2-2-4 IP Modeling (See Fig. II-2-21 to Fig. II-2-23.)

IP modeling by a computer was carried out for three survey lines which show strong FE. Two survey lines were selected in the east grid survey area and one survey line was selected in the west grid survey area. IP response bodies were simulated along those lines.

1) Line 8

IP model shows that over 6.5% FE response bodies are scattered between survey Stations 0 and 7. The model shows that response bodies of high FE are distributed thinly in shallow depths and response bodies of low FE are mixed with them. It is presumed that, the high FE response bodies interruptedly continue about 100 m of depth from the surface, irregularly in size, and dipping estward.

2) Line 9

IP model shows that over 5% FE response bodies are scattered between Stations 1 and 8. The model shows that a high FE response body of about 100 m in thickness and about 60 m in width stands nearly vertically in the depth of Stations 6 and 7, and is covered by low FE response body (30 m in width). Another high FE response body, which is a fairly well formed block, lies in the lower part of Stations 1 to 5, extending downward for tens of meters. As a whole, this IP model seems to be vertical or dipping eastward structure, however, there are low FE bodies among high FE response bodies.

3) Line 23

The IP model shows that over 3.4% FE response body stands around Stations 7 to 8, and dipping eastward to the depth. This response body is nearly 100 m wide, and continues downward from surface nearly 100 m in depth. Another response body of FE 2.5%, which is likely to be the background FE of this area, extensively prevails all over the east side area of this high FE response body, and in the depth of its west side area.

2-2-5 Laboratory IP Measurements of Rock Samples

Twenty-three rock samples were collected from the IP survey area, and their resistivity and FE values were measured in laboratory. After forming the sampled rocks into a block of about 6 cm by 5 cm by 4 cm, the block was soaked in fresh supply water for 48 hours, then naturally dried, and measured. Frequencies of 0.3 and 2.5 Hz, same as used for field surveys, were used for the measurement. The results are shown in Table II-2-1 and Fig. II-2-24. The results may be summarized as follows.

1) The resistivity of limestone, schists, granite and porphyrite are as high as at least 1 kΩ m, averaging 4.7 kΩ m. FE values for them are low, ranging 0.5 to 2.1%, averaging 1.5%, and particularly limestone shows lower FE.

2) Skarn has wide varieties of resistivity, rainging 0.6 to 25 kΩ m. But, except the sample of 25 kΩ m, it indicates low resistivity compared with limestone, schists and granite. FE value of skarn are 0.9 to 2.4%, 1.4% in average, as well as those of granite and schists.

3) The resistivity of ore is 0.002 to 1.3 kΩ m, 0.12 kΩ m in average, and shows clearly low resistivity compared with limestone, schists and granite. The FE value of ore ranges as high as 3.9 to 28.7%, 15.6% in average, and clearly differs from those of limestone, schists and granite, as resistivity.

2-3 Discussion

2-3-1 Overall Tendency in the Distribution of AR and FE

1) AR

Except the IP anomalous zones discussed below, all the AR in this survey area are fairly high, always above 1 kΩ m. In particular, in the west

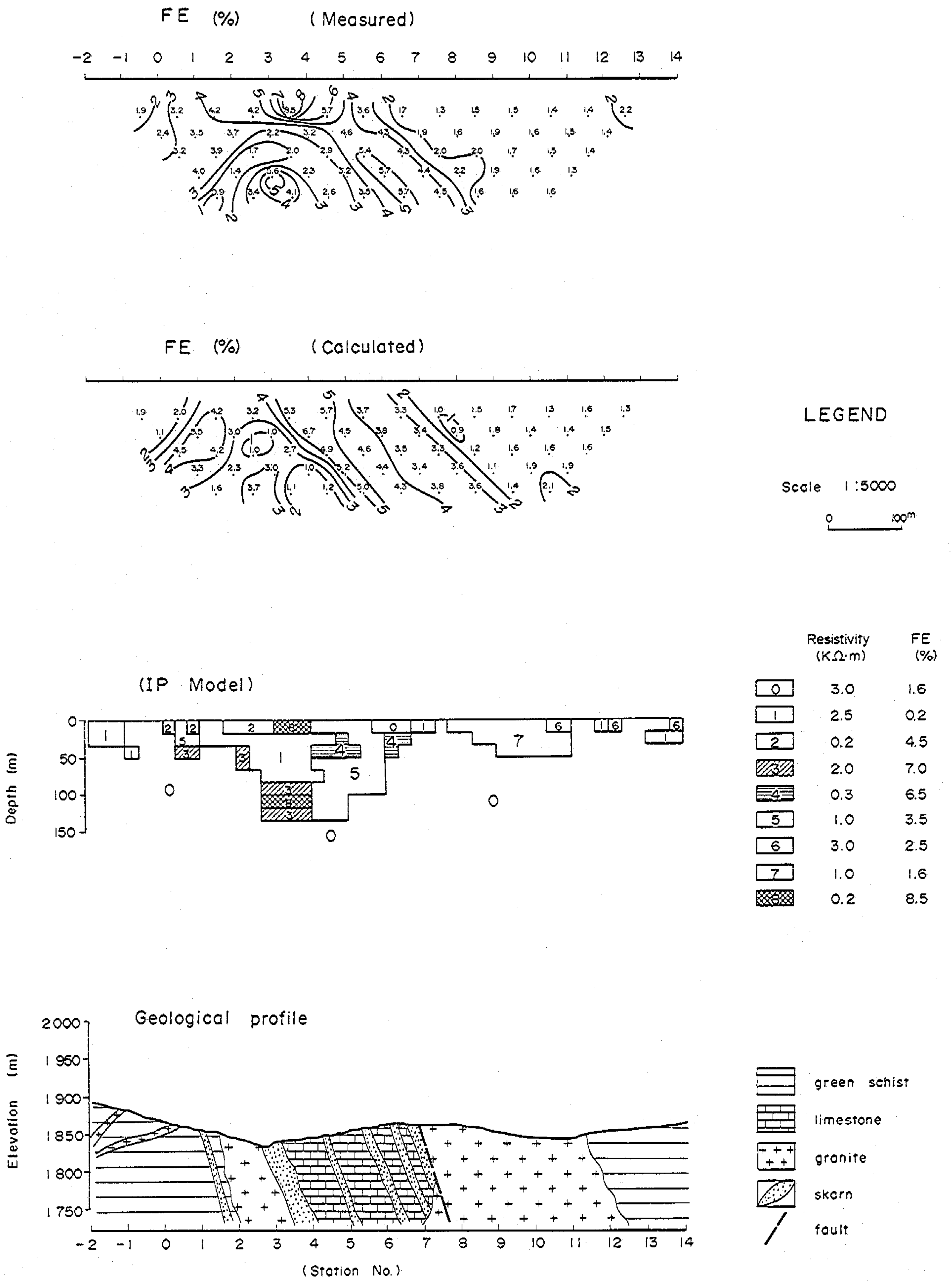

Fig. II-2-21 Results of IP Modeling (Line 8)

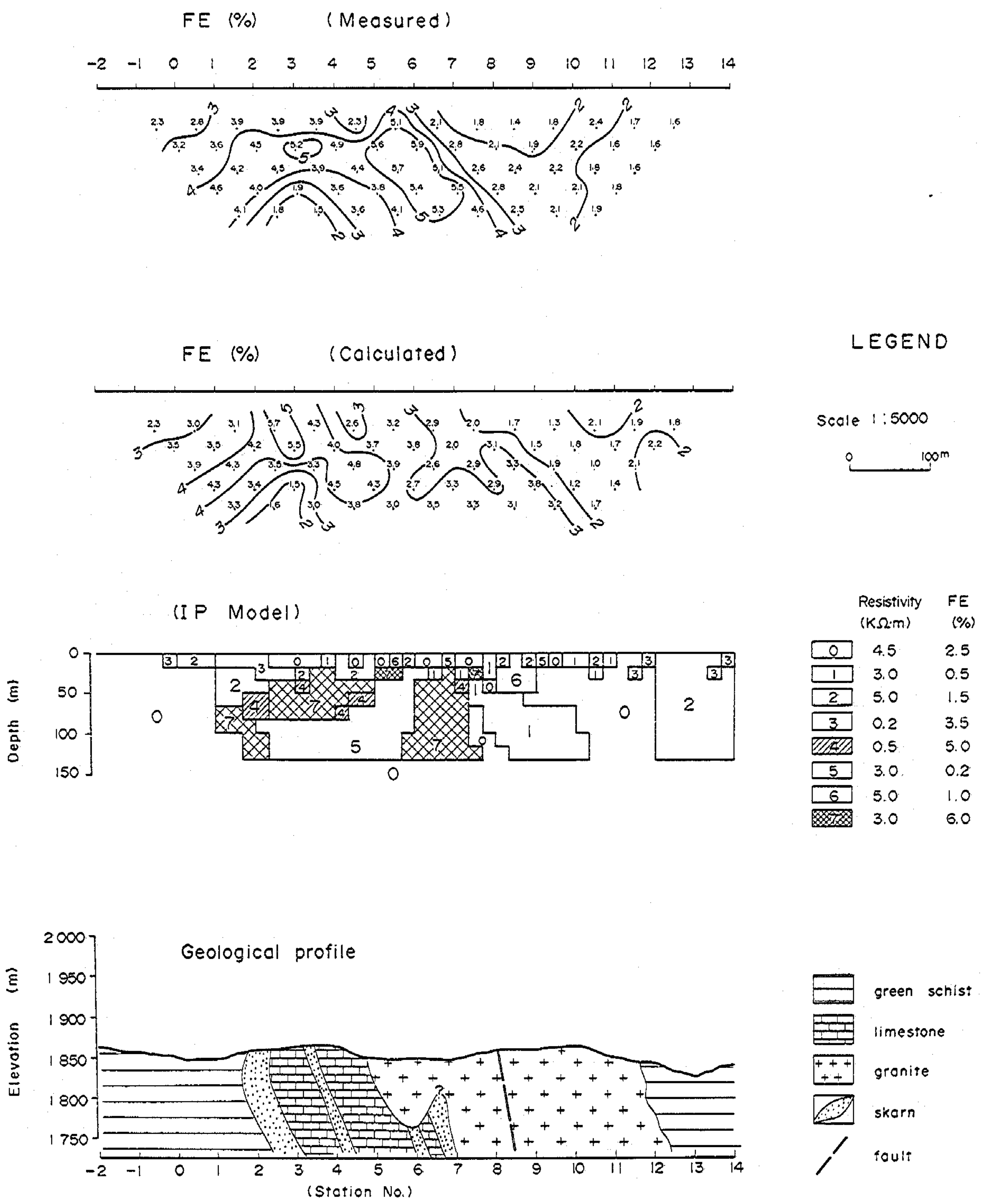

Fig. II-2-22 Results of IP Modeling (Line 9)

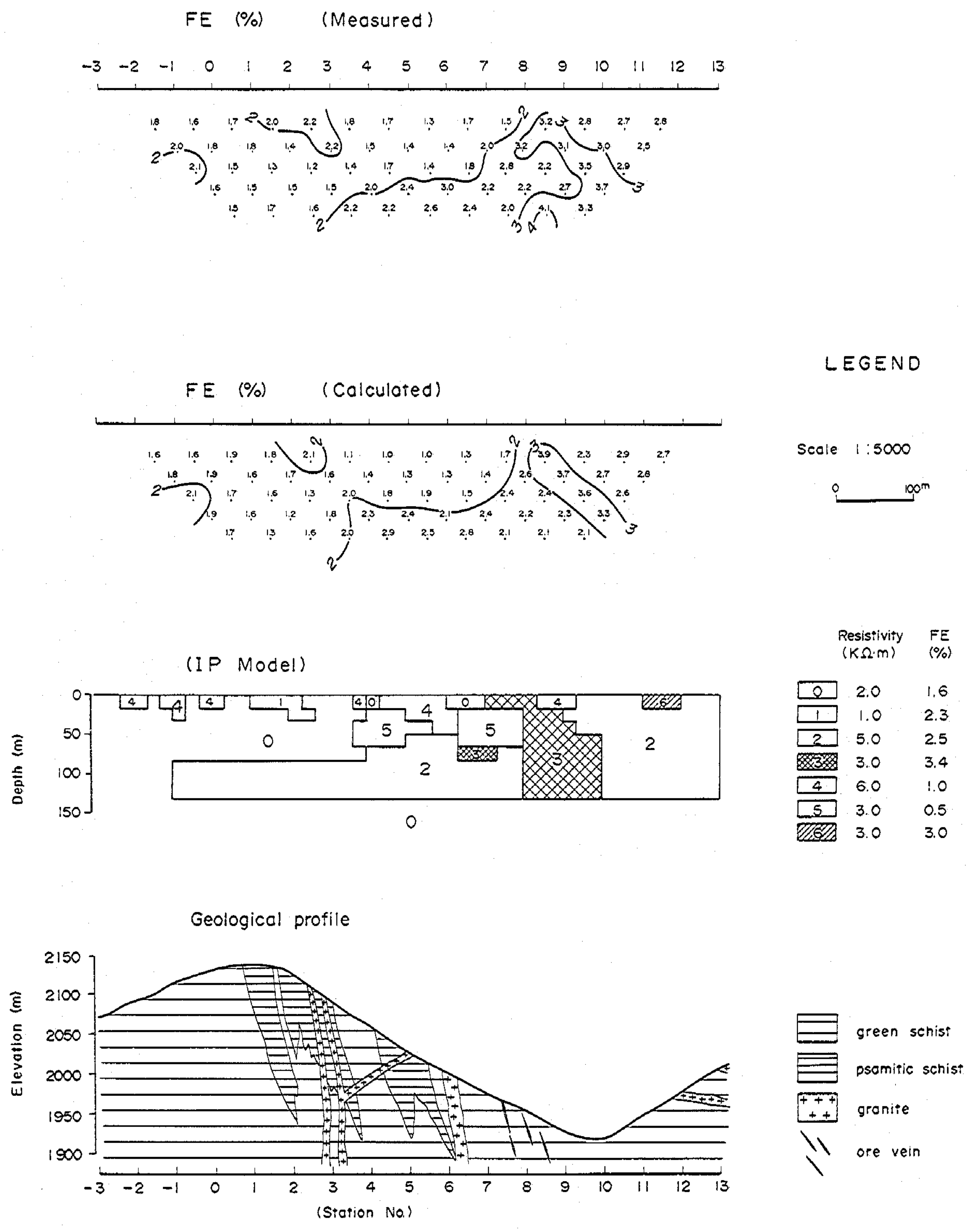

Fig. II-2-23 Results of IP Modeling (Line 23)

Table II-2-1 Results of Laboratory IP Measurements

Sampling Site (Line - Station)	Rock Type	Resistivity (kΩ·m)	FE (%)
3 - 10	green schist	4.0	1.2
11 - 3	green schist	11.4	1.6
15 - 12	green schist	5.6	1.1
21 - 3	green schist	7.1	2.1
25 - 2	green schist	2.1	1.7
25 - 9	green schist	10.0	2.1
29 - 4	green schist	5.6	1.6
29 - 12	green schist	4.0	1.1
E	green schist	6.1	1.2
average of 9 samples		(5.6)	(1.5)
1 - 7	limestone	14.2	1.4
7 - 8	limestone	2.3	0.8
15 - 6	limestone	2.0	0.5
average of 3 samples		(4.0)	(0.9)
9 - 7	granite	2.4	2.1
J	granite	12.1	2.0
K	granite	4.2	1.2
average of 3 samples		(5.0)	(1.8)
5 - 7	porphyrite	(1.4)	(1.8)
10 - 3	skarn	0.59	0.9
23 - 8	skarn	25.0	0.9
G	skarn	0.81	1.2
H	skarn	0.59	0.9
average of 4 samples		(2.2)	(1.4)
A	ore	0.002	28.7
B	ore	1.3	3.9
C	ore	0.62	14.2
average of 3 samples		(0.12)	(15.6)

A,B,C,E,G,H,J and K are rock sampling sites without IP survey. Their locations appear in PL. II-2-1.

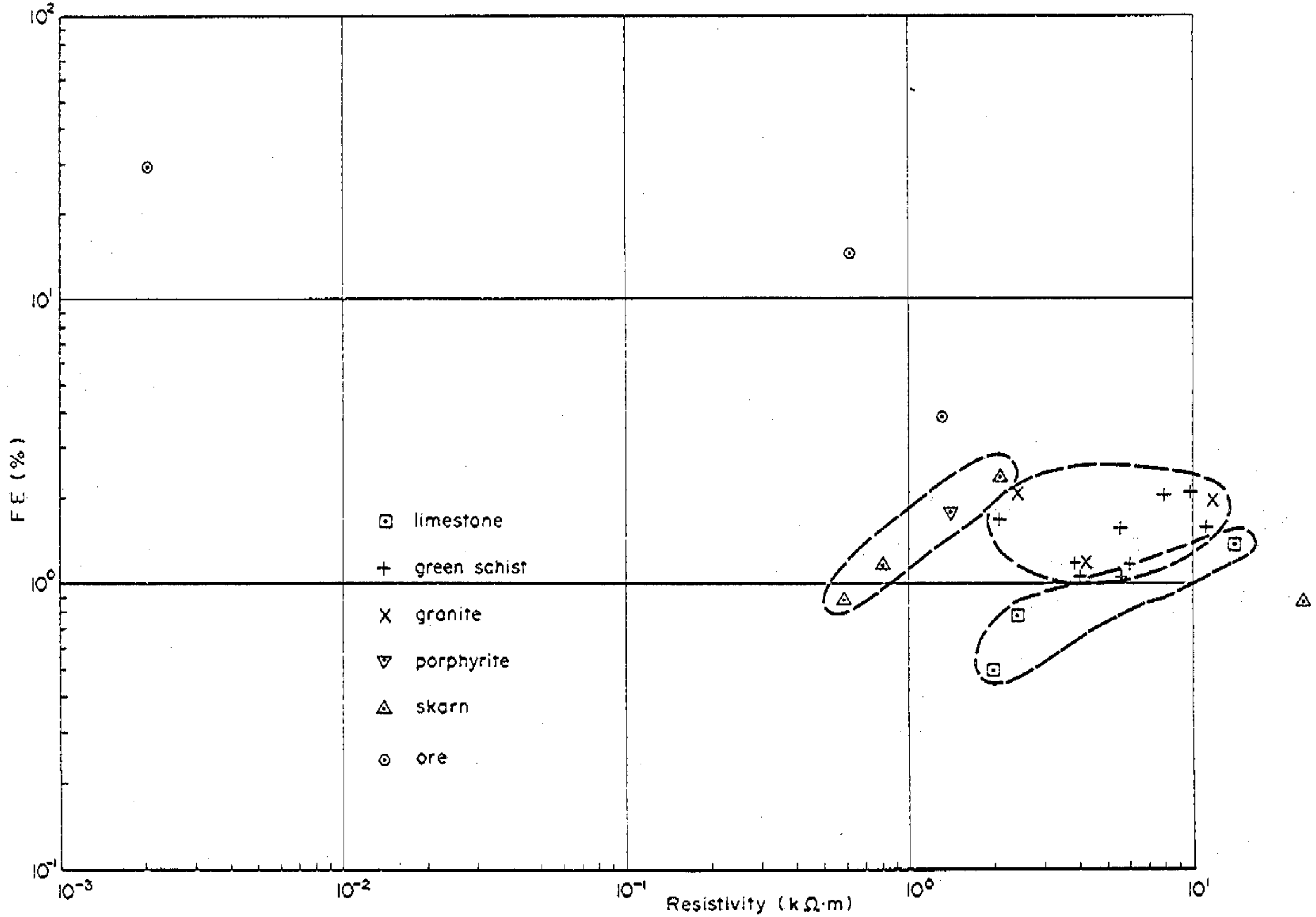

Fig. II-2-24 Results of Laboratory IP Measurements

grid survey area, all the values recorded over 1 kΩ m, including IP anomalous zones. This high AR may be due to the compact, hard, and old (Pre-Mesozoic) quality of all the limestone, schists, granite and porphyrite found in the survey area.

2) FE

Except the IP anomalous zones discussed below, nearly all the FE values found in the survey area are between 1 and 2%. However, those zones where FE values are between 2 and 3% are wider in the west area than in the east area, probably because of schists, of which FE characteristics are different from limestone distributed in the east area.

These overall features match the following results of rock sample measurements for IP characteristics.

- Except sakrns and ores, all rocks have high resistivity value of at least 1 kΩ m.
- Limestone (in the east area) show higher FE values than schists (in the west area).

2-3-2 IP Anomaly

We assume that if FE is between 3% and 5%, we rate the anomaly as weak, and if it is over 5%, we rate it as strong. Then, in this survey area, the following anomalies are found in the FE value pseudo section (Fig. II-2-2 to Fig. II-2-20).

1) Line 7: Station 1: Weak anomaly, dipping eastward
2) Line 8: Stations 2 to 5: Strong anomaly, dipping east- and westward
   Station 3 (in the depth): Strong anomaly
3) Line 9: Stations 2 to 6: Strong anomaly, dipping east- and westward
4) Line 10: Station 3: Strong anomaly, dipping eastward
   Station 1 to 3 (in the depth): Strong anomaly
5) Line 11: Stations 1 to 2: Strong anomaly, dipping east- and westward
6) Line 12: Station 2 (in the depth): Weak anomaly
   Stations 5 to 6: Weak anomaly
7) Line 13: Stations 6 to 8 (in the depth): Weak anomaly
8) Line 16: Station 2: Weak anomaly, dipping westward
9) Line 21: Stations 8 to 11: Weak anomaly
10) Line 22: Stations 8 to 10 (middle part): Weak anomaly
11) Line 23: Station 8: Weak anomaly, dipping eastward
    Station 9 (in the depth): Weak anomaly
12) Line 25: Station 9 (in the depth): Weak anomaly

(Every strong anomaly above is accompanied by a surrounding weak anomaly belt.)

After examining these anomalies, the following two IP anomalies have been selected as the principal ones.

1) Agadir anomalies

(a) Location and IP results

IP survey revealed three intense anomaly zones of high FE and low AR being at the center of the east grid survey area. They are widely surrounded by weak anomaly zones. These weak anomaly zones extend about 600 m from Line 7 to Line 13 in north-south direction and mostly less than 100 m in east-west direction with the maximum EW width of about 250 m at around Lines 8 and 9. Thus, weak anomaly zones and three intense anomaly zones are analyzed from IP measurements and geological survey (Fig. II-2-25). Centers of these three anomaly zones are at about 200 m south-west of, at about 600 m south-west of and at about 600 m south-south-west of the Agadir village. Their extension covers approximate sizes of 200 m x 200 m, 150 m x 60 m, and 150 m x 60 m, respectively. Among them, the first one is most intensive with FE of over 5%.

According to FE distributions, IP model studies and geology, each intensive anomaly zone is not made of only one single massive IP response body but of several small IP response bodies. IP response bodies have irregular shape in all directions.

(b) Model study

IP model study is carried out for the most intensive anomaly body with its center at near the Agadir village. An IP response body of over 5% FE with a width of 60 to 100 m is calculated by our model study. The IP response body is intervened in several places by other rocks both in horizontal and vertical directions.

(c) Interpretation

The above mentioned anomaly zones are interpreted with the geological map (PL. I-1-4) as follows:

- The anomaly zone with its center at about 200 m south-west of the Agadir village corresponds to several mineralized skarn zones.
- The anomaly zone with its center at about 600 m south-west of the Agadir village is inferred to be hidden small mineralized skarn zones, because the anomaly zone is low AR and high FE as other anomaly zones. Even though no skarn outcrops are found in the area.
- The anomaly zone with its center at about 600 m south-south-west of the Agadir village corresponds to several small skarn zones with weak mineralization.

2) Agadir west anomalies

(a) Location and IP results

A weak anomaly zone with high AR and medium FE is in the north-eastern part of the west grid survey area and has its center at about 1,200 m south-west of the Agadir village. The anomaly zone covers the Stations 8 and 9 of Lines 21 to 23 and is infered to extend north-south direction. FE of this anomaly zone is over 3% and is widely surrounded by a zone with FE of 2%.

(b) Model study

A dyke-shaped IP response body with over 3% FE and 70 to 100 m wide is calculated to extend to 100 m deep from the ground surface.

(c) Interpretation

Because the anomaly does not show low resistivity, it differs from those around and along skarn zones. In the west grid survey area, there are three zones with small vein type ore deposits, namely, a north-eastern part, a western finge and a southern part. The latter two zones does not show IP anomaly. Therefore, this weak anomaly may not be a direct reflect of mineral veins and may rather be weak alteration or weak mineralization.

3) Others

The area with FE of over 2%, including some over 3%, is found in the west of the Station 3 of Line 16. This area coincices with skarn distribution and may be a reflect of skarn. However, IP effect is small and its response body is very weak and small. There is no other IP anomaly in the east grid survey area.

In the west grid survey area, only limited anomaly areas are found as stated above.

2-3-3 Summary

1) In the east area, the IP survey detected extensive IP anomalous zones that coincide with skarn distributions in this area; and in the west area, it found some weak IP anomalous zones which correspond with the distribution of fine veins in the schists. The former represents a combination of low resistivity and high FE values, while the latter, that of high resistivity and medium FE values.

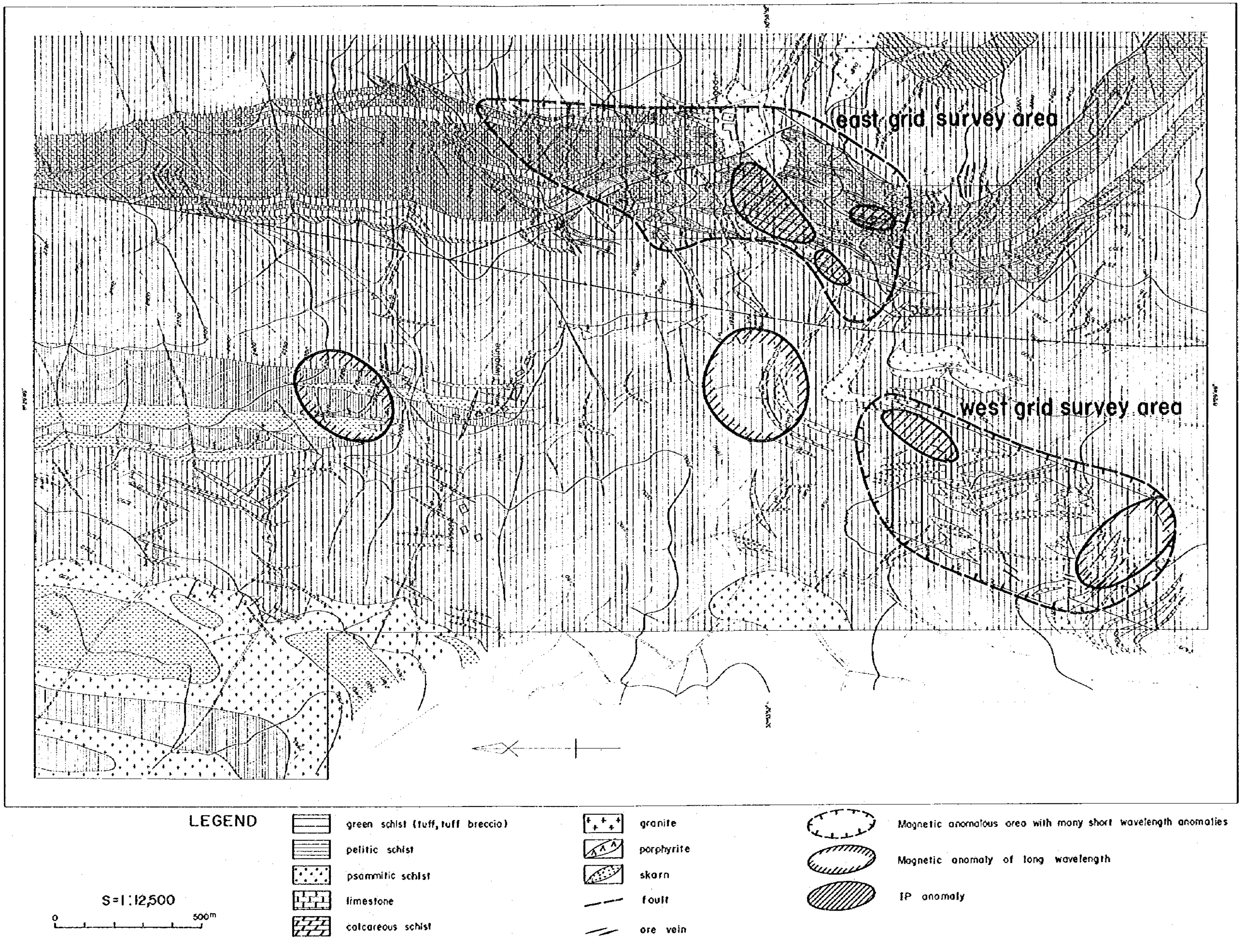

Fig.II-2-25 Distribution of Magnetic Anomaly and IP Anomaly

2) The anomalous region detected in the skarn-distributed east area (including its surrounding weak anomalous zone) covers an area several hundred meters long in the north-south direction. This region may be divided into three anomalous zones, on the basis of difference in the degree of anomalies and of the geology. Within each zone, its size is irregularly varies both horizontally and vertically, and the intensity of the IP responses are of various degrees.

3) The most prominent of them is an anomalous zone whose central part is in the vicinity of a river about 200 m to the south-west of the Agadir village. It corresponds with several skarn zones, and is 200 m by 200 m in size.

4) A smaller anomaly centering at about 600 m to the south-west of the Agadir village has no exposed skarn, but shows identical low resistivity and high FE value with the other anomalous zones, suggesting that the nature of anomalous body here is similar to the other.

5) Another smaller anomaly centering at about 600 m to the south-sout-west of the Agadir village, corresponds with a skarn zone which is narrow so far as it is exposed on the ground surface. This anomaly is less intense in IP effect.

6) In the west area, an anomaly detected in the schist dominated area (about 1.2 km to the south-west of the Agadir village) runs almost in the same direction as that of exposed fine veins, but its anomalous indications are weak. The fact that some fine veins found in the southern part of this anomalous zone did not show FE effects indicates that this anomaly represents not such fine veins themselves but weak alteration or weak mineralization.

7) The resistivity values in this area is generally high. The FE values of schists are higher than those of limestone. Sample measurements show that ores have low resistivity values and high FE values, and that schists have as high resistivity values as limestone and granite, but the former shows somewhat higher FE values than the latter. All these facts match the results of the field survey.

8) The results of the geomagnetic survey detected a large number of geomagnetic anomalies of short wavelength and medium amplitude, mainly around the skarn-distributed IP anomaly zones in the east area. Calculation of models for these geomagnetic anomalies provided a model predicting a titled plate structure, and this fact matches the results of the IP survey.

9) This survey revealed that the most prospective mineralized zone in irregular shape may exist along the river, about 200 m south-west of the Agadir village. The mineralized zone may extend down to 100 m from the ground surface.

Table II-1-1 Observed Magnetic Values at Base Station

No. 1

DATE: 1985/7/1 Magnetometer: G-806

Country: Morocco Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
:				13 : 00	39877	−5	
:				: 10	876	−4	
:				: 20	877	−5	
:				: 30	"	"	
:				: 40	"	"	
8 : 50	39872	0	Datum value	: 50	"	"	
9 : 00	871	1		14 : 00	879	−7	
: 10	"	"		: 10	878	−6	
: 20	"	"		: 20	"	"	
: 30	870	2		: 30	880	−8	
: 40	869	3		: 40	877	−5	
: 50	867	5		: 50	876	−4	
10 : 00	"	"		15 : 00	874	−2	
: 10	869	3		: 10	875	−3	
: 20	871	1		: 20	874	−2	
: 30	872	0		: 30	873	−1	
: 40	"	"		: 40	874	−2	
: 50	874	−2		: 50	875	−3	
11 : 00	875	−3		16 : 00	876	−4	
: 10	878	−6		: 10	877	−5	
: 20	"	"		: 20	880	−8	
: 30	880	−8		: 30	881	−9	
: 40	879	−7		: 40	882	−10	
: 50	"	"		: 50	"	"	
12 : 00	880	−8		17 : 00	883	−11	
: 10	"	"		: 10	"	"	
: 20	881	−9		:			
: 30	880	−8		:			
: 40	878	−6		:			
: 50	877	−5		:			

Observed magnetic values at base station

No. 2

DATE: 1985/7/2 Magnetometer: G–806

Country: Morocco Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
:				13 : 00	39871	1	
:				: 10	873	–1	
:				: 20	874	–2	
8 : 30	39880	–8		: 30	875	–3	
: 40	"	"		: 40	"	"	
: 50	"	"		: 50	"	–3	
9 : 00	"	"		14 : 00	876	–4	
: 10	"	"		: 10	"	"	
: 20	879	–7		: 20	875	–3	
: 30	878	–6		: 30	"	"	
: 40	877	–5		: 40	"	"	
: 50	877	–5		: 50	874	–2	
10 : 00	876	–4		15 : 00	875	–3	
: 10	875	–3		: 10	"	"	
: 20	874	–2		: 20	876	–4	
: 30	873	–1		: 30	"	"	
: 40	872	0		: 40	877	–5	
: 50	"	"		: 50	"	"	
11 : 00	"	"		16 : 00	879	–7	
: 10	871	1		: 10	880	–8	
: 20	870	2		: 20	881	–9	
: 30	"	"		: 30	882	–10	
: 40	"	"		: 40	"	"	
: 50	869	3		: 50	"	"	
12 : 00	870	2		17 : 00	"	"	
: 10	871	1		: 10	"	"	
: 20	"	"		:			
: 30	870	2		:			
: 40	"	"		:			
: 60	"	"		:			

Observed magnetic values at base station

No. 3

DATE: 1985/ 7 / 3 Magnetometer: G-806

Country: Morocco Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
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:				: 10	"	"	
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: 30	886	–14		: 30	"	"	
: 40	883	–11		: 40	"	"	
: 50	882	–10		: 50	"	"	
9 : 00	881	–9		14 : 00	885	–13	
: 10	880	–8		: 10	"	"	
: 20	"	"		: 20	"	"	
: 30	879	–7		: 30	"	"	
: 40	877	–5		: 40	"	"	
: 50	876	–4		: 50	884	–12	
10 : 00	875	–3		15 : 00	883	–11	
: 10	873	–1		: 10	886	–14	
: 20	872	0		: 20	884	–12	
: 30	"	"		: 30	886	–14	
: 40	"	"		: 40	885	–13	
: 50	873	–1		: 50	"	"	
11 : 00	"	"		16 : 00	882	–10	
: 10	874	–2		: 10	883	–11	
: 20	"	"		: 20	885	–13	
: 30	876	–4		: 30	883	–11	
: 40	877	–5		:			
: 50	"	"		:			
12 : 00	878	–6		:			
: 10	881	–9		:			
: 20	882	–10		:			
: 30	883	–11		:			
: 40	884	–12		:			
: 50	885	–13		:			

Observed magnetic values at base station

No. 4

DATE: 1985/7/4 Magnetometer: G-806

Country: Morocco Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
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: 30	896	–24		: 50	884	–12	
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: 50	894	–22		: 10	882	–10	
9 : 00	"	"		: 20	878	–6	
: 10	896	–24		: 30	874	–2	
: 20	892	–20		: 40	868	4	
: 25	897	–25		: 45	868	4	
: 30	898	–26		: 50	864	8	
: 35	897	–25		: 55	852	20	
: 40	892	–20		14 : 00	850	22	
: 50	893	–21		: 10	854	18	
: 55	892	–20		: 20	860	12	
10 : 00	887	–15		: 30	862	10	
: 10	"	"		: 40	866	6	
: 20	882	–10		: 50	872	0	
: 30	878	–8		15 : 00	873	–1	
: 40	873	–1		: 10	874	–2	
: 50	872	0		: 20	880	–8	
11 : 00	873	–1		: 30	881	–9	
: 05	869	3		: 40	884	–12	
: 10	866	6		: 50	885	–13	
: 20	868	4		16 : 00	881	–9	
: 30	864	8		: 05	880	–8	
: 40	867	5		: 10	884	–12	
: 50	868	4		: 15	881	–9	
12 : 00	872	0		: 20	881	–9	
: 10	878	–6		: 25	880	–8	
: 20	882	–10		: 30	882	–10	
: 30	885	–13		:			

Observed magnetic values at base station

No. 5

DATE: 1985/ 7 / 5

Magnetometer: G–806

Country: Morocco

Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
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: 20	"	"		: 20	878	–6	
: 30	876	–4		: 30	"	"	
: 40	878	–6		: 40	877	–5	
: 50	876	–4		: 50	"	"	
9 : 00	875	–3		14 : 00	876	–4	
: 10	874	–2		: 10	875	–3	
: 20	870	2		: 20	876	–4	
: 30	869	3		: 30	871	1	
: 40	870	2		: 40	869	3	
: 50	867	5		: 50	871	1	
10 : 00	"	"		15 : 00	870	2	
: 10	866	6		: 10	869	3	
: 20	"	"		: 20	870	2	
: 30	867	5		: 30	"	"	
: 40	866	6		: 40	869	3	
: 50	864	8		: 50	870	2	
11 : 00	863	9		16 : 00	868	4	
: 10	"	"		:			
: 20	864	8		:			
: 30	868	4		:			
: 40	865	7		:			
: 50	867	5		:			
12 : 00	866	6		:			
: 10	867	5		:			
: 20	869	3		:			
: 30	870	2		:			
: 40	872	0		:			
: 50	873	–1		:			

Observed magnetic values at base station

No. 6

DATE: 1985/7/7 Magnetometer: G-806

Country: Morocco Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
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:				:10	874	−2	
8:20	39881	−9		:20	875	−3	
:30	880	−8		:30	876	−4	
:40	877	−5		:40	877	−5	
:50	876	−4		:50	878	−6	
9:00	872	0		14:00	881	−9	
:10	869	3		:10	880	−8	
:20	867	5		:20	"	"	
:30	869	3		:30	881	−9	
:40	870	2		:40	"	"	
:50	873	−1		:50	880	−8	
10:00	875	−3		15:00	879	−7	
:10	876	−4		:10	878	−6	
:20	"	"		:20	874	−2	
:30	877	−5		:30	873	−1	
:40	876	−4		:40	871	1	
:50	"	"		:50	869	3	
11:00	877	−5		16:00	866	6	
:10	"	"		:10	869	3	
:20	876	−4		:20	870	2	
:30	872	0		:30	871	1	
:40	868	4		:40	872	0	
:50	867	5		:			
12:00	"	"		:			
:10	866	6		:			
:20	865	7		:			
:30	866	6		:			
:40	867	5		:			
:50	868	4		:			

Observed magnetic values at base station

No. 7

DATE: 1985/7/10

Magnetometer: G-806

Country: Morocco

Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
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:				: 10	872	0	
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: 30	884	−12		: 30	872	0	
: 40	883	−11		: 40	"	"	
: 50	882	−10		: 50	871	1	
9 : 00	"	−10		14 : 00	872	0	
: 10	881	−9		: 10	877	−5	
: 20	883	−11		: 20	"	"	
: 30	881	−9		: 30	878	−6	
: 40	"	"		: 40	876	−4	
: 50	880	−8		: 50	877	−5	
10 : 00	882	−10		15 : 00	878	−6	
: 10	"	"		: 10	879	−7	
: 20	"	"		: 20	878	−6	
: 30	"	"		: 30	"	"	
: 40	"	"		: 40	"	"	
: 50	881	−9		: 50	"	"	
11 : 00	"	"		16 : 00	879	−7	
: 10	884	−12		: 10	878	−6	
: 20	882	−10		: 20	"	"	
: 30	883	−11		: 30	879	−7	
: 40	876	−4		: 40	881	−9	
: 50	879	−7		: 50	882	−10	
12 : 00	"	"		17 : 00	885	−13	
: 10	877	−5		: 10	880	−8	
: 20	868	4		: 20	886	−14	
: 30	"	"		: 30	"	"	
: 40	866	6		: 40	888	−16	
: 50	871	1		: 50	889	−17	

Observed magnetic values at base station

No. 8

DATE: 1985/ 7 / 11

Magnetometer: G–806

Country: Morocco

Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
:				13 : 00	39894	–22	
:				: 10	893	–21	
:				: 20	894	–22	
8 : 30	39891	–19		: 30	893	–21	
: 40	888	–16		: 40	892	–20	
: 50	885	–13		: 50	890	–18	
9 : 00	884	–12		14 : 00	889	–17	
: 10	885	–13		: 10	"	"	
: 20	884	–12		: 20	888	–16	
: 30	882	–10		: 30	887	–15	
: 40	883	–11		: 40	"	"	
: 50	885	–13		: 50	885	–13	
10 : 00	886	–14		15 : 00	"	"	
: 10	887	–15		: 10	886	–14	
: 20	886	–14		: 20	884	–12	
: 30	889	–17		: 30	890	–18	
: 40	890	–18		: 40	886	–14	
: 50	888	–16		: 50	"	"	
11 : 00	890	–18		16 : 00	"	"	
: 10	894	–22		: 10	"	"	
: 20	892	–20		: 20	"	"	
: 30	896	–24		: 30	887	–15	
: 40	897	–25		: 40	"	"	
: 50	896	–24		: 50	886	–14	
12 : 00	"	"		17 : 00	"	"	
: 10	895	–23		: 10	884	–12	
: 20	"	"		: 20	"	"	
: 30	893	–21		: 30	885	–13	
: 40	"	"		:			
: 50	"	"		:			

Observed magnetic values at base station

No. 9

DATE: 1985/ 7 / 12 Magnetometer: G–806

Country: Morocco Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
:				13 : 00	39843	29	
:				: 10	842	30	
8 : 20	39879	–7		: 20	840	32	
: 30	877	–5		: 30	841	31	
: 40	876	–4		: 40	"	"	
: 50	875	–3		: 50	839	33	
9 : 00	872	0		14 : 00	833	39	
: 10	"	"		: 10	830	42	
: 20	868	4		: 20	825	47	
: 30	869	3		: 30	"	"	
: 40	868	4		: 40	827	45	
: 50	866	6		: 50	829	43	
10 : 00	859	13		15 : 00	828	44	
: 10	858	14		: 10	829	43	
: 20	856	16		: 20	830	42	
: 30	854	18		: 30	"	"	
: 40	"	"		: 40	831	41	
: 50	"	"		: 50	832	40	
11 : 00	849	23		16 : 00	831	41	
: 10	845	27		: 10	830	42	
: 20	843	29		: 20	"	"	
: 30	836	36		: 30	831	41	
: 40	831	41		: 40	830	42	
: 50	838	34		: 50	833	39	
12 : 00	841	31		17 : 00	828	44	
: 10	842	30		: 10	833	39	
: 20	845	27		: 20	832	40	
: 30	842	30		: 30	828	44	
: 40	846	26		: 40	"	"	
: 50	"	"		: 50	830	42	

Observed magnetic values at base station

No. 10

DATE: 1985/ 7 / 13 Magnetometer: G-806

Country: Morocco Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
:				13 : 00	39872	0	
:				: 10	"	"	
:				: 20	873	−1	
8 : 30	39885	−13		: 30	872	0	
: 40	884	−12		: 40	871	1	
: 50	"	"		: 50	872	0	
9 : 00	885	−13		14 : 00	873	−1	
: 10	887	−15		: 10	872	0	
: 20	"	"		: 20	871	1	
: 30	885	−13		: 30	"	"	
: 40	884	−12		: 40	870	2	
: 50	"	"		: 50	869	3	
10 : 00	883	−11		15 : 00	867	5	
: 10	882	−10		: 10	"	"	
: 20	"	"		: 20	864	8	
: 30	881	−9		: 30	862	10	
: 40	"	"		: 40	863	9	
: 50	882	−10		: 50	860	12	
11 : 00	878	−6		16 : 00	859	13	
: 10	"	"		: 10	857	15	
: 20	877	−5		:			
: 30	876	−4		:			
: 40	875	−3		:			
: 50	873	−1		:			
12 : 00	869	3		:			
: 10	"	"		:			
: 20	865	7		:			
: 30	864	8		:			
: 40	866	6		:			
: 50	872	0		:			

Observed magnetic values at base station

No. 11

DATE: 1985/7/14

Magnetometer: G–806

Country: Morocco

Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
:				13 : 00	39852	20	
:				: 10	854	18	
8 : 20	39870	2		: 20	853	19	
: 30	868	4		: 30	"	"	
: 40	865	7		: 40	855	17	
: 50	860	12		: 50	"	"	
9 : 00	858	14		14 : 00	857	15	
: 10	857	15		: 10	"	"	
: 20	856	16		: 20	"	"	
: 30	"	"		: 30	858	14	
: 40	857	15		: 40	857	15	
: 50	"	"		: 50	855	17	
10 : 00	859	13		15 : 00	854	18	
: 10	858	14		: 10	853	19	
: 20	859	13		: 20	854	18	
: 30	"	"		: 30	853	19	
: 40	860	12		: 40	854	18	
: 50	859	13		: 50	"	"	
11 : 00	861	11		16 : 00	"	"	
: 10	"	"		: 10	853	19	
: 20	858	14		: 20	852	20	
: 30	859	13		: 30	853	19	
: 40	861	11		: 40	"	"	
: 50	862	10		: 50	854	18	
12 : 00	861	11		17 : 00	856	16	
: 10	860	12		:			
: 20	859	13		:			
: 30	856	16		:			
: 40	857	15		:			
: 50	"	"		:			

Observed magnetic values at base station

No. 12

DATE: 1985 / 7 / 15

Magnetometer: G-806

Country: Morocco

Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
:				13 : 00	39862	10	
:				: 10	"	"	
8 : 20	39879	–7		: 20	"	"	
: 30	878	–6		: 30	863	9	
: 40	877	–5		: 40	864	8	
: 50	876	–4		: 50	"	"	
9 : 00	875	–3		14 : 00	866	6	
: 10	"	"		: 10	867	5	
: 20	874	–2		: 20	868	4	
: 30	873	–1		: 30	"	"	
: 40	"	"		: 40	870	2	
: 50	874	–2		: 50	869	3	
10 : 00	"	"		15 : 00	870	2	
: 10	872	0		: 10	869	3	
: 20	871	"		: 20	870	2	
: 30	869	3		: 30	"	"	
: 40	868	4		: 40	"	"	
: 50	"	"		: 50	871	1	
11 : 00	866	6		16 : 00	870	2	
: 10	863	9		: 10	869	3	
: 20	862	10		: 20	"	"	
: 30	861	11		: 30	871	1	
: 40	"	"		: 40	869	3	
: 50	860	12		: 50	868	4	
12 : 00	859	13		17 : 00	"	"	
: 10	"	"		: 10	"	"	
: 20	"	"		: 20	"	"	
: 30	860	12		:			
: 40	861	11		:			
: 50	863	9		:			

Observed magnetic values at base station

No. 13

DATE: 1985/7/16 Magnetometer: G-806

Country: Morocco Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
:				13 : 00	39873	–1	
:				: 10	874	–2	
8 : 20	39887	–15		: 20	873	–1	
: 30	886	–14		: 30	"	"	
: 40	885	–13		: 40	874	–2	
: 50	884	–12		: 50	875	–3	
9 : 00	883	–11		14 : 00	"	"	
: 10	881	–9		: 10	"	"	
: 20	880	–8		: 20	"	"	
: 30	878	–6		: 30	"	"	
: 40	876	–4		: 40	"	"	
: 50	874	–2		: 50	"	"	
10 : 00	873	–1		15 : 00	"	"	
: 10	"	"		: 10	"	"	
: 20	874	–2		: 20	876	–4	
: 30	"	"		: 30	"	"	
: 40	873	–1		: 40	"	"	
: 50	"	"		: 50	877	–5	
11 : 00	874	–2		16 : 00	876	–4	
: 10	873	–1		: 10	875	–3	
: 20	874	–2		: 20	"	"	
: 30	875	–3		: 30	874	–2	
: 40	"	"		: 40	"	"	
: 50	876	–4		: 50	873	–1	
12 : 00	875	–3		17 : 00	"	"	
: 10	"	"		: 10	872	0	
: 20	874	–2		: 20	871	1	
: 30	"	"		: 30	"	"	
: 40	"	"		: 40	"	"	
: 50	873	–1		: 50	873	–1	

Observed magnetic values at base station

No. 14

DATE: 1985/7/17

Magnetometer: G-806

Country: Morocco

Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
:		·		13 : 00	39842	32	
:				: 10	837	35	
8 : 20	39867	5		: 20	835	37	
: 30	865	7		: 30	"	"	
: 40	863	9		: 40	839	33	
: 50	858	14		: 50	837	35	
9 : 00	854	18		14 : 00	841	31	
: 10	857	15		: 10	"	"	
: 20	"	"		: 20	"	"	
: 30	856	16		: 30	840	32	
: 40	857	15		: 40	841	31	
: 50	858	14		: 50	840	32	
10 : 00	"	"		15 : 00	"	"	
: 10	857	15		: 10	839	33	
: 20	855	17		: 20	837	35	
: 30	"	"		: 30	834	38	
: 40	"	"		: 40	829	43	
: 50	853	19		: 50	825	47	
11 : 00	852	20		16 : 00	829	43	
: 10	850	22		: 10	828	44	
: 20	846	26		: 20	833	39	
: 30	840	32		: 30	834	38	
: 40	837	35		:			
: 50	838	34		:			
12 : 00	840	32		:			
: 10	842	30		:			
: 20	848	24		:			
: 30	846	26		:			
: 40	849	23		:			
: 50	846	26		:			

Observed magnetic values at base station

No. 15

DATE: 1985/7/18

Magnetometer: G–806

Country: Morocco

Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT.)	Remarks
:				13 : 00	39876	–4	
:				: 10	"	"	
8 : 20	39884	–12		: 20	874	–2	
: 30	"	"		: 30	877	–5	
: 40	881	–9		: 40	880	–8	
: 50	"	"		: 50	881	–9	
9 : 00	878	–6		14 : 00	882	–10	
: 10	877	–5		: 10	883	–11	
: 20	"	"		: 20	"	"	
: 30	878	–6		: 30	"	"	
: 40	"	"		: 40	"	"	
: 50	876	–4		: 50	"	"	
10 : 00	875	–3		15 : 00	"	"	
: 10	874	–2		: 10	881	–9	
: 20	872	0		: 20	882	–10	
: 30	870	2		: 30	879	–7	
: 40	868	4		: 40	"	"	
: 50	870	2		: 50	878	- 6	
11 : 00	871	1		16 : 00	879	–7	
: 10	"	"		: 10	878	–6	
: 20	872	0		: 20	877	–5	
: 30	"	"		: 30	876	- 4	
: 40	"	"		: 40	875	–3	
: 50	874	–2		: 50	872	0	
12 : 00	"	"		:			
: 10	873	–1		:			
: 20	874	–2		:			
: 30	873	–1		:			
: 40	874	–2		:			
: 50	875	–3		:			

Observed magnetic values at base station

No. 16

DATE: 1985/ 7 / 19

Magnetometer: G-806

Country: Morocco

Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
:				13 : 00	39876	–4	
:				: 10	877	–5	
8 : 20	39882	–10		: 20	880	–8	
: 30	"	"		: 30	882	–10	
: 40	881	–9		: 40	883	–11	
: 50	879	–7		: 50	884	–12	
9 : 00	"	"		14 : 00	885	–13	
: 10	877	–5		: 10	884	–12	
: 20	"	"		: 20	883	–11	
: 30	878	–6		: 30	882	–10	
: 40	877	–5		: 40	881	–9	
: 50	876	–4		: 50	880	–8	
10 : 00	875	–3		15 : 00	879	–7	
: 10	"	"		: 10	877	–5	
: 20	876	–4		: 20	876	–4	
: 30	875	–3		: 30	875	–3	
: 40	"	"		: 40	877	–5	
: 50	876	–4		: 50	878	–6	
11 : 00	875	–3		16 : 00	"	"	
: 10	874	–2		: 10	877	–5	
: 20	873	–1		: 20	876	–4	
: 30	"	"		: 30	"	"	
: 40	871	1		: 40	"	"	
: 50	869	3		: 50	"	"	
12 : 00	868	4		:			
: 10	867	5		:			
: 20	"	"		:			
: 30	870	2		:			
: 40	871	1		:			
: 50	877	–5		:			

Observed magnetic values at base station

No. 17

DATE: 1985/ 7 / 20

Magnetometer: G-806

Country: Morocco

Area: Agadir

(Datum value 39872 nT)

Time	Observed value (nT)	Diurnal correction value (nT)	Remarks	Time	Observed value (nT)	Diurnal correction value (nT)	Remarks
:				13 : 00	39876	-4	
:				: 10	878	-6	
8 : 20	39885	-13		: 20	879	-7	
: 30	"	"		: 30	"	"	
: 40	"	"		: 40	880	-8	
: 50	884	-12		: 50	882	-10	
9 : 00	883	-11		14 : 00	881	-9	
: 10	"	"		: 10	882	-10	
: 20	882	-10		: 20	881	-9	
: 30	881	-9		: 30	883	-11	
: 40	"	"		: 40	882	-10	
: 50	879	-7		: 50	879	-7	
10 : 00	880	-8		15 : 00	880	-8	
: 10	"	"		: 10	"	"	
: 20	"	"		: 20	"	"	
: 30	"	"		: 30	876	-4	
: 40	"	"		: 40	877	-5	
: 50	879	-7		: 50	"	"	
11 : 00	878	-6		16 : 00	"	"	
: 10	876	-4		: 10	874	-2	
: 20	"	"		: 20	873	-1	
: 30	875	-3		: 30	870	2	
: 40	"	"		: 40	865	7	
: 50	874	-2		: 50	864	8	
12 : 00	873	-1		17 : 00	"	"	
: 10	874	-2		: 10	866	6	
: 20	873	-1		:			
: 30	"	"		:			
: 40	"	"		:			
: 50	875	-3		:			

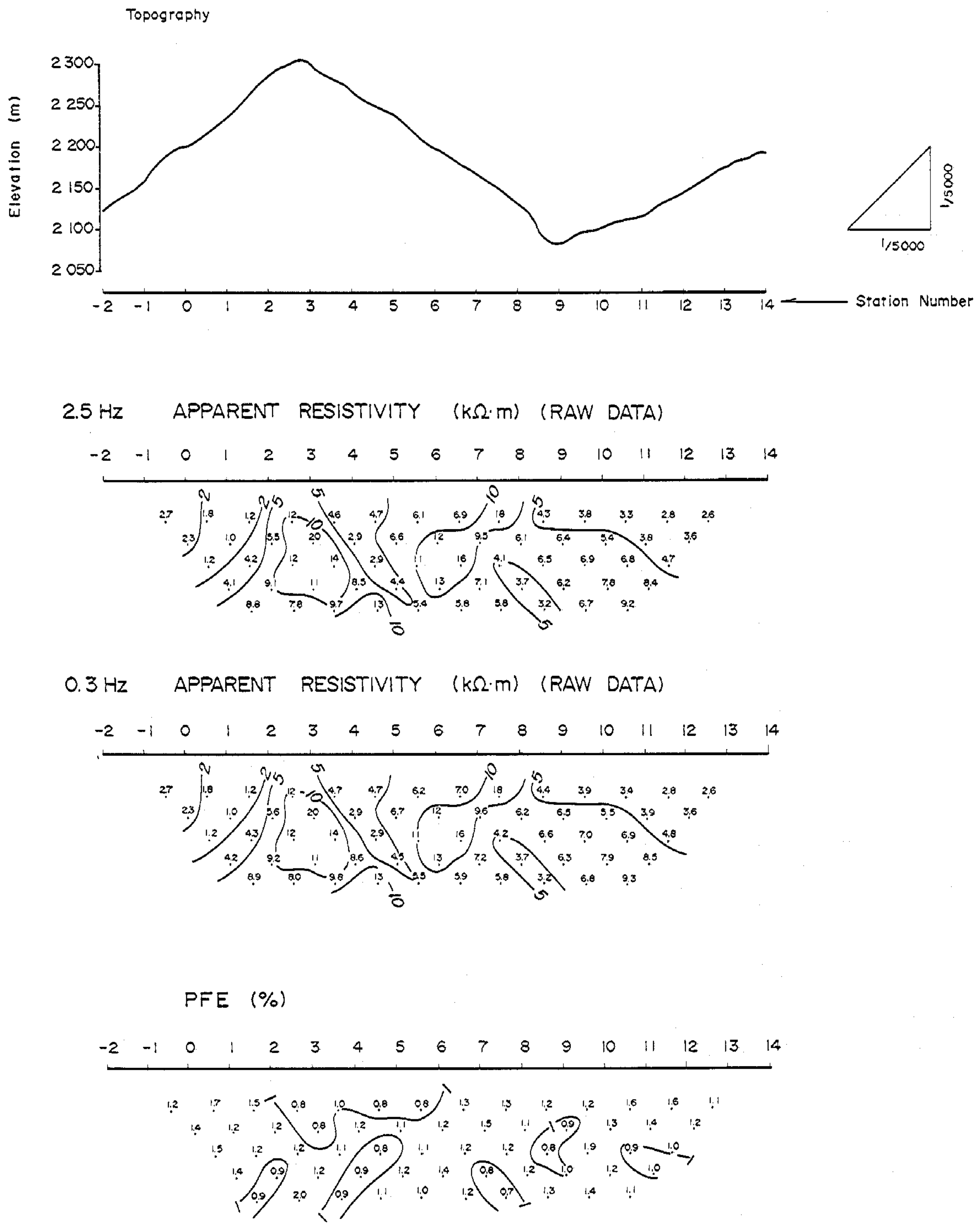

Fig. II-2-2 Apparent Resistivity and IP Effect Pseudo Section
(Line 1)

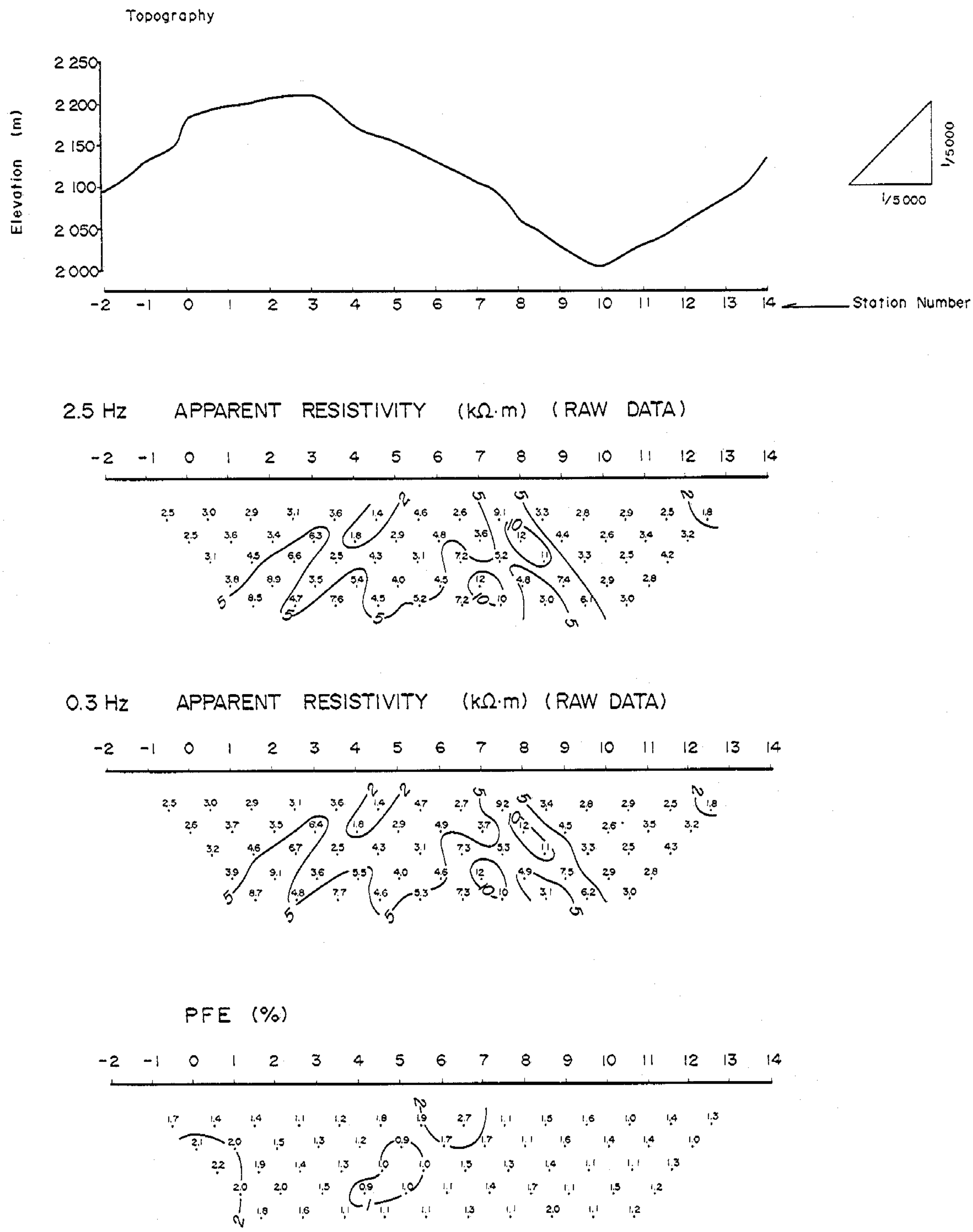

Fig. II-2-3 Apparent Resistivity and IP Effect Pseudo Section
(Line 3)

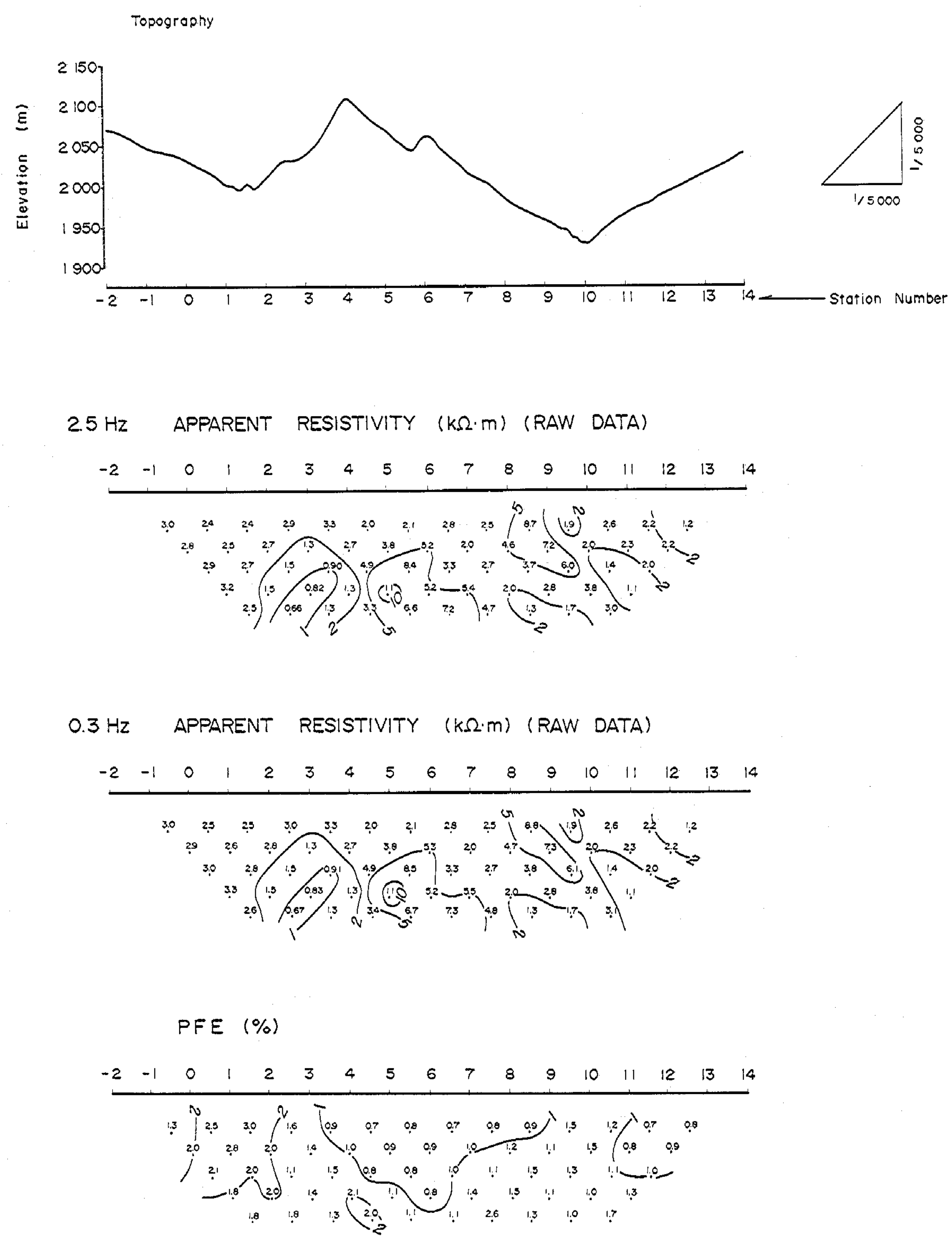

Fig. II-2-4 Apparent Resistivity and IP Effect Pseudo Section (Line 5)

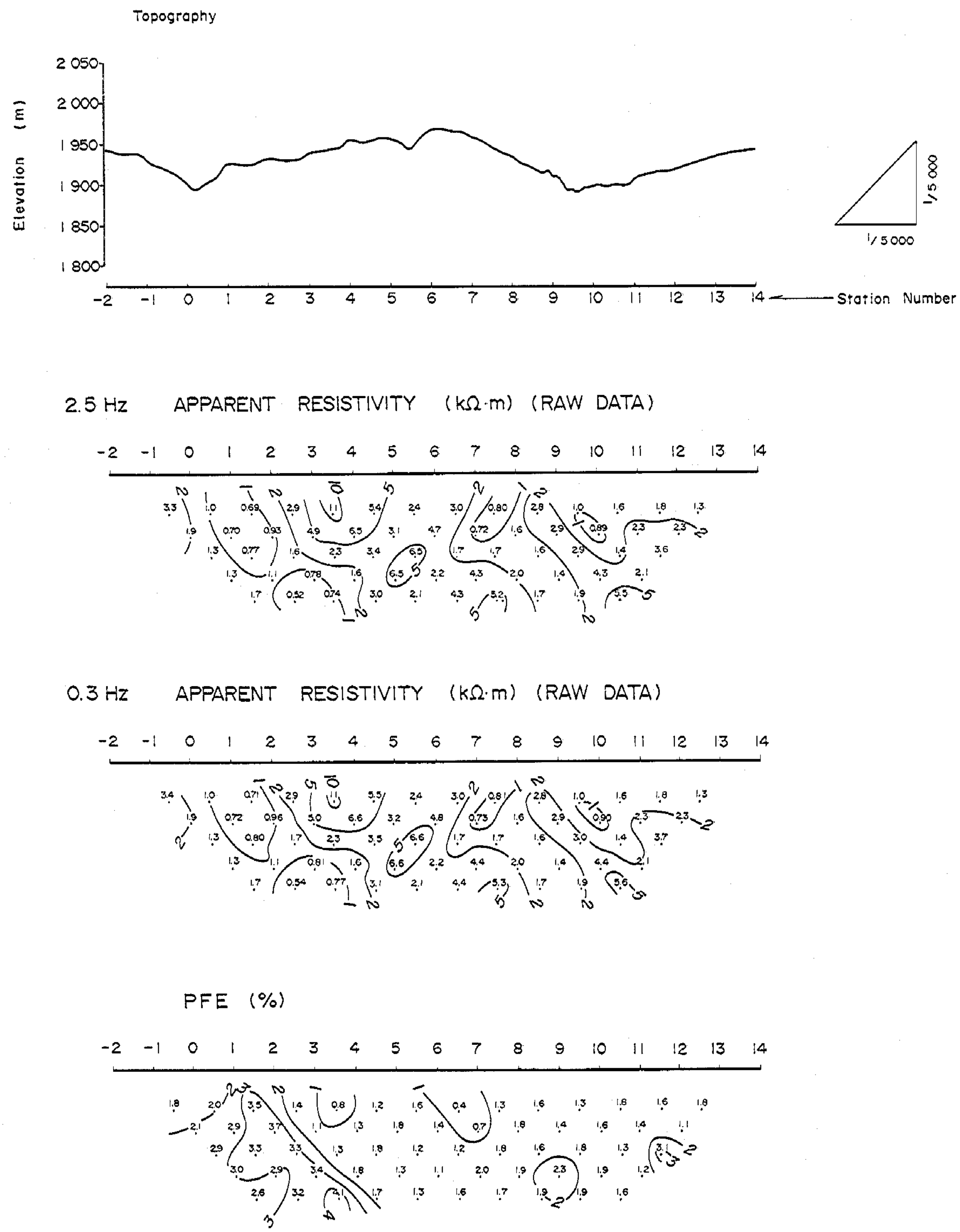

Fig. II-2-5 Apparent Resistivity and IP Effect Pseudo Section
(Line 7)

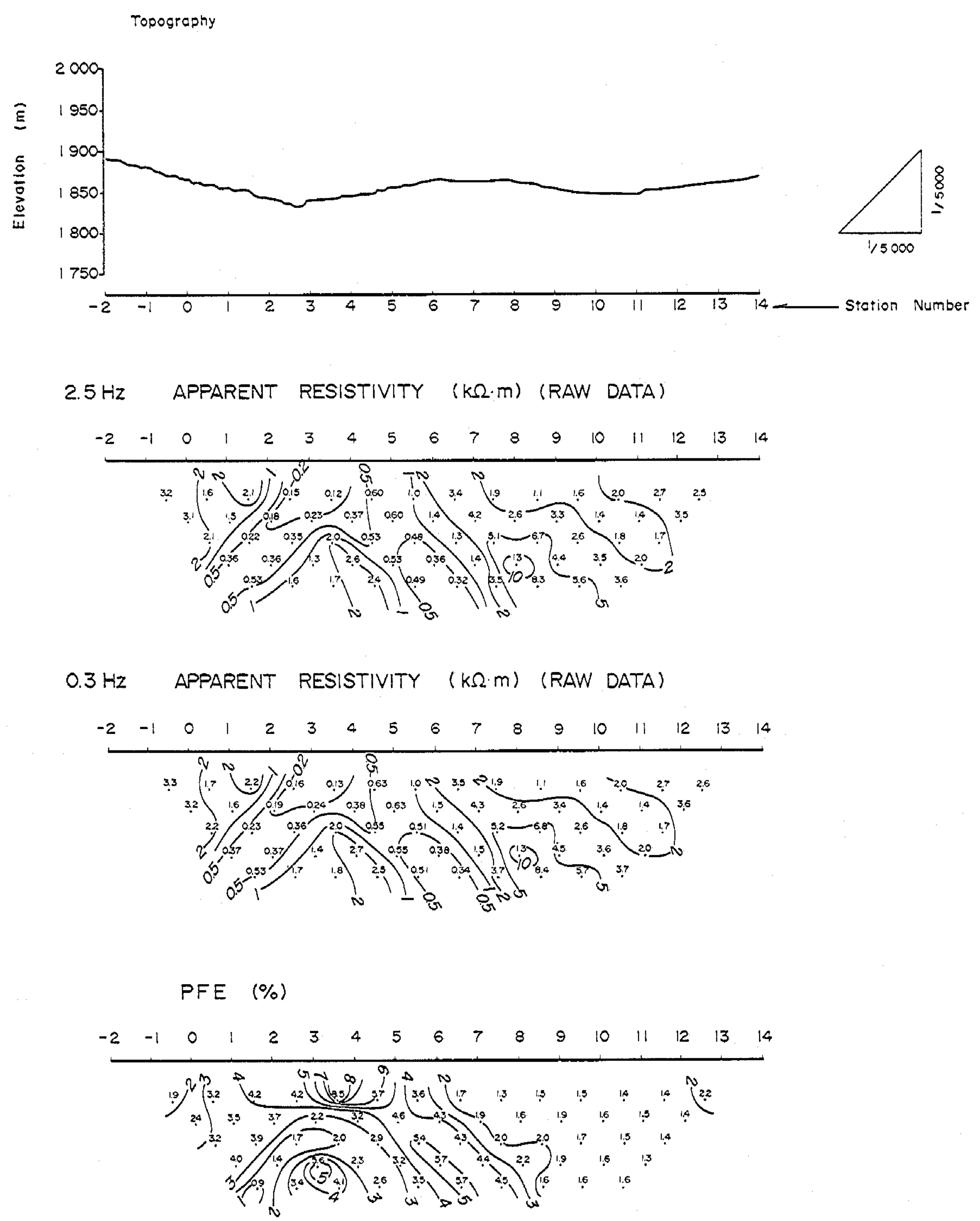

Fig. II-2-6 Apparent Resistivity and IP Effect Pseudo Section (Line 8)

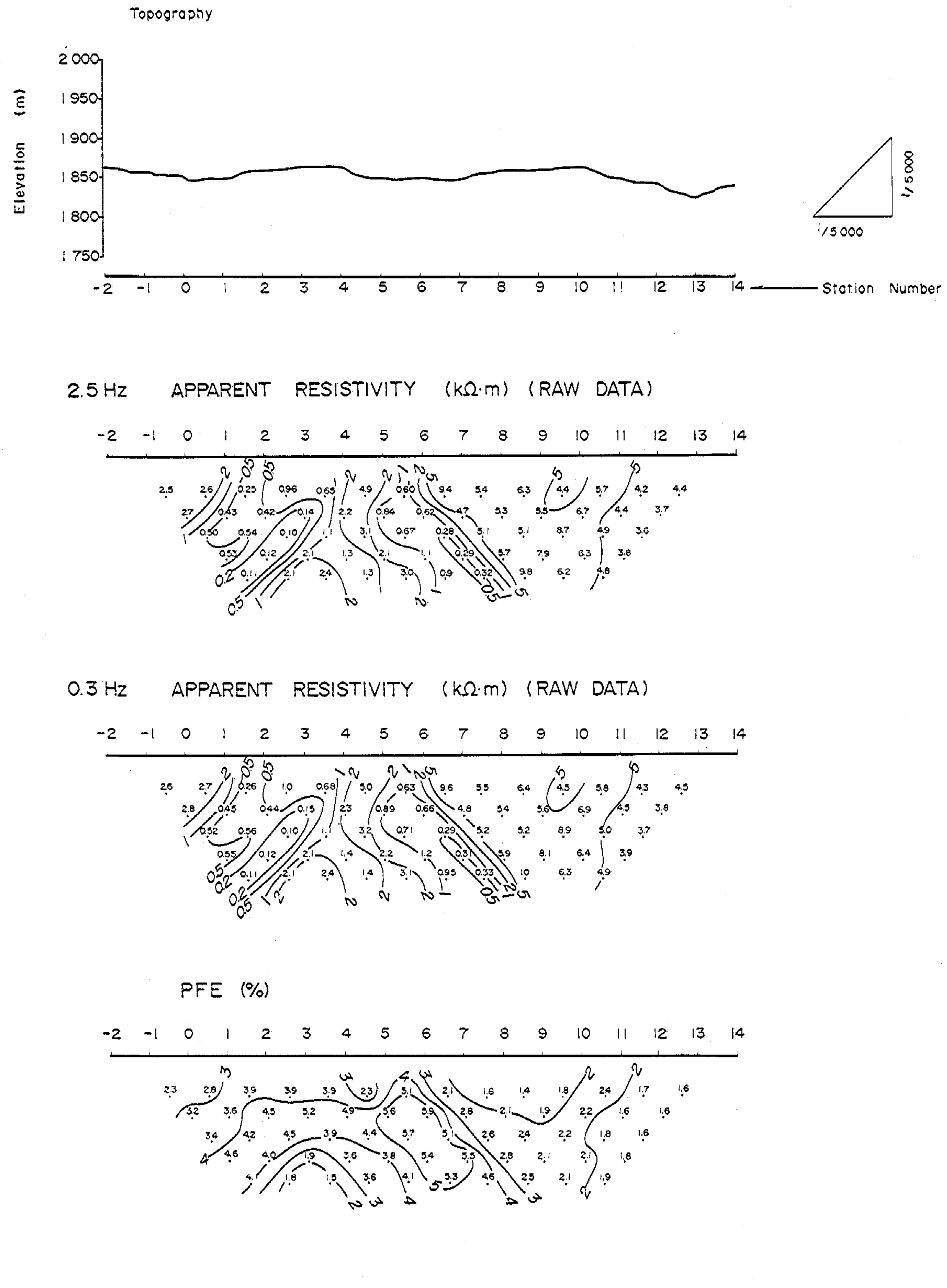

Fig. II-2-7 Apparent Resistivity and IP Effect Pseudo Section (Line 9)

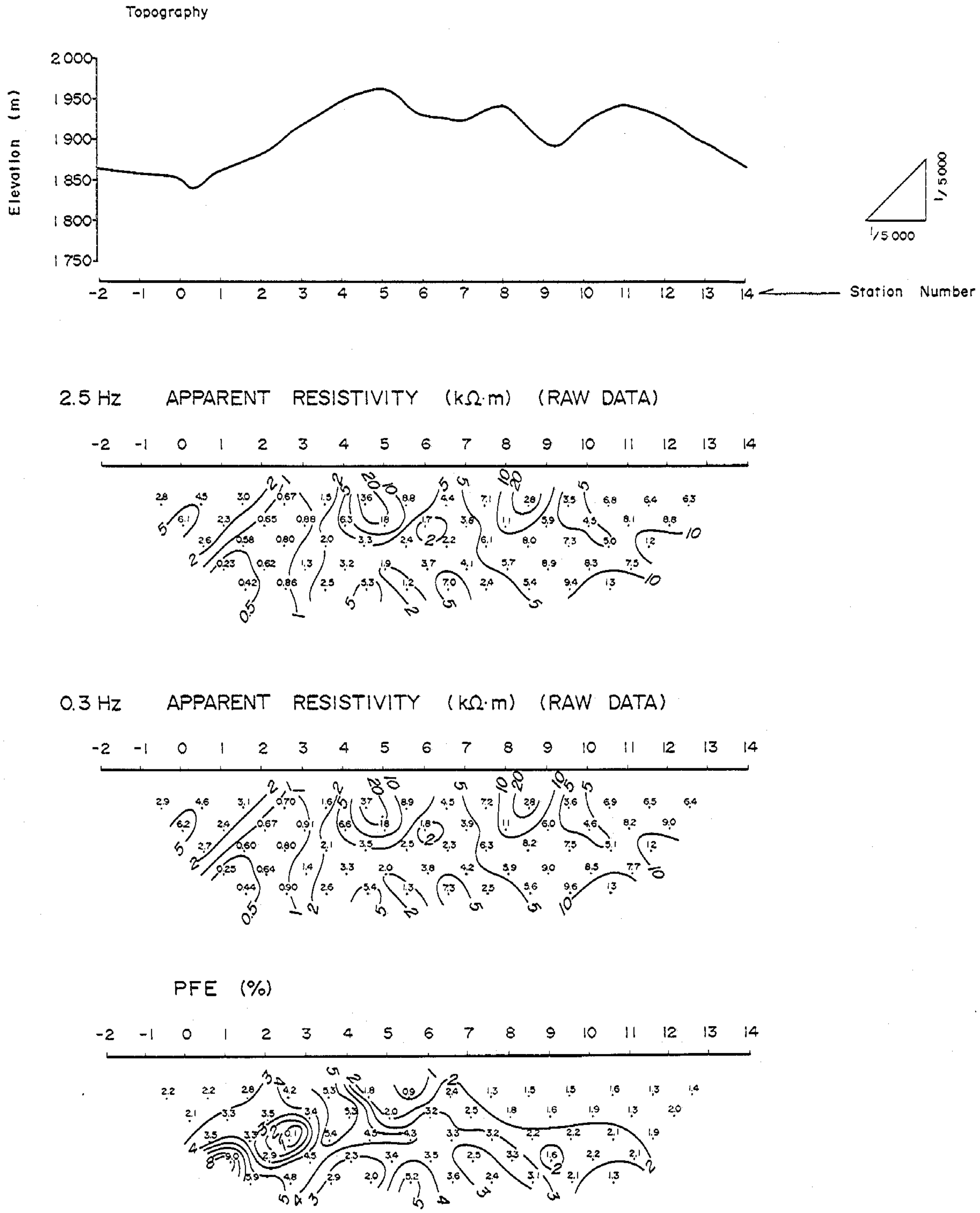

Fig. II-2-8 Apparent Resistivity and IP Effect Pseudo Section
(Line 10)

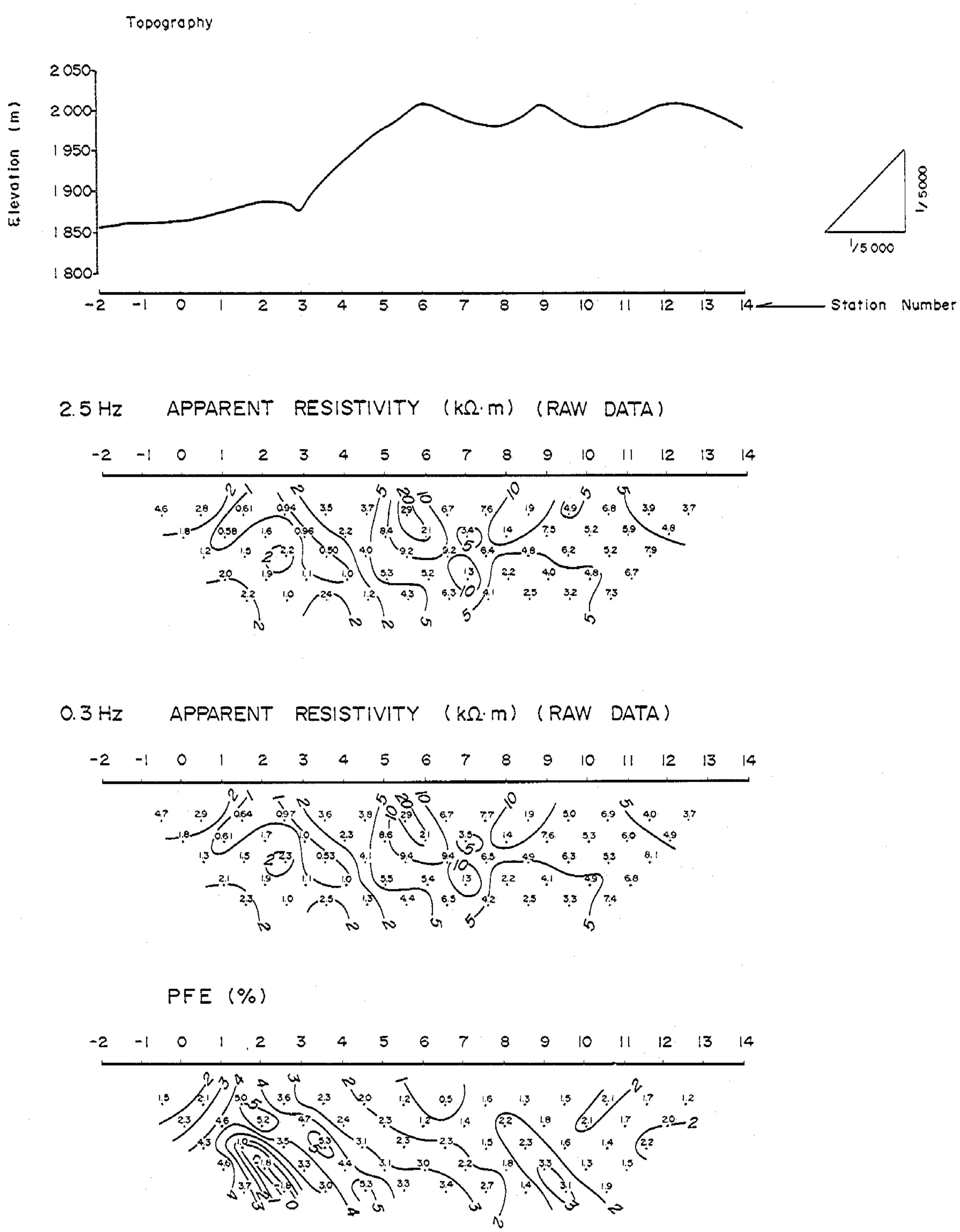

Fig. II-2-9 Apparent Resistivity and IP Effect Pseudo Section (Line 11)

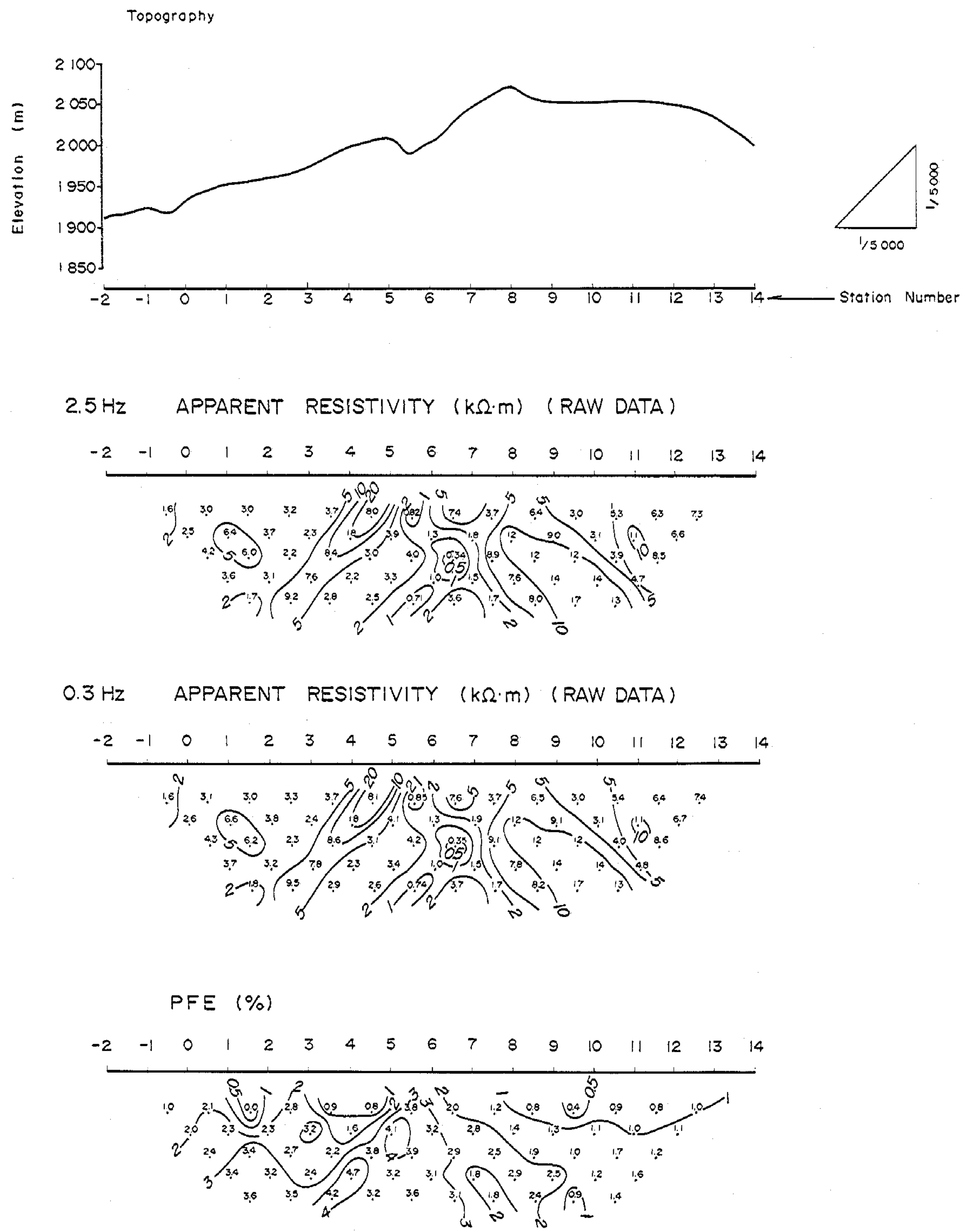

Fig. II-2-10 Apparent Resistivity and IP Effect Pseudo Section (Line 12)

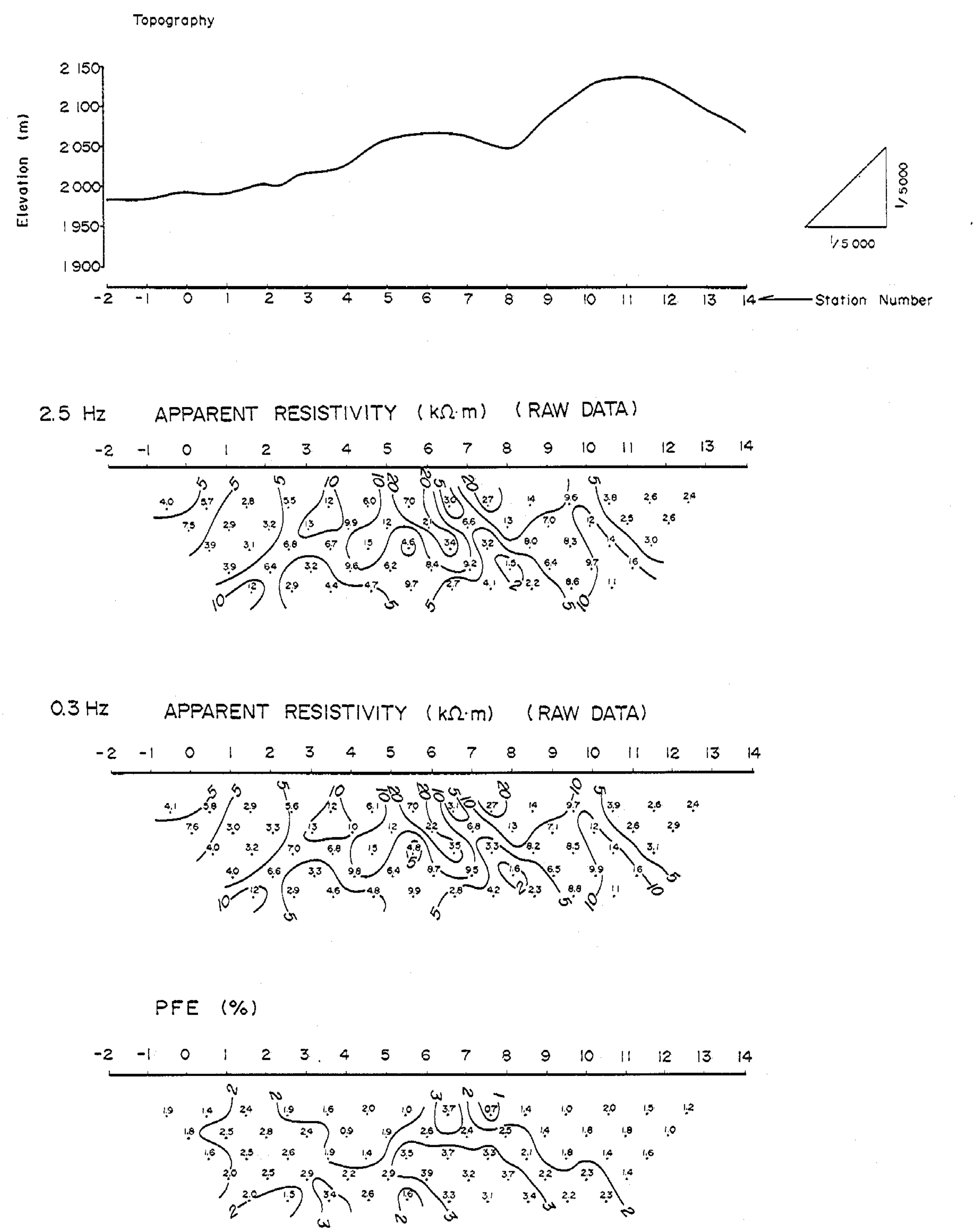

Fig. II-2-11 Apparent Resistivity and IP Effect Pseudo Section
(Line 13)

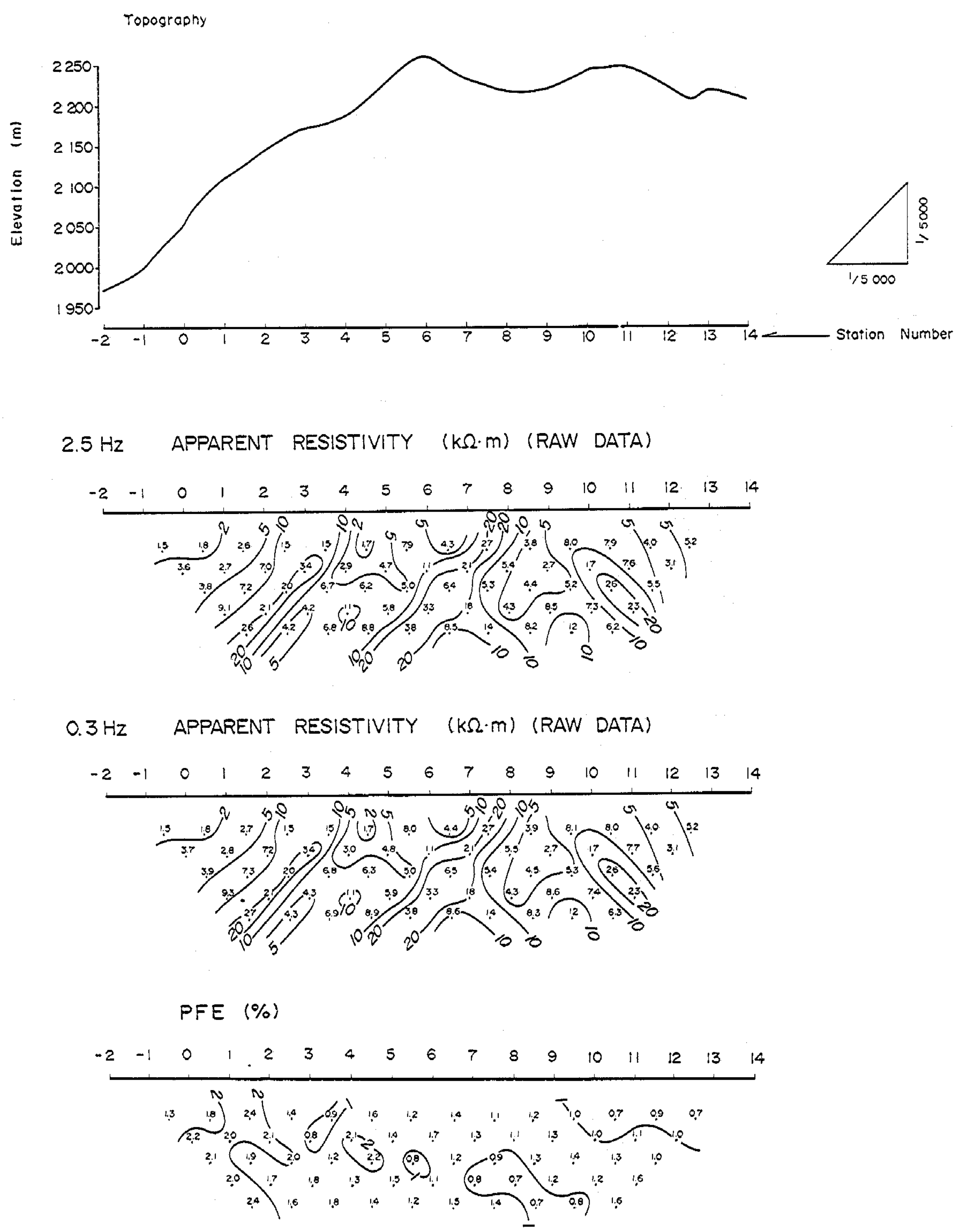

Fig. II-2-12 Apparent Resistivity and IP Effect Pseudo Section (Line 15)

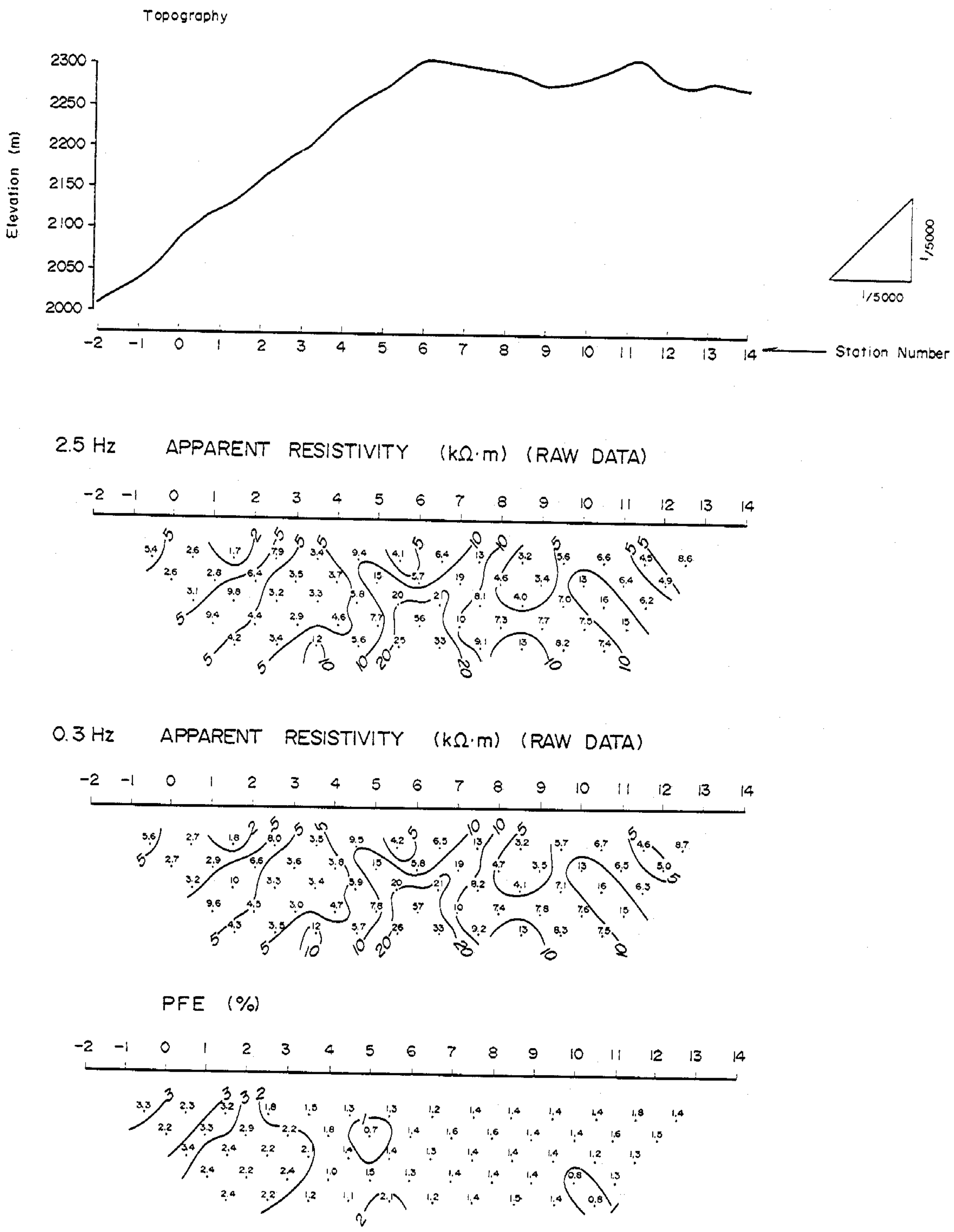

Fig. II-2-13 Apparent Resistivity and IP Effect Pseudo Section (Line 16)

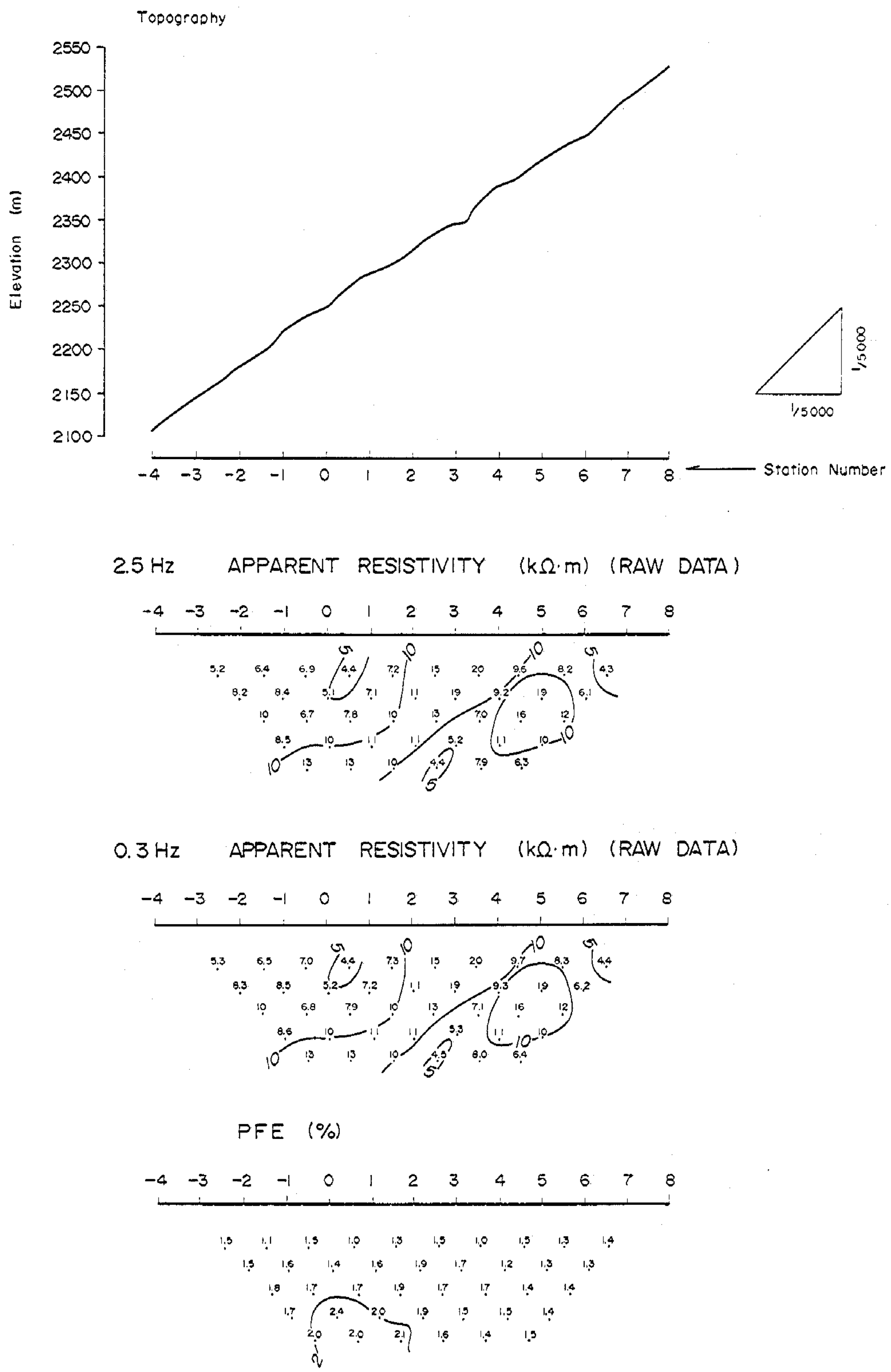

Fig. II-2-14 Apparent Resistivity and IP Effect Pseudo Section
(Line 18)

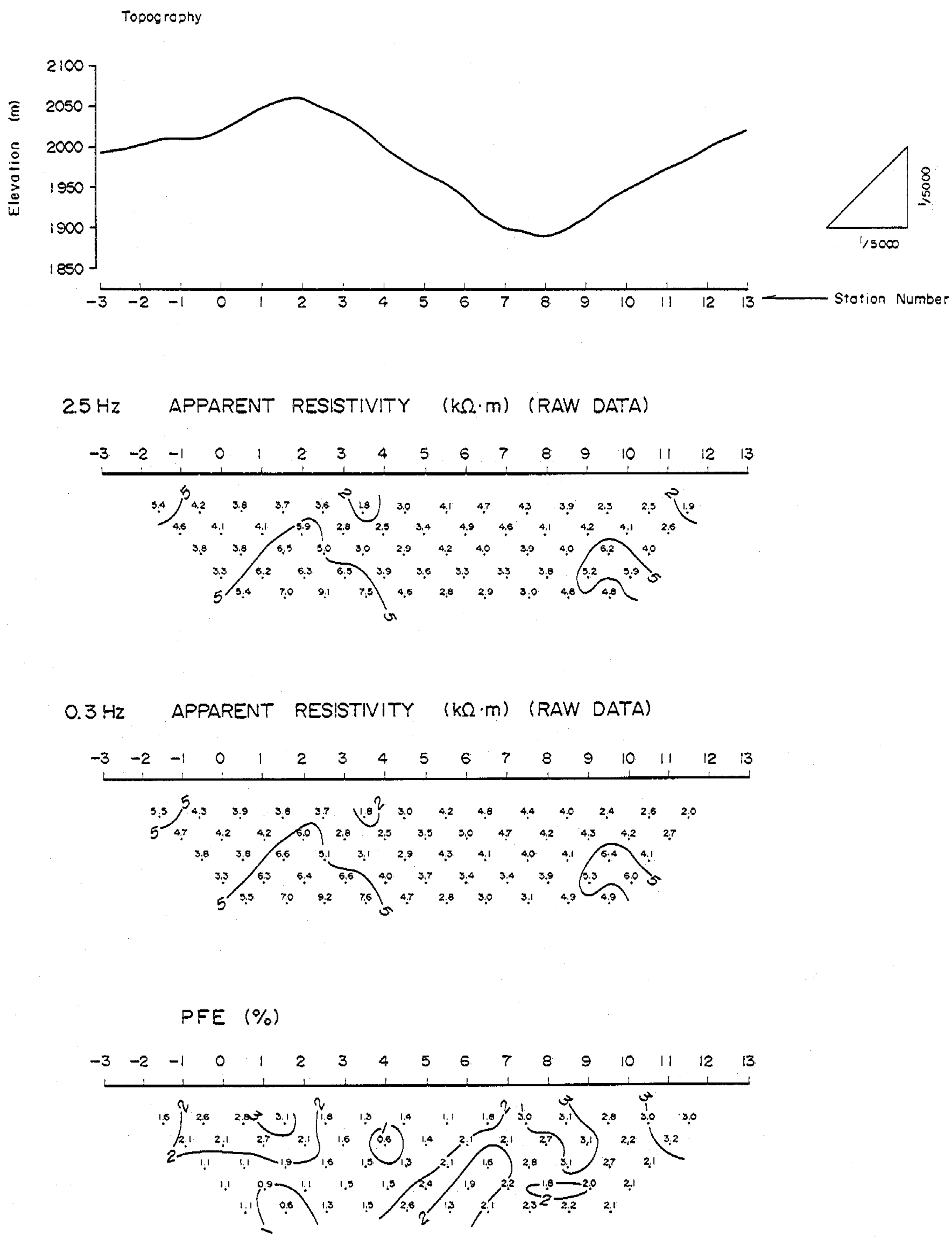

Fig. II-2-15 Apparent Resistivity and IP Effect Pseudo Section
(Line 21)

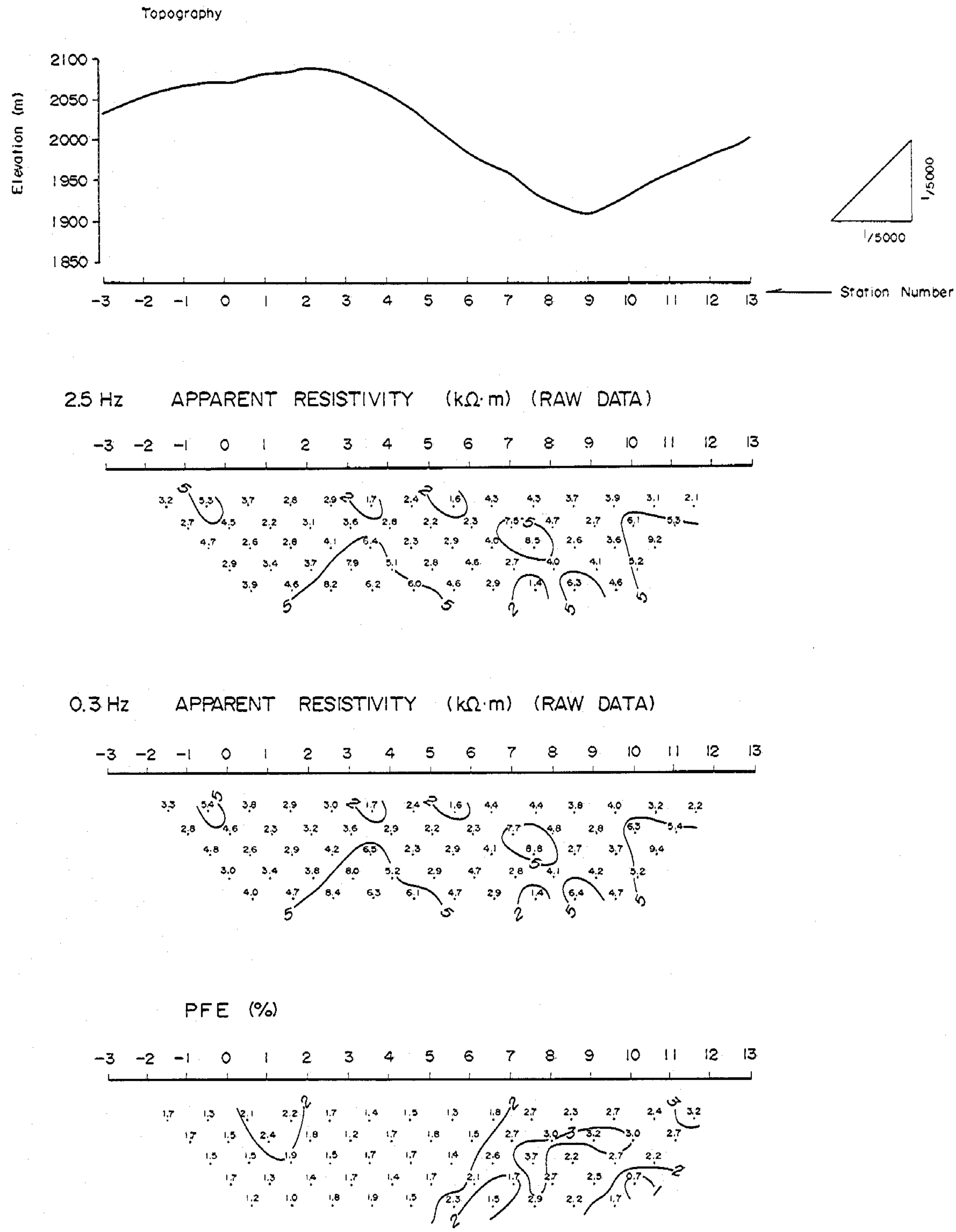

Fig. II-2-16 Apparent Resistivity and IP Effect Pseudo Section
(Line 22)

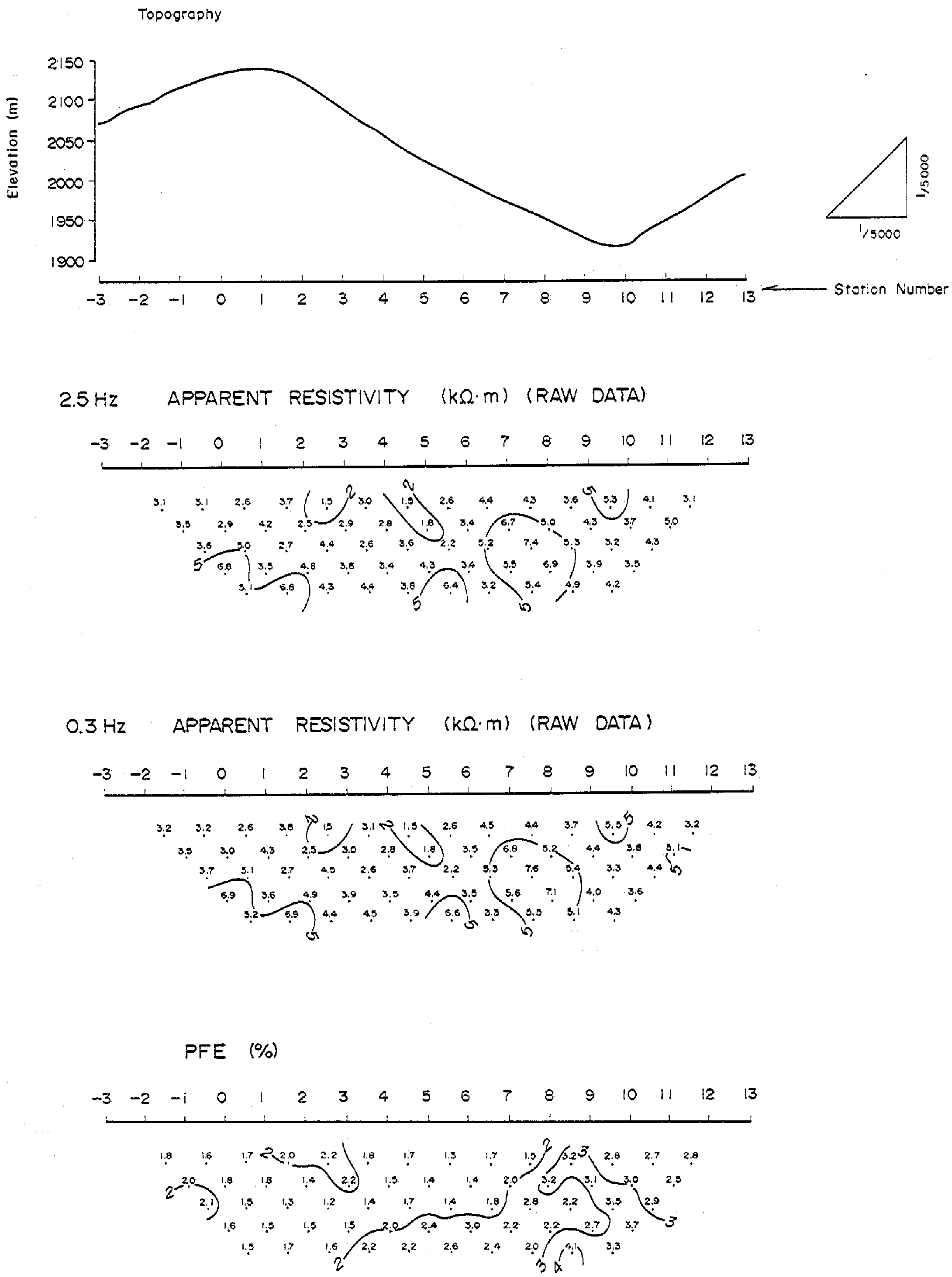

Fig.II-2-17 Apparent Resistivity and IP Effect Pseudo Section
(Line 23)

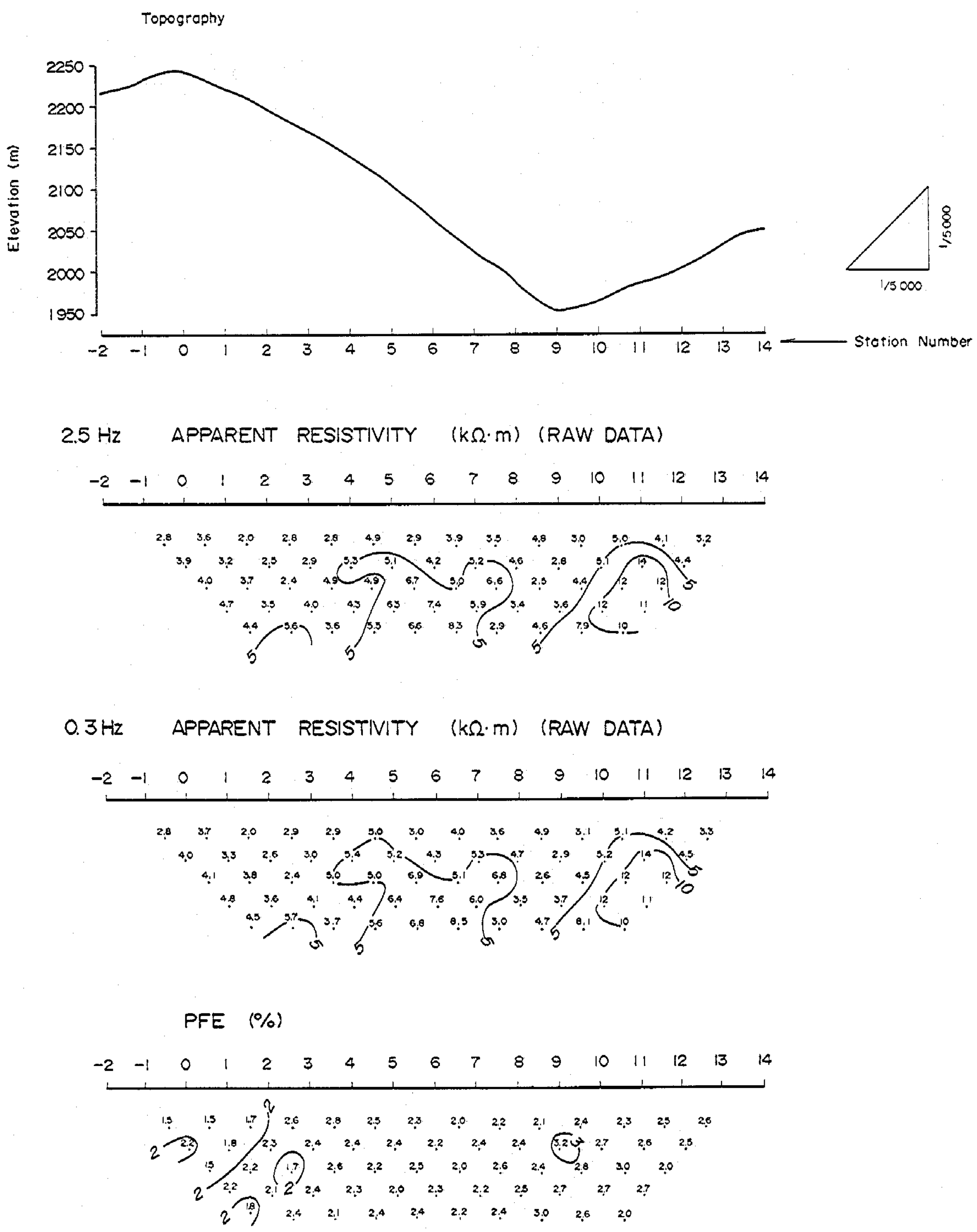

Fig. II-2-18 Apparent Resistivity and IP Effect Pseudo Section
(Line 25)

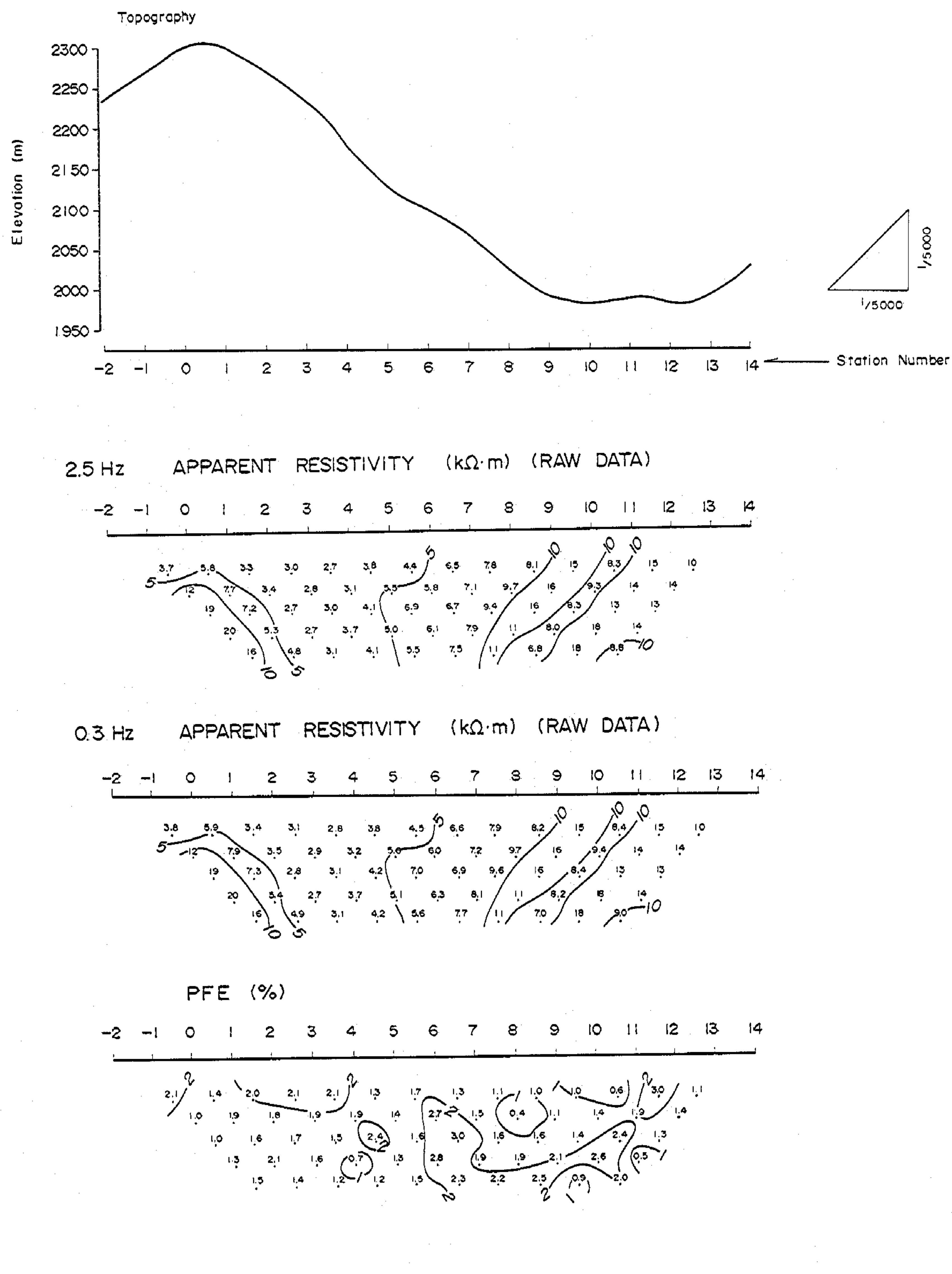

Fig. II-2-19 Apparent Resistivity and IP Effect Pseudo Section (Line 27)

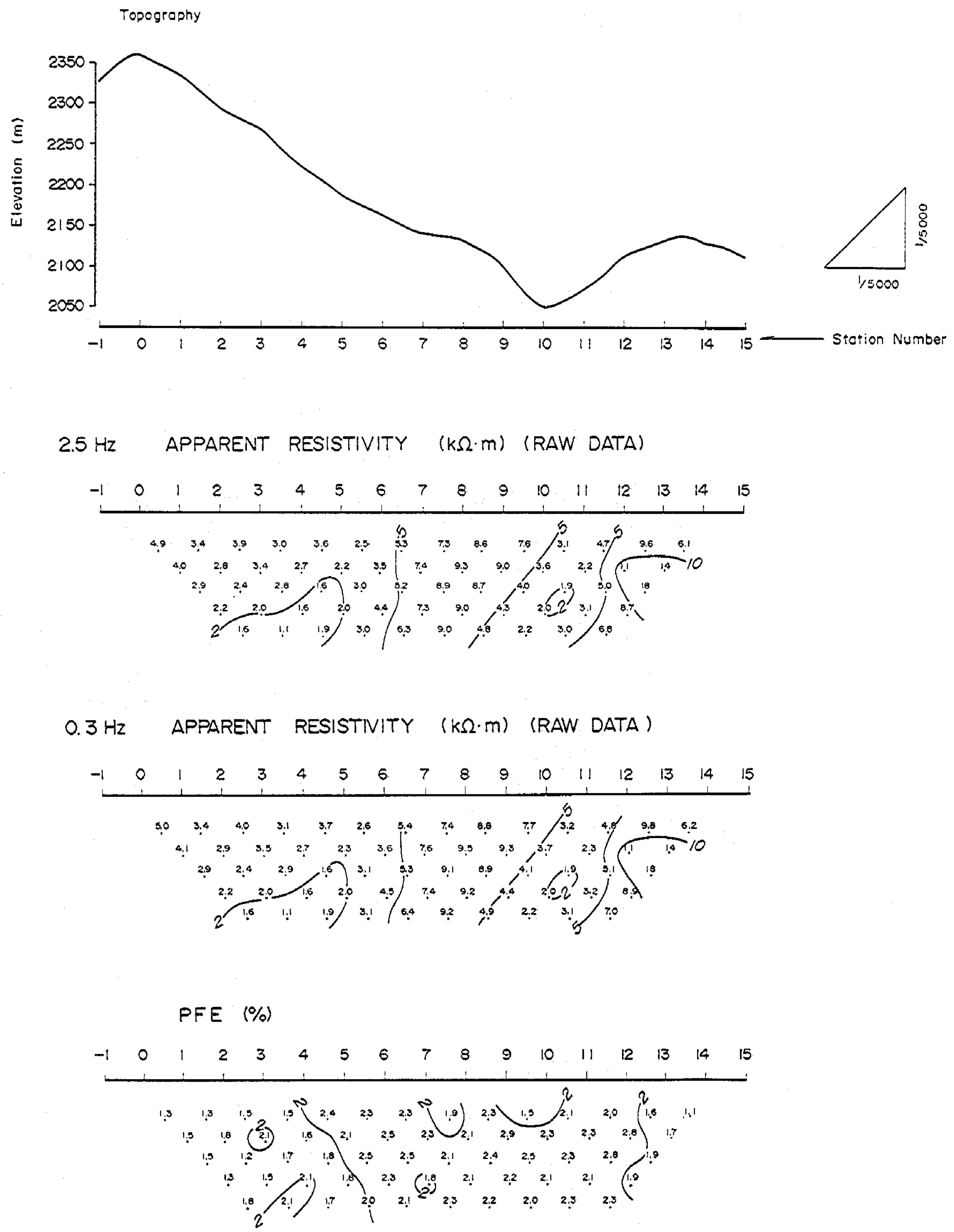

Fig. II-2-20 Apparent Resistivity and IP Effect Pseudo Section
(Line 29)

CONCLUSION AND RECOMMENDATION

CHAPTER 1 CONCLUSION

The purpose of the third phase survey in the Haut Atlas Occidental Area of the Kingdom of Morocco was to clarify the emplacement of ore deposits and to confirm the continuity of ore deposits in three sectors Agadir Sector, Iguidi Sector and Taddart Sector in which emplacements of ore deposits were found promising during the first and second phase, by detailed geological survey, geochemical survey by rocks and geophysical survey applying magnetic method and IP method in Agadir Sector, by the detailed geological surveys and geochemical by rocks surveys in Iguidi Sector and Tadart Sector.

The new informations and the conclusion obtained from the results of the third phase investigation are as follows;

1-1 Agadir Sector

This sector is underlain by the Paleozoic Group and the Mesozoic Group and associated with the Hercynian intrusive rocks. The Paleozoic Group was classified into CII Formation, CIII Formation and CIV Formation according to differences of constituent rocks.

The CII Formation mainly consists of pelitic schist, is distributed in the western part in this sector trending from north to south. The lower part of this formation shows frequently gneissose rock facies affecting by the granite intrusion.

The CIII Formation is widespreaded whole of the sector, and consists of the alternation of conglomeratic green schist, psammitic schist, pelitic schist crystalline limestone and calcareous schist. The CIV Formation consist of thick pelitic schist and distributed in the eastern marginal part and its outer area of this sector. These formations generally show the strikes of NE-SW trending and dipping 50° ∿ 70° eastward, but partially shows NW-SE direction.

The intrusive rocks are composed of the stocks and dykes of granite and of dykes of porphyrites. The granites are composed largely of fine to medium grained biotite granites, and some of them shows aplitic and porphyritic textures. Especially, the widespread exposure of granite which is the eastern margine of the Tichka granites (diameter: about 20 km) is observed in the western part of this sector. These granites affected the thermal metamorphism to the surrounding rocks. Dikes of granite of which several meters to several 10 meters in width, are observed all over the sector. And some of thems hows steep inclination, and others shows low angle (10° ∿ 20°) inclination.

The Mesozoic Group which is composed of the Triassic red sandstone is in fault contact with the Paleozoic Group at the southern most in this sector.

The geological structure in this sector is characterized by the monoclinic structure dipping eastward of the Paleozoic Group, the block movement by the faults and the intrusion of granites. The faults of N80°E, N80°W, NS and N50°E trends were recognized in this sector, the drug foldings and large scaled deplacements were also recognized.

Though the skarn ore deposit and vein-type ore deposit were recognized in this sector, the most important ore deposit on the point of scale and grades is the Agadir skarn ore deposit observed near the Agadir village.

This ore deposit contains chalcopyrite and pyrrhotite mineralization was formed in the several skarn zone which is replaced partially limestone beds of about 400 meters in width.

The skarnization was recognizable about 2 kilometers north to south centering the Agadir village, and skarn zones range from several meters to 30 meters in width, and from several 10 meters to about 500 meters in length, especially, have a tendency to be made a large form at the hanging and foot wall and at the contact part of limestone with the granites.

Mineralizations were recognized in the part of skarn zones, and range from several meters to about 20 meters in width and from 15 meters to 100 meters, especially are predominant near the riverside. The ore grades of outcrop at this part were attained Cu: 0.60%, Mo: 0.01%, W: 0.03%. In the Mauass part, located in the about 1 kilometer west of this village, the copper-pyrrhotite veins of less than 1 meter in width, accompanied small amount of skarn minerals were observed.

The geochemical survey (analysis element are Cu, W, Mo) in the area including the Agadir and the Mauass ore deposits was carried out by the rock sampling at the point of every 50 meters on the thirty EW traverse lines of which the interval of 100 meters in right angle to the strikes of the formation.

As the results of this survey, Cu strong anomalous values are roughly corresponded to the mineralizations in the skarn and ore veins, and weak anomalous zones are correspond to the skarn zone which no mineralization has been observed. Though W and Mo anomalous values are faintly correspond to the veins, since almost of all analysis values are under the detectable limit, their correspondence has been remained as the problems.

As the results of magnetic survey carried out in the area of about 8 km^2 including the Agadir ore deposit, the long waved-large amplitude anomalies and the short wared-medium amplitude anomalies were detected. The former anomalies were observed in the distribution area of the conglomeratic green schist. They are less correspond to the mineralizations. It is considered that these anomalies might be reflected the high magnetic igneous rocks or the high magnetic schist in the underground.

The later anomalies observed in the limestone were well corresponded to the mineralized skarn zones. Furthermore, the later anomalies observed in the conglomeratic green schist area were not recognized clear correspondence to the ore vein ore deposit, it is considered that these anomalies are correspond to the high magnetic schist.

As the results of IP survey, the anomalous zones at the about 200 meters southwest of the Agadir village and at the 1.2 km west of the village were recognized.

The former shows low resistivity and high FE values, this anomalous zone of more than FE 3% is a scale of about 300 meters in width at the center and about 600 meters north-south in length, and is roughly correspond to the distribution of skarn zone. More over, the high anomalous zones more than FE 5% in this anomalous zone were recognized four places which are correspond to the mineralized skarn. From the results of simulation, it is assumed that the vertical or steep dipped high FE response bodies are continued about 100 meter in depth.

The later anomalous zone shows high resistivety and medium FE values (about 3%), which is a scale of about 200m x 200m. This anomalous zone is not clear the relationship between vein ore deposits, it seems to correspond to the weak alteration.

No anomalous zone correspond to the vein ore deposits in the southwestern part was detected.

From the result of above surveys, the Agadir ore deposit has been selected as the promising favorable emplacement of large scaled mineralization. However, it is considered at present that the ore deposit will be not the subject for production because to the grades of the outcrop is low such as Cu: 0.6%, Mo: 0.01%, W: 0.03%.

From the geochemical survey and magnetic survey, the tendency of spreading mineralization along the skarn zone has been recognized, and from the results of IP survey, the tendency of correspondence between anomalous zone and mineralizations has been recognized, and it has been assumed that the mineralization continue to about 150 meter depth in the underground. Furthermore, the strong mineralization is limited in the limestone which is less than 600 meter north-south centering the riverside near the Agadir village.

Therefore, as the further exploration, it is necessary to confirm the continuity in the deep port and the condition of mineralization.

1-2 Iguidi Sector

This sector is underlain by the Pre-Cambrian andesites and the Paleozoic CI Formation and associated with the intrusive dolerite.

The Paleozoic CI Formation is overlain and in fault contact with the Pre-Cambrian Group.

The CI Formation is distributed in the southeastern side of the N50°E fault which was observed along the northwestern margine in this sector. It is composed of upper, middle and lower dolomites and siltstone, and strikes N50°E ∿ N70°E, dips 30° ∿ 70° northwestward. The dolerite intruded along the above fault is affected the strong alteration.

The geological structure in this sector is characterized by the subsidence of southeast block caused by the above fault, by the monoclinic structure dipping northwestward of the Paleozoic formation, by the displacement by the NS faults and by the fissures of NS, NE-SW systems in the dolomite bed.

It is considered that the mineralization in this sector has been made by the post igneous action of dolerite intrusion after the faulting, and formed copper stockwork ore deposit accompanied quartz veinlets along the fracture in dolomites.

Weak mineralizations were recognized along the dolomite, especially, about 2,000 meters in length in the middle dolomite.

The mineralization observed near the old adits in the western part is of from 10 meters to 15 meters in width and about 250 meters in length. The average grade of this mineralization is Cu 1.3%.

As the results of the geochemical survey, the distribution of Cu anomalous zone was correspond to the mineralization on the surface. However, Ag anomalous values shows the different distribution from the Cu distribution, this fact suggest the mineralization in this sector should be consider as the simple copper mineralization.

From the results of above mentioned survey, the mineralization has been recognized widely in this sector and the concentration of mineralization near the old adit has been observed, however, its grades is a problem rather than quantity as to the further ore production.

Therefore, it is necessary to confirm the condition of mineralization in the deeper part in the underground.

1-3 Taddart Sector

This sector is underlain by the Paleozoic CII Formation and CIII Formation.

The CIII Formation is composed of green schist, pelitic schist, psammitic schist and limestone, and the CII Formation is composed of pelitic schist and psammitic schist. The CIII Formation is overlain conformably the CII Formation. These formations strike generally N30°E and dips 30° ∿ 70° eastward, show the monoclinic structure as a whole.

These formations have been affected the displacement by the fault of EW, NE-SW and NS trends, and each blocks show the different rock facies.

The ore deposits in this sector are copper quartz vein ore deposit. The quartz vein aggregated area, about 400 meters x 400 meters, accompanied with silicified zone were recognized in the western part in this sector.

This area is bordered by the above fault and consist of the conglomeratic green schist.

The ore veins range generally from several centimeters to 2.0 meter in width and from several 10 meters to several 100 meters in length, and their strikes show various trends such as E-W, NS, NE-SW, NW-SE systems and their dips are generally about 40°.

The highest grade of ore vein is Cu: 8.0%, Ag: 115 g/t, however, the grades range from Cu: 0.5% to Cu: 4.0% generally, and average grade of vein is estimated Cu: 2.5% Ag: 2.0 g/t.

As the results of the geochemical survey, both of Cu and Ag element have shown the same tendency. Strong anomalous zone are distributed as a elongated form along the western and southern margine of above vein aggregated area. It has been recognized that these anomalies show the tendency of well correspondence to the mineralized veins.

From the above survey results, it has been considered that mineral solution rise up along the secondary fructure caused by the faulting and the block movement, and that the quartz vein contains copper and silver has been emplaced.

Though some of veins shows the Cu grade of several percent, the grades of most of veins show low grades.

Therefore, it is far from sufficient to be the subject of production on the point of the grades and quantity at present. It is the question which the enrichment of this ore deposit will be expectable in the deep part in the underground.

CHAPTER 2 RECOMMENDATION

From the results of this phase survey and the conclusion attained from the consideration of these results, it has been considered that the posibility of emplacement of the high grade and large scaled ore deposit is rare.
However, it is expectative that these ore deposit will be enriched in the deeper part in the underground.

Therefore, the surveys in the following sector are recommended as the further investigation program if possible.

1) Agadir Sector: Drilling downward at the riverside near the Agadir village, to confirm the continuity of the skarn ore deposit.

2) Iguidi Sector: IP survey and drillings near the N10°E fault and NS fissures in the dolomite to confirm the continuity of stockwork ore deposit.

3) Taddart Sector: IP survey and drilling at the vein aggregated area to confirm the continuity and the enrichment of the vein type ore deposit in the deeper part.

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APPENDICES

A. I-I Microscopic Observations (Thin Section)

No.	Sample No.	Location	Rock Name	Texture	Primary Minerals												Secondary Minerals													
										Others															Others					
					Quartz	Plagioclase	K-feldspar	Biotite	Hornblende, Amphibole	Muscovite	Allanite	Sphene	Zircon	Garnet	Apatite	Opeque minerals	Quartz	Carbonate	Epidote	Chlorite	Sericite	Biotite	Amphibole	Opeque minerals	Sphene	Muscovite	Silimanite	Plagioclase	Tourmaline	Rutile
1	a3	Agadir	Aplite	Aplitic, granular	◎	◎	◎			△			•		•					•	•									
2	a58	Agadir	Granodiorite porphyry	Porphyritic	◎	◎		○				•			•	•		•	•	△	△									
3	a67	Agadir	Cabonaceous schist	Banding									•			•	△	◎		△	•								•	
4	a77	Agadir	Skarnized porphyrite			○											△	○	○	•			○							
5	a131	Ikissane	Aplite	Aplitic, granular	◎	◎	◎	•		△						•				△	•									
6	a136	Ikissane	Granodiorite		◎	◎	△	○	○			△			•	•				•	•									
7	a138	Ikissane	Biotite schist	Banding									•		•	•	◎					◎				○		△		
8	a143	Igherm	Psammitic schist										•			•	◎	△			△							△		
9	a187	Tawyalt	Porphyrite	Porphyritic		◎		○	△			•			•		△		•	•	•									
10	S6	Agadir	Aplite	Aplitic, granular	◎	◎	◎			○				△		•				•										
11	S35	Agadir	Altered porphyrite		△	◎							•		•	•	△	△		△		○								
12	S38	Agadir	Porphyrite			◎			◎			△							•	△	•	△								
13	S58	Mauass	Biotite-silimanite schist	Banding									•		•	•	◎				•	○		•			○	•		
14	S62	Agadir	Altered tuff(?)			○	○										◎		△	•		△	◎							
15	S63	Agadir	Granophyre	Micrographic intergrowths	○	◎	○	○				•	•		•				•	△	•									
16	W1	Agadir	Granophyre	Micrographic intergrowths	◎	○	◎			△										•		•		•						•
17	W2	Agadir	Fine grained biotite granite	Granular	◎	◎	◎	○		△	•		•						•	△	△									
18	W3	Agadir	Carbonate rock		△																•		•	•						
19	W4	Tiwaline	Porphyrite	Porphyritic	○	◎			○			△			•						△	○		•						
20	W7	Tiwaline	Biotite schist	Blastoporphyritic		○									•		◎		•	△		○			△	△				
21	W21	Agadir	Granodiorite porphyry	Porphyritic	◎	◎	○	△				•	•			•		△	•	○	△									
22	W34	Taddart	Qz diorite porphyry	Porphyritic	◎	◎				△			•		•			•		•	◎									

◎ abundant ◎ more ○ common △ Less • Scarce a3

Aplite

Weakly sericitized aplite.

It is composed mainly of quartz, plagioclase and K-feldspar with subordinate amounts of muscovite. Zircon and apatite are present in accessory amount. Plagioclase, with albite twinning and upto 1.2mm in length, has been weakly sericitized along the crystal margin and cleavages.

a58

Granodiorite porphyry

Granodiorite porphyry altered at hydrothermal condition.

The constituents are plagioclase, quartz and biotite, as accessories sphene and apatite. Phenocryst plagioclase, with zonal texture and well developed twinning, has been strongly sericitized. Groundmass consists of lath shaped plagioclases, anhedral quartz and biotite with partly replaced by chlorite.

a67

Carbonaceous schist

Greenish schist with well developed schistosity. It is chiefly composed of carbonate minerals and quartz with small amounts of chlorite and tour maline.

a77

Skarnized porphyrite

Skarnized porphyrite penetrated by carbonate vein.

There are actionolite and epidote as skarn minerals, accompanied by a little quartz. The constituent of porphyrite is plagioclase and has been strongly replaced by carbonate minerals and epidote.

a131

Aplite

Weakly argillized aplite.

It is composed mainly of quartz, plagioclase and K-feldspar, with accessory muscovite.

Plagioclase, with albite twinning and upto 1.0mm in length, occurs in tabular crystals with weakly sericitization.

a136

Granodiorite

Medium grained granodiorite.

The constituent are quartz and plagioclase, next in abundance is hornblende, then biotite and K-feldspar.

Pale green hornblend with developed cleavages and twinning, shows weak pleocroism.

a138

Biotite schist

Dark grey biotite schist came from pelitic sediments. It is chiefly composed of quartz and brown biotite, with small amounts of plagioclase and apatite.

a143

Psammitic schist

Fine grained schistose rock came feom arkose sandstone. Main constituent is quartz, next in abundance plagioclase, then sericite and carbonate minerals. Fircon is present in accessory amounts.

a187

Porphyrite

Green porphyrite weakly altered by secondary quartz.
It is composed mainly of plagioclase, biotite and hornblende, with accessory sphene and apatite.
Plagioclase, with zonal texture and upto 2.3 mm in length, occurs in tabular to columnar crystals.
Groundmass consist of lath shaped plagioclase with a little sericite and anhedral quartz.

S6

Aplite

Fine grained garnet bearing aplite.
It is chiefly composed of quartz, plagioclase and K-feldspar, subordinate amounts of muscovite and garnet.
Plagioclase occurs in subhedral crystals with well developed albite twinning.
Granules of partly chloritized garnet are scattered throught.

S35

Altered porphyrite

Strongly hydrothermally altered porphyrite. Main constituent is plagioclase, next in abundance is quartz.
Zircon and apatite are present in accessory amount. Lath shaped plagioclases of up to 2.5 mm in length is moderately turbid in the interior.
Mafic minerals, probably pyroxenes, also suffered the alteration into the assemblage of biotite and chlorite showing their pseudomorphs.

S38

Porphyrite

Dark greenish porphyrite altered at hydrothermal condition.
It is composed essentially of plagioclase and actinolite.
Actinolite, with distinct pleocroism of pole green to yellowish green, occurs in long prismatic crystals and columnar to fiberous aggregate with partly biotitized and chloritized.
A little of epidote accompanied by sphene, also occurs in euhedral crystals.

S58

Biotite-silimanite schist

Fine grained biotite-silimanite schist. Main constituent is quartz, next in abundance is biotite, then silimanite.
There is a little plagioclase and K-feldspar interstices of quartz.

S62

Altered tuff

Altered tuff accompanied by a lot of actinolite. Clastic grains are of plagioclase and K-feldspar with partly silicified. Matrix is composed of secondary, fine grained quartz with accessory biotite.

Long prismatic actinolites, accompanied by a little of epidote, lie in the matrix.

S63

Granophyre

Weakly argillized granophyre accompanied by biotite.

There is a lot of myrmekite at the contact between plagioclase and K-feldspar.

Plagioclase, with zonal texture and stripe twinning, occure in tabular crystals up to 1.5 mm in length and is moderately turbid in the interior, owing to sericite.

W1

Granophyre

Weakly argillized granophyre.

It is composed of quartz, K-feldspar, plagioclase and small amounts of muscovite.

K-feldspar, with perthite texture, mainly occurs as microcline.

Plagioclase shows euhedral to subhedral crystals with albite or carlsbad turnning.

Well developed myrmekite is observed in contact of plagioclase and K-feldspar.

W2

Fine grained biotite granite

Weakly argillized, fine grained biotite granite. The constituents are quartz, plagioclase and K-feldspar, with subordinate amounts of biotite partly replaced by chlorite.

Apatite and sphene are dispersed as accessory minerals. Quartz occurs in micrographic intergrowths with K-feldspar. Plagioclase is often turbid in the interior, owing to sericite and fine dust.

W3

Carbonate rock

Carbonate rock accompanied by small amounts of quartz and Fe-oxide minerals.

Carbonate minerals are divided into two kinds by grain size, rhombohedral and medium-grained, and detrial and fine-grained. The later occurs in euhedral to anhedral crystals and is dispersed throughout.

W4

Porphyrite

Strongly biotitized porphyrite.

It is composed mainly of plagioclase and actinolite, as accessory sphene and apatite.

Phenocryst plagioclase, with zonal texture and twinning, has commonly been replaced by sericite. Actinolite, with twinning

and up to 2.0 mm in length, occurs in tabular and prismatic crystal and has partly been replaced by biotite.
Groundmass is occupied mostly by medium grained plagioclase, anhedral quartz and secondary biotite.

W7

Biotite schist

Biotite schist with blastoporphyritic texture. Euhedral plagioclase, with albite twinning and up to 2.5 mm in length, has been argillized and partly replaced by quartz.
Groundmass is composed mainly of recrystallized, fine quartz and biotite with fine opaque minerals. Sphene and apatite are present in accessory amounts.

W21

Granodiorite porphyry

Altered granodiorite porphyry.
It is composed mainly of plagioclase, quartz and K-feldspar.
In this rock, the graphic intergrowths texture consisted of K-feldspar and vermicular quartz, is commonly to be found at the margin of a plagioclase crystal.
Phenocryst plagioclase has strongly been replaced by sericite and chlorite, and mafic minerals altered to chlorite and a little of carbonate minerals. Sphene and zircon are scattered in a groundmass.

W34

Quartz diorite porphyry

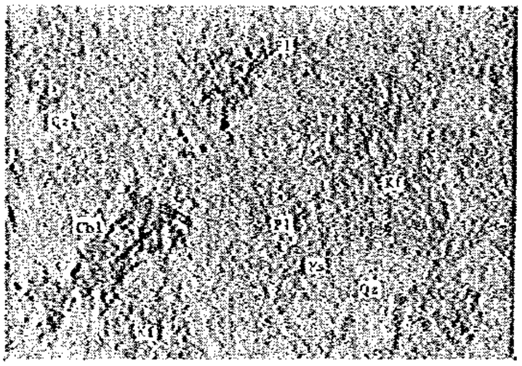
Quartz diorite porphyry completely altered at hydrothermal condition.
It is composed mainly of plagioclase and quartz, with accessory zircon and apatite.
Phenocryst plagioclase of 1.2x0.4 mm in average has been replaced by sericite and small amount of chlorite.
Groundmass consits of anhedral quartz and albitic lath shaped plagioclase.

A. I-2 Microphotograph (Thin Section)

Abbreviation

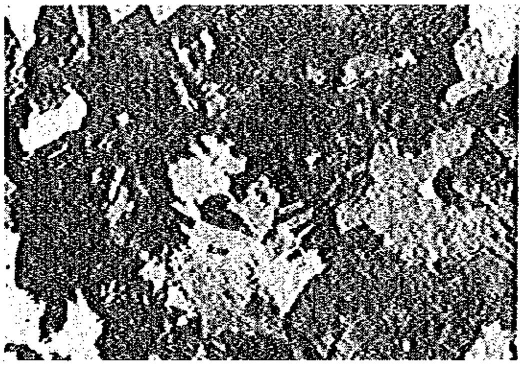
Act	:	actinolite
Ap	:	apatite
Bi	:	biotite
Carb	:	carbonate
Chl	:	chlorite
Ep	:	epidote
Gar	:	garnet
Hb	:	hornblende
Kf	:	K-feldspar
Mic	:	microcline
Myr	:	myrmekite
Opq	:	opaque
Pl	:	plagioclase
Qz	:	quartz
Ser	:	sericite
Sil	:	silimanite
Sph	:	sphene
Tour	:	tourmaline

Sample No. : a-3
Rock name : Aplite
Location : Agadir
Texture : Aplitic, granular



(open nicol)

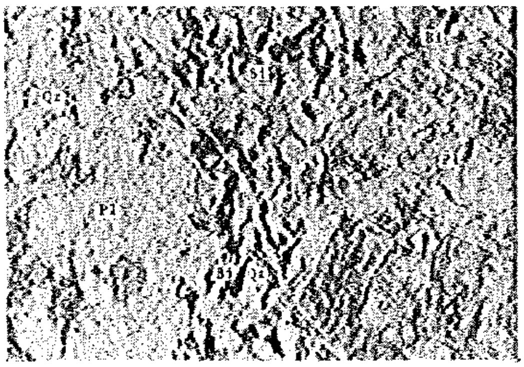
0 0.5mm



(crossed nicols)

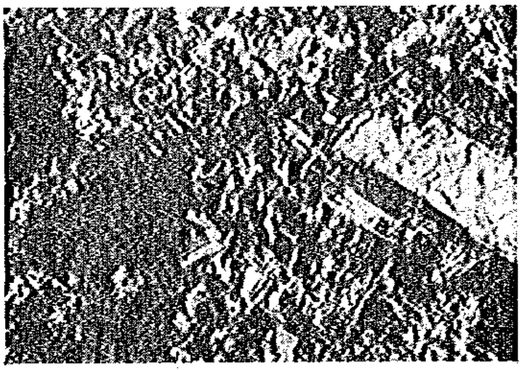
0 0.5mm

Sample No. : a-58
Rock name : Granodiorite porphyry
Location : Agadir
Texture : Porphyritic



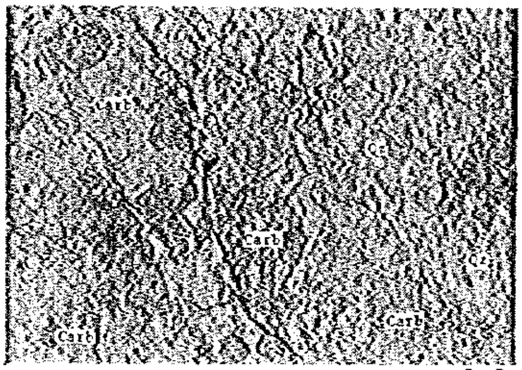
(open nicol)

0 0.5mm



(crossed nicols)

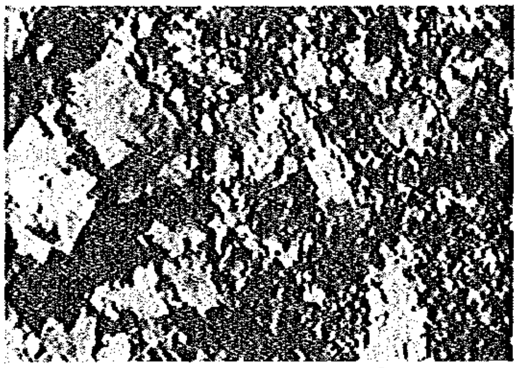
0 0.5mm



Sample No. : a-67
Rock name : Cabonaceous schist
Location : Agadir
Texture : Banding

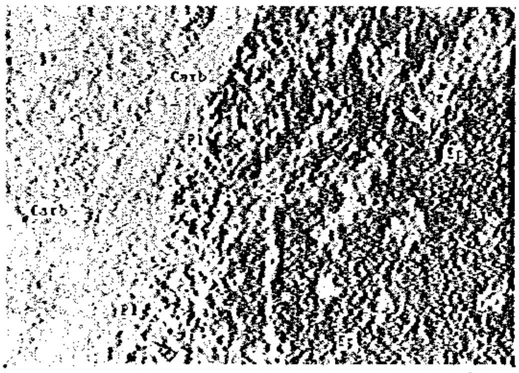
(open nicol)

0 0.5mm



(crossed nicols)

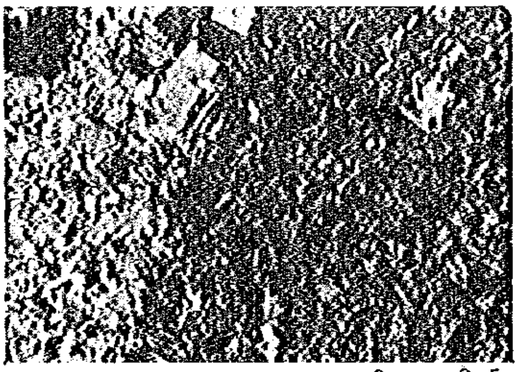
0 0.5mm



Sample No. : a-77
Rock name : Skarnized porphyrite
Location : Agadir

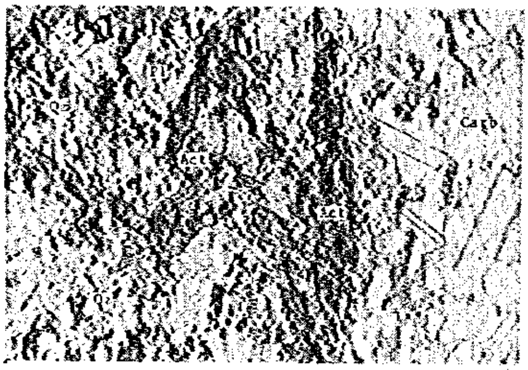
(open nicol)

0 0.5mm



(crossed nicols)

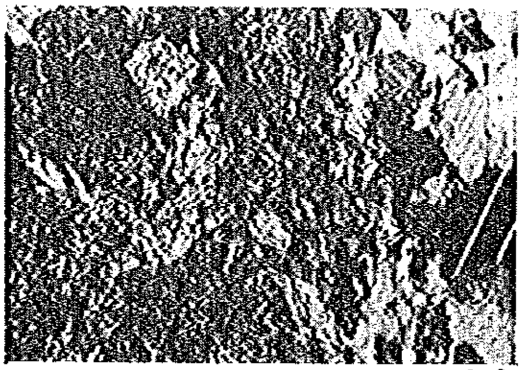
0 0.5mm



(open nicol)

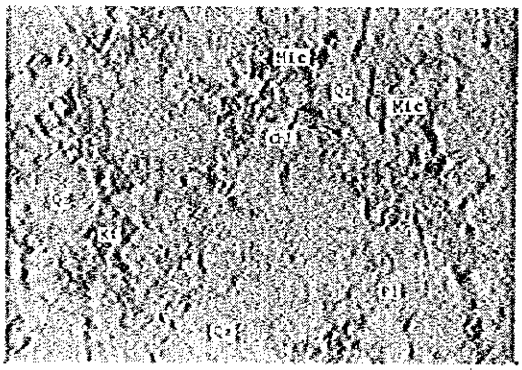
0 0.5mm

Sample No. : a-77
Rock name : Skarnized porphyrite
Location : Agadir



(crossed nicols)

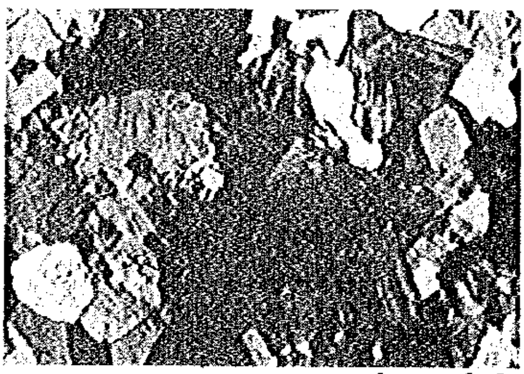
0 0.5mm



(open nicol)

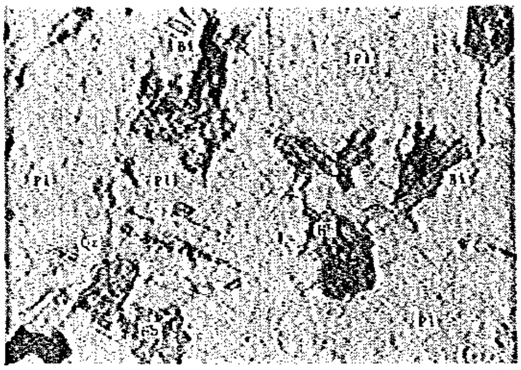
0 0.5mm

Sample No. : a-131
Rock name : Aplite
Location : Ikissane
Texture : Aplitic, granular



(crossed nicols)

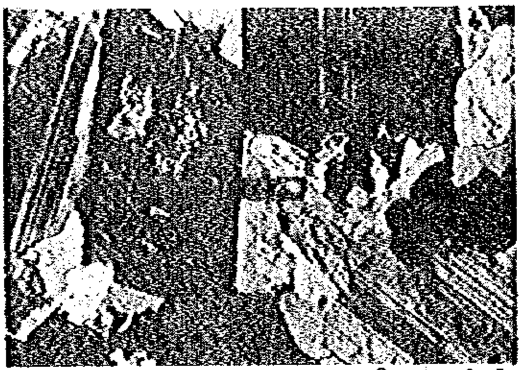
0 0.5mm



Sample No. : a-136
Rock name : Granodiorite
Location : Ikissane

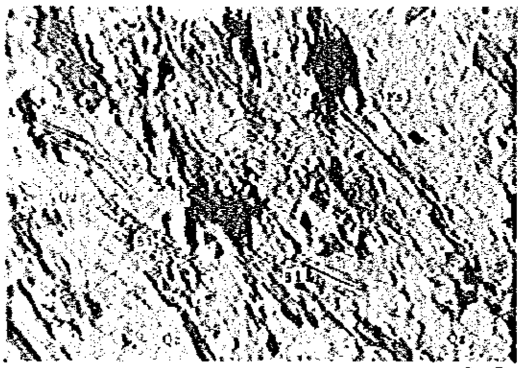
(open nicol)

0 0.5mm



(crossed nicols)

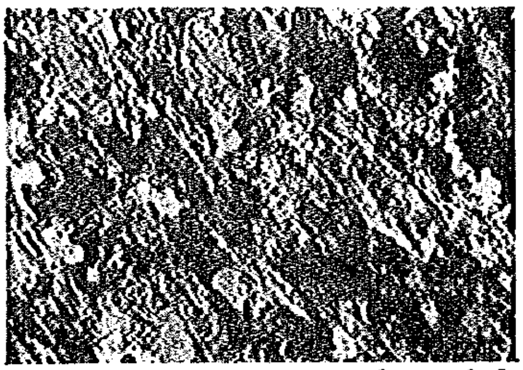
0 0.5mm



Sample No. : a-138
Rock name : Biotite schist
Location : Ikissane
Texture : Banding

(open nicol)

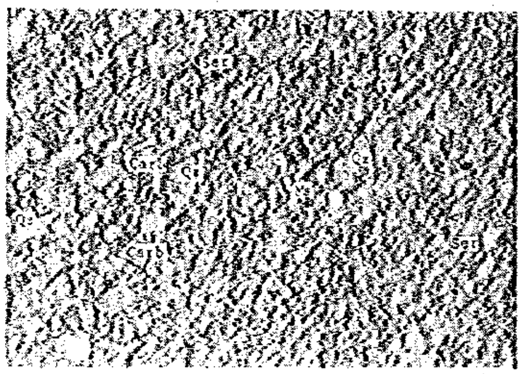
0 0.5mm



(crossed nicols)

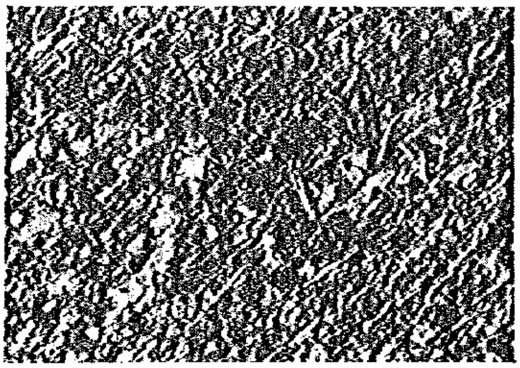
0 0.5mm

Sample No. : a-143
Rock name : Psummitic schist
Location : Igherm



(open nicol)

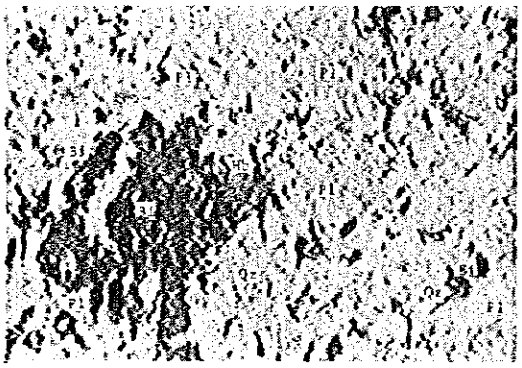
0 0.5mm



(crossed nicols)

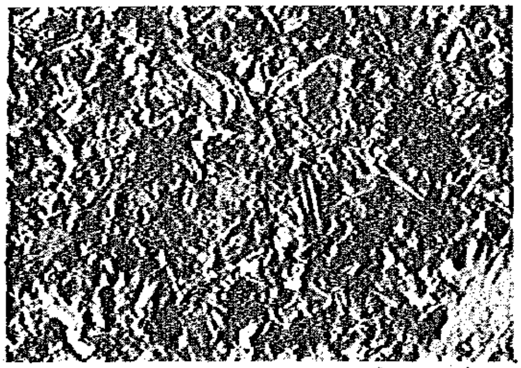
0 0.5mm

Sample No. : a-187
Rock name : Porphyrite
Location : Tawyalt
Texture : Porphyritic



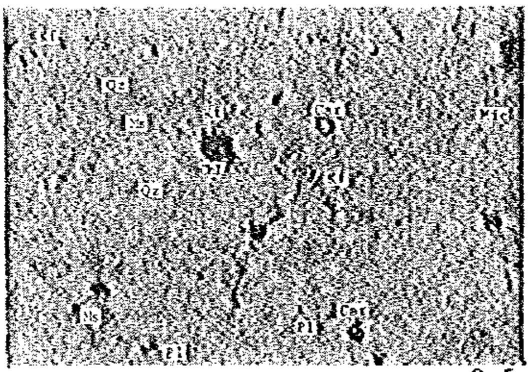
(open nicol)

0 0.5mm



(crossed nicols)

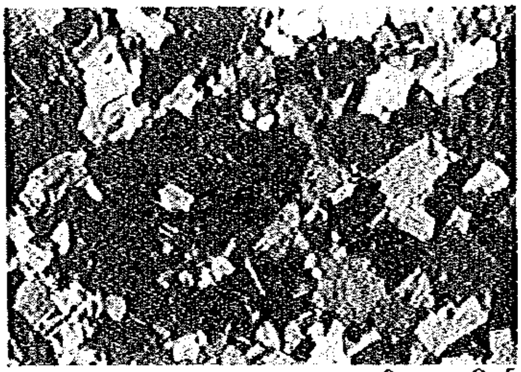
0 0.5mm



Sample No. : S-6
Rock name : Aplite
Location : Agadir
Texture : Aplitic, granular

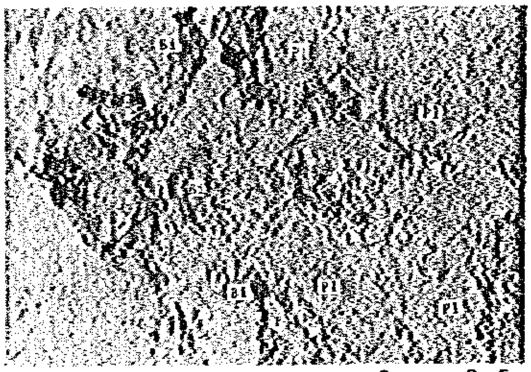
(open nicol)

0 0.5mm



(crossed nicols)

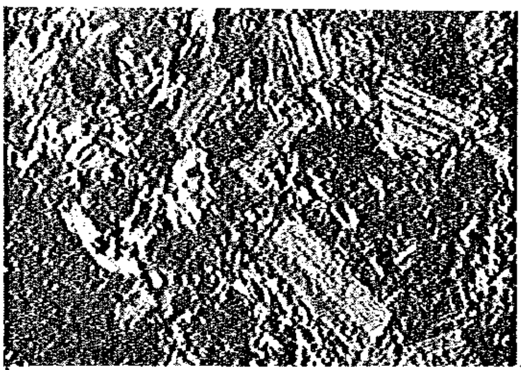
0 0.5mm



Sample No. : S-35
Rock name : Altered porphyrite
Location : Agadir

(open nicol)

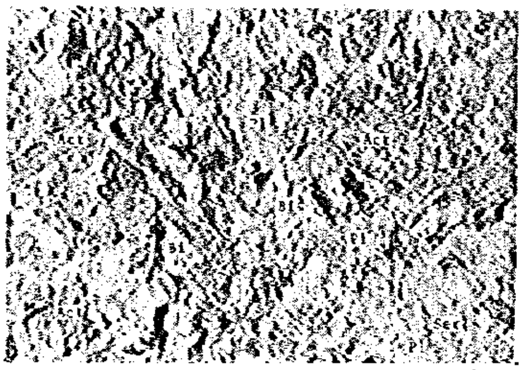
0 0.5mm



(crossed nicols)

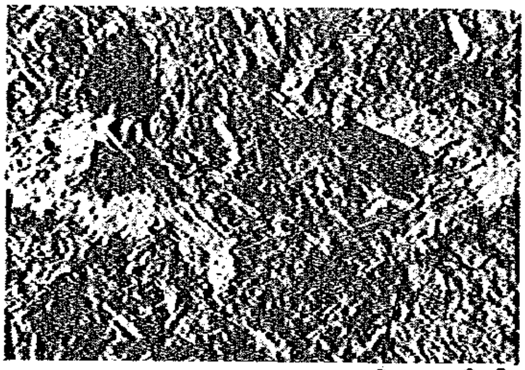
0 0.5mm

Sample No. : S-38
Rock name : Porphyrite
Location : Agadir



(open nicol)

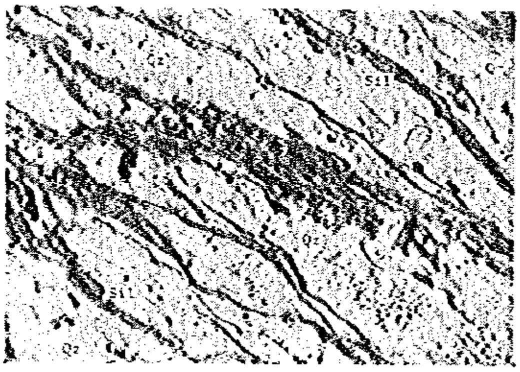
0 0.5mm



(crossed nicols)

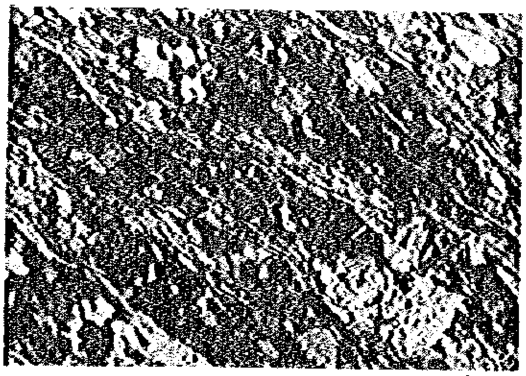
0 0.5mm

Sample No. : S-58
Rock name : Biotite-silimanite schist
Location : Mauass
Texture : Banding



(open nicol)

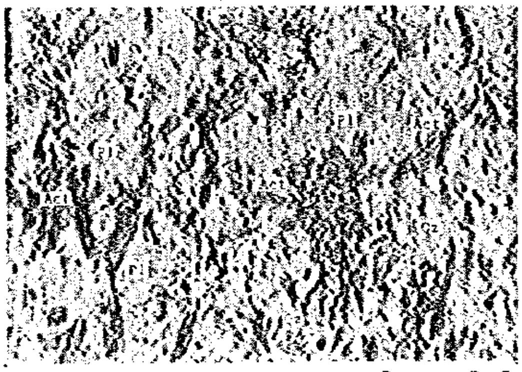
0 0.5mm



(crossed nicols)

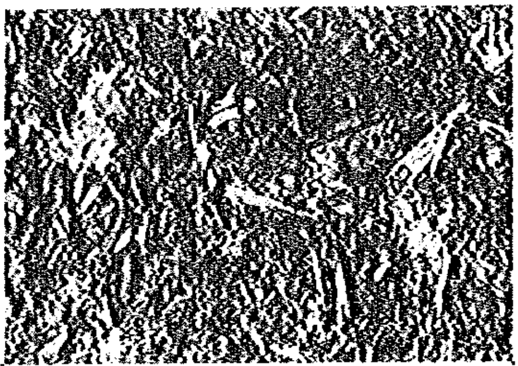
0 0.5mm

Sample No. : S-62
Rock name : Altered tuff (?)
Location : Agadir



(open nicol)

0 0.5mm



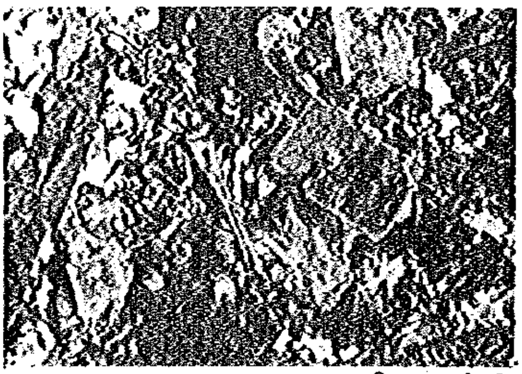
(crossed nicols)

0 0.5mm

Sample No. : S-63
Rock name : Granophyre
Location : Agadir
Texture : Micrographic intergrowths

(open nicol)

0 0.5mm



(crossed nicols)

0 0.5mm