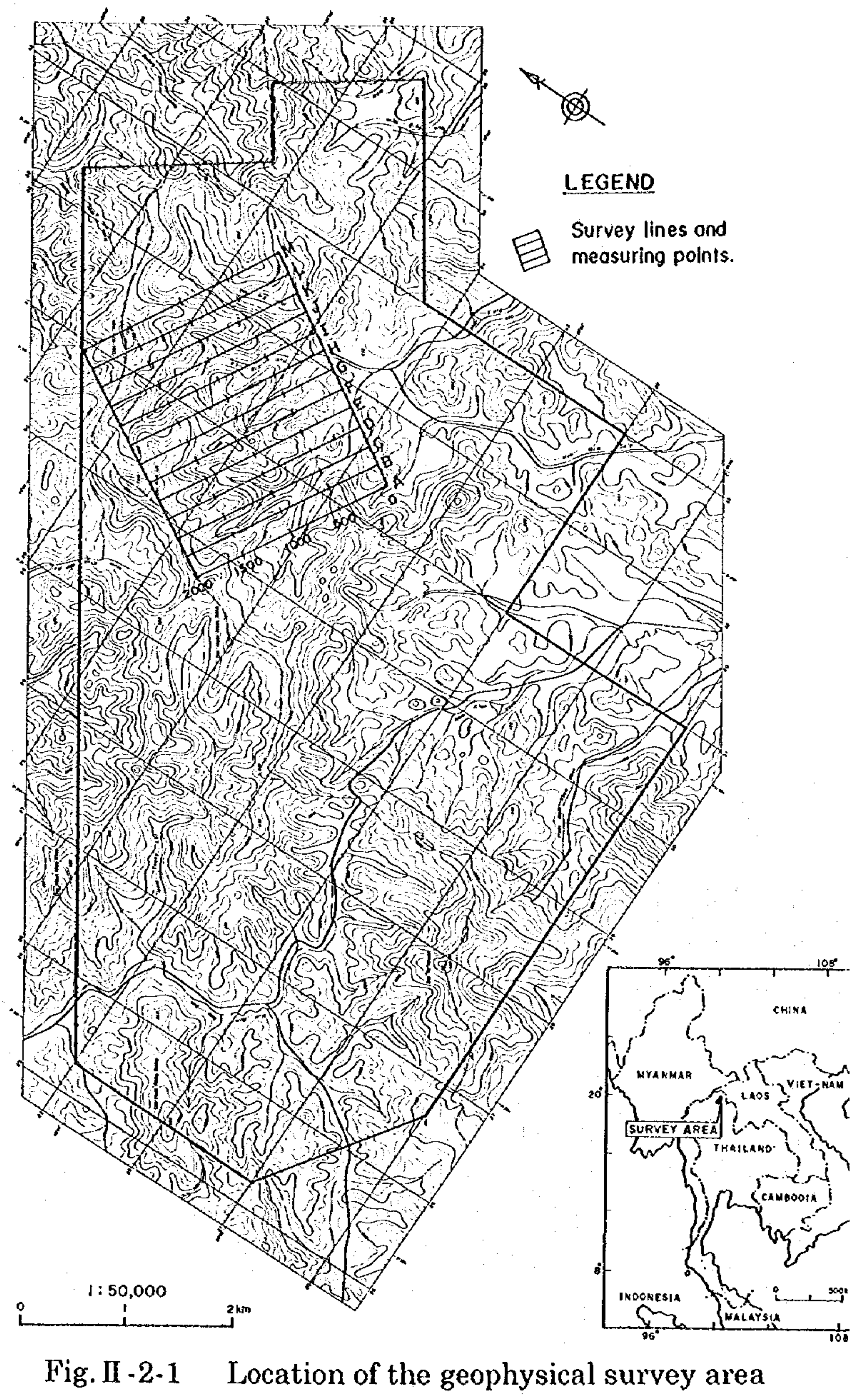


Fig. II-2-1 Location of the geophysical survey area

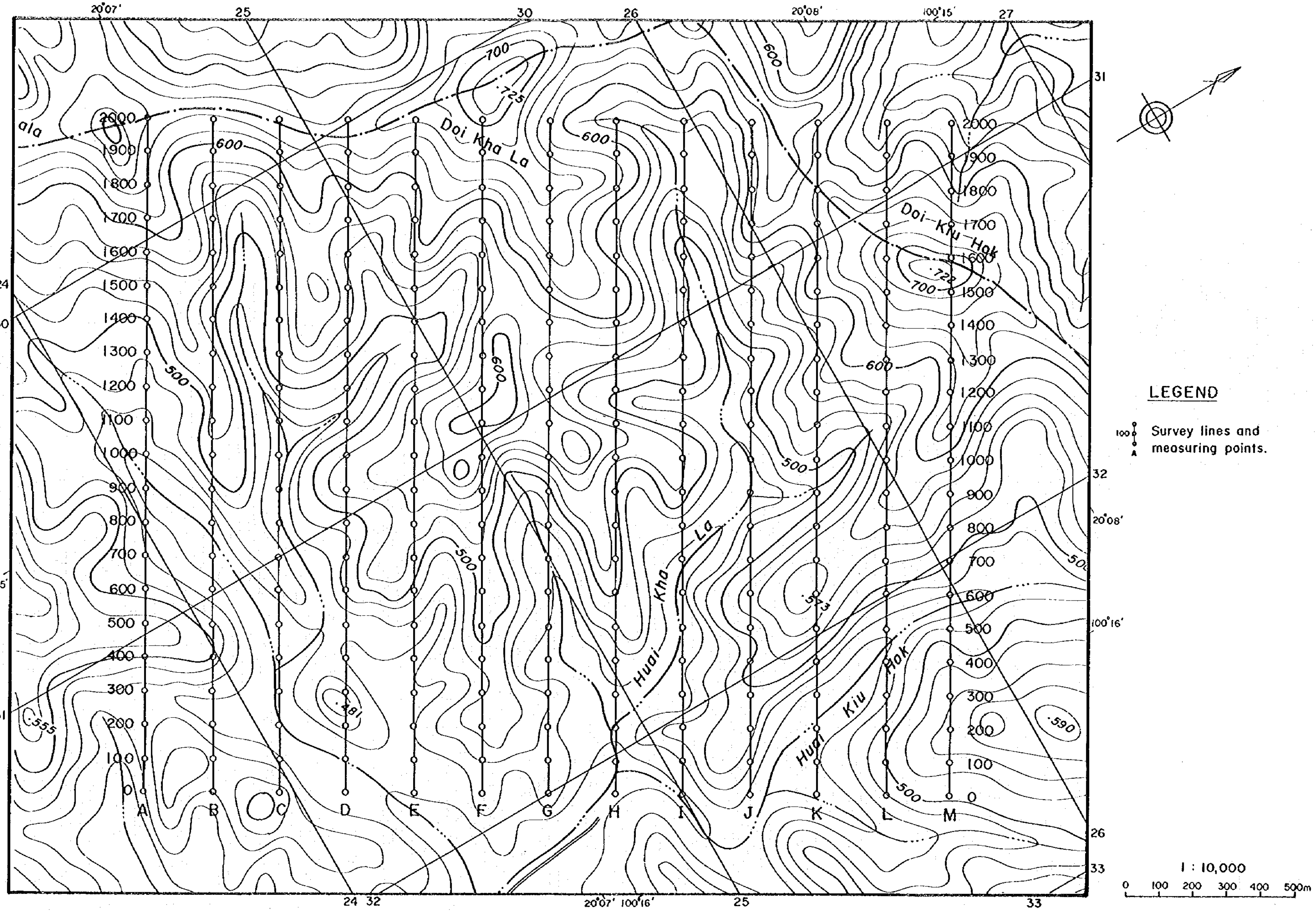


Fig. II-2-2 Location of the survey lines and measuring points

Any difference between the MT and AMT methods and the CSAMT method is that the MT method is objecting to the phenomenon of electromagnetic induction as the signal source, which associates with lightning discharges or solar activities occurring in the natural world. In contrast to the MT and AMT methods, the CSAMT resorts to the electromagnetic waves generated artificially as its signal source instead of the natural signal source, while the MT and AMT methods object to the weak natural signals for measuring. The CSAMT method objects to the artificial signal source so that this method is strong against noise and the effective measurement can be carried out even in a short time. However, equation (1) is effective only when the distance between the signal source and the survey point is far apart, that are the electromagnetic waves must be plain waves. For this reason, with the CSAMT method, the area (Far field) which the signals can be assumed as the plane waves, the area (Near Field) which the signals cannot be assumed as plane waves and the middle area (Transition zone) is produced. Thus, equation (1) cannot be applied except for the far field.

The distance from the signal source where the signals can be used as the far field is dependent on both the measuring frequency and the subterranean resistivity value. In other words, the high frequency signals deteriorate rapidly as the distance increases, nevertheless, the signal source becomes less effective sharply, the low frequency signals can be carried a farther distance so that the signal source is to be affected in a wide range. Also, diminishing of the electromagnetic waves in the area with high resistivity zone is limited but rapidly decreases in the area with low resistivity zone. Generally, the distance from the signal source that can be treated as the far field is said to be about 3 to 4 times of the skin depth. The relationship between the skin depth (m), the measuring frequency f (Hz) and the subterranean resistivity value ρ (Ωm) is expressed by the following equation:

$$\delta = 503 \times \sqrt{\frac{\rho}{f}} \quad \cdots\cdots\cdots\cdots\cdots\cdots (2)$$

Here, δ is called a skin depth, which indicates the depth (m) where the amplitude of signals observed on surface of the earth becomes l/e (63%) after penetrating into underground.

In this survey, a grounded dipole line which length was 3,850m with both ends grounded was provided to the south west of the survey area running parallel to the direction of the survey lines as the signal source. The distance to the survey line A which is shortest was 4,100 m and to the survey line L was 6,100 m. The measurement was carried out by applying the electric current of 13 frequencies between 4,096 Hz and 1 Hz as shown in Table II-2-1. The current range was from 1 A to 4.4 A. The map showing the location of the ground dipole lines is shown in Fig.II-2-3.

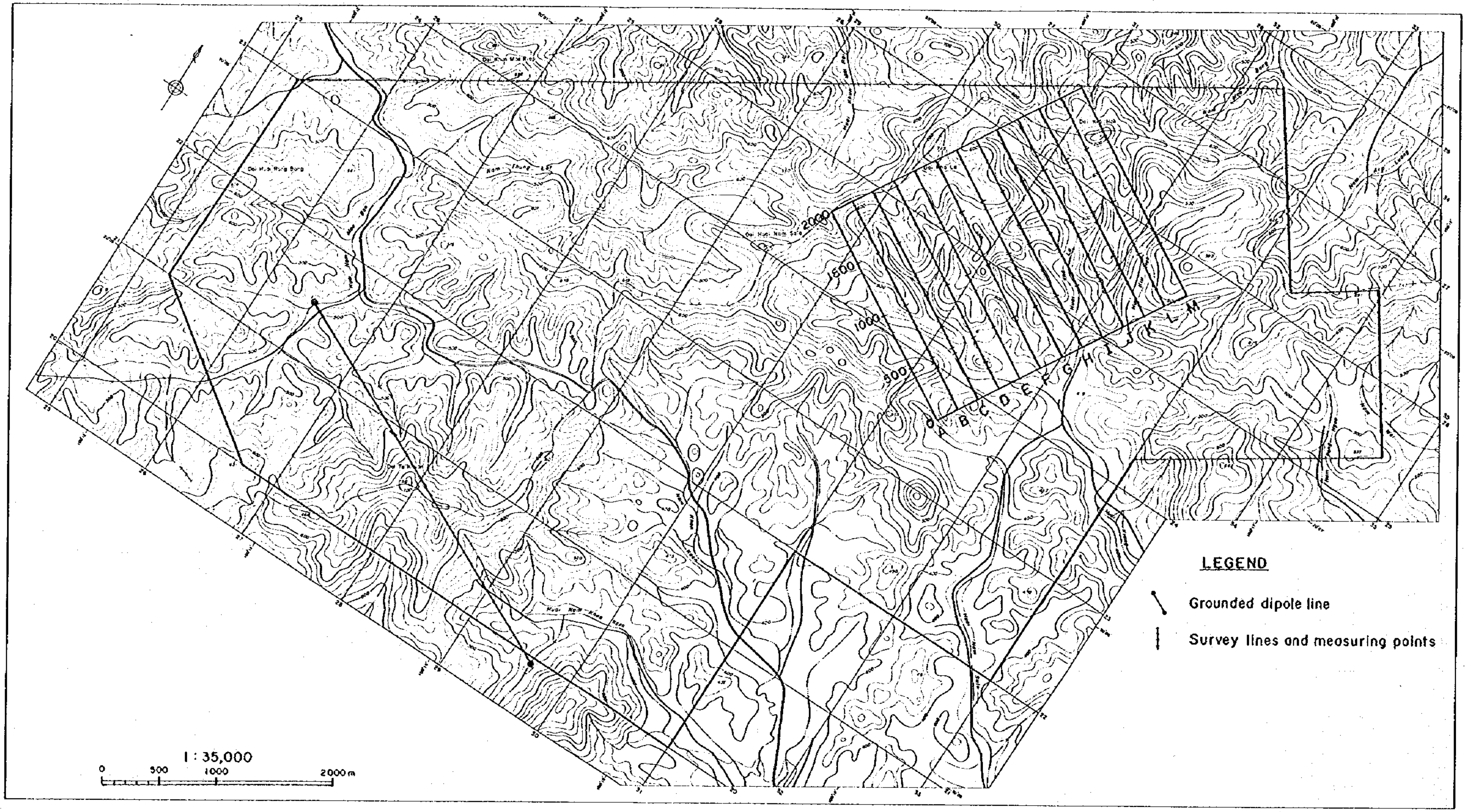


Fig. II -2-3 Configration of the grounded dipole line and survey area

Table II-2-1 Frequency table of CSAMT measurement

No.	Frequency(Hz)	No.	Frequency(Hz)
12	4,096	5	32.00
11	2,048	4	16.00
10	1,024	3	8.00
9	512.0	2	4.00
8	256.0	1	2.00
7	128.0	0	1.00
6	64.00	—	—

That the electric fields (100 m between the electrodes) run along the survey lines that were set up previously, the magnetic field that crosses it perpendicularly, the apparent resistivity at each survey line and the phase difference between the electric and magnetic fields were all measured. The electric field was measured simultaneously at 7 survey points, for which the array method measuring in the center of the magnetic field was adapted to increase its efficiency.

The schematic illustration of the CSAMT method is shown in Fig.II-2-4 and the list of equipment is shown in Table II-2-2.

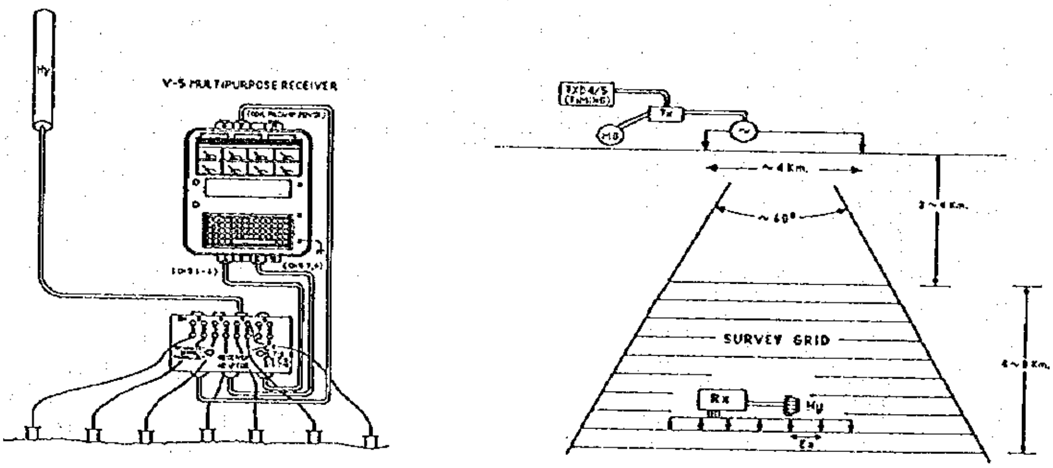


Fig.II-2-4 Field layout of CSAMT survey

Table II-2-2 List of equipment

Description	QTY	Specification
Multipurpose receiver V5-16	1	16Bit 500kHz A/D,Sensitivity 0.2μV
Induction coil AMT-25	1	Sensitivity 100nV/nT
Transmitter IPT-1	1	DC~10kHz、3kVA、10A-max
Porous pot Pb-$PbCl_2$	20	Noise level < 100nV
Portable computer	1	Pentium 90MHz、16KHz RAM

2-1-2 Method of Interpretation

All of the interpreted resistivity plane maps and cross sections were made based on the results of two-dimensional inversion interpretations. It is because that the apparent resistivity value measured by the CSAMT method include in the topographical effects where the abnormal electric field failing to correspond with the actual subterranean resistivity structure, and the locally abnormal resistivity on the surface of the earth. These are called a static shift and are the problem caused by the two-dimensional resistivity structure. It could not be evaluated by one-dimensional interpretation assuming the horizontally multi-layered structure, resulted in showing the incorrect resistivity structure.

(a) Topographical Effects

Topographical effect is caused by the distorted telluric current flow into the direction of the electric field being measured that is occurred by topographical changes. The telluric current flow density increases in valley terrain. As a result of this, the density of the equipotential line is increased, and the measurement potential difference is also increased. What's more, it forms the high apparent resistivity anomaly, nevertheless, in the mountainous terrain, the telluric current density decreases and forms a low apparent resistivity anomaly. The low apparent resistivity anomaly is formed in convex terrain, and the area where topographical inflected, the high apparent resistivity anomaly is formed. In concave terrain, the high apparent resistivity anomaly is formed. Such topographical consequences are inordinately great in the apparent resistivity values of the CSAMT method.

(b) Effects of Local Resistivity Anomaly

The effect of local resistivity anomaly on the surface of the earth is that when the survey point is located in a local resistivity zone in the subterranean shallow zone. The apparent resistivity curve shifts parallel to either the high resistivity or low resistivity side, corresponding to the resistivity values of the local anomaly, so that the apparent resistivity curve can not show actual subterranean resistivity structure. Such effects may occur in the survey methods that the apparent resistivity structure is obtained by measuring the electric field, not only the CSAMT method but also the direct current electric method. Generally, in the direct current electric method, the distance between the electrodes is gradually extended to get the deeper information so that all the measurement data cannot be affected. However, the electromagnetic method that obtains the deeper information by changing the frequency without moving the potential electrodes, may result in that all the data from high frequency to low frequency are influenced by static effects.

Topographical effects can be assessed by carrying out two-dimensional interpretation allowing for topography. Unless combined with an investigation method that measures only the magnetic field without measuring the electric field, such as the transit electromagnetic method (TEM), an objective evaluation cannot be obtained. However as this phenomenon is a problem that only affects the apparent resistivity and not the phase difference, the influence can be assessed to a certain degree from phase difference section diagrams. Also, by establishing measurement points continuously along the survey lines, a relative assessment can be obtained by comparing the measurement results of adjacent measurement points. Furthermore, interpretation that includes the static effects to a certain degree can be carried out by conducting two-dimensional interpretation along the survey lines.

(c) Two-Dimensional Interpretation

Two dimensional inversion interpretation is a repetitive interpretation method that combines forward modeling by the finite element method with automatic interpretation by the method of nonlinear least squares approximation. When the subterranean structure cannot be approximated a horizontally multi-layered structure, it is impossible to conduct adequately interpretation by using such as one-dimensional interpretation which cannot take into account the effects of resistivity changes in the profile line direction. Therefore it is necessary to use two-dimensional interpretation which can include the effects of resistivity discontinuous boundaries in the survey line direction.

In two-dimensional interpretation, the subterranean structure is divided at resistivity blocks. In the past, a resistivity model was made which applied the presumed resistivity block values, and a comparison was made of the theoretical values calculated from the resistivity model and the actual measured values. Forward modeling was attempted in which a model showing the results nearest to the measured values was assembled by trial and error. But this method had problems, such as the inclusion of the arbitrariness of the interpreter in the interpretation results. The two-dimensional inversion interpretation method used in our interpretation enables objective interpretation results to be obtained without regard for the arbitrariness of the interpreter, by using an automatic repetitive interpretation method where the resistivity values applied to each block are assumed by the method of nonlinear least squares.

Using the CSAMT method, a resistivity block boundary was established at each measurement point and a quadrilateral resistivity block was prepared in which the blocks were divided so that they were thin in the shallow zone, gradually becoming thicker towards the deep zone. They were deformed in conformity with the topography of the surface of the earth, forming resistivity blocks whose shape was parallel to the topography in a horizontal direction.

When resistivity values are applied to each of these resistivity blocks, the apparent resistivity and phase difference curves at each measurement point are obtained as the surface response corresponding to the subterranean resistivity structure by forward modeling according to the finite element method. To minimize any remaining difference between the surface responses and the measured values, the values of the resistivity blocks were found by automatic repetitive interpretation according to the method of nonlinear least squares. The resistivity block values from the first repetitive interpretation (initial guesses) were taken to show a subterranean homogeneous structure with the same resistivity values and the influence of the initial values on the interpretation results was eliminated.

The one-dimensional inversion interpretation which presupposes the horizontally multi-layered structure carried out the interpretation at all measurement points allowing for the influence of transmission source, and these results are shown in the appendix.