2-4 SAN CLEMENTE Area

2-4-1 Particulars in the Past Survey

During the regional geological survey of the first year, gold mineralization was observed in a part of rhyolitic rocks dominantly distributed in the area, in which small-scale exploration work by hand had been being carried out in the San Serveriano mine.

The occurrence of gold ore of the mine is different from the ordinary vein type deposit showing neither notable silicification nor hydrothermal alteration. Gold occurs along irregular tiny cracks in relatively fresh rhyolite as very fine grains of electrum which contains about 25 percent of silver, showing the occurrence which might be called a kind of network dissemination type. The whole 8 rock samples taken from every part of the rhyolitic rocks of the area showed the assay value more than Au 0.11 g/t which was considered geochemically anomalous (JICA & MMAJ, 1980).

In the survey of the second year, 379 rock samples were taken from the entire rhyolite mass distributed with the areal extent of approximately 2.5 km x 5.0 km, of which geochemical study was made on the main rock-forming components and each content of gold and silver, and in addition, detailed geological survey was conducted.

As the result, the rhyolitic rocks of the area were divided into four facies such as rhyolitic lava, rhyolitic tuff breccia, compact rhyolite and dyke, and it was made clear that although each content of K_2O and Na_2O varies with the change of rock facies, all the rocks belonged to alkaline rock containing about 8 percent of the two components in total. It was shown, moreover, that the most rock samples which contain golds belonged to compact rhyolite, in which Na_2O is concentrated in the range of 2.0% ∿ 4.0%, whereas K_2O in the range of 3.8% ∿ 5.6% on the side of higher content than 74.4 percent of SiO_2.

As described in the above, it was made clear that the gold mineralization was closely related to the activity of compact rhyolite, and at the same time, the occurrence of several A-class gold anomalies (more than 1.16 ppm Au) were detected.

Accordingly, it was directed, in this year, to obtain the information for investigating the value of exploration in future by performing more detailed geological survey and geochemical prospecting (rock sampling by 50-meters grid-spacing) for the three small target zones.

2-4-2 Location, Settlements, Topography and Vegetation

The area situated about 21 kilometers to the north-northeast of Ixmiquilpan City occupies an area of 14 square kilommeters with 3.5 kilometers width extending 5.5 kilometers in the NNE - SSW direction. The nearest villages are Santuario at the eastern end of the area and San Clemente about 2 kilometers to the west on the outside of the area. Both villages are small settlements each with several tens houses.

The topography is characterized by an independent mountain mass formed by rhyolitic rocks protruding in the center of the area. The highest point is the mountain top in the center of the area about 2,900 meters above sea level, and the lowest point is in the bottom of a creek at the southwestern end of the area with altitude of about 2,060 meters above sea level, being the difference of altitude as much as 840 meters.

The topography is generally steep at higher places than about 2,600 meters with precipitous cliffs on all sides. The lower places, however, show a relatively gentle landform with a gentle slope of the foot of the mountain mass. A steep landform is sometimes observed in a part along the creeks.

Vegetation is divided into thin wood of conifers on the higher side and xerophilous community consisting of cactus and agave on the lower side with the boundary of about 2,400 meters of altitude.

2-4-3 General Geology

Geology of the area consists of sedimentary rocks of Jurassic to Cretaceous, and Tertiary intrusive rocks and volcanic rocks which intrude or cover the sedimentary rocks.

The sedimentary rocks show a limited discontinuous distribution at its peripheral part, and they are divided into the Las Trancas Formation (Jts) and the El Doctor Formation (Kdf).

The Tertiary volcanic rocks consist of basaltic rocks (Tba 1) and rhyolitic rocks (Trhy 2), and the former covers the sedimentary rocks at the peripheral part of the area or occurs in the surrounding area of the latter in the form of window. The rhyolitic rocks, however, occupy the most part of the area forming the San Clemente mountain mass.

The intrusive rocks consist of diorite porphyry which intrudes the sedimentary rocks and is covered by volcanic rocks, and small dykes of basalt (Tiba), andesite (Tian), dacite (Tidc) and rhyolite (Tirh) which intrude basaltic rocks and rhyolitic rocks (see Fig. 2-4-1, Fig. 2-4-2, PL. 2-4-1 and PL. 2-4-2).

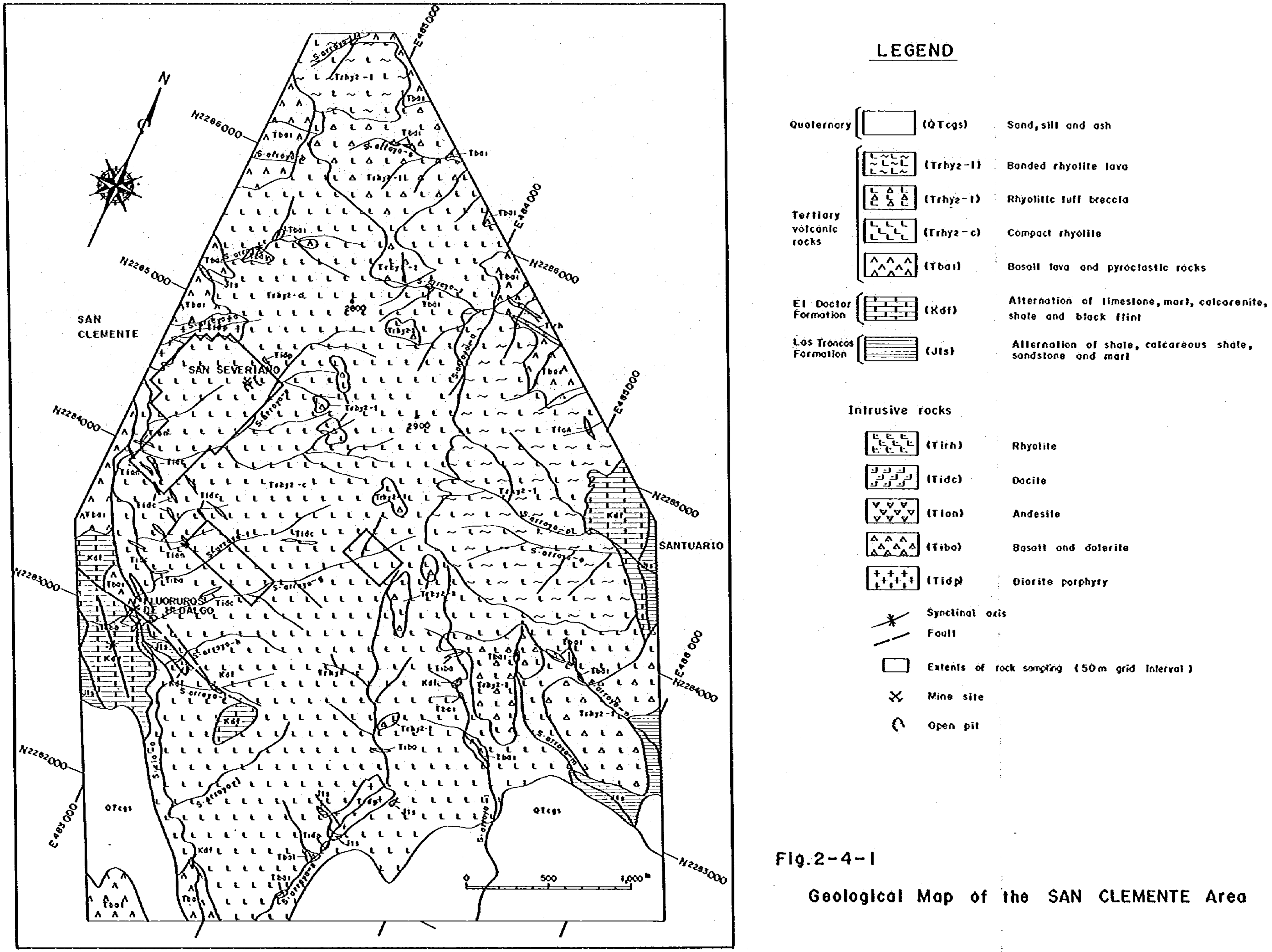
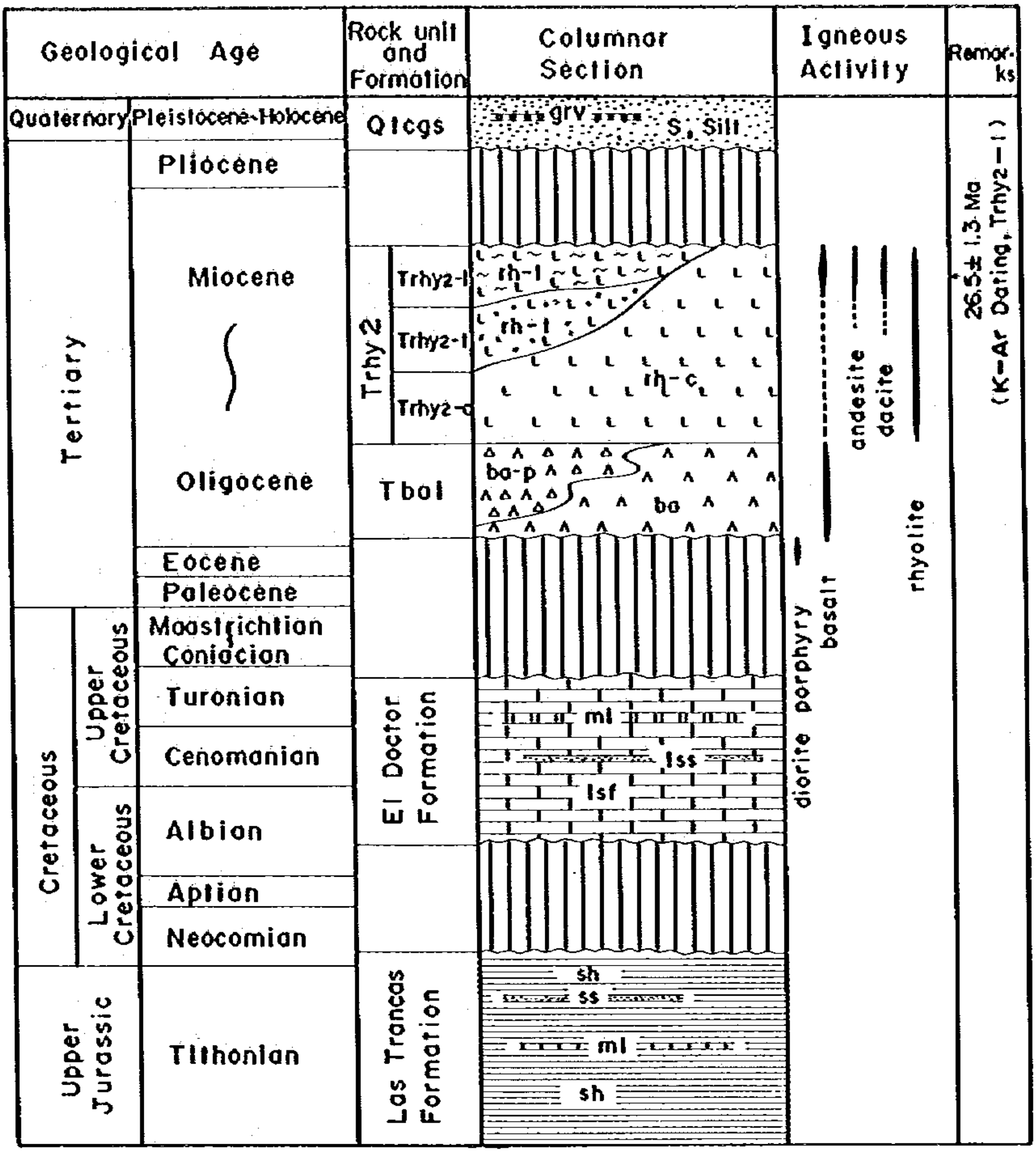


Fig.2-4-1

Geological Map of the SAN CLEMENTE Area



Abbreviations

grv	: gravel	ba	: basalt
s	: sand	lsf	: limestone with black flint
silt	: silt	ml	: marl
rh-l	: banded rhyolite	lss	: calcarenite
rh-t	: rhyolitic tuff breccia	ss	: sandstone
rh-c	: compact rhyolite	sh	: shale
p	: pyroclastic rocks		

Fig.2-4-2 Stratigraphic Column of the SAN CLEMENTE Area

[Sedimentary rocks]

Las Trancas Formation

It is discontinuously distributed on a small scale at the eastern end, the southeastern end and the southern end of the area. The rocks consist mainly of black to dark gray thin-bedded shale and intercalations of thin-bedded to medium-bedded calcareous sandstone and marl. The formation has been intruded by rhyolite at the southern end of the area and is covered by rhyolitic tuff breccia in the southeastern part. No marked hydrothermal alteration can be observed in the formation, but it is strongly weathered and eroded to have become soft and brittle.

El Doctor Formation

It is distributed at the eatern end and the southern end of the area on a small scale in the same way as the Las Trancas Formation. The rocks mainly consist of dark gray to gray medium-bedded limestone and marl and is characteristically interbedded with thin beds or lenses of black flint. It has been intruded by rhyolite at the southern end of the area and covered by rhyolite lava at the eastern end. Generally no recrystallization can be observed in it, and is fresh in appearance.

[Tertiary volcanic rocks]

Basaltic rocks

The rocks are mainly distributed discontinuously in the lowland along the creeks in the surrounding area of the foot of the San Clemente mountain mass. The rocks generally consist mainly of blackish gray to dark grayish green basalt with notable amygdaloidal structure and is partly interbedded with autobrecciated lava and volcanic breccia of the same source, and andesitic lapilli tuff.

Under the microscope, intersertal texture is observed, wherein colorless glass fills the interstices between the euhedral crystals of lath-shaped plagioclase, altered granular pyroxene and magnetite. Pyroxene and plagioclase have been replaced by chlorite and calcite as the result of brecciation and alteration. Especially, chloritization results in to show dark grayish green tint of the rock in many places of autobrecciated rock and volcanic breccia.

Andesitic lapilli tuff occurs in the northwestern part of the area as small intercalations in basalt lava. Under the microscope, the rock shows a texture that breccia of augite andesite and fragmental crystals of plagioclase and quartz are embedded in the glass shards.

These basaltic rocks unconformably cover directly the pre-Tertiary formations and are covered or intruded by other Tertiary volcanic rocks. They are the products of the ealiest activity among the Tertiary volcanic rocks found in the project district, and the time is considered to be from early to middle Oligocene.

Rhyolitic rocks (Trhy2)

The ryolitic rocks which forms the San Clemente mountain mass protruding in the central part of the area and occupies the most part of the area, is classified into four types such as (i) rhyolite tuff breccia (Trhy2-t), (ii) rhyolite lava (Trhy2-l), (iii) compact rhyolite (Trhy2-c) and (iv) rhyolite dyke (Tirh). Although these are the products of a series of activity, a delicate variation of each chemical composition indicates the relation of sequence among them (MMAJ & JICA, 1981).

Table 2-4-1 shows the average chemical composition of these rocks.

Table 2-4-1 Average Chemacal Composition and Some Metal Contants of the San Clemente Rhyolitic Rocks (after JICA & MMAJ, 1981)

Classification of Rocks	SiO_2 %	TiO_2 %	Al_2O_3 %	FeO* %	MgO %	CaO %	Na_2O %	K_2O %	As ppm	Ag ppm	Cu ppm	Pb ppm	Zn ppm	Remarks
Compact rhyolite (Trhy2-c)	75.77	0.09	12.85	1.11	0.12	0.15	3.47	6.28	0.57	16.06	9.93	59.13	65.82	Average value of 22 samples
Rhyolitic tuff breccia (Trhy2-t)	74.65	0.16	12.42	1.69	0.76	0.11	0.63	7.66	0.10	6.45	6.82	37.82	62.77	Average value of 11 samples
Banded rhyolite lava (Trhy2-l)	73.85	0.21	12.82	1.81	0.15	0.03	0.42	7.87	0.21	10.20	4.35	28.35	69.35	Average value of 8 samples
Rhyolite dyke (Tirh)	73.93	0.23	13.48	1.78	0.21	0.38	2.55	4.58	0.65	17.93	12.00	31.50	210.00	Average value of 2 samples

* Total Fe as FeO

In contrast to rhyolite lava (Trhy2-l) which generally has a notable banded structure, showing typical texture of effusive rock together with rhyolite tuff breccia (Trhy2-t), compact rhyolite (Trhy2-c) and rhyolite dyke (Tirh) are partially of porphyritic, fine grained and holocrystalline, showing texture of hypabyssal rock facies. Gold and silver mineralization tends to be especially concentrated in compact rhyolite (Trhy2-c). The lithology and mode of occurrence of these rocks is as follows.

(1) Rhyolite lava (Trhy2-l)

The rock is distributed at the foot of mountain of the northern end and in the east-central part from the hillside to the foot of mountain. At the northern end, it covers basalt lava (Tbal) and rests on rhyolitic tuff breccia (Trhy2-t). In the east-central part, it covers basalt lava (Tbal) and Cretaceous, resting on compact rhyolite (Trhy2-c). It displays various tints such as gray, dark gray, gray-purplish red and brown, and is characteristic with banded flow structure, being rugged and loose in appearance. It varies in rock facies such as the one with notable crystals of argillized plagioclase, those containing quartz in addition and the other poor in crystals of these minerals.

Under the microscope, porphyritic structure of plagioclase and quartz is observed, and subhedral to euhedral tabular plagioclase (less than 3 mm across) has been altered to microlitic aggregate of quartz and albite. Quartz about 1 milimeter across has been corroded. Biotite (0.5 mm across) is sometimes observed though small in amount. The groundmass consists of pale brown glass, the most part of which has been devitrified to produce microlitic aggregate of chalcedony to chalcedonic quartz and cristobalite. A conspicuous banding of flow structure is observed in the groundmass. K-Ar dating of the rock in the east-central part of the area showed 26.5 ± 1.3 Ma (JICA & MMAJ, 1981).

(2) Ryolitic tuff breccia (Trhy2-t)

Beside the main occurrence of the rock from the northern ridge to the northeastern foot of the mountain and at the southeastern foot, small exposures are discontinuously scattered along the main ridge extending southwesterly. It is covered by rhyolite lava (Trhy2-l) in the vicinity of northern ridge. In other parts, however, it rests on compact rhyolite (Trhy2-c) in the form of roof pendant.

It is pinkish brown to reddish brown and contains essential breccias consisting of rhyolite (less than 5 cm across) and small amount of accidental breccias such as shale, basalt and quartzite. Under the microscope, the texture wherein the lithic fragments of andesite and silt beside rhyolite breccia, and the fragmental crystals of quartz, plagioclase and biotite are embedded in the brown glass shards, are observed. Brown glass has been altered to the microlites of zeolite, cristobalite and chalcedony by devitrification.

(3) Compact rhyolite (Trhy2-c)

The rock occupies the most part of the area and is distributed within the extend with the width of about 2 kilometers and extension of about 4.5 kilometers in the NNW-SSE direction, forming the main part of the San Clemente mountain mass.

Megascopically, it is grayish white to grayish pink and pale brown, and compact and hard. Although phenocryst consists characteristically of quartz and alkali-feldspar in general, non-porphyritic one is sometimes observed. Biotite is partly observed to have been contained in these facies.

Under the microscope, porphyritic structure of quartz and alkali-feldspar is conspicuous, in which biotite and muscovite are observed in small amount. Quartz displays anhedral crystal form in many cases due to corrosion. Some crystals of alkali-feldspar are combined together to form glomeroporphyritic texture, inside of which have been replaced by very fine-grained secondary sericite. Carlsbad twin and perthite, however, are often remained.

Groundmass consists of mozaic aggregate of microlite mainly of colorless microlitic quartz 0.05 to 0.1 milimeters across, containing potash feldspar and plagioclase, which is holocrystalline though fine grained.

In the western part of the area, the rock cuts the Las Trancas Formation, the Kdf member of the El Doctor Formation, basaltic rocks (Tba 1), and diorite porphyry (Tidp), the contact plane of which is steep and the intruded rocks are partly crushed. In the northern part and the southeastern part, however, the underlying beds are exposed in the rock as a window, where the beds are covered by the rock with gentle inclination. Accordingly, it appears that the rock bodies at the northern limit and in the southeastern part are emplaced in the form of lava flow, but those distributed in the western to the southwestern part take a form of lava dome.

On the other hand, rhyolite dyke has a rock facies similar to compact rhyolite (Trhy2-c). Chemical composition, however, shows a little difference as described above, with the tendency of slightly lower content of SiO_2 and higher content of Al_2O_3. Since the dyke intruded into pre-Tertiary and basaltic rocks (Tbal), the time relation with other rhyolitic rock facies has not been made clear.

[Tertiary intrusive rocks]

Dioritic rocks (Tidp)

The rocks are exposed at four places, that is, the largest one shows an exposure in the d-creek to the west of the San Severiano mine with a scale of 150 meters width and 600 meters length, other two bodies occur in rhyolite to the north of the mine in the form of small window, and two small bodies in the southern part of the area.

They are generally fine-grained holocrystalline rocks with colors of dark grayish green to gray-brownish green. The rock facies, however, varies frequently from diorite-porphyritic or dioritic to anorthositic, showing heterogeneous occurrence. Moreover, these rocks have been subjected to strong alteration, wherein most of the mafic minerals have been replaced by chlorite and calcite, showing an appearance of 'masa' (Japanese local name given to the weathered soft sandy rock derived from granitic rocks).

Under the microscope, main constituent minerals such as tabular plagioclase (less than 0.5 mm across), anhedral quartz (less than 0.5 mm across) and hornblende are observed associated with small amount of potash feldspar, and a strong alteration resulted in to produce chlorite, calcite, zoisite and epidote.
Since the occurrence of these rocks is known in the Pechuga area to the west of the area, the time of intrusion would have been early Oligocene assuming that they are the products of the same activity.

Basalt dyke (Tiba)

The rocks are observed as two dykes in the pre-Tertiary sedimentary rocks in the vicinity of the Fluoruros de Hidalgo mine, as two dykes in the rhyolite to the north of the mine, and as two dykes in the rhyolite in the southern part of the area.

It is dark gray to dark grayish green, compact and hard. Under the microscope, porphyritic texture and intersertal texture are observed. Phenocrysts consist of euhedral tabular plagioclase (less than 1.5 mm across) inside of which has been altered, subhedral augite and rhombic pyroxene, and very small amount of quartz. Groundmass consists of fresh lath-shaped plagioclase, granular augite, small amount of rhombic pyroxene, opaque minerals, and secondary serpentine and chlorite.

These dykes have a width of about 10 meters and an extension of about 100 meters. The directions of intrusion are N70° ∿ 80°E, N20° ∿ 30°E, and N50°E, showing a steep dip.

Andesite dyke (Tian)

The rock occurs as small dykes such as five bodies in the south-western part of the area and one body in the eastern part. The former intruded into compact rhyolite (Trhy2-c) and the latter into rhyolite lava (Trhy2-l) respectively.

It is grayish green to pale greenish brown in general and cloudy phenocrysts of plagioclase are markedly observed. Under the microscope, phenocryst mainly consists of plagioclase, and small mount of potash feldspar and quartz are also observed. Plagio-clase is euhedral and prismatic and about 0.5 milimeters size in the greater part. Quartz is anhedral, and undulatory extinction is partly observed. Groundmass consists of plagioclase, potash feldspar and microcrystals of quartz, and all of the mafic min-erals have been replaced by chlorite and epidote. Potash feld-spar and plagioclase have been sericitized in many parts.

The five rock bodies in the southwestern part of the area intrude in the N55° ∿ 70°W direction, dipping southward steeply. The width of dykes is 3 to 10 meters.

Dacite dyke (Tidc)

Eleven bodies are observed in the southwestern part of the area where andesite dykes are distributed as small dykes intruded into compact rhyolite (Trhy2-c). Although the color and the presence of cloudy plagioclase are the characteristics of the rock, which is quite similar to the andesite dykes mentioned above, it is different from those in a little abundance of quartz micro-scopically.

It is considered, however, to be the product of a series of activity since they are distributed in the same area and it resembles to andesite in a broad sense.

2-4-4 Geological Structure

As previously mentioned, the most part of the area are overlain by rhyolitic rocks, and sedimentary rocks are distributed on a small scale in its peripheral area. Therefore, the main geological structure of the area is observed only in a few faults in addition to the folding structure in sedimentary rocks. This is because that the whole project district including this area was under the influence of the Laramide orogency from late Cretaceous to early Tertiary (early Oligocene). That is, although folding structures occur in the sedimentary rocks, no noticeable trace of structural movement can not be observed in rhyolitic rocks which is the product of later Oligocene. The distribution of rhyolite, however, considered to be important in relation to the mineralization, will be summarized in this clause.

<u>Folding structure</u>

A synclinal structure having the axis in the NNW-SSE direction is observed in the Kdf member of the El Doctor Formation distributed to the southwest of the Fluoruros de Hidalgo mine in the southwestern part of the area. The synclinal structure is parallel with a large-scale synclinal structure estimated to occur in the El Doctor Formation which is covered by rhyolite lava in the eastern half of the San Clemente mountain mass.

<u>Faults</u>

A fault with the trend of WNW-ESE is observed in the vicinity of the Fluoruros de Hidalgo mine in the southwestern part of the

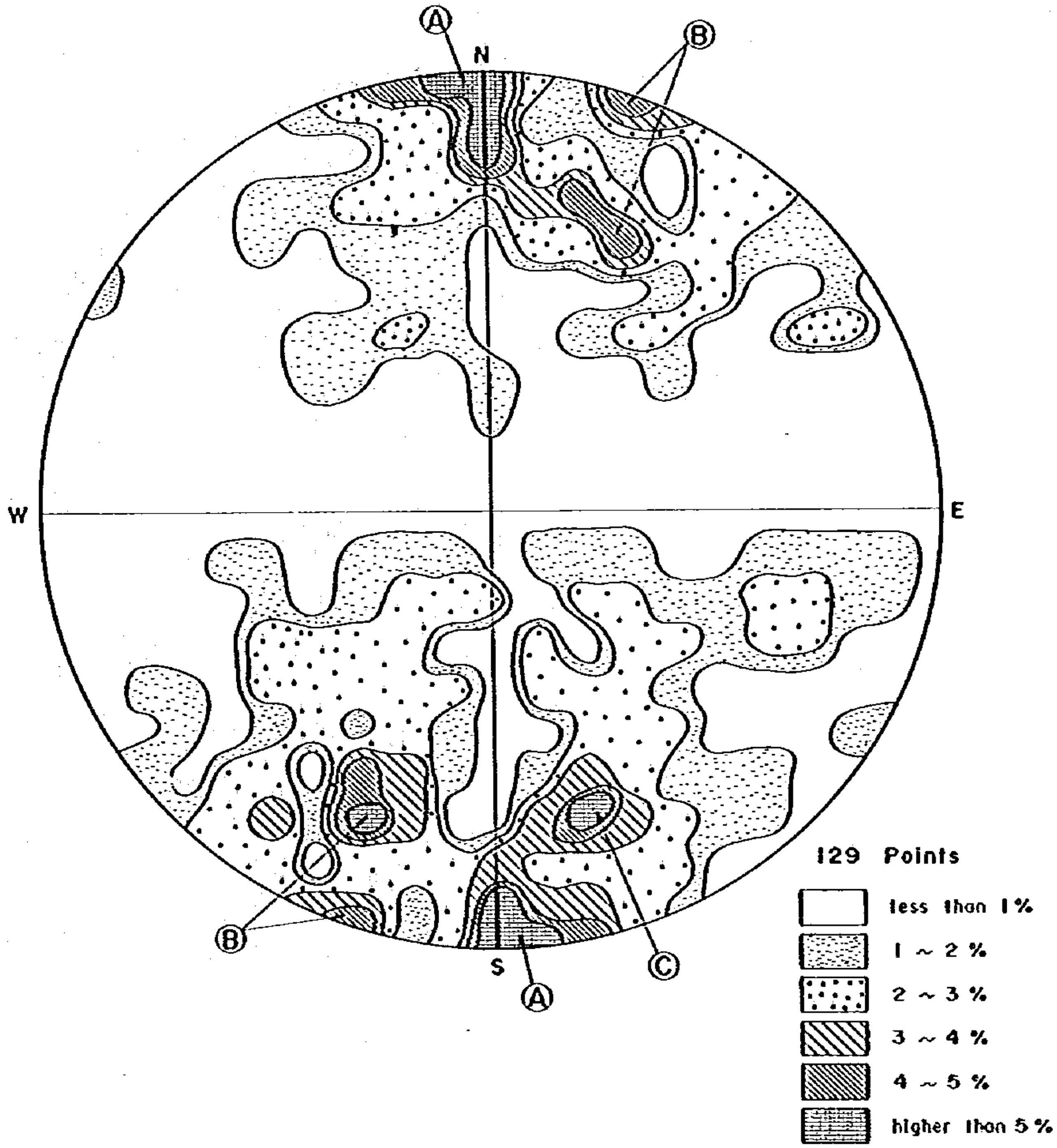


Fig.2-4-3 Fracture Pattern in the Compact Rhyolite in and around the San Severiano Mine

area. The fault is accompanied by a fracture zone of 30 to 40 meters width shown on the wall of old open pit, and a marked joint system can be observed to have been developed in the surrounding rocks.

In addition, minor folding structures in the Las Trancas Formation (Jts) and small faults in rhyolite are observed, both of which are small on a scale. It is, however, an interesting fact that the andesite dykes (Tian) and dacite dykes (Tidc) both of which are concentrated in the southwestern part of the area, have a tendency to have intruded in the WNW-ESE direction and that it is similar to that of the faults.

Contact relation between compact rhyolite (Trhy-c) and other rock bodies

When overlooking over the whole San Clemente mountain mass which extends in the NNW-SSE direction, the rock in the western to the southwestern part of the mountain mass cuts other rocks in contact with the relation of intrusion, and it covers sedimentary rocks and basalt lava (Tba 1) on the eastern and southeastern side. Roof pendants of sedimentary rocks and tuff breccia (Trhy2-t) are observed sitting on the rock in the central to the western part. The rock in the western to southwestern part shows porphyritic, holocrystalline and hypabyssal lithofacies as compared with that of the latter occurrence though it is fine-grained.

From these evidences, it appears that the rock forms a lava dome having its steep vent in the western to the southwestern part and exhalative facies widened laterally with low angles in the eastern to southeastern part. The gold-silver mineralization is observed at the part of vent.

Fissure system in compact rhyolite (Trhy2-c)

None of large fault and fructured zone are observed in the rock. Very fine cracks, however, are generally observed.

An attempt was made, in this survey, to investigate the strike and dip of the fine cracks measured in and around of mineralized zone of gold and silver by projecting these onto Schmidt net (Fig. 2-4-3). As the result, the predominant trends can be summarized as follows:

A type: N75°E ∿ N85°W, 75°S ∿ 90° and 80°N ∿ 90°

B type: N65°W ∿ N75°W, 90°, 65° ∿ 75°SW and 65° ∿ 75°NE

Each of these shows to form a couple in which strike is approximately in the same direction and dips are in the opposite direction. Among these joint systems, local predominance of B type is observed in gold and silver mineralized zone.

2-4-5 Ore Deposits

Two kinds of mineralization have been known in this area, that is, gold-silver mineralization (represented by the San Severiano mine) in the compact rhyolite (Trhy2-c), and fluorite mineralization (represented by the Fluoruros de Hidalgo mine) found at the contact between the compact rhyolite and the Kdf member of the El Doctor Formation. In terms of the latter, however, the survey up to last year resulted in not to discover any showings to warrant further exploration.

As to the gold-silver mineralization, since promising indications have been confirmed in three zones including the San Severiano mine as the result of geochemical prospecting by rock samples conducted last year, it was taken as the target of this phase work.

The survey of this year consists of (1) the observation and sampling at the remains of old mine workings and old test pits found in the San Severiano mine and (2) the investigation of average contents of gold and silver on the rock samples taken from the three geochemical-anomalous zones with 50 meters grid-spacing, having purposed for the evaluation of the future exploration.

Results of the survey are as follows.

San Severiano Mine (see Table 2-4-2, Fig. 2-4-4 and PL. 2-4-4)

(1) History of exploration

The mine is situated about 1 kilometer to the east of the San Clemente settlement, and old test pits are scattered in the area of approximately 300 meters (north to south) by 500 meters (east to west) including a ridge with altitude of 2,560 meters above sea level which is put between the d creek and the c creek.

The remains of old working consist of two old open pits (each 40 m x 30 m in size) excavated on the slope in the eastern part and numerous small pits and trenches scattered on the western side from the pits in the San Severiano mining area. Small levels were also excavated for about 10 to 20 meters.

The time of the prospecting can not be made clear. About ten miners were working by pick and hammer in 1979 (at the time of the first phase survey), which was said to have been soon after the resumption of exploration. The remains of several stone mills on the small creeks in the proximity area which might have been used for grinding the ore, and the numerous test pits, though small on a scale, lead to

Table. 2-4-2 Chemical Analyses of Samples of the San Severiano Mineralized zone.

Sample №	Coordinates		Assay results		Sample №	Coordinates		Assay results	
	E	N	Au	Ag		E	N	Au	Ag
C 1M	482731	2283796	2.0	74	C19M	482539	2284665	0.08	1.8
C 2M	482850	2284734	18.6	7282	C20M	482592	2284646	0.26	4.6
C 3M	482945	2284679	1.0	4.4	C21M	482579	2284650	0.17	2.8
C 4M	482945	2284679	18.6	1485	C22M	482581	2284639	0.24	3.7
C 5M	482580	2284540	0.31	5.4	C23M	482594	2284633	0.12	5.85
C 6M	482535	2284392	0.36	1.6	C24M	482574	2284669	0.07	2.5
C 7M	482540	2284432	0.22	7.7	C25M	482554	2284675	2.6	2.4
C 8M	482554	2284739	0.68	16	C26M	482566	2284745	0.04	4.6
C 9M	482577	2284740	0.37	19	C27M	482565	2284747	0.28	2.6
C10M	483089	2284639	1.2	11	C28M	482976	2284655	1.8	2.7
C11M	484008	2283585	0.66	8.2	C29M	482950	2284656	1.45	5.4
C12M	482648	2284705	0.59	4.3	C30M	482951	2284652	1.4	3.4
C13M	482675	2284711	0.52	3.1	C31M	482933	2284578	2.4	3.3
C14M	482687	2284721	0.05	1.4	C32M	482926	2284566	0.11	1.0
C15M	482620	2284725	0.42	3.9	C33M	482910	2284526	0.09	14
C16M	482633	2284718	0.05	12	C34M	482941	2284609	2.5	2.5
C17M	482635	2284702	0.24	18.9	C35M	482934	2284605	0.94	5.4
C18M	482626	2284704	0.13	2.9	C36M	482933	2284602	2.04	3.4

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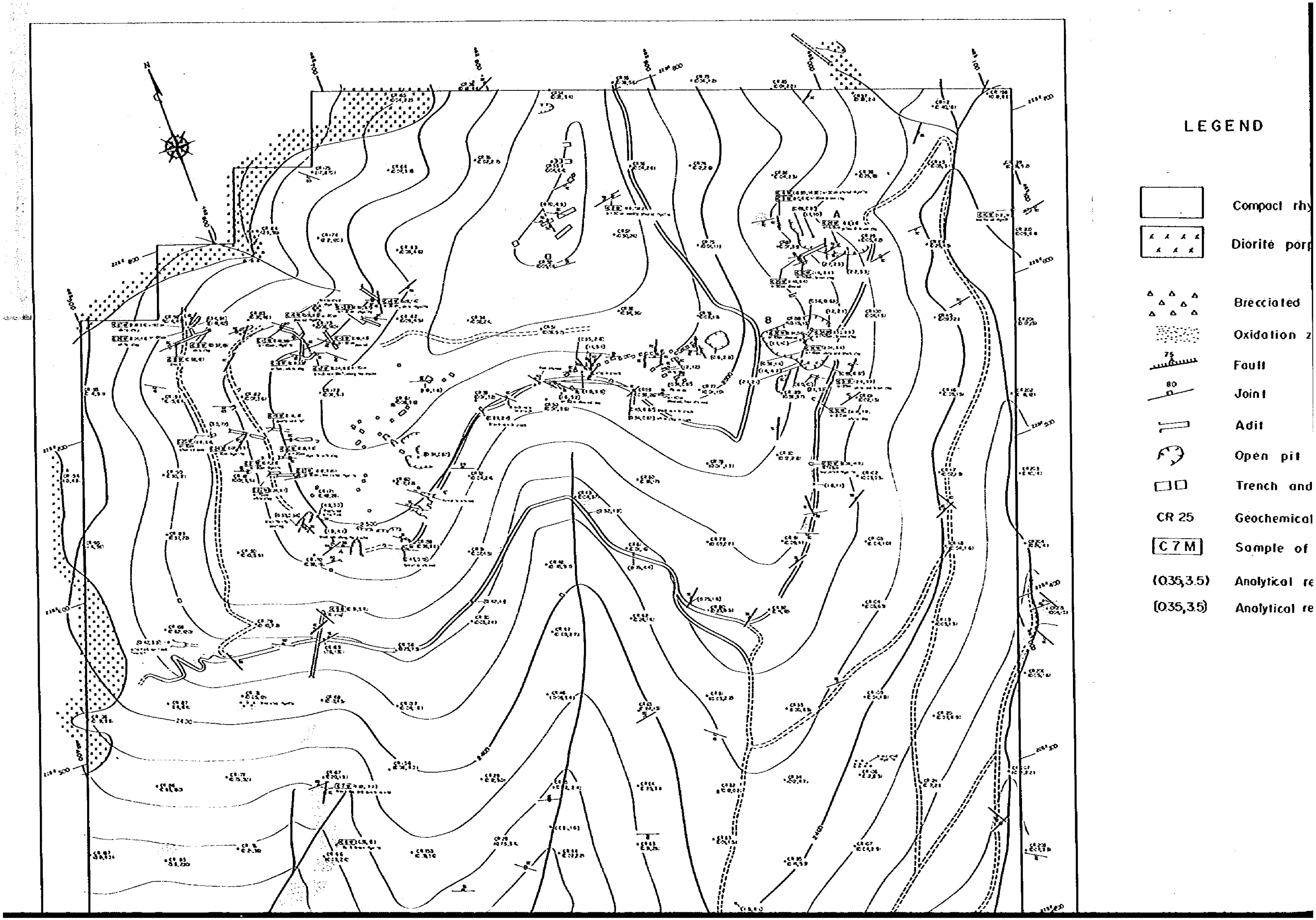
Table 2-4-3 Occurrence of the Open Pits, Tunnels and Trenches in the San Severiano Mining Area

Location of the Test Pits, the Mine Workings and Their Forms	Place of Sampling	Sample No.	Sampling Width(cm)	Assay Value Au g/t	Assay Value Ag g/t	Occurrence
Open pit A Location: on the mountain slope at the northeastern end of the San Sevirianо mining area, situated on the southern bank of a small creek flowing east-southeastward. Size of pit: approx. 60 m(E-W) x 25 m (N-S) Tunnels located in the pit Level: found at about in the center of the pit, drifted toward S80°W for 17 m, then toward south for 7 m. Winze: located at about 10 m east of the level and excavated toward S80°W for 2 m. Trench Location: about 10 m to the west of the northwestern end of the open pit.	Open pit A	Average of 11 samples	-	2.84	3.71	The arithmetic mean of the whole samples (11 samples) taken in the pit.
	Level	C 30 M	3	1.4	3.4	A brown clay vein (1-3 cm in width) along the joint at 1.5 m from the end of the level, striking N85°W and dipping 85°NE.
	Winze	C 28 M	5	1.8	2.7	A yellowish brown to brown clay vein (1-5 cm in width) along the joint parallel to the winze, striking N80°E and dipping 73°NW.
	Trench	C 3 M	20	1.0	4.9	A yellowish brown clay zone striking N11°E and dipping 65°NW.
		C 4 M	50	18.65	14.85	Pale brown, weakly argillized rhyolite adjacent to C3M-clay zone, on the western side of it.
Open pit B Location: on the mountain slope about 70 m to the southwest along the road from the eastern end of the open pit A. Size of pit: approx. 40 m(E-W) x 35 m (N-S) Tunnels located in the pit Tunnel for prospecting and mining: found at about in the center of the pit, and excavated irregularly Test pits Location: along the road about 30 m to the southwest of the open pit.	Open pit B	Average of 18 samples	-	1.36	2.62	The arithmetic mean of the whole samples (18 samples) taken in the pit.
	Tunnel	C 34 M	5	2.5	2.5	Brown clay (1-5 cm in width) along the joint at the northwest of the tunnel, striking N30°W and dipping 30°NW.
		C 36 M	40	2.04	3.4	Network clay veins formed in rhylite on the south-western side of the tunnel.
	Test pit	C 31 M	35	2.4	3.3	A part of the fractured zone accompanied with white and brown clay in the southwestern side of the zone located at the entrance of the pit with the width of 1.2 m, striking N40°W and dipping 70°NW.
Trench: at the eastern slope about 110 m to the west-northwest from the north-western end of the open pit A.	Trench	C 2 M	50	18.6	728.2	A slightly fractured rhyolite with joint system striking N80°E and dipping 70°W.
Small pit: at about 100 m to the east-southeast of the eastern end of the open pit A	Small pit	C 10 M	100	1.2	11	Pale brown weathered rhyolite.
Trench: at about 360 m (horizontal distance) toward N80°W from the western end of the open pit B	Trench	C 25 M	50	2.6	2.4	Fractured zone in white rhyolite accompanied with quartz veinlets (less than 1 mm in width).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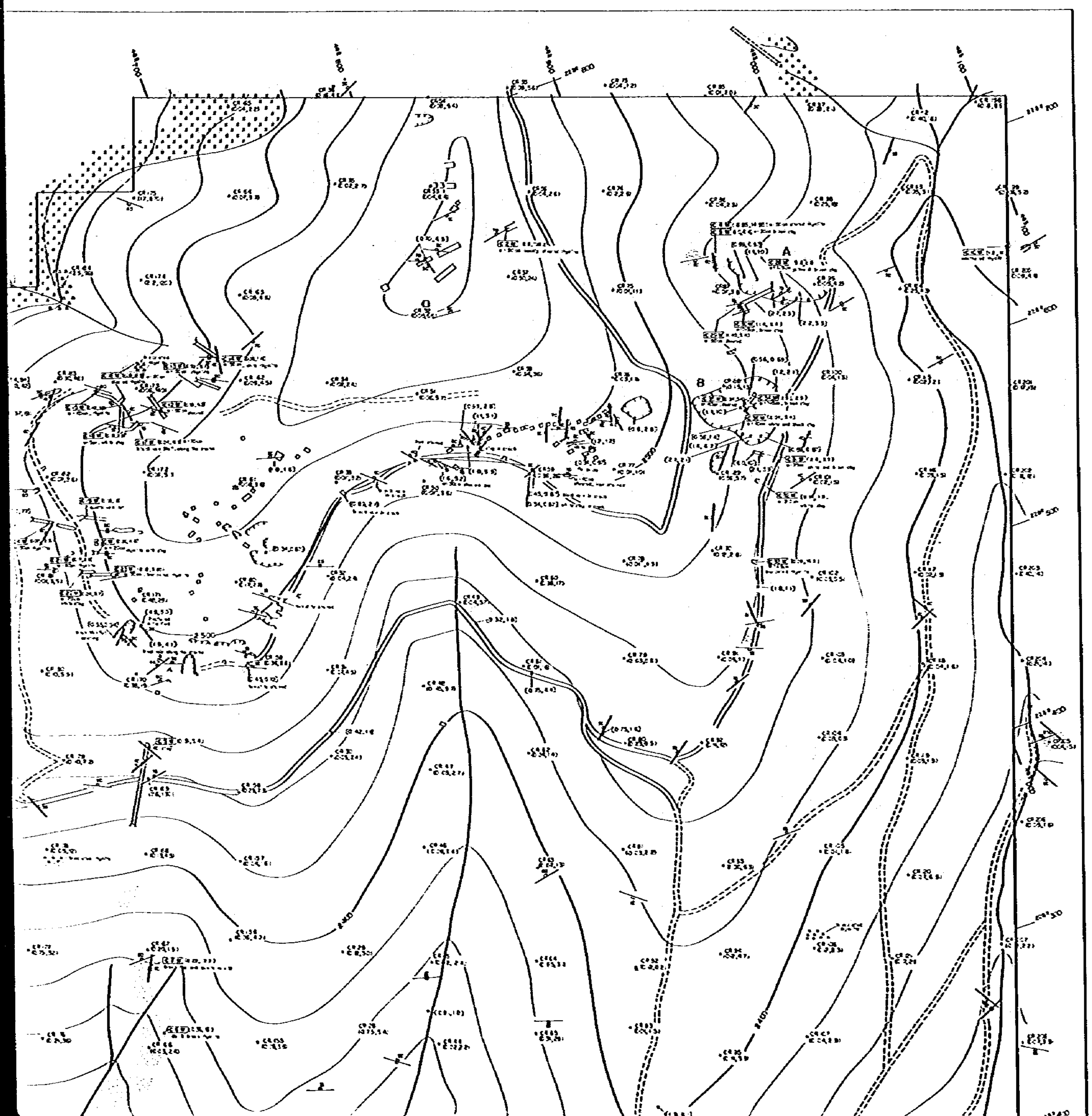

LEGEND

- Compact rhyolite
- Diorite porphyry
- Brecciated rhyolite
- Oxidation zone
- Fault
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- Adit
- Open pit
- Trench and pit
- CR 25 — Geochemical rock sample.
- C7M — Sample of ore.
- (0.35,3.5) — Analytical results of Au g/t , Ag g/t (1982)
- (0.35,3.5) — Analytical results of Au g/t , Ag g/t (1981)

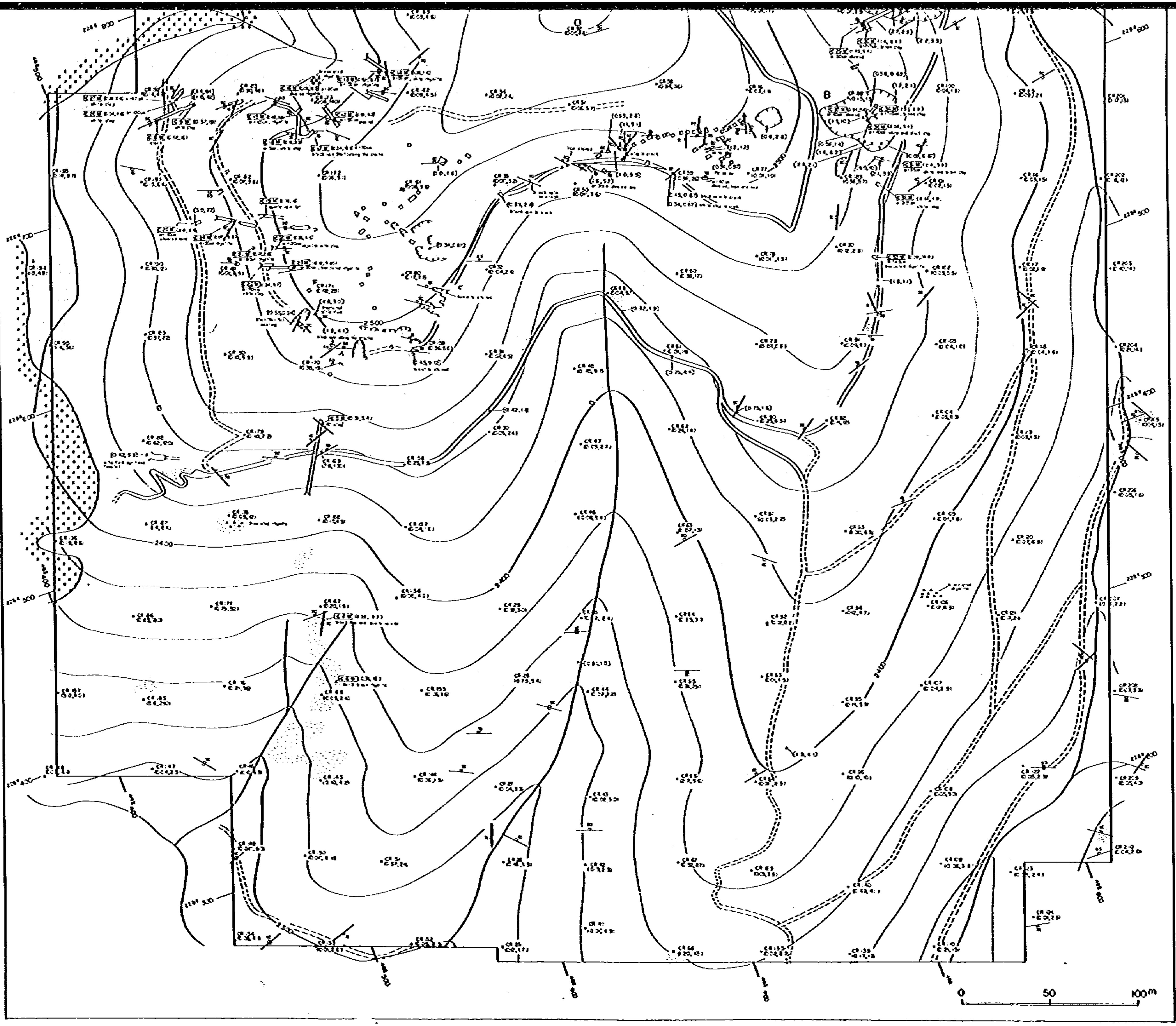

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Fig.2-4-4 Geolo
San Severiano

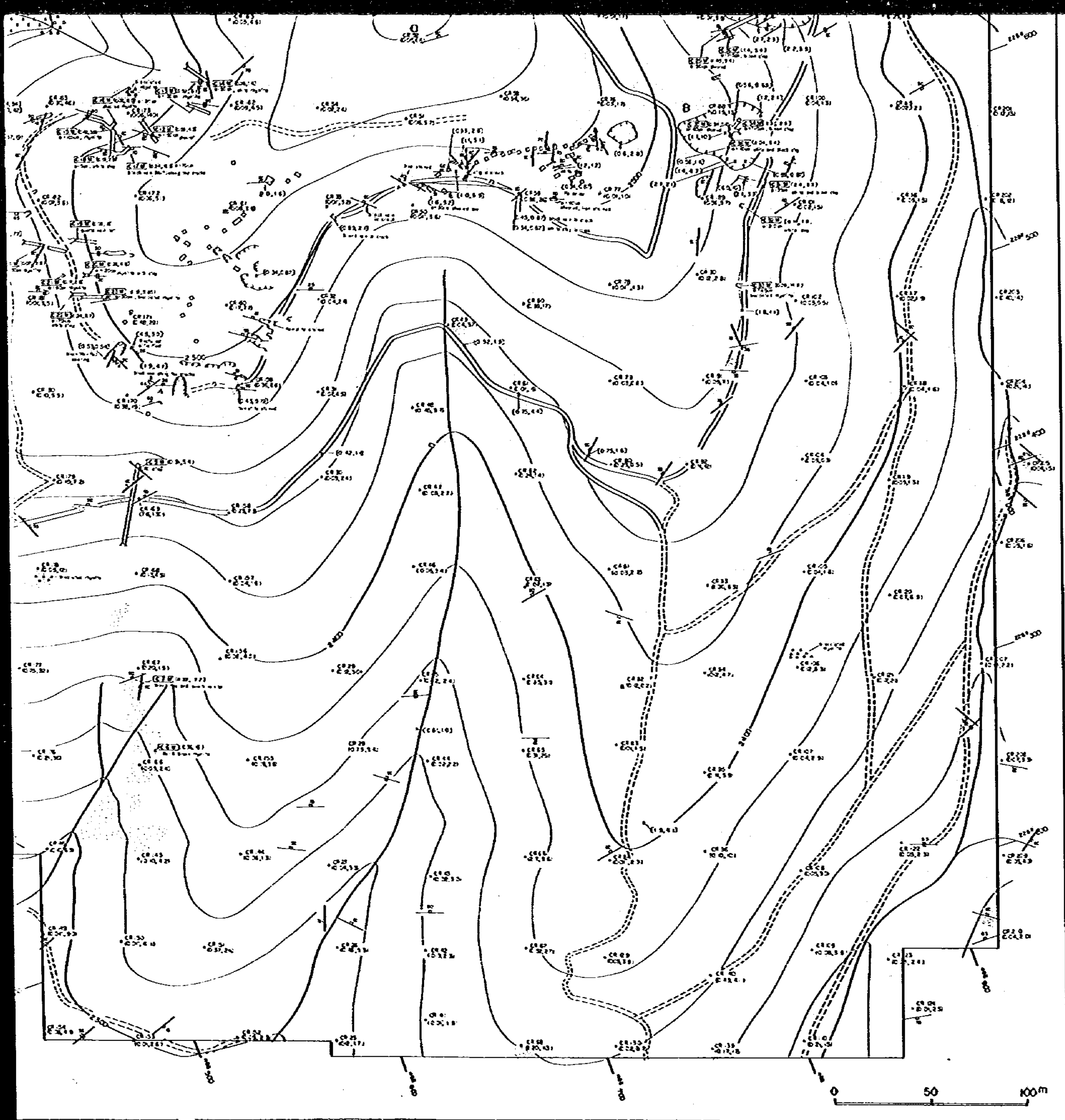


Fig.2-4-4 Geological Sketch of the San Severiano Mine, SAN CLEMENTE

the estimation that the exploration of gold deposit in the area was started from the considerably old time and has been conducted intermittently up to these days.

According to the investigation of CRM, the mining right is said to be expired at the beginning of November, 1981.

(2) Type of ore deposit and occurrence of gold

The gold-silver mineralization in the compact rhyolite of this mining area is thought to be of irregular network to dissemination type associated with no remarkable hydrothermal-alteration such as silicification, carbonitization, etc. in the country rock by the reasons of mode of occurrence mentioned later.

The observation of the old test pit and mine workings revealed that the open pits were excavated in the rock indiscriminately, and small tunnels were drifted along the cracks and argillized part. Because of absence of particular indications for prospecting and mining such as quartz vein or silicified zone, it is very difficult to observe the gold gain in the field directly.

As the result of observation of a number of samples containing gold grains to be observed with the aid of lens taken from the float ore scattered in the vicinity of old pits and the powder samples remained after chemical analysis, the occurrence of gold ore can be classified as follows.

(i) Hematite film type

Gold is observed as irregular to potato-like grains (0.05 mm ∿ 0.2 mm across) on brown to chocolate-colored hematite film along tiny joint crack or fine network fissures. Sometimes micro-crystals of quartz are observed on hematite film. In most cases, no crystal plane can be observed on the surface of gold grain.

(ii) Clay - hematite network type

It is the gold grain (about 0.05 mm across) which can be observed in clay of hematite network veins accompanied by greenish gray clay (montmorillonite and kaoline) cutting the fractured part of rhyolite.

The gold grains of types (i) and (ii) show a golden color, which can obviously be discriminated with the aid of lens. These are abundantly observed at the pits of A and B of the San Severiano mine.

Quantitative analysis of these gold grains by EPMA revealed the composition to be of atomic rate of 65% ∿ 67% in gold and 33% ∿ 35% in silver, showing that they are electrum close to native gold (Fig. 2-4-5).

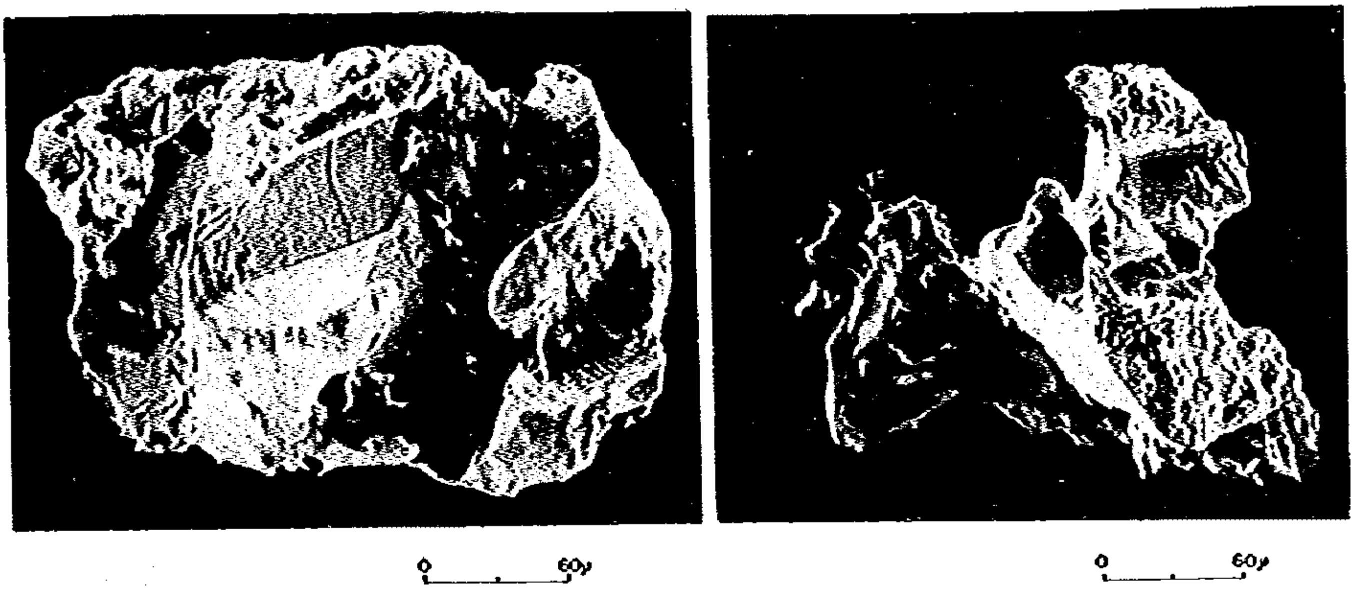


Fig. 2-4-5 Photomicrographs of Electrum Grains from the San Severiano Mine by Scanning Electron Microscope

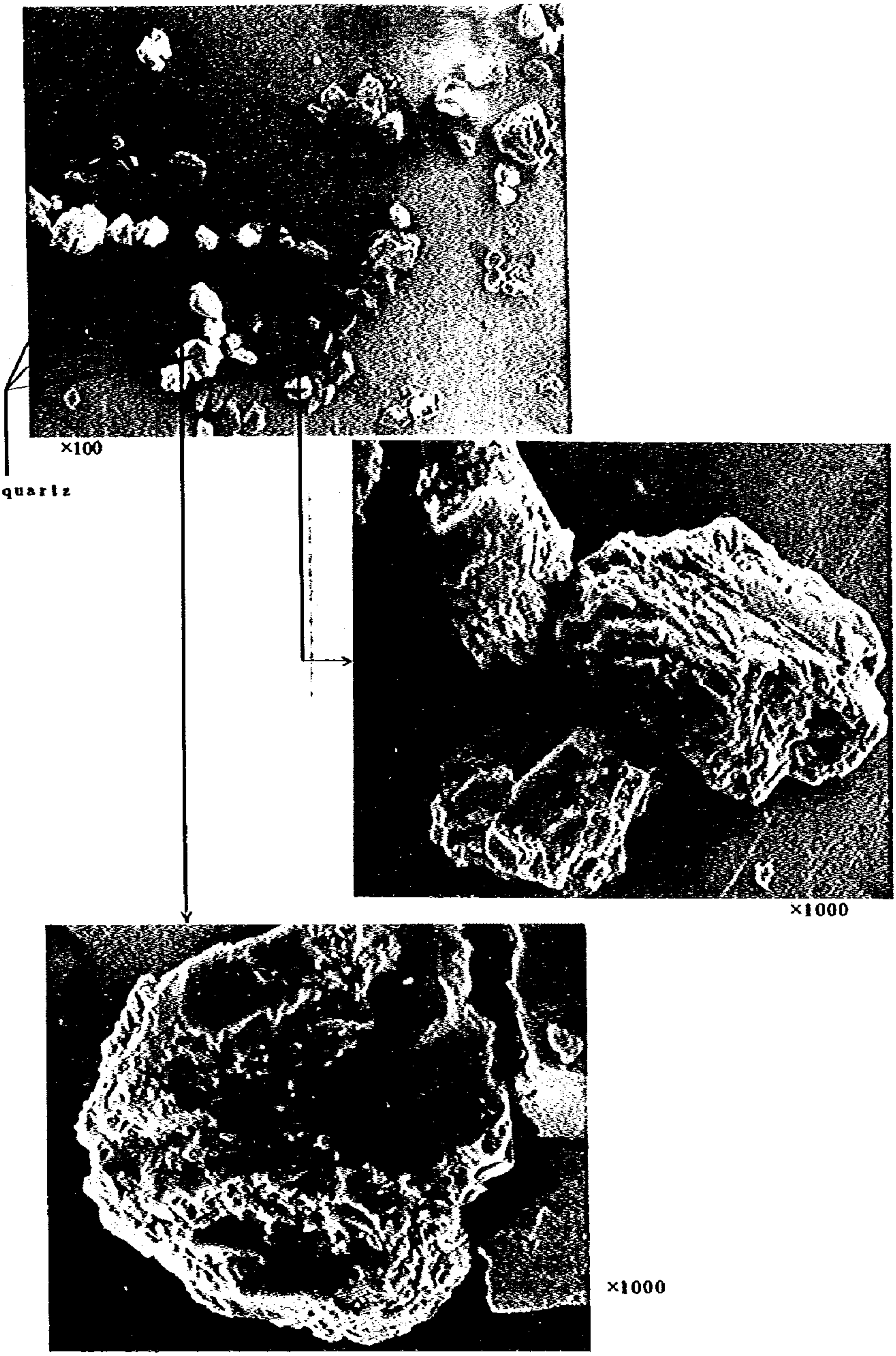


Fig. 2-4-6 Photomicrographs of Complex - sulfosalts Mineral Grains by Scanning Electron Microscope

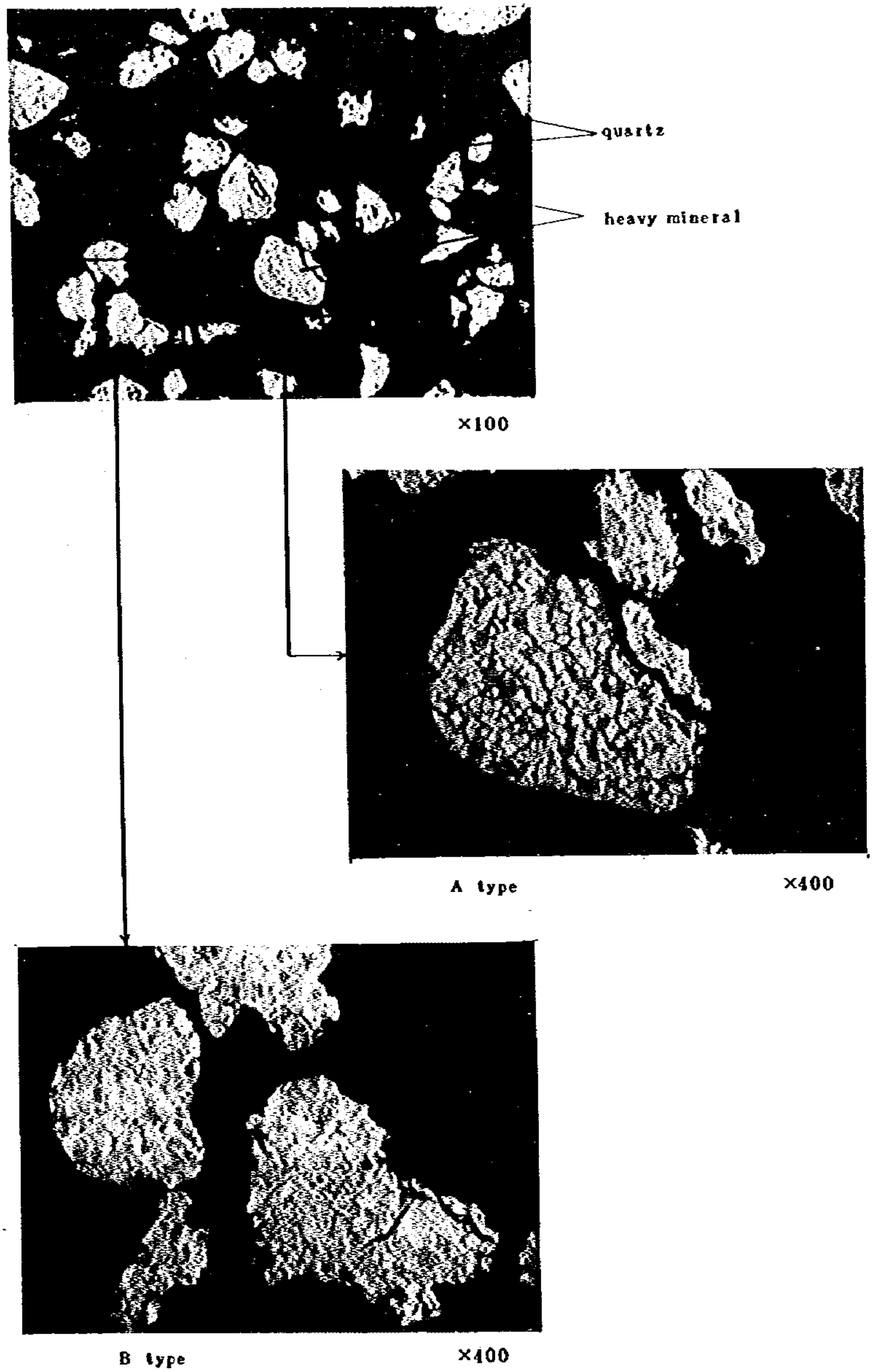
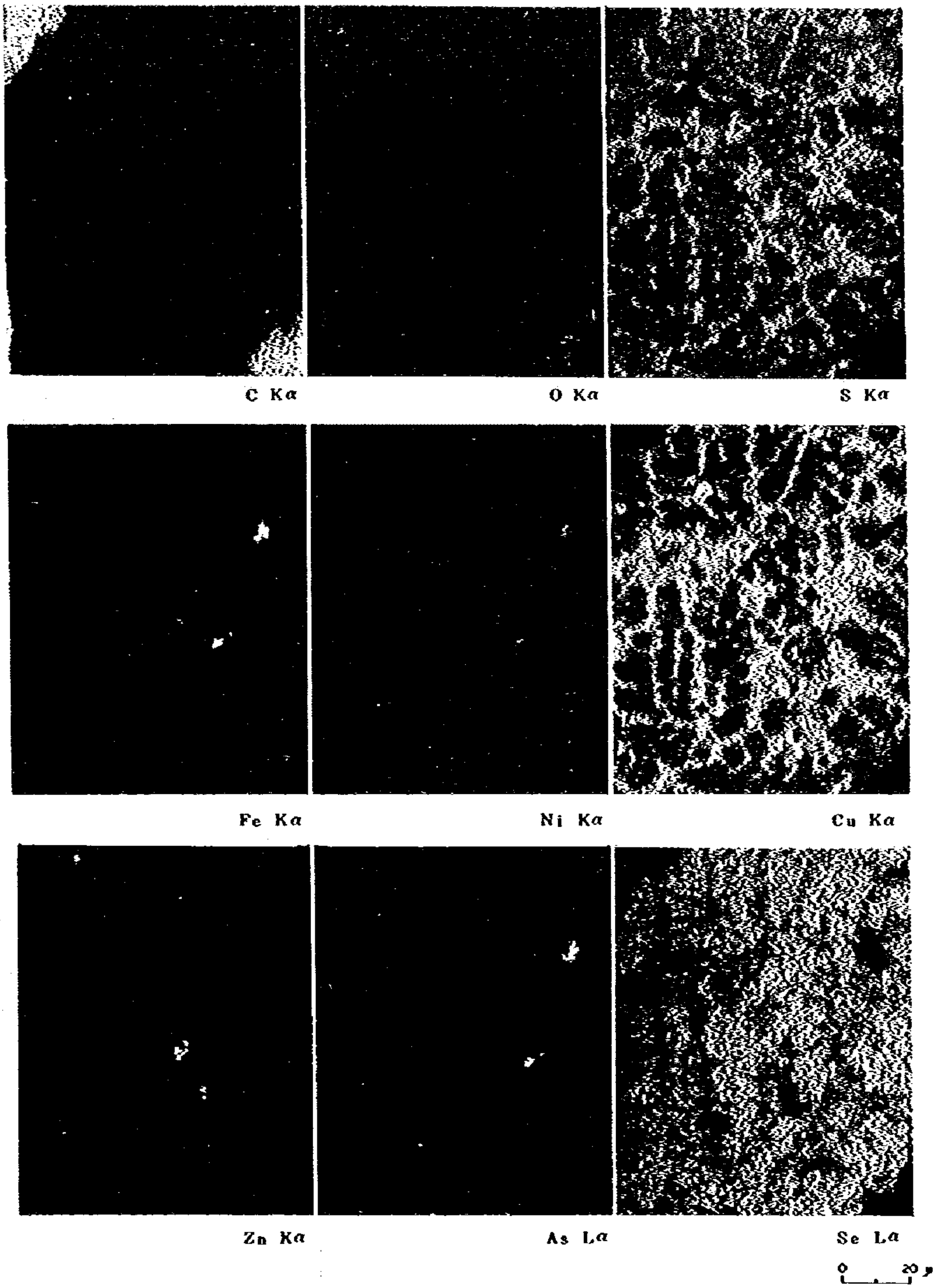


Fig. 2-4-7 Photomicrographs Showing textures of Complex-sulfosalts Minerals by Reflecting Microscope



(A type)

Fig. 2-4-8 Backscattered Electron Image and Characteristic X-ray Images of Complex-Sulfosalts Minerals

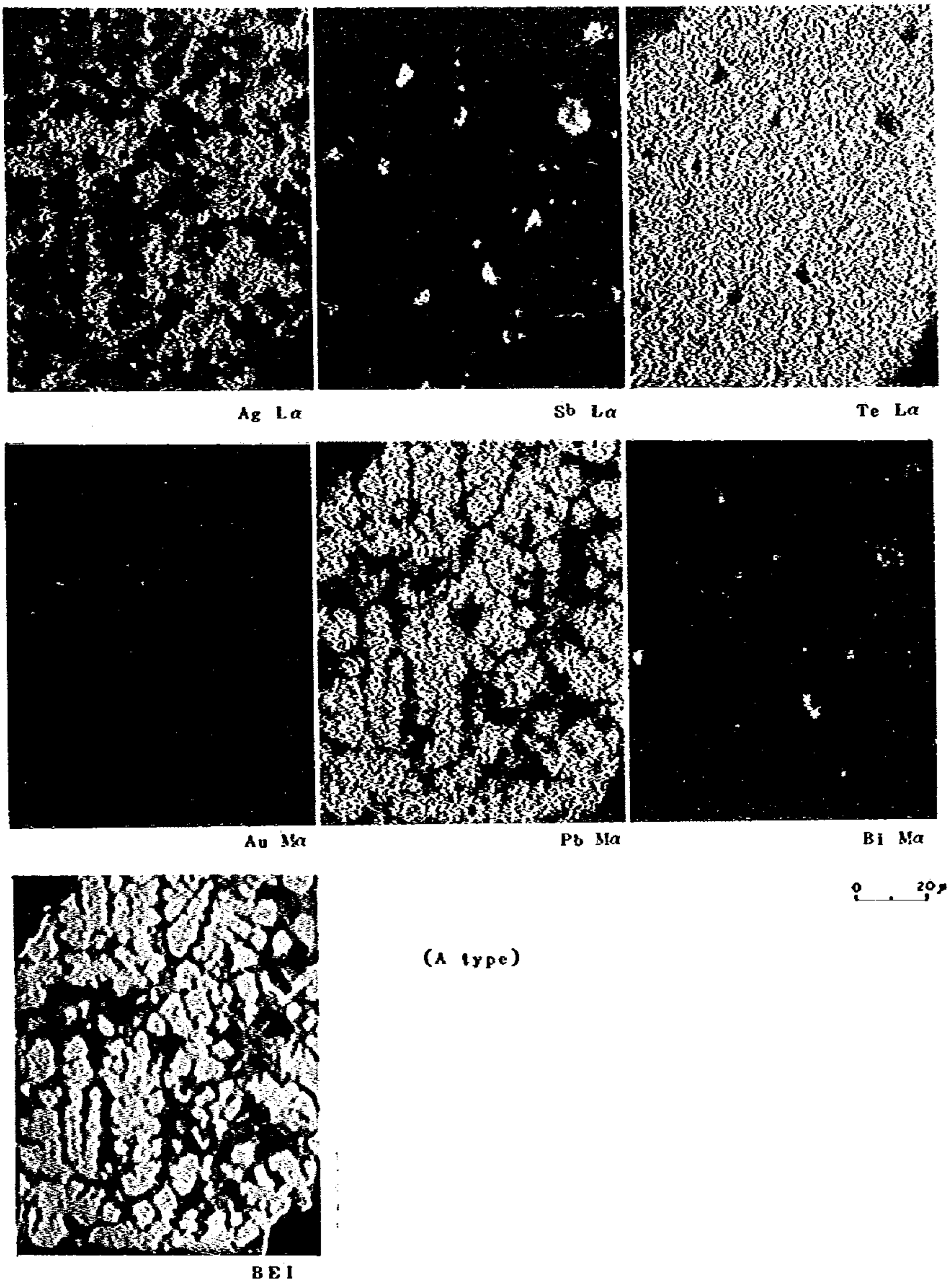
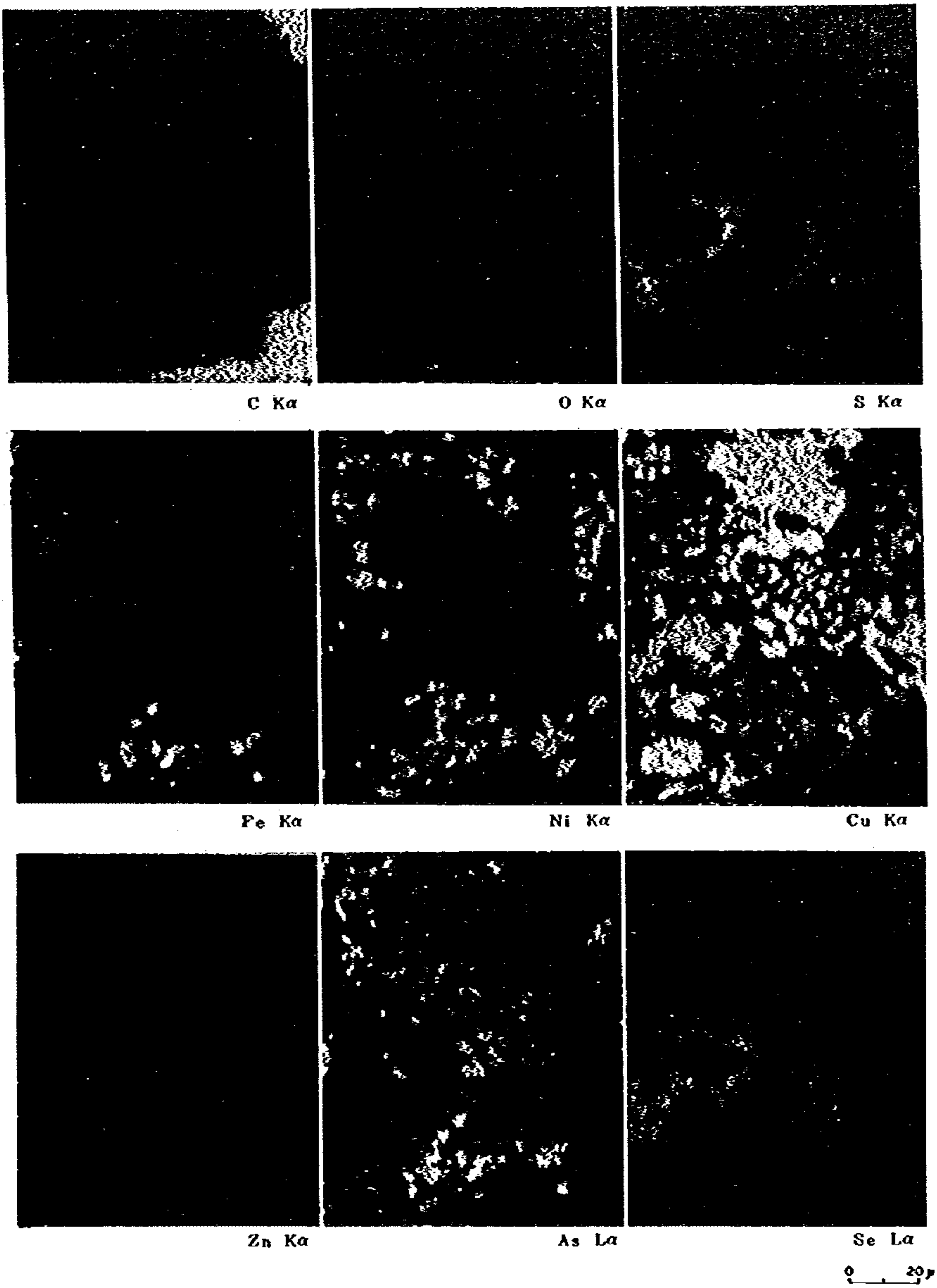


Fig. 2-4-8 (Continued)



(B type)

Fig. 2-4-8 (Continued)

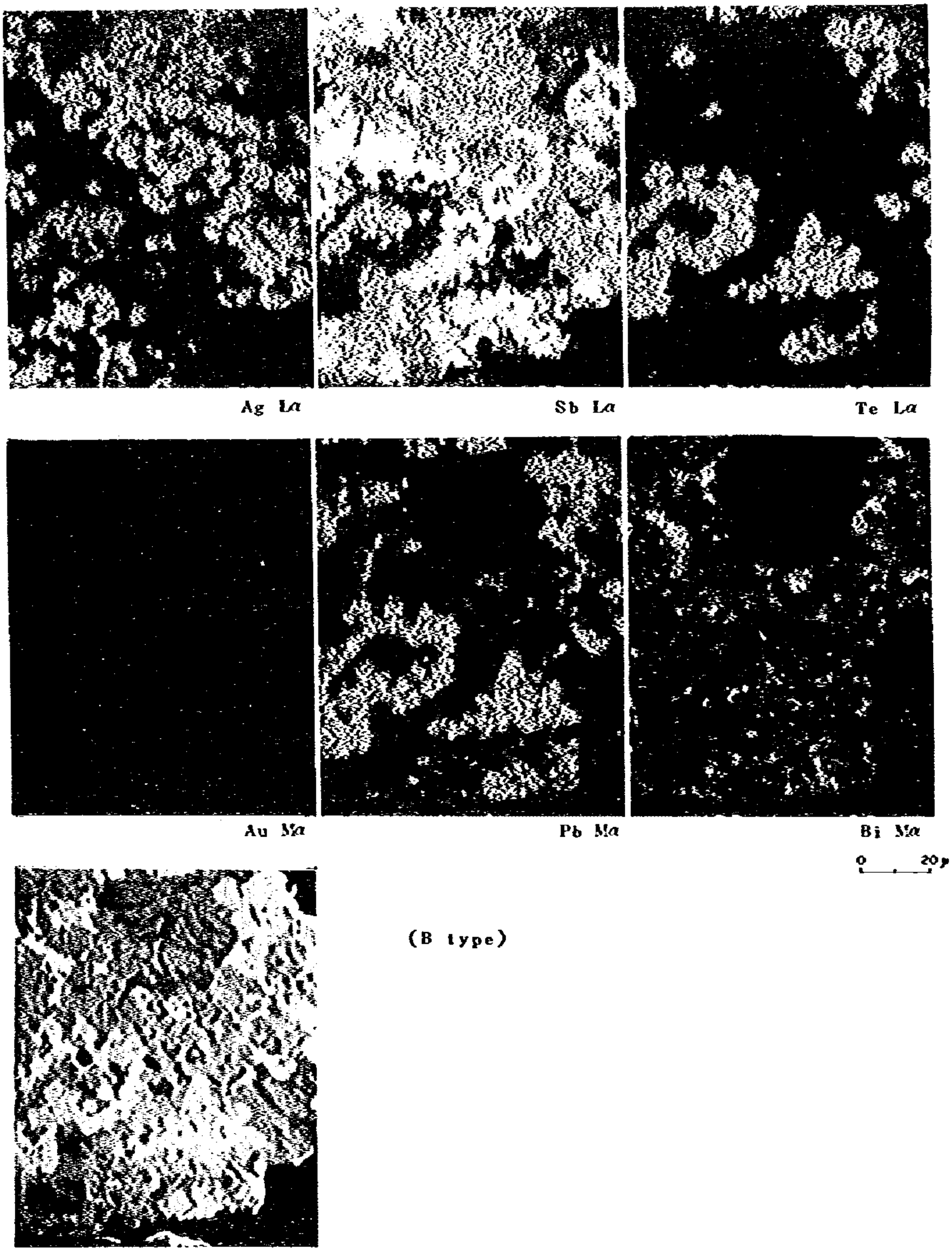


Fig. 2-4-8 (Continued)

Table 2-4-3, Fig. 2-4-4 and PL. 2-4-4 show the present conditions of the remains of old open pits, small tunnels and trenches in the San Severiano mine which were excavated to prospect or to mine the gold mineralized zone showing the types described above. Such remains of test pits generally tends to be arranged in the west-northwestern direction from the old open pits of A and B at the eastern end showing that the mineralization was controlled by the joint system of such direction.

(iii) Dissemination type

The gold and silver mineralized zone confirmed newly on this time at the position to correspond to the western end of the rhyolite body about 500 meters to the west of the San Severiano mine, is of the highest grade and of the largest scale in this area.

During the field survey of the area, neither remarkable presence of joint system and hydrothermal alteration nor remains of old test pit were observed. Moreover, no electrum grain has not been confirmed even with the aid of lens. The occurrence of mineralization of high grade and large scale, however, was made clear as the result of chemical analysis of the samples.

In order to investigate the occurrence of gold, sluicing was conducted on a small amount of powder sample obtained from the remains of the sample used for chemical analysis which showed the highest grade in the mineralized zone (No. CR-175, 17.0 g/t Au, 870 g/t Ag). As the result, a considerable amount of particles (0.05 mm ∿ 0.2 mm across) of heavy minerals of dark silver gray with metallic luster having irregularly granular to potato-like shape, was obtained.

The only mineral grains obtained by sluicing simultaneously with the heavy minerals was quartz, and any other minerals were hardly observed.

Although it was observed that abundant hematite grains settled together with electrum grains when powder samples of (i) and (ii) types were sluiced, no admixture of such minerals was observed in the case of this sample. Taking into account, moreover, that the sample was relatively fresh rhyolite, it is likely that these particles of heavy minerals would show an occurrence of dissemination in rhyolite.

Under the microscope, the surface of heavy mineral particles gives a complicated appearance overlapped with tabular and foliated structures (see Fig. 2-4-6).

The results of investigation by EPMA on texture and composition of these particles by having prepared the polished sections, are as follows.

The texture of these heavy minerals is divided into the A type which shows a texture that several kinds of minerals in μ unit are gathered together in coloidal form and the B type which distinctly shows the exsolutions texture (see Fig. 2-4-7). The quantitative analysis by characteristic X-ray (see Table 2-4-4, Fig. 2-4-6, and Fig. 2-4-7) shows that these heavy minerals are the complex sulfosalts which consist of main ingredients of silver, copper, tellurium, antimony and lead with accessory ingredients of bismuth, selenium, arsenic, nickel, iron and sulfur including gold.

Although the sulfosalts minerals are a group of minerals generally shown by $A_m B_n X_p$, where A = Ag, Cu, Pb; B = As, Sb, Bi; X = S, this complex sulfosalts contain tellurium and gold on top of these elements to make the composition more complicated.

Table 2-4-4 Qualitative Analysis of Complex Sulfosalts Mineral Grains by EPMA

	C	O	S	Fe	Ni	Cu	Zn	As	Se	Ag	Sb	Te	Pb	Bi	Au	Others
Type A	Δ	Δ	o	Δ	Δ	$	Δ	Δ	$	$	$	$	$	Δ	x	x
Type B	Δ	Δ	Δ	Δ	o	$	x	o	Δ	$	$	$	$	o	?	x
Type B	Δ	Δ	Δ	?	o	$	x	o	Δ	$	$	$	$	o	Δ	x

$: abundant   o : Common   Δ: rare   x: not detected

? : difficult to identify

Beam spot size : approx. 80 μmϕ

2-4-6 Average Grade of Gold and Silver in the Three Areas of Target of Exploration

In the survey of this year, rock samples were taken by 50-meters grid-spacing, of which gold and silver contents were statistically processed by means of the system of geochemical prospecting for the three target areas including the geochemically anomalous zones obtained by last year's work, to select the promising mineralized zone.

The target areas (Fig. 2-4-1, PL. 2-4-6)

The surveyed areas consist of the three areas such as the western area including the San Severiano mine, the eastern area located at about 1,500 meters to the east-southeast of the western area and the southern area at about 1,000 meters to the south-southeast of the former.

The number of samples was 302 pieces in total including 210 samples from the western area, 34 from the eastern area and 58 from the southern area. In each area, the samples were taken by 50-meters grid spacing. These rock samples were pulverized to 200 mesh and chemically analyzed in Japan.

Data processing (Fig. 2-4-6)

Because the three areas are closely situated each other in a rhyolite body, contents of gold and silver obtained from 302 samples were treated as one statistical population respectively, and classified by means of the cumulative frequency distribution diagram. The classification was also made on the values of total content of gold and silver in addition to that of each content of these elements. In this case, the values of total amount was calculated with the formula of "Au content + 1/50 Ag content" in order to discuss the economical value of the ore, taking into account that those of silver are equivalent to one fiftieth those of gold.

Since the target areas are the geochemically anomalous zones, the result showes a geochemically high content of both gold and silver in general, and logarithmic normal distribution has not been shown as usually observed in the cumulative frequency distribution diagram made from the ordinary samples of geochemical prospecting. In terms of gold, a type of composite population was shown in which no population on the side of lower grade was present, whereas the curve was gradually bent to a positive side proceeding toward higher content side. Although silver showes a similar behavior to gold in general, a little regular tendency is observed.

The classification shown in Table 2-4-5 was made using these cumulative frequency distribution diagram. Although these values are so high that they can not immediately be applied to regional geochemical prospecting for gold and silver in other regions, they agree with the purpose to directly extract the gold and silver mineralized zones from the known areas as geochemically anomalous zone. Therefore, in connection with the classification of each value of gold and "Au + 1/50 Ag", 1.00 ppm value was adopted beside the ordinary classification, as a point to set up a standard on the point of view of mining evaluation.

Fig. 2-4-9 Cumulative Frequency Distribution of Au, Ag and Au+Ag x 1/50 Contents of Rock Samples from the SAN CLEMENTE Area

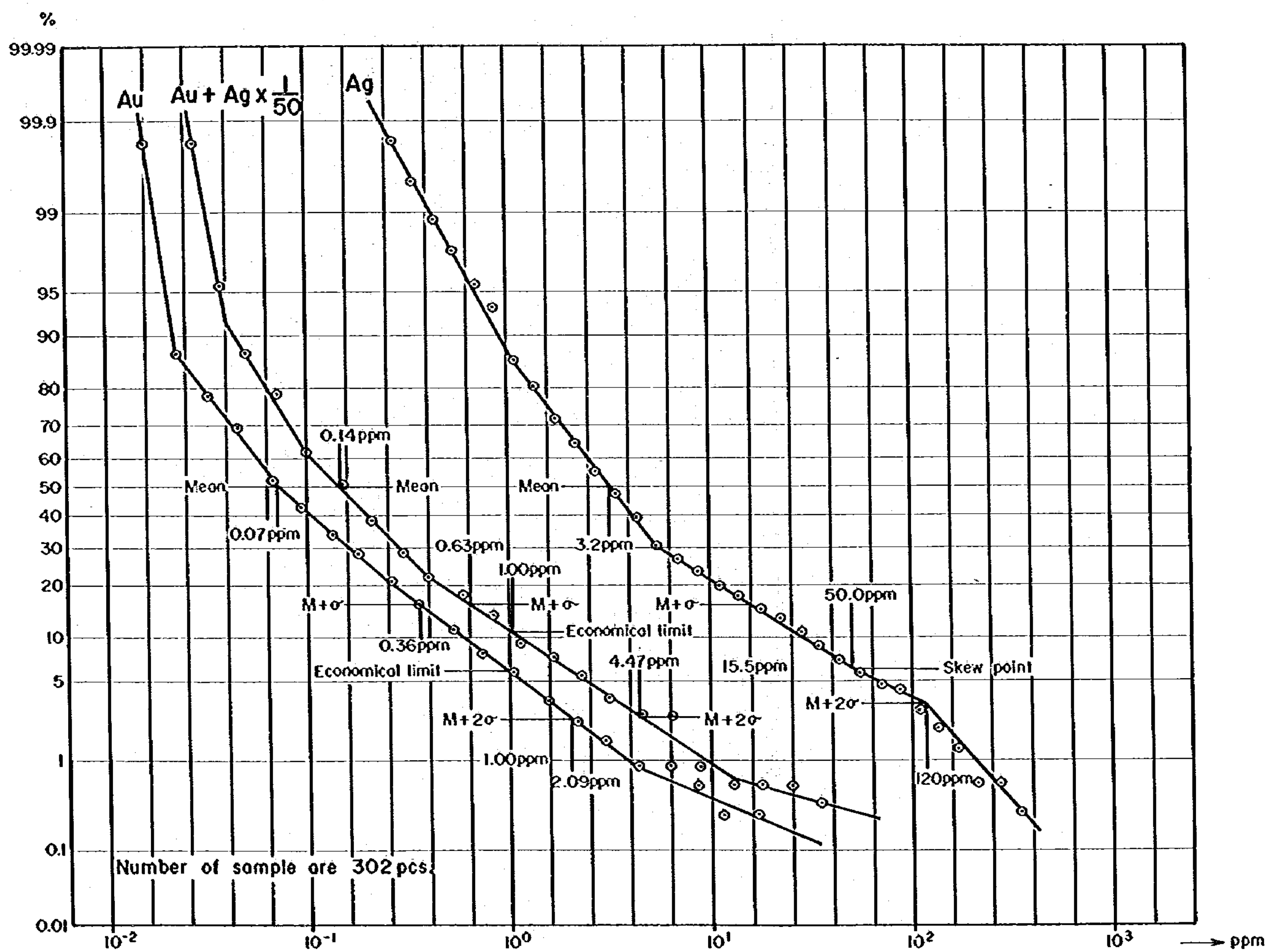


Table 2-4-5 Statistical Classification for Au and Ag Contents of Rock Samples from the Geochemically Anomalous Zones in the SAN CLEMENTE Area

Au (ppm)	Ag (ppm)	Au + $\frac{1}{50}$ Ag (ppm)
AA-class $\geqq$ 2.09	AA-class $\geqq$ 120.0	AA-class $\geqq$ 4.47
----- 2.09 ---- M+2σ	----- 120.0 ---- M+2σ	----- 4.47 ---- M+2σ
2.09 > A-class $\geqq$ 1.00	120.0 > A-class $\geqq$ 50.0	4.47 > A-class $\geqq$ 1.00
------ 1.00--eocnomical point	----50.0--- skew point	----- 1.00 ---economical point
1.00 > B-class $\geqq$ 0.36	50 > B-class $\geqq$ 15.5	1.00 > B-class $\geqq$ 0.63
----- 0.36 ---- M+σ	------ 15.5 ---- M+σ	----- 0.63 ---- M+σ
0.36 > C-class $\geqq$ 0.07	15.5 > C-class $\geqq$ 3.2	0.63 > C-class $\geqq$ 0.14
----- 0.07 ---- Mean	------ 3.2 ---- Mean	----- 0.14 ----- Mean

Correlation between gold and silver

The gold and silver minerals produced in the mineralized zone are (1) electrum which has a composition close to native gold and (2) gold bearing sulfosalts minerals. The result of chemical analysis showes that, although the rate of silver content against gold in electrum is twice or less than that, those in complex sulfasalts are about 50, showing a notable difference between them. As shown in Fig. 2-4-10, however, the

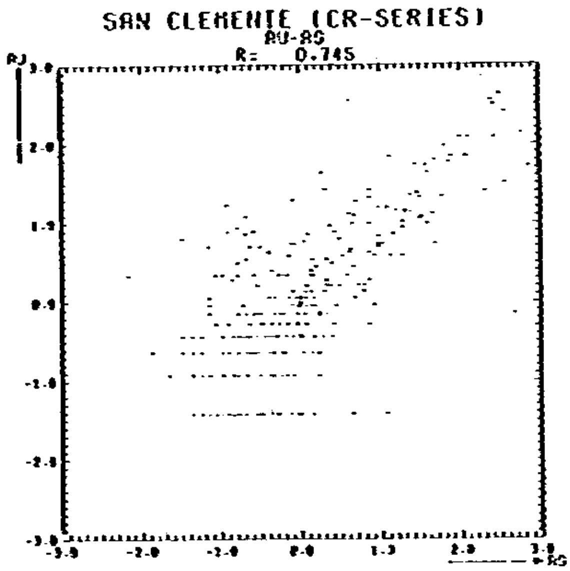


Fig. 2-4-10 Coefficient and Diagram of Correlation for Au and Ag

correlation diagram plotted with the analytical values of the whole samples and the coefficient of correlation (0.745) show a good correlationship between them.

From these facts, it appears that the principal minerals of gold and silver produced in the mineralized zones are on the whole the sulfosalts, and that electrum is produced as an accessory mineral.

Distribution, scale and average grade of mineralized zone

As the result of survey of this year carried out in the three geochemically anomalous zones, a mineralized zone of high grade and of large-scale was detected in the western area, although any notable mineralized zone has not been observed in the eastern and southern areas. The detail of it is shown in the following (see Fig. 2-4-11, 2-4-12, 2-4-13, 5-3).

The mineralized zone is roughly divided into two zones such as A-mineralized zone in the northern part of the area and B-mineralized zone in the southern part (see Fig. 5-3, PL. 5-3).

(1) A-mineralized zone

The extent of the mineralized zone is about 500 meters extension in the EW direction of average width of 300 meters, having an area of about 150,000 square meters, in which six concentrated parts of gold and silver from A-1 to A-6 are included. The zone is subdivided into two zones such as western mineralized zone including A-1, A-2 and A-3 which are concentrated on the western side and the eastern mineralized zone including A-4, A-5 and A-6 concentrated on the eastern side.

Table 2-4-6 Scale and Grade of the A-Mineralized Zone

*No.	Area (m^2)	No. of Analyzed Samples	Average grade (g/t)			Ag/Au	Remarks
			Au	Ag	Au+1/50Ag		
A-1	100x150=15,000	5	4.53	255.0	9.63	56	Rock samples by 50 m grid
A-2	255x100=25,500	11	1.40	87.0	3.13	62	ditto
A-3	50x150= 7,500	3	2.72	59.0	4.00	22	ditto
A-4	50x200=10,000	4	0.82	25.75	1.34	31	ditto
A-5	50x50 = 2,500	18	1.36	2.62	1.41	2	Channel samples in the pit
A-6	25x75 = 1,875	11	2.84	3.71	2.92	1	ditto

Note * Each Extent of the part of concentration of gold and silver was determined to be within the area occupied by the point showing the values of B-class or higher than that [(Au + 1/50Ag ≧ 0.63)].

The area of the whole western mineralized zone including the high-grade parts of A-1, A-2 and A-3 and the low-grade parts in the surroundings reaches as much as 80,000 m^2 and the average grade of "Au + 1/50 Ag" is 3.06 g/ton.

While the ratios of silver content against gold content is 22 to 56 as shown in the parts from A-1 to A-4, those of A-5 and A-6 are 1 and 2 respectively showing a remarkable difference between them. This difference seems to be attributed to the fact that the principal ore mineral is electrum which is close to native gold in A-5 and A-6, whereas they are gold bearing silver telluride complex sulfosalts in A-1 to A-4, directly showing a marked difference in silver content against that of gold.

(2) B-mineralized zone

The zone occupies an area extending in the NNE-SSW direction for 300 meters with the whole width of 150 meters, in which the two gold and silver concentrated parts of B-1 and B-2 are included. They are, however, inferior to the A-mineralized zone in size and grade as shown in the following table.

Table 2-4-7 Scale and Grade of the B-mineralized Zone

No.	Area (m^2)	Number of Samples Analyzed	Average grade (g/t)			Ag/Au	Remarks
			Au	Ag	Au+1/50Ag		
B-1	50 x 350=17,500	7	0.92	47.6	1.87	52	
B-2	50x200+50x50 = 12,500	5	0.79	69.0	2.17	87	

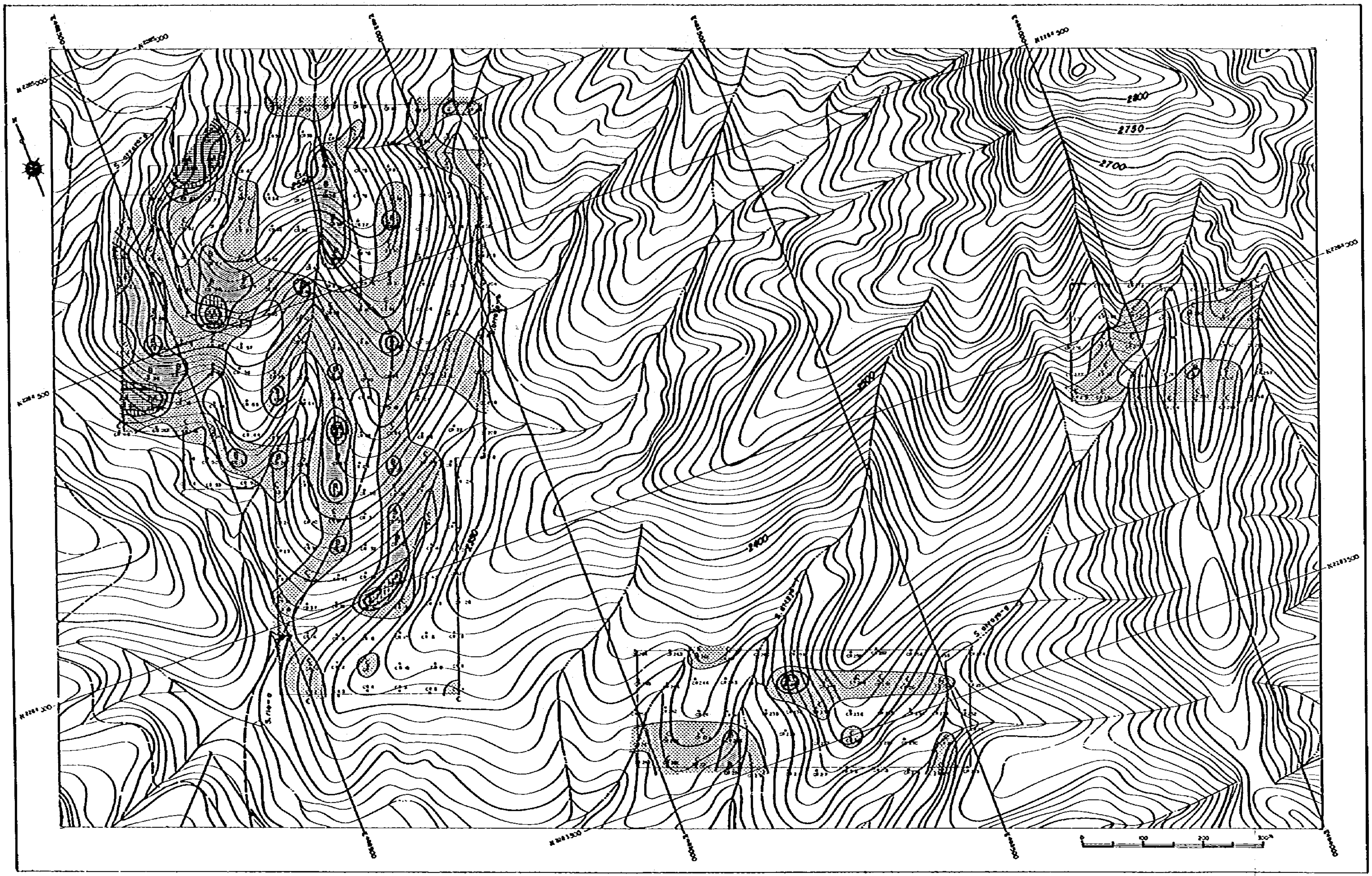
2-4-7 Considerations and Recommendation for Future Exploration

The survey was conducted with purpose of extracting the promising mineralized zones as the target of the future exploration from the geochemically anomalous zones of gold and silver. As the result, the A-mineralized zone which includes the San Severiano mine and extends west-northwesterly, and the B-mineralized zone on the southern side of that are confirmed. The comparison of these two mineralized zones leads to the conlusion that the A-mineralized zone is more superior. The A-mineralized zone is further divided into two parts of the eastern zone and the western zone, among which the latter is worth special notice.

The average grade in the western zone reaches up to about 0.1 oz/t when calculated in terms of gold for the total contents of gold and silver. This grade was obtained as the result of sampling at the points of 50-meter grid-specing, and is not the result of continuous sampling of the mineralized zone. Therefore, following exploration will be required in future to discuss the economical promisingness of the mineralized zone.

1. It is recommended to get hold of the distribution and average grade of gold and silver on the surface of the mineralized zones. It will be necessary, for this purpose, to confirm the continuous outcrop of the mineralized zone by stripping and trenching and to perform continuous channel sampling.

2. Exploration by diamond drilling should be conducted to investigate the presence or absence of economical ore at depth and to provide all the information that is required.



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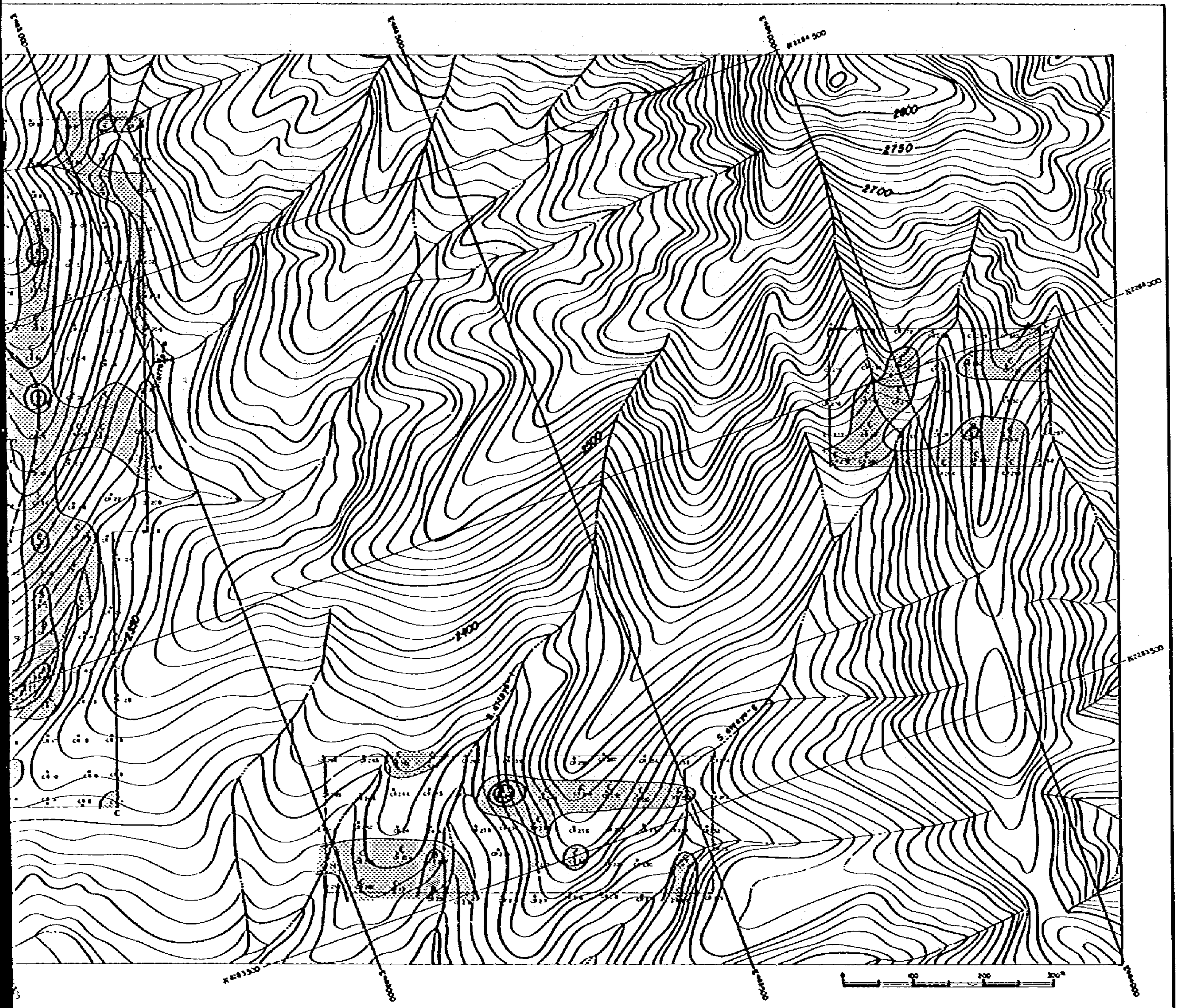
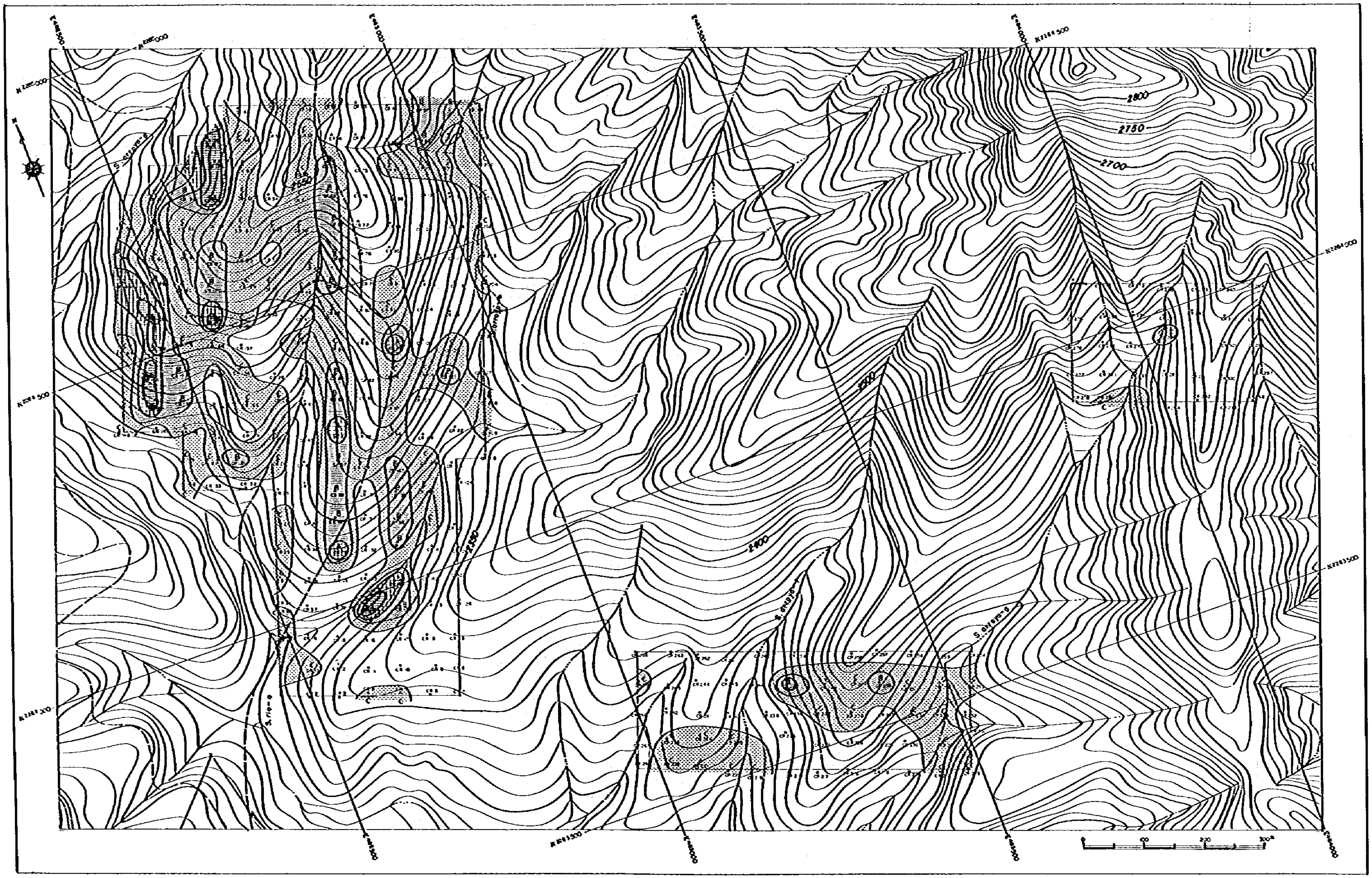


LEGEND

Symbol	Class of anomaly	Au contents (in ppm)
	AA	Au ≧ 2.09
	A	2.09 > Au ≧ 1.00
	B	1.00 > Au ≧ 0.36
	C	0.36 > Au ≧ 0.07

Fig.2-4-11 Geochemical Au Anomalies of the SAN CLEMENTE Area



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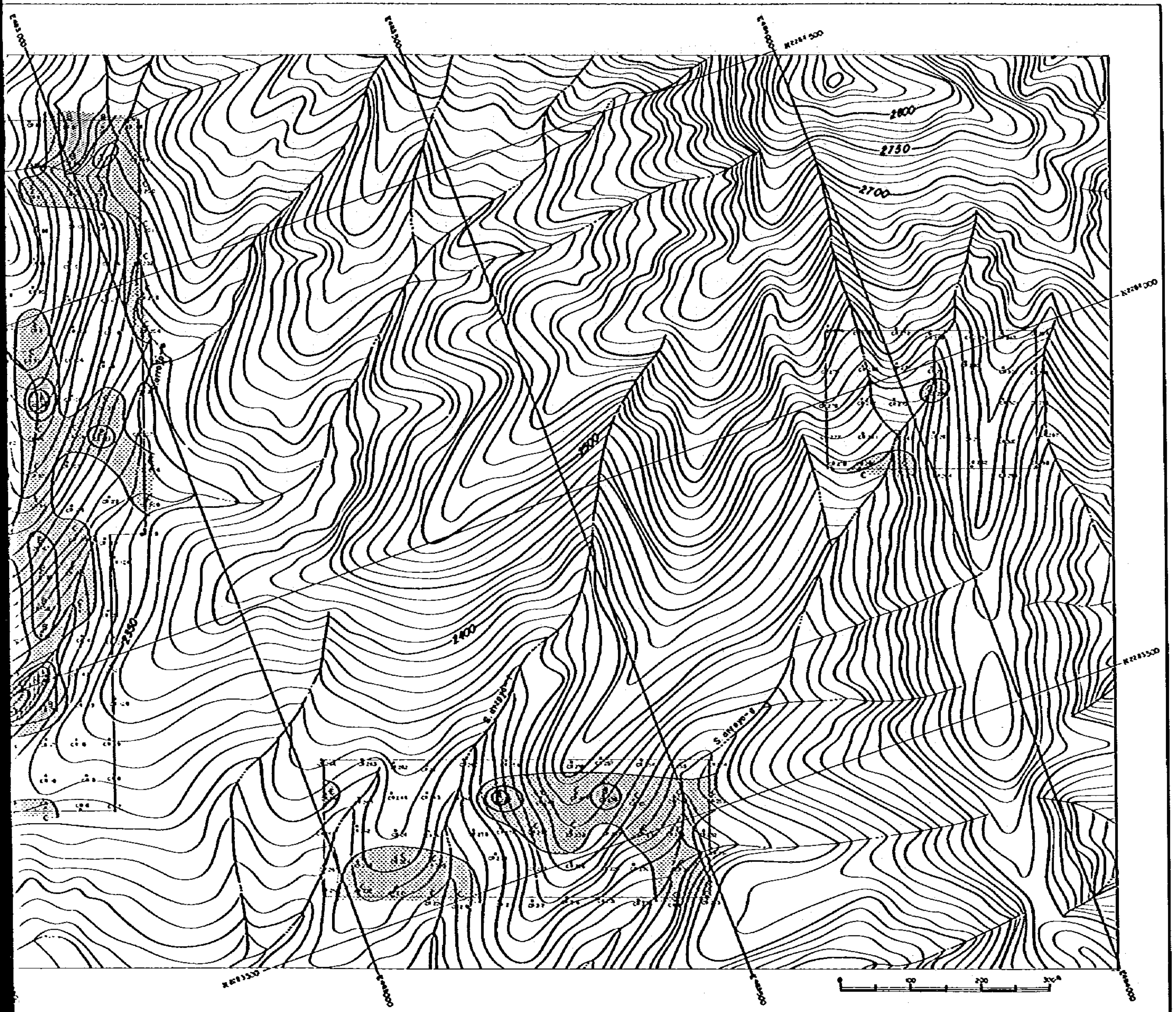
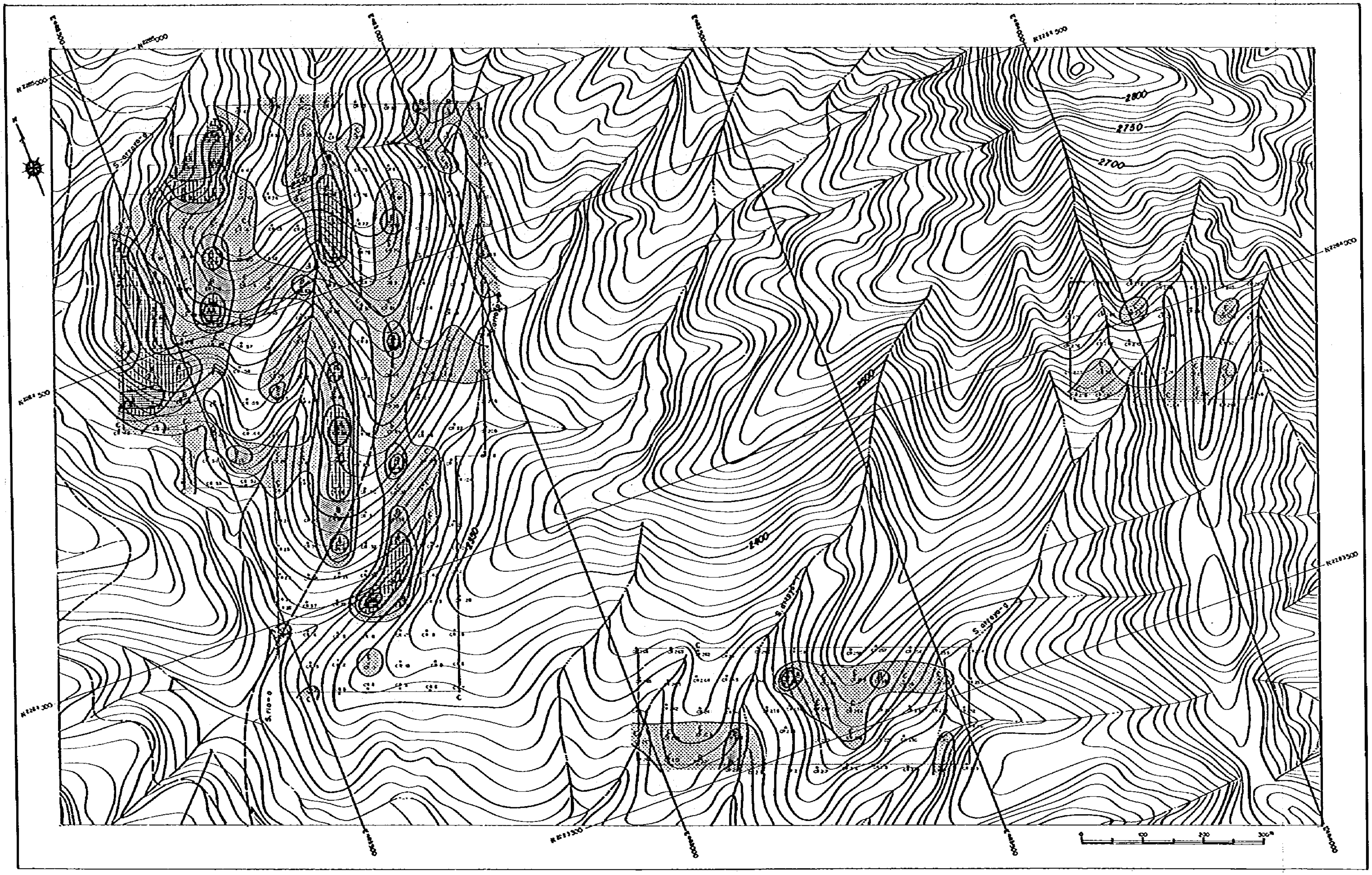


LEGEND

Symbol	Class of anomaly	Contents (in ppm)
	AA	Ag ≧ 120.0
	A	120.0 > Ag ≧ 50.0
	B	50.0 > Ag ≧ 15.5
	C	15.5 > Ag ≧ 3.2

Fig.2-4-12 Geochemical Ag Anomalies of the SAN CLEMENTE Area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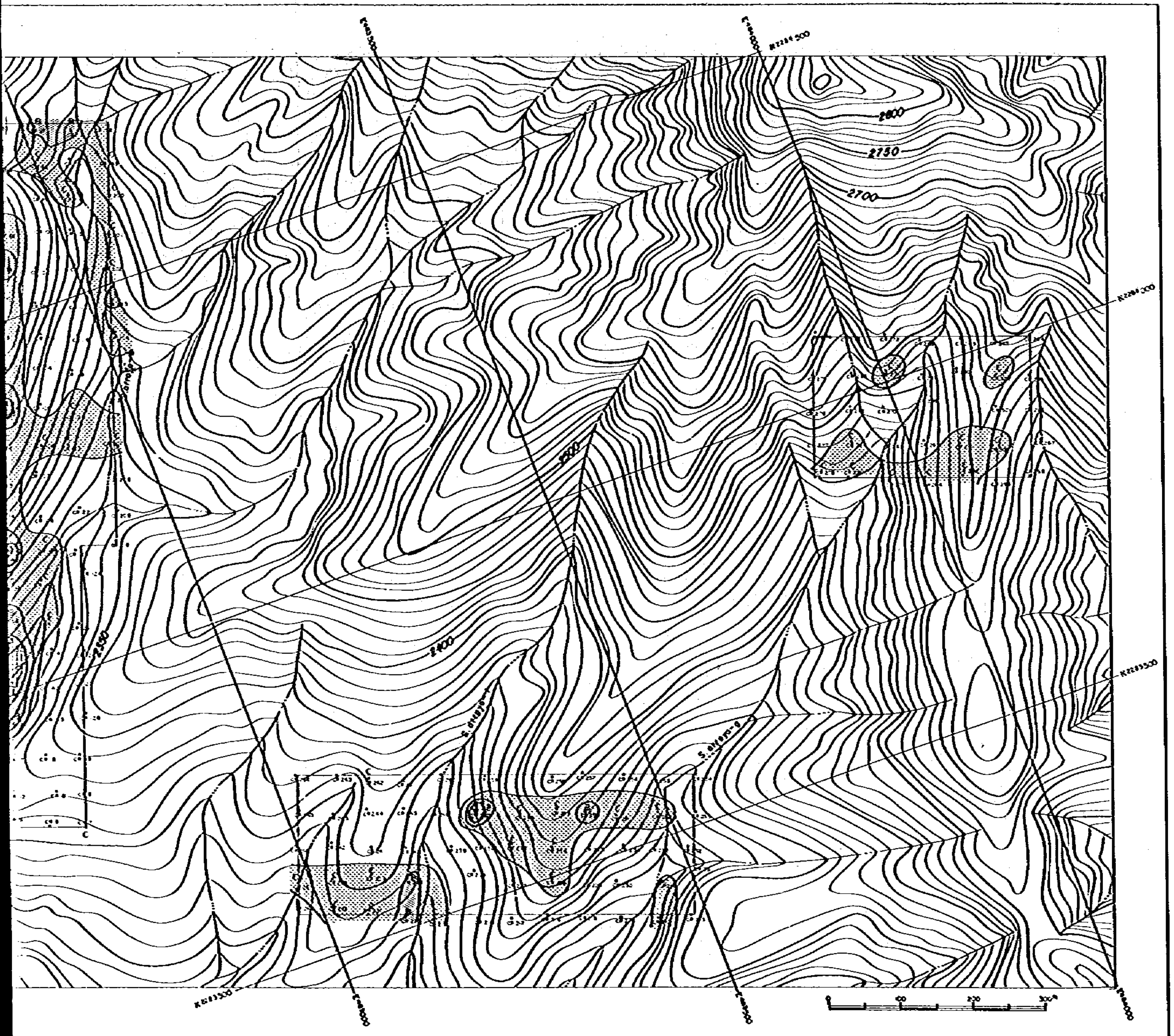

LEGEND

Symbol	Class of anomaly	Au + 1/50 Ag Contents (in ppm)
	AA	AA ≧ 4.47
	A	4.47 > A ≧ 1.00
	B	1.00 > B ≧ 0.63
	C	0.63 > C ≧ 0.14

Fig. 2-4-13 Geochemical「Au + 1/50 Ag」 Anomalies of the SAN CLEMENTE Area

CHAPTER 3 GEOCHEMICAL PROSPECTING

CHAPTER 3 GEOCHEMICAL PROSPECTING

3-1 Outline of Survey

The geochemical prospecting of this year was conducted in parallel with the geological survey in the SAN CLEMENTE area and geophysical survey in both areas of the EL TEJOCOTE and the PROVIDENCIA beside geological survey.

In the SAN CLEMENTE area, the survey was performed to make clear the details of the gold and silver mineralization picked up during the second phase work, and to evaluate the potential for future exploration, on the other hand. The survey was, therefore, conducted to investigate the distribution of gold and silver contents in the mineralized zone of the alkaline rhyolite, different from the ordinary geochemical prospecting in which detection of geochemical anomaly is the main purpose, and the result was already described in Clause 5 of Section 4 in Chapter 2. The results of geochemical preospectings in other two areas will be described here.

Soil samples were taken with at intervals of about 100 meters along the IP electric survey lines (200 meters line-spacing). Three elements of copper, silver and lead were determined as the indicators taking the result of geochemical prospecting in the previous year and, considering the type of mineralization observed in the areas.

Table 3-1 Number of Geochemical Samples from the EL TEJOCOTE and the PROVIDENCIA Areas

	Sampling Space		Total Length (km)	Number of Samples
	Line-spacing	Point Interval		
EL TEJOCOTE	200	±100	15	213
PROVIDENCIA	200	±100	15	230

3-2 Sampling Scheme

Formation of surface soil is poor because of the predominance of limestone in the both areas. Soil of B-horizon was hardly observed in the most points, and caliche (secondary consolidated calcareous crust) and dark gray organic soil contaminated with iron oxide were sampled instead.

3-3 Chemical Analysis

The samples were chemically analyzed at the laboratory installed as an annex to the CRM office at Ixmiquilpan.

The method of analysis was as follows.

(1) Sample preparation

After drying the material in an oven for a given time, reduced and pulverized to be the sample for analysis.

(2) Procedure of analysis

Weigh 2.0 grams of each sample, put into Pyrex beaker, add 20 mℓ conc. HNO_3 and 2 mℓ conc. H_2SO_4 and some deionized water, mix, decompose by sand-bath heating on a hot plate until white fume of sulphuric acid is generated and then allow to cool. After that make up to 50 mℓ with 1N HNO_3, filter, and determine the solution by usual atomic absorption method.

(3) Check analysis

Reanalysis was made to check the analytical values and its reproductibility having selected 80 samples arbitrarily from the total 443 samples. The result showed a good correspondency to the initial values of analysis to those of reanalysis with a few exceptions excepted.

3-4 Data Processing

Since the targets of both areas were limited to small extents, the statistical populations of geochemical elements would have to show the character reflecting the geological and geochemical conditions in each area. Accordingly, the cumulative frequency distribution graphs of metal contents were prepared independently for each population to investigate background and anomalous values in Lepeltier method (1969) (Ref. Fig. 3-1, 3-2), and the results of which are summarized as Tables 3-2 and 3-3.

In this cumulative frequency distribution graphs, classifications of geochemical background and anomalous values were determined using such as values of M, M+σ, M+2σ, and skew point in case that clear inflection is indicated meaning a change from low contents-side population which shows logarithmic normal distribution, to another population of higher contents.

Classifications of the anomalies by the statistical graphic-method are summarized as in the Tables 3-2, 3-3 for each area and element.

Fig. 3-1 Cumulative Frequency Distribution of Ag, Cu and Pb Contents of Soil Samples from the EL TEJOCOTE Area

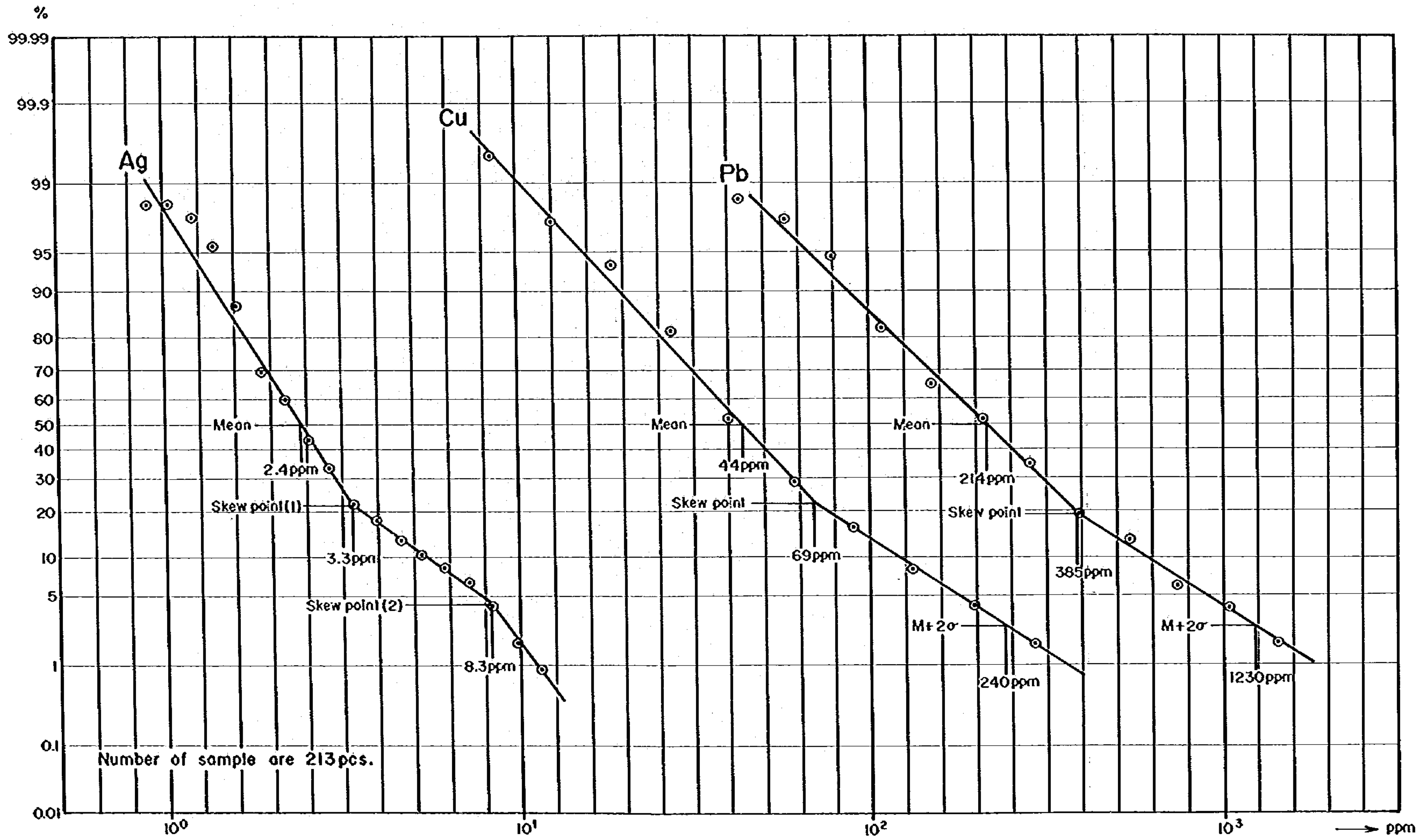

Fig. 3-2 Cumulative Frequency Distribution of Ag, Cu and Pb Contents of Soil Samples from the PROVIDENCIA Area

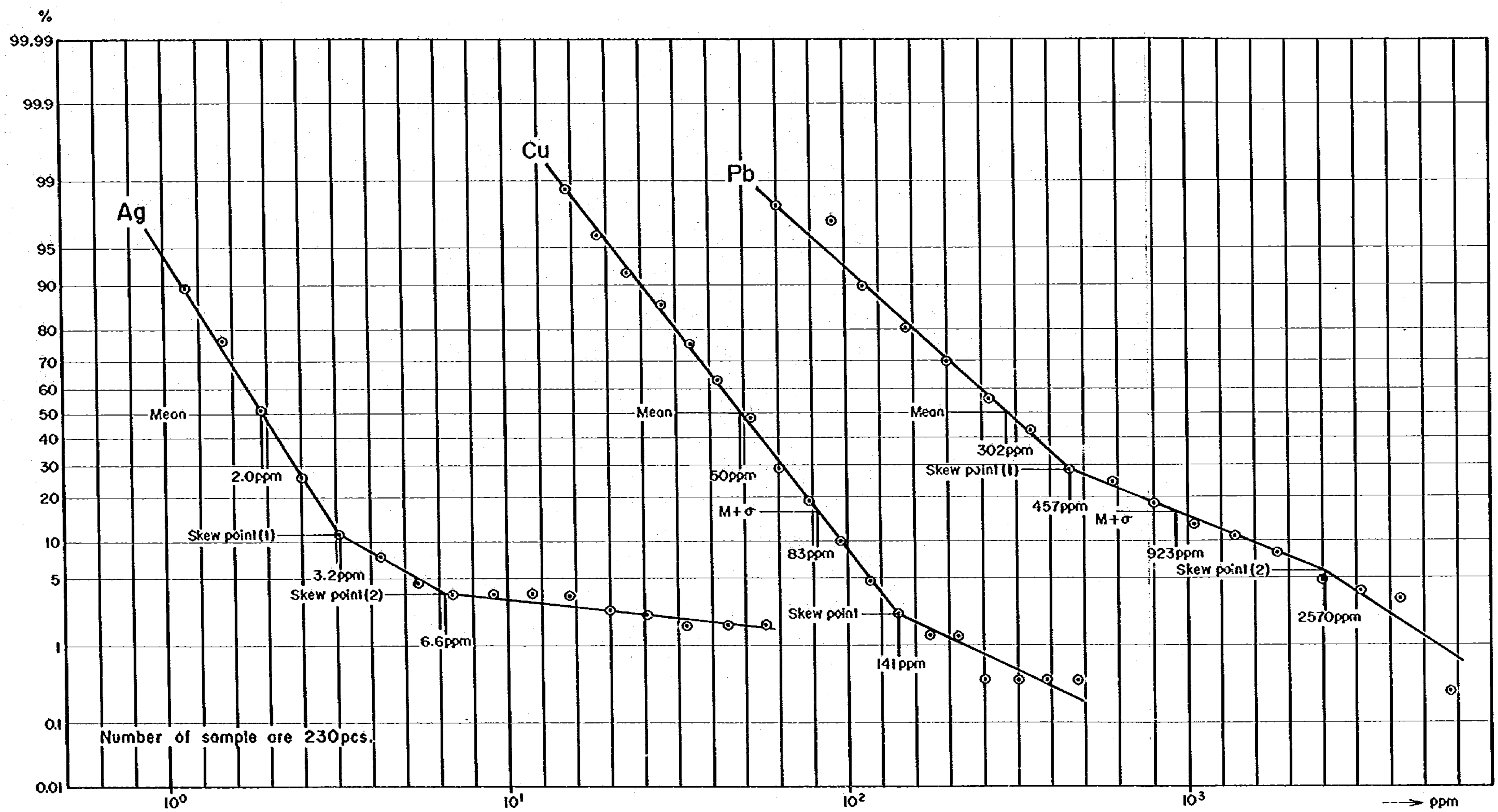

Table 3-2 Statistical Classification of Geochemical Elements of the EL TEJOCOTE Area

Ag (ppm)	Cu (ppm)	Pb (ppm)
A-class anomaly ≥ 8.3	A class anomaly ≥ 240	A-class anomaly ≥ 1,230
------8.3---skew point	------ 240 ------ $M+2\sigma$ *(3)	------1,230------- $M+2\sigma$
8.3>B-class anomaly≥3.3	240>B-class anomaly≥69	1230>B-class anomaly≥385
------3.3---skew point	--------69----skew point	--------385----skew point
3.3>C-class anomaly≥2.4	69>C-class anomaly≥44	385>C-class anomaly≥214
------2.4---------- M *(1)	--------44---------M	--------214---------- M

Table 3-3 Statistical Classification of Geochemical Elements of the PROVIDENCIA Area

Ag (ppm)	Cu (ppm)	Pb (ppm)
A-class anomaly ≥ 6.6	A-class anomaly ≥ 141	AA-class anomaly ≥ 2,570
------6.6---skew point	-------141----skew point	------2,570----skew point (2)
6.6>B-class anomaly≥3.2	141>B-class anomaly≥83	2,570>B-class anomaly≥923
------3.2---skew point	--------83---------$M+\sigma$ *(2)	--------923-------$M+\sigma$
3.2>C-class anomaly≥2.0	83>C-class anomaly≥50	923>C-class anomaly≥457
------2.0-----------M	--------50-------- M	--------457----skew point (1)
		457>high background≥302
		--------302-------M

Note:

*(1) M value .... the value shown at the point of 50% of cumulative frequency distribution, which approximately corresponds to geometric mean of population

*(2) $M+\sigma$ value ...... the value shown at the point of 16% of cumulative frequency distribution

*(3) $M+2\sigma$ value ..... the value shown at the point of 2.5% of cumulative frequency distribution

In comparison both areas with each other on the value used for classification of those anomalies, it is understood that the values have reflected the characters of geochemical anomalies occurred in each area. Taking lead for example, the mean value of the whole population was raised in the PROVIDENCIA area because of the presence of anomalies of large-scale and high grade, whereas the scale and grade of the EL TEJOCOTE area fell short of those in the former area. It is, however, the other way about when taking copper for example. In either case, since the main theme of geochemical prospecting of this time was to detect mineralized zones in the limited small areas, some difference was revealed as shown in the above.

Distribution maps of anomaly were prepared on each area and element by the use of these classification (PL. 3-2, 3-4, 3-5, 3-6 and 3-7).

The section in which more than several anomalous values are concentrated, was demarcated as a geochemically anomalous zone, and the correlation between the elements, the relation with geology and ore deposit were investigated. The results are summarized as follows.

3-5 Geochemical Anomaly in the EL TEJOCOTE Area

(1) Correlation between the elements (see Fig. 3-3)

As shown in Fig. 3-3, the coefficient of correlation between lead and silver shows the highest value of 0.803, and a negative correlation is observed between copper and lead. This relation supports the fact, as mentioned later, that lead and copper anomalies occur independently without any mutual

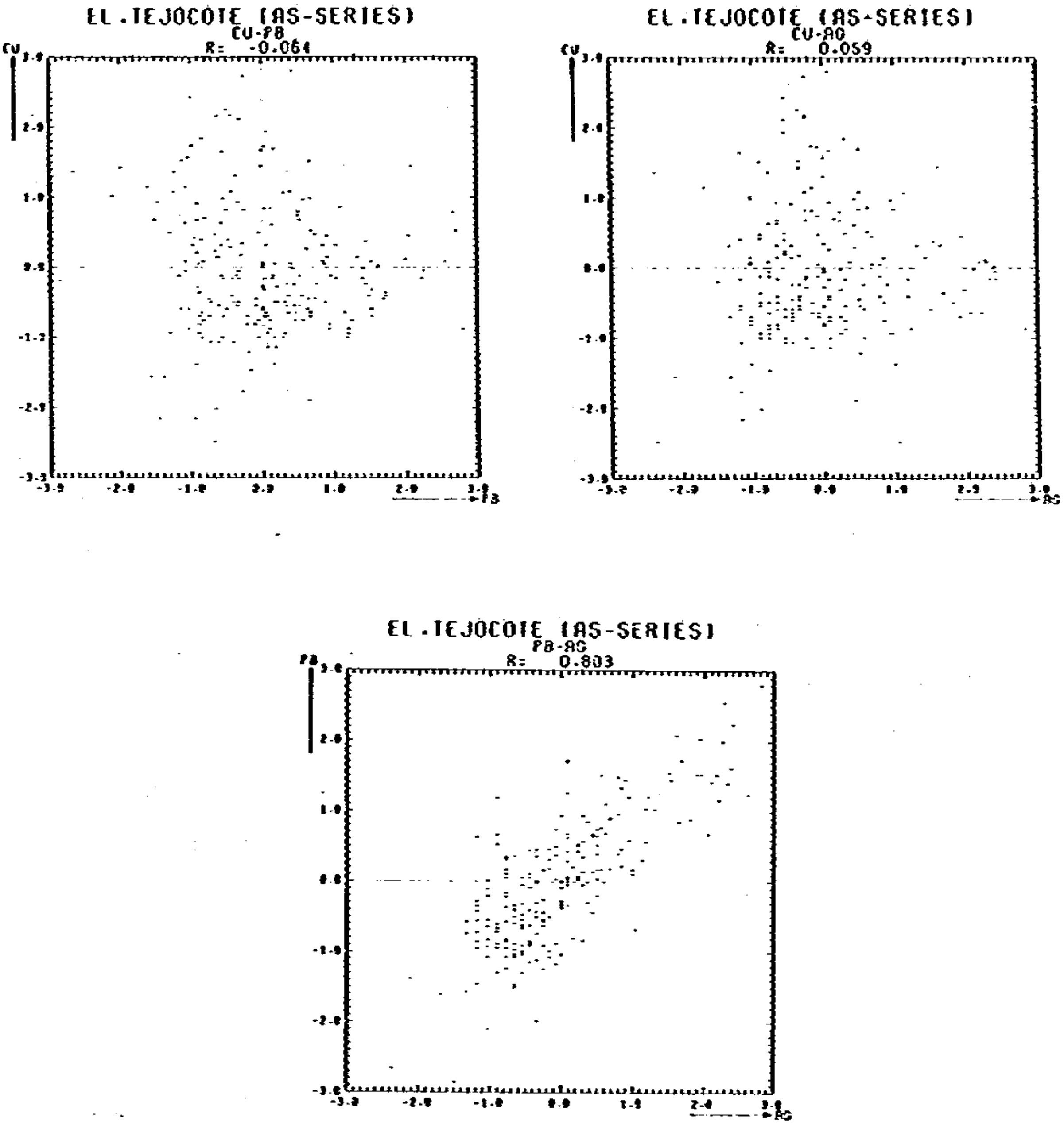

Fig. 3－3　Correlation Diagrams and Coefficients among Geochemical Cu, Pb and Ag Elements of the EL TEJOCOTE Area relation. In other words, although the anomalous zones of lead and silver are distributed in almost the same area overlapping each other, the anomalous zone of copper is isolated independently.

(2) Distribution (see PL. 3-2)

The anomalous zone of lead and silver continues on a large scale from the center to the northeastern part of the area. This anomalous zone varies toward northeast gradually to contain the higher anomalies such as from high background through B-class to A-class. In the northeastern part, the extent of B-class anomalous zone which contains several A-class anomalies, reaches up to 800 m x 1,000 m. Topographically, it is distributed on the northeastern slope of the mountain ridge (including Mesa de la Cebada) in the central to southern part of the area.

On the other hand, the copper anomalous zone is distributed in the southern half of the surveyed area. Although this anomalous zone has a halo of C-class anomalies in the central part of the area, the main part of it consists of many B-class anomalies and several A-class anomalies at the southern end of the area. Its extent is about 2,000 meters in the direction of east to west and several hundred meters in that of north to south. Topographically, the zone is situated from Mesa de la Cebada to Cerro de la Cebada in the southern part of the area and on the southern slope of these mountains.

(3) Relation of the geochemically anomalous zones with geology and ore deposit

The geology of the southern half of the area where the copper anomalous zone is distributed, consists of thick-bedded to massive limestone of the Kdl member of the El Doctor Formation distributed from Mesa de la Cebada to Cerro de la Cebada in a landform of flat plateau, and dioritic rocks (Tidi) intruded into limestone in the valley of the River Arroyo El Molinito which flows east-northeastward at the southern end of the area.

A discontinous and irregular occurrence of skarn zone is observed at the contact between intrusive rocks and calcareous rocks, and mineralization of mainly magnetite associated with chalocopyrite also occurs. The distribution of copper anomalous zone is consistent with the trend of contact between intrusive rocks and limestone, and in addition, a tendency is shown that the higher A-class anomalies of copper are scattered along the contact.

As mentioned above, the geochemical anomalies of copper in the area seems to indicate the iron and copper mineralization of pyrometasomatic type observed at the contact between calcareous rocks (Kdl) and intrusive rocks (Tidi). The A-class anomalies showing the value of 240 ppm and over of copper content have been found at only three points and the highest value is 394 ppm, which can not be said to be a very high value.

On the other hand, geochemically anomalous zone of lead and silver on a large scale is detected in the northeastern part of the area where calcareous rocks of the Kdl member is distributed with gentle dips, in which no remarkable hydrothermal alteration nor recrystallization of the limestone could be observed.

The cause of geochemical anomaliy in this part is considered as follows. During the survey of this time, lead, zinc and silver mineralizations of hydrothermal to manto type were observed at several places in the limestone outside of iron and copper ore deposit emplaced in the skarn zone at the contaot between intrusive rocks and calcareous rocks, and such mineralization has not been accompanied by remarkable hydrothermal alteration and recrystallization of limestone. The ore bodies are composed of secondary minerals such as limonite and jarosite. Taking into consideration that this part is located in the surrounding area of the intrusive rocks, that the anomalous zone show a tendency to extend predominantly northeastward to the outside of the surveyed area, and that a mineralized zone of lead and zinc occurs in the vicinity of the Plomosas settlement at about 1 kilometer beyond the boundary of the area, the occurrence of A-class anomalies (about 0.15% lead) at six points and other many B-class anomalies constituting the anomalous zone, seems to indicate the existence of silver bearing lead mineralized zone in the proximity of them.

3-6 Geochemical Anomaly in the PROVIDENCIA Area

(1) Correlation between the elements (see Fig. 3-2)

The coefficients of correlation between lead and silver, and

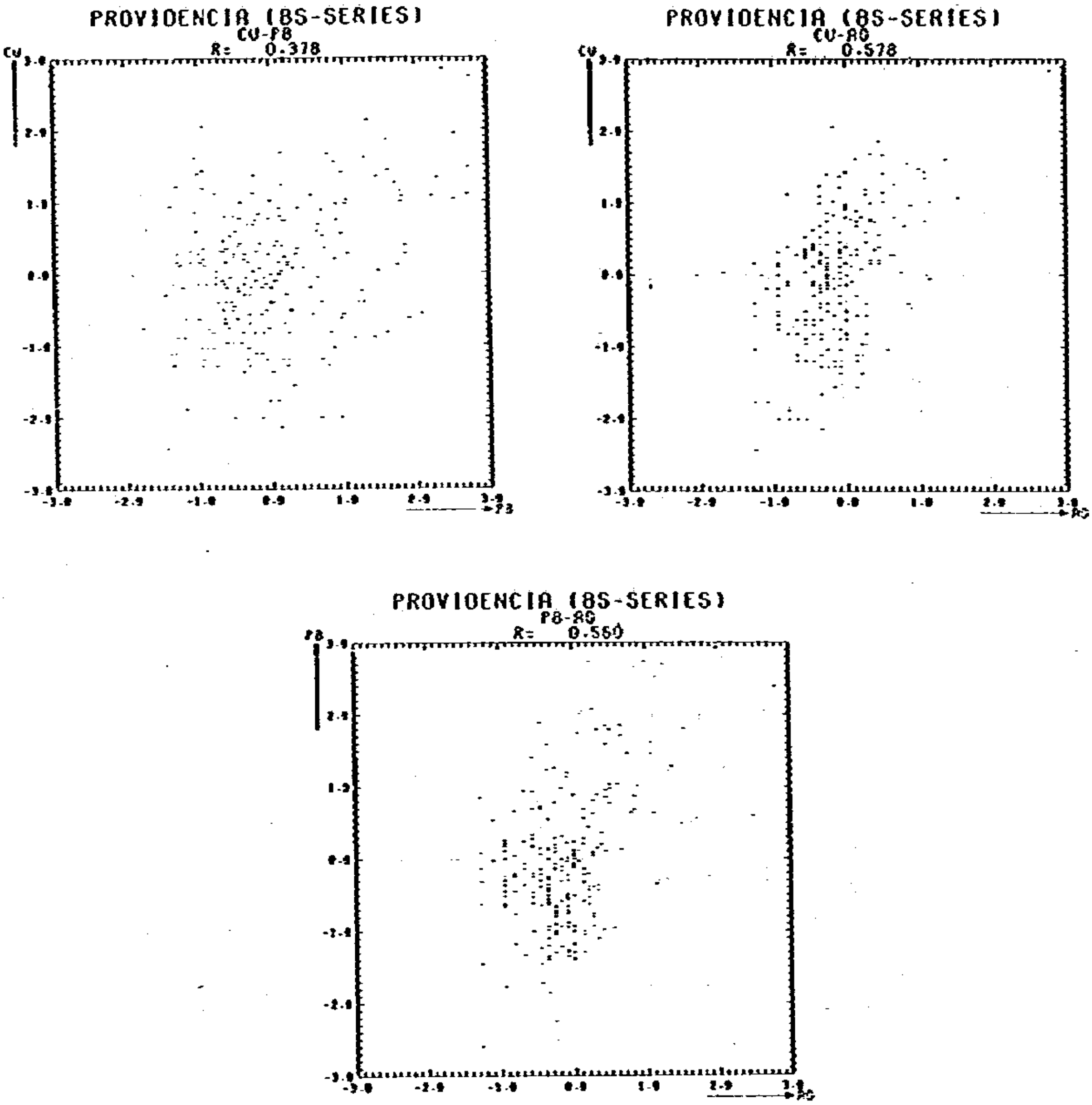

Fig. 3－4　Correlation Diagrams and Coefficients among Geochemical Cu, Pb and Ag Elements of the PROVIDENCIA Area copper and silver are 0.560 and 0.578 respectively showing the correlation of similar order, but that between copper and lead is 0.378, showing a little more dispersion as compared with the former two. The comparison of distribution of each element shows a good consistency as to the anomalies of AA-class to B-class, but some inconsistency is observed in distribution as to C-class. The anomalies of the largest scale and the highest grade are represented by lead, followed by silver and copper.

The high grade ore of zinc is notable, however, in the assay values of ore analyzed during the survey of this time, which leads to the estimation that if zinc component was adopted as indicator element in the survey, the anomalies of the same scale to the lead component would have been detected.

(2) Distribution (see PL. 3-4, 3-5, 3-6 and 3-7)

An anomalous zone on a large scale which continues in the NS direction, were detected centering in the survey line No. 20 overlapped with three elements. Beside these, small-scale C-class anomalies mixed with B-class anomalies are scattered sporadically with sometimes different locations for each element.

The details of composition for each element of the large-scale anomalous zone centering on the survey line No. 20 are as follows.

(Lead component)

9 points of AA-class and 12 points of A-class anomalies are concentrated from the survey line No. 18 to No. 24.

5 points of AA-class, more than a half of this class, showed the values of 1.4% ∿ 9.8% Pb and others showed 0.3% ∿ 0.4% Pb. The reason why such high grade as good as ore grade will partly be attributed to the waste ores remained at the old mine workings and old test pits as mentioned later.

The anomalous zone which includes the anomalies higher than B-class has a large scale extent extending for 1,200 meters from north to south with about 400 meters width, which reflects well the characteristics of mineralization of the area.

(Silver component)

The distribution of A-class anomalies is small in scale as compared with the Pb component. The anomalous zone, however, when included with both B-class and C-class anomalies, is well consistent with the distribution of the Pb anomalous zone though small in scale. Beside the concentration of A-class anomalies at 5 points in the survey line No. 20, each point of them are only scattered in survey lines of No. 16, 18, 22 and 24. These are, however, included in the large-scale anomalous zone with exception of one point on No. 16. The anomalies in No. 20 have the values of 16.2 ppm ∿ 107.3 ppm Ag, showing relatively high grade.

(Copper component)

Three points of A-class anomaly such as two points (193 and 496 ppm) in survey line No. 20 and one point (183 ppm) in No. 24 are detected overlapping with the former, but the anomalous zones composed of geochemical anomalies, are small on a scale as compared with the former.

The B-class anomalies have a similar tendency to the A-class. Therefore, it can be said that the anomalies of both A and B-class are well consistent with those components of lead and silver. The lower limits of copper component of each B-class and A-class are 83 ppm and 141 ppm respectively, showing that the contents of copper element are inferior to those of lead and silver which have the high grade as good as to be ore grade.

(3) Relation of geochemically anomalous zone with geology and mineralization

Geology of the geochemically anomalous zone which swells centering on the eastern side of the survey line No. 20 and narrowly extends in the north-south direction, consists of medium bedded limestone rhythmically interbedded with thin beds of black flint and dark gray pelitic limestone. The general strike and dip are N35° ∿ 40°W and 50° ∿ 60°SW respectively, and numerous minor foldings are observed.

The zone is characterized by many remains of prospecting and old mine workings represented by the mines such as Providencia, San Juan, San Juana and Mojonera Huilco 10. Most of the ore are oxidized having altered to secondary minerals mainly composed of limonite, hematite and jarosite. The result of laboratory test showed that these ores contained carbonates of lead and zinc, and micro-grains of silver minerals. The form of ore deposits shows irregular vein, manto to massive types. Thus the geochemically anomalous zones of the area are considered as a reflection of these mineralized zones.

3-7 Summary

The geochemical survey by soil sampling of this year was conducted to substantially delineate the mineralized zone in the two areas of the EL TEJOCOTE and the PROVIDENCIA. The results are summarized as follows.

(1) Determination of indicator element and anomaly

Three elements of silver, copper and lead were determined to be the indicator elements, and background and anomalous values were determined by means of graphic method by the cumulative frequency distribution.

As the result, each element showed geochemical behavior reflecting sensitively the main metallic components of the known mineralized zones, which proved that they were sufficiently competent as indicator elements. In the both areas, lead component especially showed a high content in general, followed by silver and copper. Although in the EL TEJOCOTE area, lead and silver shows separate behavior with copper, the three elements shows the similar behavior in the PROVIDENCIA Area. It seems, from these behavior, that the difference of time of mineralization of each component or that of zonal arrangement of each component in each area were shown.

The result of analysis by the cumulative frequency distribution revealed the existence of population on the side of lower content which showed logarithmic normal distribution as well as the population biased to the side of higher content, which led to make distinctly the classification of anomalies.

(2) Comparison of geochemically anomalous values (ppm) between two areas

EL TEJOCOTE Area	PROVIDENCIA Area
(Ag)	
A-class anomaly ≧ 8.3	A-class anomaly ≧ 6.6
8.3 > B-class anomaly ≧ 3.3	6.6 > B-class anomaly ≧ 3.2
3.3 > C-class anomaly ≧ 2.4	3.2 > C-class anomaly ≧ 2.0
(Cu)	
A-class anomaly ≧ 240	A-class anomaly ≧ 141
240 > B-class anomaly ≧ 69	141 > B-class anomaly ≧ 83
69 > C-class anomaly ≧ 44	83 > C-class anomaly ≧ 50
(Pb)	
	AA-class anomaly ≧ 2,570
A-class anomaly ≧ 1,230	2,570 > A-class anomaly ≧ 923
1,230 > B-class anomaly ≧ 385	923 > B-class anomaly ≧ 457
385 > C-class anomaly ≧ 214	457 > C-class anomaly ≧ 302

The result of classification of the geochemical anomalies for statistic population of each area is as shown in the above, which revealed that these values reflected the characteristics of mineralization of each area as described in the following.

(i) Silver

The values of classification of the two areas are almost similar. It is shown, however, that the extent of anomality in the PROVIDENCIA Area is considerably higher than that of the EL TEJOCOTE Area from the fact that although the values of four samples belonging to those of A-class anomaly lie between 8.3 ppm and 13.9 ppm in the EL TEJOCOTE Area, the value of nine A-class samples lie between 16.9 ppm and 107.3 ppm in the PROVIDENCIA Area.

(ii) Copper

The lower limit of A-class anomaly of the EL TEJOCOTE area is 240 ppm showing a high value which is as much as almost twice that of the PROVIDENCIA area. This obviously suggests the influence of pyrometasomatic copper mineralization found in the EL TEJOCOTE area and support, on the contrary, the absence of notable copper mineralization in the PROVIDENCIA area.

(iii) Lead

The values of almost the same order are used for the classification of anomalous values of A, B and C classes in the both areas, although there are some differences. It is, however, a marked difference that the values of AA-class are present in the PROVIDENCIA Area. 10 samples classified as AA-class are contained in the PROVIDENCIA Area which lie between 2,806 ppm and 98,000 ppm. 6 samples out of 10 showed the values more than 10,000 ppm. Beside these, 19 samples are included in the A-class, and the total of both classes is almost equivalent to 10 percent of the whole samples. On the other hand, the number of A-class samples from the EL TEJOCOTE Area is only 4, the values of which lie between 1,250 and 1,776. Accordingly, the great difference between the two areas in regard to lead mineralization would be able to be understood.

The comparison of the geochemically anomalous zones delineated in the both areas of the EL TEJOCOTE and the PROVIDENCIA based on the result described above will lead to conclude that those of the PROVIDENCIA Area are more predominant in scale and substance and that the mineralization to be observed on the surface is superior. Therefore, the future exploration to confirm the occurrence of ore deposit at depth is earnestly desired in the PROVIDENCIA Area.

CHAPTER 4 GEOPHYSICAL SURVEY (IP ELECTRIC SURVEY)

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4-1 Summary of Survey

The IP electric survey was conducted, as the geophysical survey of the third year, in the two areas including El TEJOCOTE and PROVIDENCIA to obtain geophysical informations on subsurface structure, mineralized zone and ore deposit for 15 line kilometers in each area (30 kilometers in total).

Although the IP anomalous zones detected in the two areas seem to be caused by the mineralized zone of copper, lead and silver, the values of IP anomaly have not been so great.

4-2 Outline of Survey

4-2-1 Survey Area and Configuration of Survey Lines

The survey areas are the El TEJOCOTE area and the PROVIDENCIA area as shown in Fig. 4-1 (Location Maps of IP Survey Areas), and the survey line and the survey points are shown in Fig. 4-2 (Location Map of IP Survey Lines and Points, EL TEJOCOTE Area) and Fig. 4-3 (Location Map of IP Survey Lines and Points, PROVIDENCIA Area).

4-2-2 Quantity of Survey

	El TEJOCOTE Area	PROVIDENCIA Area
Area covered	2.7 km^2	2.7 km^2
Number of lines	10	10
Length of each line	1.5 km	1.5 km
Total line length	15 km	15 km
Line spacing	200 m	200 m

	El TEJOCOTE Area	PROVIDENCIA Area
Separation of points	100 m	100 m.
Electrode configuration	pole-dipole	pole-dipole
Survey depth	300 m	300 m
Direction of survey line	N-S	N55°E

4-2-3 Instruments

Transmitter

Type : IPC-7/15 KW

Maker : SCINTREX (CANADA) LTD.

Output voltage : 0 ∿ 5000 V, DC

Output current : 0 ∿ 20 A, DC

Receiver

Type : IPR-8

Maker : SCINTREX (CANADA) LTD.

Maximum sensitivity range : 0.3 mV

Chargeability range : 0 ∿ 100 milli-seconds

Generator

Type : MG 15 KW-AC

Maker : VOLKS WAGEN (WEST GERMANY)

Outout : 15 KW, 400 Hz, 300 V

4-2-4 Setting of Survey Lines

Line setting was carried out using transit and measuring tape. Survey points were set an interval of 100 meters in horizontal distance, which were marked by the posts with numbering on it.

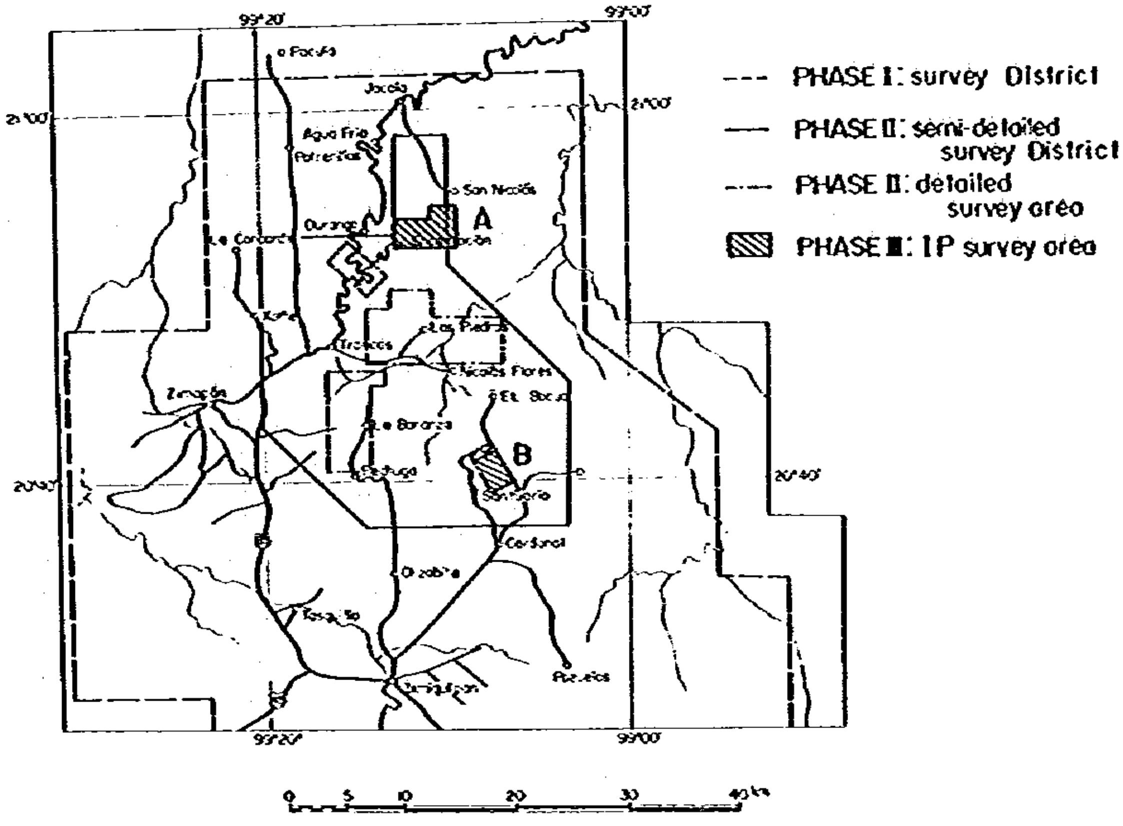

Fig. 4-1 Location Map of IP Survey Areas
(A: EL TEJOCOTE Area, B: PROVIDENCIA Area)

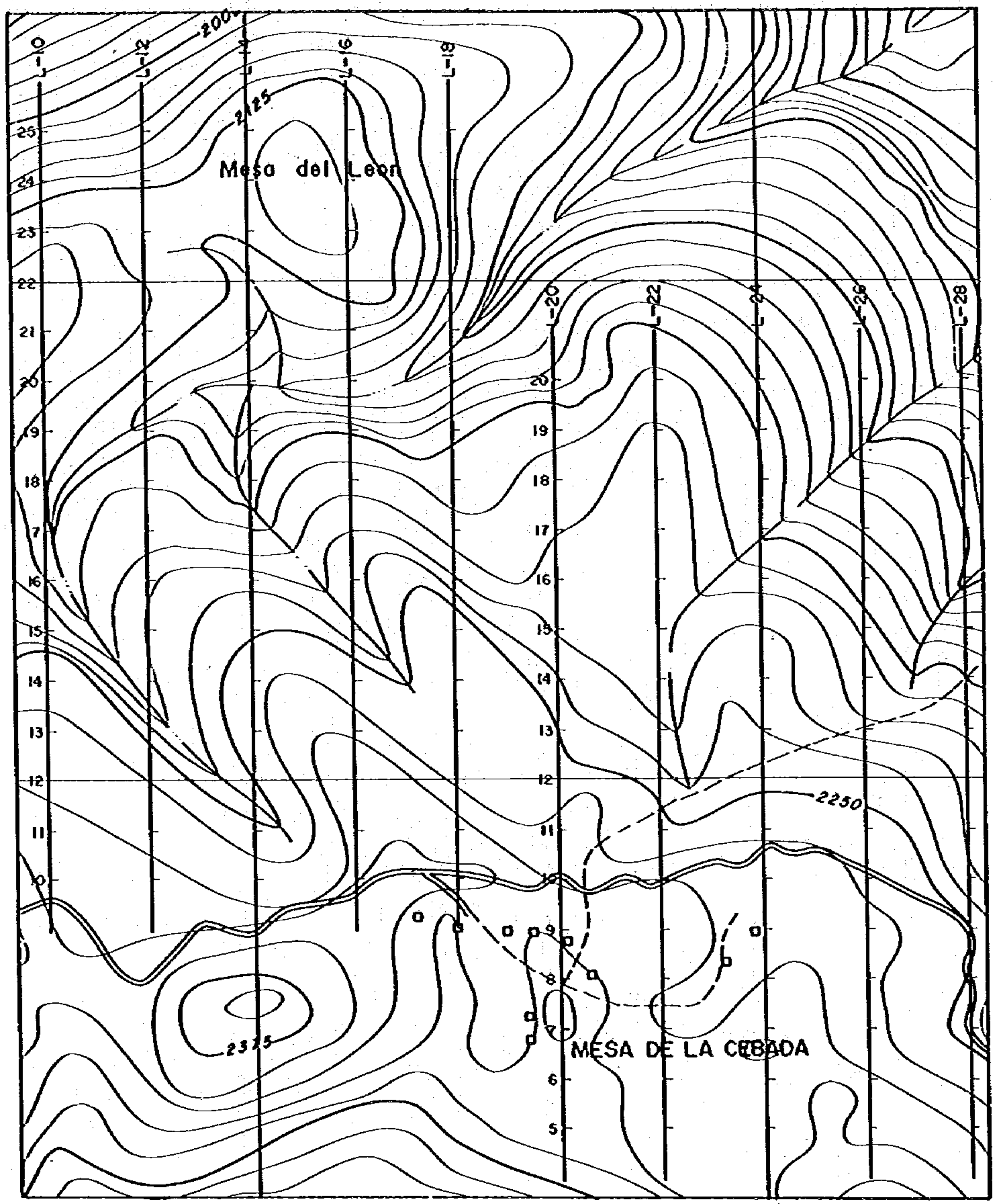

Fig. 4-2 Location Map of IP Survey Lines and Points of El TEJOCOTE Area (S=1:10,000)

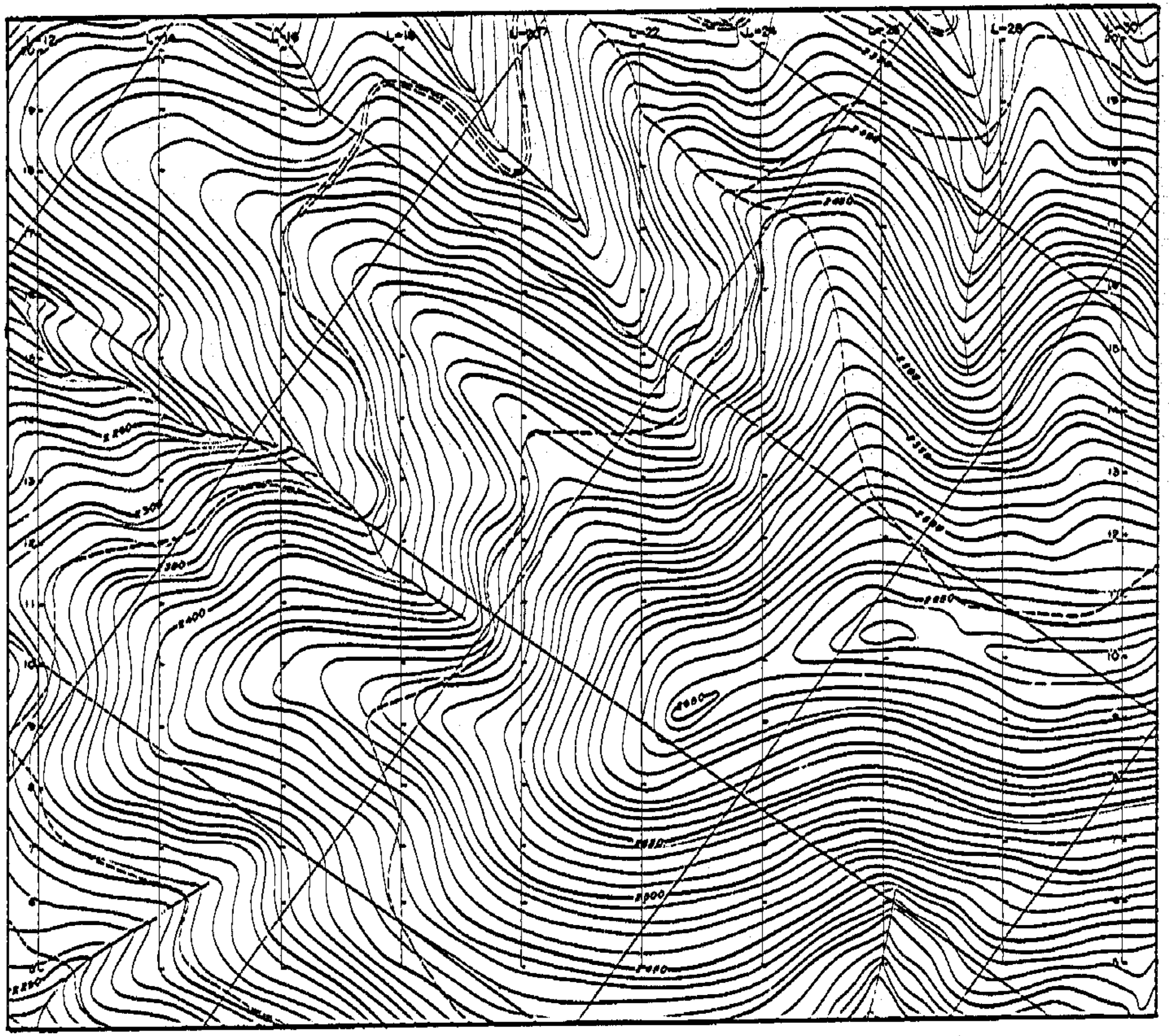

Fig. 4-3 Location Map of IP Survey Lines and Points of PROVIDENCIA Area (S=1:10,000)