2-5-4 Geological History

The Pre-Cambrian basements in this area has been located at the southern marginal area of the paleozoic geosyncline zone which is outer region of Anti-Atlas Zone.

In the Paleozoic age, the sedimentation, associated with the volcanic activities, began to occurred under the continental and shallow water circumference.

After that, the sedimentation has been continued under the shallow water and marine condition, and partially progressed at the deep sea condition or continental shelf. In early hercynian time, which is the ends of Paleozoic time, the tectonic movements associated with the regional metamorphism and foldings occured in this area. Since the grade of the metamorphism in the Paleozoic formations increases and their folded structure become more intensely in the ascending order. It is suggested that the lateral compression due to the relative subsidence has been affected more intensely in this area.

In later hercynian time, intrusion of plutonic rocks such as the Tichka granites occured, and affected the thermal metamorphism to the surrounding rocks, especially, some of limestone has been converted to the skarn minerals.

Since no mineralization are recognized in the Mesozoic Groups in this area. It is presumable that ore deposits in this area made up with the post igneous activety of the granite intrusion.

This area was uplifted and began to occur the erosion before the Mesozoic sedimentation, and this erossion continued until the completion of a peneplane, furthermore, the subsidence took place gradually in this area. Between from the Mesozoic to Tertiary, this area was repeated the monotonously uplift and subsided movements, and progressed the sedimentation under the continental or shallow water circumference.

In the Alpine tectonic movements period of the end of Tertiary. Major fault movements occured and block movement progressed intensely in this area. Therefore, the post Paleozoic strata has been uplifted to the comparative high places and intersected between faults.

The completion of built up the highland such as the form observed at present, occured at the latest time of the Alpine tectonic movement. Major tectonic fault between the Atlas mountain land and the Marrakech plane of the north was made up and its vertical displaced distance is assumed more than 3,000 meters.

2-5-5 Mineralization

Seventy three localities of mineralization of ore deposits or mineral indications in area have been clarified by this survey. The locations of these mineralization are shown in Fig.5, Fig.6 and the outline of the ore deposts and the mineral indication are shown in Table-3.

As to the types of mineralization, although vein-type ore deposits are found most frequently, skarn-type ore deposits and a stockwork ore deposit are observed as well. The vein-type ore deposits contain copper, lead, zinc, silver, molybdenum, and barite, the skarn-type ore deposits contain copper, tungsten, and iron, and the stockwork ore deposit contains copper. The country rock of all of these ore deposits are exclusively rocks of the Pre-Cambrian Group, the Paleozoic Groups, and the intrusive rock of Hercynian Period, and none of mineralization exists in the rocks after Paleozoic age.

Furthermore, many dykes of microgranite and porphyrite of same period are recognized near the main ore deposits.

This facts suggests that the mineralizations in this area have the close relationship with the intrusive rocks in the Hercynian period of the end of Palerozoic Era.

The outlines of the ore deposits of each type of mineralization is described in the followings.

1) Vein type ore deposits

The host rocks containing vein type ore deposits are the metamorphic rocks of the Paleozoic Group and the granitic rocks intruding them. Among the barite ore deposists, there are some of huge sizes as it is the case of SMIM ore deposit, whose greatest width is 20 meters, with the horizontal extension of 80 meters and the vertical continuity of 110 meters. However, concerning the other species of the ores than barite, the sizes of the ore deposits are small to moderate from those of the width of several centimeters and the horizontal extension of several meters to those of the width of 1.20 meters and the extension of several ten meters.

Vein-type ore deposits are also high-angled quartz veins of which the strikes are running toward various directions such as NS, EW, NNE-SSW, NE-SW, WNW-ESE, NW-SE, etc.

These directions are intimately related to those of fault system in the Paleozoic formations in this area, that is, the directions of ore veins are same as or secondary shear faults of those of fault systems.

These facts suggest that the mineralizations in this area were made up following the fault activity.

Among the vein-type ore deposits in this area, ore deposits of the Assif Al Mal Mine (Pb, Zn, Ag), the Gundafa Mine (Cu, Pb, Zn), the L'Ounein Mine (Cu, Pv, Zn) are recorded to have produced ores in the past.

The Assif Al Mal Mine is fissure filling vein type ore deposit trending in north and south, contained in the black pelitic schist of the Paleozoic CIII Formation.

There are three ore veins, known as the principal vein, No. 3 vein and No. 4 vein. As for the sizes of the principal vein, the horizontal extension is 150 m, and the vertical continuity is 110 m with the width of 15 cm $\sim$ 20 cm. The No.3 vein and the No.4 vein are in parallel with the principal vein, located at 200 meters east of the vein. The horizontal extensions are reported to be 70 meters and 90 meters, respectively.

The recorded production is only in 1950's as follows; monthly crude ore production 1,500 tons with the grades of Zn: 7%, Pb: 1% and Cu: 0.1 $\sim$ 0.2%; monthly zinc concentrate production 200 tons with the grade of Zn: 60% $\sim$ 61%; monthly lead concentrate production 30 tons with the grade of Pb: 72% and Ag 550 g/t.

The Gundaha Mine is the copper, lead and zinc ore deposits of which the vein are more than 1,000 meters length, and varying from 0.2 meters to 2 meters in width. The direction of the vein trends from WNW to ESE and dips 75° southward and it is composed of 4 veins. The productions of this mine in the past were 320,000 tons of crude ore, 3,600 tons of copper concentrate (Cu 6%), 11,000 tons of lead concentrate (Pb 19%), and 45,000 tons of zinc concentrate (Zn 75%). Although this mine is not being worked at present, the small scaled explorations are being made by B.R.P.M.

The L'Ounein Mine is the copper and quartz vein deposits at about 1 km south of the Tawrirt village. This deposit is composed of 3 veins of which the veins more than 1,000 meters length and vary from 0.2 meters to 2 meters in width. The direction of the veins trends from WNW to ESE, and dip steeply northward or southward. Main ore minerals are chaleopyrite, bornite, and chalcocite accompanied with minor amounts of azurite, covelline, malachite, and pyrite. The Cu grade of stock pile indicates from 11.75% to 17.00%.

There are other three vein-type ore deposits, the Erdouz ore deposit (Cu, Pb, Zn, Ag), the Ikissane ore deposit (Mo, Cu) and the Taddart ore deposit which having the high potentialities of mineralization comparatively.

These ore deposits are described in detail in the separated paragraph.

2) Skarn type ore deposits

As the skarn type ore deposits, the Azegour ore deposit (Cu, Mo, W) located in the neighborhood of the Azegour village, and the Agadir ore deposit existed in the adjacent area of the Agadir village are recognized in this area.

The Azegour ore deposit has been produced during from 1930 to 1956. Although the mine is not operated at present, the production from 1930 to 1956 was recorded to be about 900,000 tons of the crude ores with the grades of Cu: 1.4 ∿ 2.8%, MoS_2: 0.2 ∿ 0.7%, WO_3: 0.35% ±. The area developed for the mining of this deposit is 1,300 meters in north and south, and 150 meters in east and west. The lowest level developed is at the altitude of 1,338 meters above sea level, and the difference from the outcrop on the surface to this lowest level is about 200 meters.

Both two deposites are emplaced in the skarn zones which is replaced limestone, and huge granite stocks such as the Azegour granite and Tichka granites have been recognized in the neighborhoods of each ore deposits.

Regarding above two ore deposits, various exploration method have been applied in this survey, so they are described in detail in the separate paragraph.

3) Stockwork ore deposit

The stockwork ore deposit existing in this area is the Iguidi ore deposit located in the west of the Iguidi village in the eastern part.

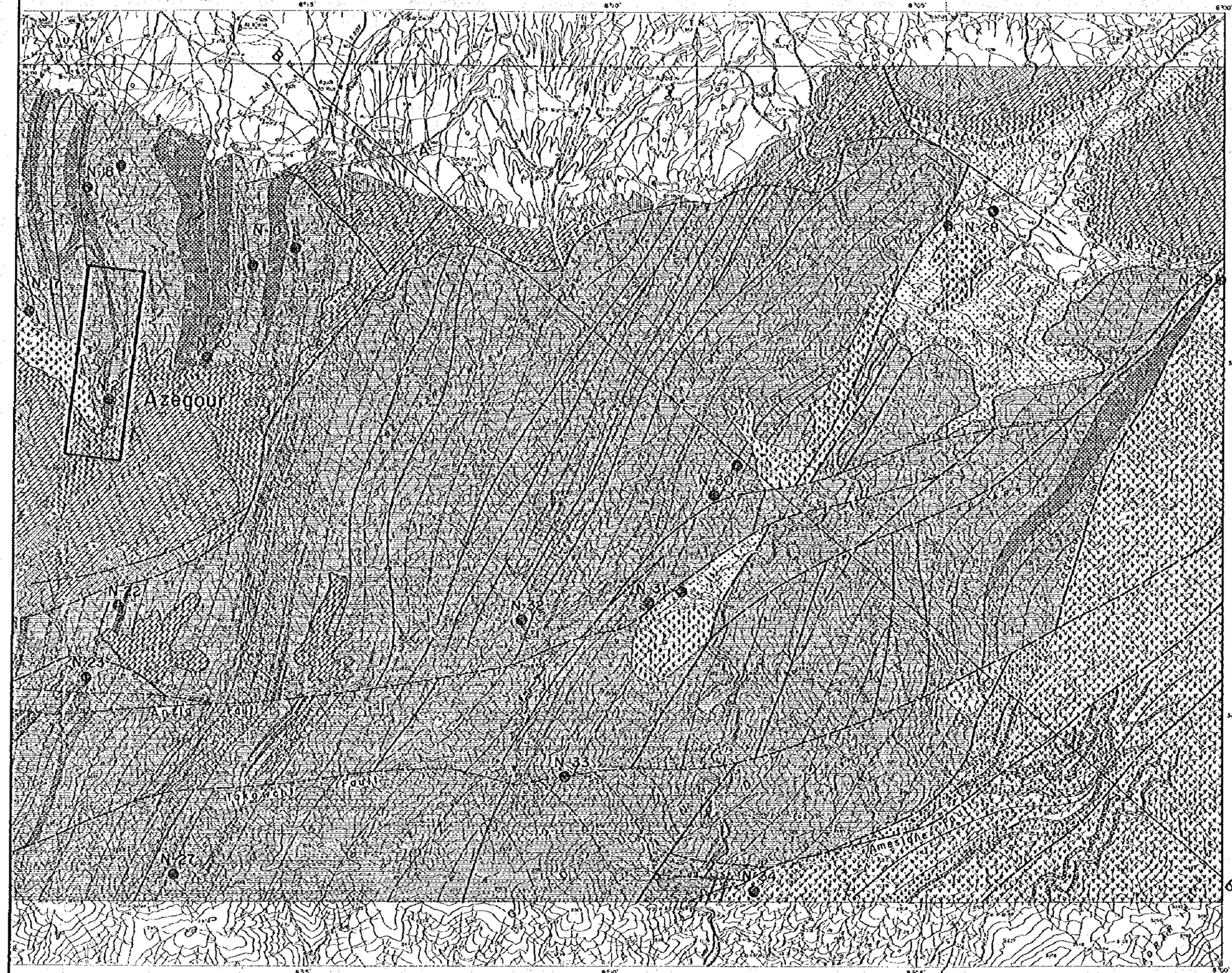
This ore deposit is existed in the dolomite bed of the Ci Formation, and is a cupriferous ore deposit associated with the network of quartz veinlets.

The mineralization is recognized about 2 km along the dolomite. Mineralized zone in the western part is 2 to 15 meters in width and more than 250 meters in length, and its grades of this ore deposit are shown at Cu:1.3%.

4) Stratiform type ore deposits

There are stratiform type ore deposits of the marble deposit which is originated from the limestones in the Paleozoic formations, and the rock salt deposit which is contained in the red sandstone in the Triassic System of the Mesozoic Group. Both of them are being worked at present. And, thin layers of gypsum are recognized in the Cretacious System.

Fig.5 Ore Deposits and Mineral Showings in Northern Area



LEGEND

Quaternary		Q	sand, gravel, travertine
Tertiary		Es	sandstone
Cretaceous		Ks	sandstone, siltstone
		Kd	dolomite, siltstone, sandstone
		Kr	red sandstone
Jurassic		Js	sandstone, siltstone
Triassic		Tb	basalt
		Ts	sandstone, siltstone
Paleozoic		Pp	pelitic schist
		Pm	psammitic schist
		Pt	green schist(tuff, tuff breccia)
		Pl	limestone
		Pa	calcareous schist
Pre-Cambrian		Xa	andesite
		Xl	limestone
		Xt	tuff, tuff breccia, lapilli tuff
Intrusive rock		Gr	granite, diorite
		Po	porphyrite
		Do	dolerite

- fault
- unconformity
- anticlinal / synclinal axis / overturned fold
- stratigraphic boundary
- bedding plane

N1~N34 Ore Deposits, Mineral Showings

0 5 km

and Mineral Showings in Northern Area

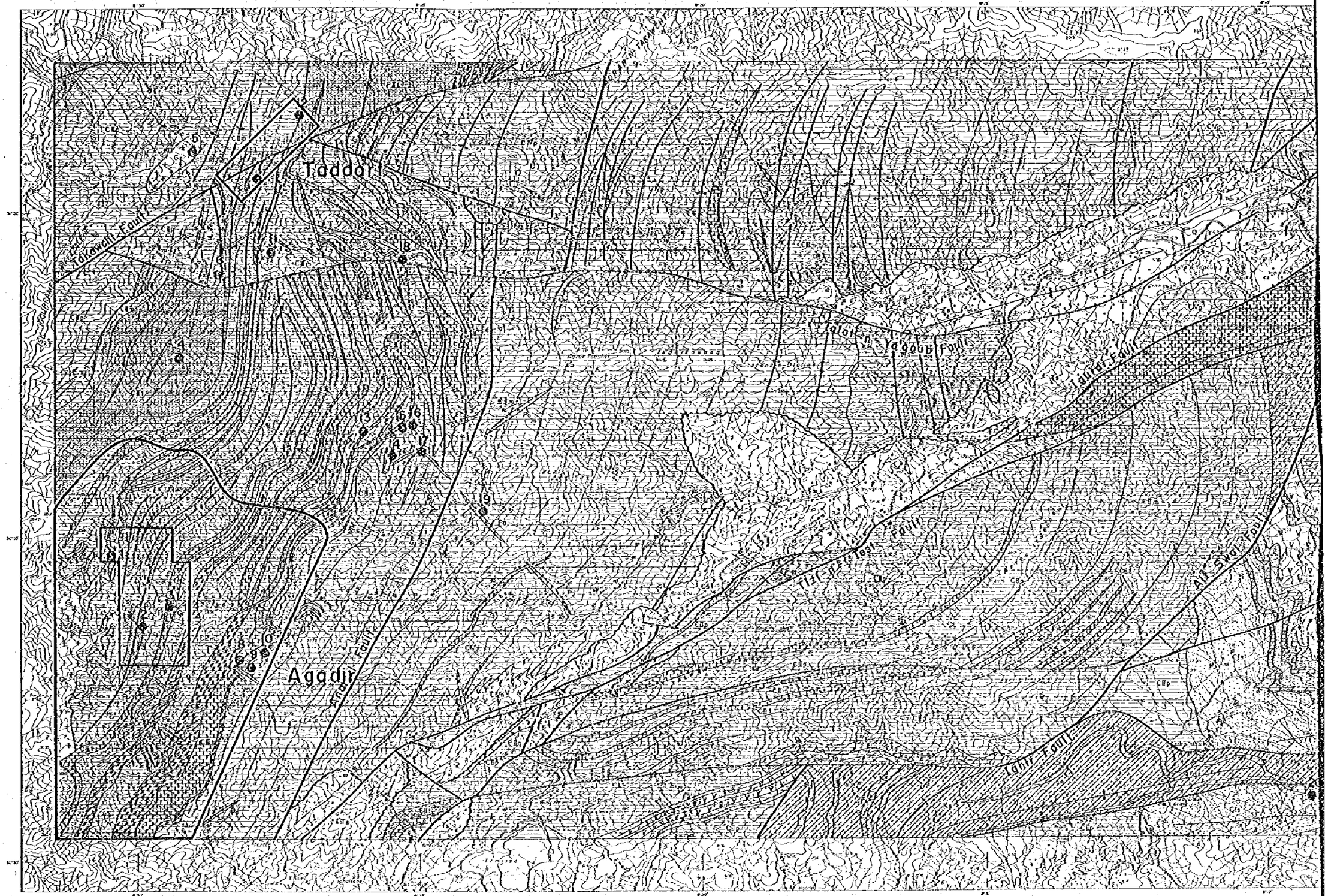
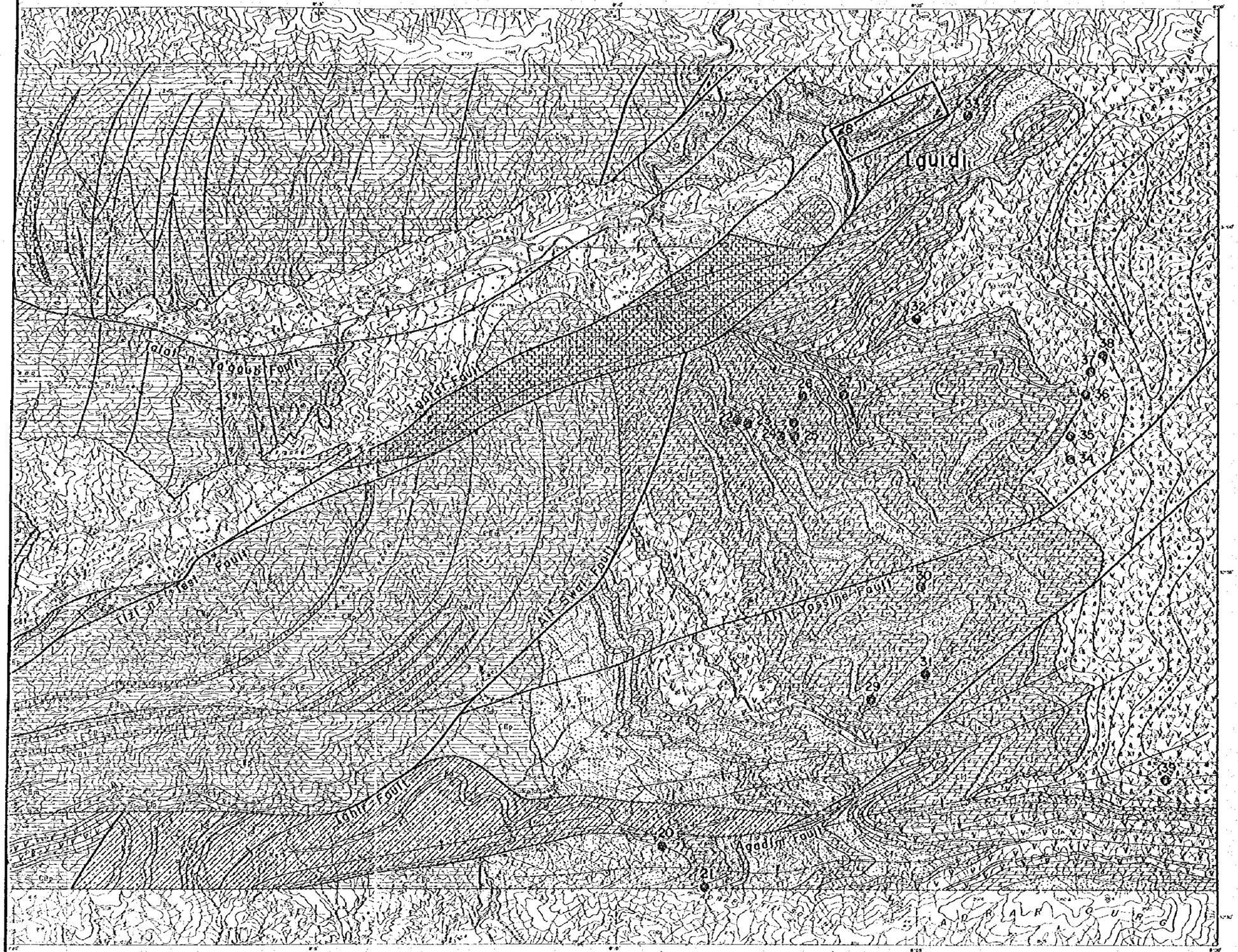


Fig. 6 Ore Deposits and Mineral Showings in Southern Area



LEGEND

- Quaternary
  - Q gravel, sand, mud
- Cretaceous
  - Kd dolomite
  - Ks sandstone, siltstone, conglomerate
- Triassic
  - Ts sandstone, siltstone, conglomerate
- Ordovician ~ Cambrian
  - CIV Formation
    - CIVp peritic schist
    - CIVl limestone
    - CIVh andesite, tuff, tuff breccia
  - CII Formation
    - CIIm psammitic schist
    - CIIp pelitic schist
    - CIIl limestone
    - CIIa calcareous schist
    - CIIh green schist (tuff, tuff breccia)
  - CII Formation
    - CIIm psammitic schist
    - CIIp pelitic schist
    - CIIl limestone
    - CIIa andesite, tuff, tuff breccia
  - CI Formation
    - CIs siltstone, sandstone
    - CIa andesite, tuff, tuff breccia
    - CIl limestone
    - CId dolomite
    - CIc conglomerate
- Pre-Cambrian
  - Xa andesite
  - Xt tuff, tapilli tuff, tuff breccia
- Intrusive rock
  - Gr granite, granodiorite
  - Po porphyrite, microgranite

- fault
- unconformity
- anticlinal / synclinal axis / overturned fold
- stratigraphic boundary
- bedding plane
- A — A' section line

1~39 Ore Deposits, Mineral Showings

0 5km

Deposits and Mineral Showings in Southern Area

Table 3 List of Ore Deposits and Mineral Showings (Northern Area)

No.	Name	Location	Kind of Ore	Type	Host Rock	Ore Deposits			Grade						Ore Mineral	Remarks
						Strike & Dip	Length(m)	Width(cm)	Ag(g/t)	Cu(%)	Pb(%)	Zn(%)	Mo(%)	W (%)		
N1	Ait Brahim	Sidi Bou Otmane WNW 7km	Ba	Vein	CIIp	N40~65E, 70~80NW	20~50	70~110	-	-	-	-	-	-	Ba	3 Barite-veins
N2	Imi-n-Ouassif	Sidi Bou Otmane WNW 2.2km	Py	do	do	-	3	10	10	tr	0.04	0.01	-	-	Py	
N3	Assif al Mal	Sidi Bou Otmane NE 0.7km	Cu,Pb,Zn	do	do	NS,90	150	20	-	0.1~0.2	1.0	7.0	-	-	Cp,Gn	{Production(1957) 1500 t/N, 3 veins
N4	Anebdour	Sidi Bou Otmane S 1.5km	Cu	do	do	N55W,70N	-	10	10	0.5	0.02	0.05	-	-	Az,Ma	
N5	Taskourt	Taskourt NW 1.5km	Ba	do	do	N30~60E, 30~70S	-	10~50	-	-	-	-	-	-	Ba	4 Barite veins
N6	Amegdoul	Amegdoul E 0.7km	Pb,Ba	do	CIIm	-	-	-	-	-	-	-	-	-	Gn,Ba	
N7	Talborit	Adassil N 5km	Pb,Ba	do	CIIp	N10E,90	-	100~300	-	-	-	-	-	-	Gn,Ba	4 Barite veins
N8	Ighermane	Ighermane NE 1.7km	Pb,Zn	do	do	N10W,60E	-	100	10	0.01	0.03	1.0	-	-	Gn,Sp	
N9	Tifirt	Tifirt SW 1.2km	Cu,Ba	do	do	N55E,20N	-	50	2	0.10	tr	tr	-	-	Ma,Ba	
N10	Ait Bourd	Ait Bourd S 2.0km	Pb,Ba	do	do	N50W,70S	-	120	13	0.01	3.1	0.06	-	-	Gn,Ba	
N11	Areg	Areg N 0.1km	Cu,Pb,Ag	do	CIIp	N60W,50S	30	300	-	-	-	-	-	-	Gn,Ma	Old working
N12	Areg tunnel	Areg NE 1.1km	Cu,Pb,Zn	do	do	NS,35W	12	20~30	178	0.85	1.31	1.39	-	-	Gn,Sp,Cp	
N13	Anammer	Anammer	Pb	do	do	N55E,70SE	10	2~5	20	0.01	0.15	0.70	-	-	Gn	
N14	Tifrouine	Tifrouine W 1.2km	Cu	do	Gr	N20E~N50E 70SE	-	10~20	-	-	-	-	-	-	Cp,Py	
N15	Tizgui	Areg S 2.0km	Cu	do	CIIp	-	-	-	-	-	-	-	-	-	Ma	
N16	Targa	Targa NNW 0.7km	Pb	Stratiform	CIIa	N30E~70E, 50S	40	5~10	3	0.05	0.11	0.11	-	-	Ga	
N17	Toulkine	Toulkine N 2.0km	Fe,Ba	Skarn	CIIt	-	15	400	-	-	-	-	-	-		Depth 20m
N18	Tiglit	Ait Wagna SSE 3.5km	Marble	Stratiform	CIIl	-	-	-	-	-	-	-	-	-	Marble	Open pit 50 t/d
N19	Amezmiz	Mine road Azegour/ Amezmiz	Cu	Vein	do	N30~60E, 30~50NW	-	20~30	-	-	-	-	-	-	Ma	
N20	Toug al Kheyr	Toug al Kheyr NW 2.0km	Ba	do	do	NS,70W	250	10~50	-	-	-	-	-	-	Ba	
N21	Azegour	Azegour NNE 1.5km	Cu,Mo,W	Skarn	do	NS, 40~70E	-	-	-	1.4~2.8	-	-	MoS_2 0.2~0.7	WO_3 0.35	Cp,Mo	{Production(1930~1956) 900,000t Ore body: 10~15 Length: 20~50m Width: 5~20m
N22	Tilfitine	Azegour SE 3.8km	Pb,Zn,Ba	Vein	do	NS,70E	-	25~30	135~540	0.65~2.05	0.48~13.0	7.80~48.29	-	-	Ba,Gn	
N23	Tnirt	Toirt SSE 2.0 km	Mo	do	do	N55E,80S	350	10~50	-	-	-	-	-	-	Mo	
N24	Anamrou 1	Anamrou SW 1.7km	Pb,Zn	do	do	N60E,70SE	-	1~3	11	0.04	0.08	0.12	-	-	Gn,Sp	
N25	Anamrou 2	Anamrou SW 2.2km	Cu,Pb,Zn	do	do	N50E,45SE	-	35	25	0.34	0.08	0.14	-	-	Cp	
N26	Erdouz N and S	Erdouz	Pb,Zn	do	do	NS\W	10 10~20	10 10	170 94	0.20 0.39	8.5 1.3	13.5 3.14	-	-	Gn,Sp,Cp,Py	{Production(1927~1972) Pb 30t, Zn 23.8t Ag 25.47 kg
N27	Aghrass	Kettou S 4.7km	Pb,Zn	do	CNp	N45E,70SE	5	20	-	-	-	-	-	-		
N28	Imarira	Imarira W 1.2km	NaCl	Stratiform	Ts	-	-	-	-	-	-	-	-	-		
N29	Tinzert	Tinzert SE 1.0km	Cu	Vein	Xa	N20E,55NW	10	5	3	2.50	0.01	0.01	-	-	Cp,Ma,Py	
N30	SMIM	Imigdal NW 2.0km	Ba,Pb,Zn	do	CN	N30E,30NW	87	300~2200	1060	0.23	33.70	3.90	-	-	Ba,Gn,Sp	
N31	Imidel	Imidel W 2.0km	Ba	do	do	N60~70W, 85~90N	200~300	200~300	-	-	-	-	-	-	Ba	{5 parallel veins production 50 t/d
N32	Tizi Mill	Tizi Mill W 0.5km	Cu	do	do	N30W,90	-	10~30	-	-	-	-	-	-	Ma,Cp,Py	
N33	Taourirt	Taourirt E 0.5km	Ba,Cu	do	do	N55E,65S	-	100	10	0.30	tr	0.01	-	-	Ba,Ma	
N34	Iguer-n-Kouris	Iguer-n-Kouris SE 1.0km	Ba	do	Xa	N40~80W, 50~90S	20	10~130	-	-	-	-	-	-	Ba	6 parallel veins

Host Rock

Formation		Rock Name
Triassic		Ts ... sandstone, siltstone
Ordovician ~ Cambrian	Cl	a ... calcareous schist
		p ... pelitic schist
	CE	m ... psammitic schist
	CIII	l ... limestone
	CN	t ... green schist (tuff, tuffbreccia)
		d ... dolomite
Pre-Cambrian (PIR)		Xa ... andesite
		Xt ... tuff, taffbreccia

Ore Mineral

As ... Arsenopyrite	Ma ... Malachite
Az ... Azurite	Mg ... Magnetite
Ba ... Barite	Mo ... Molybdenite
Bi ... Bismuth	Po ... Pyrrhotite
Bo ... Bornite	Py ... Pyrite
Cp ... Chalcopyrite	Sp ... Sphalerite
Gn ... Galena	Te ... Tetradymite
Hm ... Hematite	

Table 3 List of Ore Deposits and Mineral Showings (Southern Area)

No.	Name	Location	Kind of Ore	Type	Host Rock	Ore Deposits			Grade						Ore Mineral	Remarks
						Strike & Dip	Length (m)	Width (cm)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Mo (%)	W (%)		
1	Ikissane	Ikissane	Cu, Mo, W	Vein	Gr	N60W,50SW	10~80	20~40	-	0.01~0.07	-	-	0.03~0.46	-	Mo, Py, Po, Bi	5 quartz veins
2	Mauass	Agadir S 1.0km	do	Skarn	CHlt	N30E,N50W, 70E	10~50	100	-	0.04~1.30	-	-	0.01~0.02	0.01~0.02	Py, Po, Mg	
3	Agadir	Agadir	do	do	CHl	NS,NW~SE, 70S	50~500	max. 40m	-	0.60	-	-	0.01	0.03	Cp, Bi, Te	5~6 ore body
4	Tizi-n-Oumzro	Tizi-n-Oumzro	Cu	Vein	CHlt	N20E,60E	2	10	3	0.04	<0.01	<0.01	-	-	Cp, Py	
5	Tamsoult	Tamsoult	do	do	Gr	N60E,30N	3	100	10	0.03	0.01	<0.01	-	-	As	
6	Ansa	Ansa SE 2.0km	do	do	CHm	N50E,80N	-	20	-	-	-	-	-	-	Cp, Py	
7	Taddart A	Taddart	do	do	CHlt	NS,EW, NE~SW,NW~SE 70S	50~500	20~200	20	2.50	-	-	-	-	Cn, Py, Cp	400mx400m quartz veins rich
8	Tizi-n-Izrakine A	Igherm S 1.6km	do	do	CHl	N45W,85N	-	5~10	15	0.25	0.02	0.04	-	-	Cp, Py	
9	Tizi-n-Izrakine B	Igherm SSE 1.7km	do	do	do	N60W,85N	-	5	7	0.06	<0.01	0.02	-	-	Cp, Py	
10	Tizi-n-Izrakine C	Igherm Se 1.7km	Pb	do	do	N70E,70N	-	5	-	-	-	-	-	-	Gn, Sp	
11	Amslouh	Amslouh E 1.7km	Cu	do	CHm	N70W,70N	-	30	2	0.65	<0.01	<0.01	-	-	Cp, Py	
12	Taddart 8	Taddart NE 2.3km	do	do	CHlt	NS,90	100	30~70	10	8.02	<0.01	<0.01	-	-	Cp, Py	Stock pile of Malachite 1,000t
13	Tirmouza A	Tirmouza NW 1.6km	do	do	CHm	N35W,80E	-	10	1	1.60	<0.01	0.03	-	-	Cp, Py	
14	Tirmouza B	Tirmouza W 0.5km	do	do	do	NS,80E	-	20	1	0.05	0.01	0.02	-	-	Py	
15	Tirmouza C	Tirmouza NNW 1.0km	do	do	do	NS,85E	-	10	7	2.20	0.01	<0.01	-	-	Cp, Py	
16	Tirmouza D	Tirmouza N 1.2km	do	do	do	EW,70N	-	10	15	0.09	0.15	<0.01	-	-	Py	
17	Tirmouza E	Tirmouza NE 0.5km	do	do	CMp	N55E,80S	-	10	0.5	0.04	0.15	0.02	-	-	Py	
18	Arg	Arg W 1.5km	do	do	CHl	N5E,90	-	5	10	0.40	<0.01	0.03	-	-	Cp, Py	
19	Zaywat Askar	Zaywat Askar	do	do	CMp	N80W,70N	-	-	1	1.80	<0.01	0.08	-	-	Cp, Sp	
20	L'Ounein A	Tawrirt S 0.6km	do	do	Cld	N60W,75S	-	120	190	11.75	0.03	0.38	-	-	Bo, Cp	Length Width 1500m x 1~3m 3 quartz veins
21	L'Ounein B	Tawrirt SSW 2.0km	do	do	do	N65W,75N	-	200	215	19.00	0.07	0.48	-	-	Ma	
22	Gundafa	Gundafa	Cu, Pb, Zn	do	do	N70W,75S	500+	30	10	3.06	0.68	18.50	-	-	Cp, Gn, Sp	Crude ore 320,000t (1927 - 1970) Length Width 800m x 0.2~3.0m 6 quartz veins
23	do	do	do	do	do	N70W,75S	500+	200	7	0.03	0.05	0.15	-	-	Py	
24	do	do	do	do	do	N80W,65S	600+	20	10	7.05	0.03	0.05	-	-	Cp, Py	
25	do	do	do	do	do	N40W,75NE	600+	30	10	4.02	0.19	0.30	-	-	Cp, Gn, Sp	
26	do	do	do	do	do	N85E,75N	-	300	-	-	-	-	-	-		
27	do	do	do	do	do		-	-	-	-	-	-	-	-		
28	Iguidi	Iguidi	Cu	Network vein	Cld	N70E,50NW	250	5~15 (m)	-	1.30	-	-	-	-	Cp, Hm	
29	Achdirt	Achdirt NE 0.5km	do	Vein	do	N35W,85SW	50	120~150	4	2.70	<0.01	0.14	-	-	Az	Under mining by SOCOMIS
30	Agadirane	Agadirane NW 2.0km	do	do	do	N10E~N10W	-	60	-	-	-	-	-	-		
31	Imi-n-Tislit	Imi-n-Tislit, NE 0.1km	do	do	do	N35W,30SW	13	500	-	-	-	-	-	-		
32	Ighir	Ighir	Ba	do	Xa	N75W~N80E 90	-	20~30	-	-	-	-	-	-	Ba	5~6 Barite veins
33	Tizi-n-Iguidi	Tizi-n-Iguidi	do	do	Cld	N30E,80E	300~500	300~700	-	-	-	-	-	-	Ba	3 Barite veins
34	Anammer A	Tagdit-n-Oufella E 1.7km	Cu	do	Xa	N10W,20W	-	15	12	0.64	<0.01	<0.01	-	-	Cp, Py	
35	Anammer B	Tagdit-n-Oufella E 2.0km	do	do	do	N40E,60E	-	300	280	3.75	<0.01	<0.01	-	-	Cp, Py	
36	Anammer C	Anammer S 1.6km	do	do	do	N40E,75W	-	50	8	0.44	<0.01	0.01	-	-	Cp, Py	
37	Anammer D	Anammer S 1.0km	do	do	do	N60W,80N	-	50	4	0.06	<0.01	0.01	-	-	Cp, Py	
38	Anammer E	Anammer S 0.5km	do	do	Xt	N25E,70W	-	30~50	4	3.00	<0.01	0.01	-	-	Cp, Py	
39	Tandilt	Tandilt	do	do	Xa	N10W,60W	16	400	-	-	-	-	-	-		

Host Rock

Formation		Rock Name
Triassic		Ts ... sandstone, siltstone
Ordovician ~ Cambrian	Cl	s ... calcareous schist
		p ... pelitic schist
	CE	m ... psammitic schist
	CEl	l ... limestone
	CM	t ... green schist (tuff, tuffbreccia)
		d ... dolomite
Pre-Cambrian (PH)		Xa ... andesite
		Xt ... tuff, tuffbreccia

Ore Mineral

As ... Arsenopyrite	Ma ... Malachite
Az ... Azurite	Mg ... Magnetite
Ba ... Barite	Mo ... Molybdenite
Bi ... Bismuth	Po ... Pyrrhotite
Bo ... Bornite	Py ... Pyrite
Cp ... Chalcopyrite	Sp ... Sphalerite
Gn ... Galena	Te ... Tetradymite
Hm ... Hematite	

PARTICULAR 2

SURVEY RESULTS

CHAPTER 1 HAUT ATLAS OCCIDENTAL AREA

As the results of the survey works utilized various survey method, the geology, the geography, the geological structure and the characteristics of the igneous activities in this area have been cleared. And also, the characteristics of each ore deposits, the relationships between the mineralization and the geological structure have been elucidated.

These survey results have been made it possible to extract the favorable areas for the emplacement of ore deposits, and furthermore, the detailed geological surveys, the geochemical surveys and the geophysical exploration have been led to execute.

The reconnaissance geological surveys and the geochemical surveys were carried out for the northern part in the first phase and for the southern part in the second phase.

The clarified geology and geological structure by the above surveys have been described in the previous paragraph.

All of the mineralizations and mineral indication are recognized in the strata before Mesozoic formation, no mineralization has been observed in the formations after the Paleozoic. In addition, the skarn ore deposits exist in the circumference of the hercynian granites and other main ore deposits are accompanied by dykes of microgranite and porphyrite. And many vein type ore deposits show the same directions nearby the faults ore occur along the secondary shear plane of the faults. From these facts, it is considered that the mineralization has been made in the hercynian age of the end of Paleozoic era.

The mineralizations in this area can be classified by their constituent minerals and host rocks as follows (Refer to Fig.5, Fig.6 and Table 3).

1) Copper quartz vein and barite vein ore deposits in the Pre-Cambrian Group [southeastern part: Anammer A ∿ Anammer E]
2) Copper-lead-zinc-quartz vein ore deposits in the Paleozoic CI Formation [southeastern part: Gundafa, L'Ounein]
3) Copper stockwork ore deposit in the dolomite of Paleozoic CI Formation [eastern part: Iguidi]
4) Copper-lead-zinc quartz vein ore deposit in the Paleozoic CII Formation [northwestern part: Assif Al Mal]
5) Copper-lead-zinc-silver vein ore deposit in the Paleozoic CIII Formation [central part: Erdouz, west central part: Taddart]
6) Copper-tungusten-molybdenum-Iron skarn ore deposit in the limestone of Paleozoic CIII Formation in the circumference of the granites [northern central part: Azegour, southwestern part: Agadir]
7) Copper-molybdenum quartz vein ore deposit in the granites [southwestern part: Ikissane]

Several of above ore deposits such as Assif Al Mal Mine, Erdouz Mine, Azegour Mine, Gundafa Mine and L'Ounein Mine had been produced in a large scale in the past, and some of them are continued the exploration in a small scale.

As the result of the geochemical survey by the stream sediments, high anomalies of Cu, Pb and Zn elements are distributed the area corresponds to the above mentioned mineralizations and mineral indications, high anomalies of W elements are correspond to the area of Erdouz ore deposit. Azegour ore deposit and some of the distribution area of granites and high anomalies of Mo element are clarified to distributed near the Agadir ore deposit and at the midstream of Nfis river.

From the results of first phases survey, no favorable areas of emplacement of ore deposit have been extracted except the copper-tungsten-molybdenum

skarn ore deposit in the northern part of Azegour ore deposit and the copper-lead-zinc-silver vein ore deposit in the Erdouz sector. However, as the results of second phases survey, the copper-molybdenum-tungsten skarn ore deposit in the Agadir Sector in the southwestern part, the copper stockwork ore deposit in the Iguidi Sector in the eastern part and copper vein ore deposit in the Taddart Sector in the central western part in this area have been extracted as the sector having the high potentiality of mineralization comparatively. And, above results have been led to the conclusion that the further exploration should to be follows in the successive phase.

CHAPTER 2 ERDOUZ SECTOR

For this sector, semi-detailed geological survey and geochemical survey were carried out in first phase. And, based on the results of first phases survey, detailed geochemical survey and CSAMT survey were carried out in the second phase.

Clarified geology, geological structure and mineralization in this sector as the result of these survey are follows (Refer to Fig.7).

1) Geology and geological structure

The geology in this sector consists of the limestone predominant formation correlated to the Paleozoic CIII Formation. Constituent rocks are crystalline limestone, pelitic schist, psammitic schist, green schist, calcareous schist and dyke rocks of granite and porphyrite intruding them.

The green schist is widespreaded from the western part to the west of this sector, and other schists and limestone are distributed from the central part to the eastern part in this sector.

The granite dykes are as wide as several meters and they have intruded the above-stated rocks in many places in this sector. The trends of the dykes are generally northeast and southwest. The intrusion is recognized to have been along the tectonic weak planes such as faults and the fissures.

The porphyrite dykes are as wide as several meters, intruded along the faults of NE-SW system running in the central part of this sector.

Geological structure of this sector is characterized by the anticlinal folded structure having almost horizontal axis trending northeast, by the block-faultings of trending of northeast and east-west, and by the micro-granite dyke of same directions.

The principal faults in this sector are Anzig fault and Takawcht fault running in east and west, respectively along the northern margin and along the southern margin of this sector, in addition to the Erdouz fault running in northeast and southwest across the central part of this sector. The blocks divided by these faults are different one another in the points of species of the component rocks and the folding structures.

2) Mineralization

Mineralizations in this sector are observed as the vein-type copper, lead and zinc ore deposits, and concentrated mineralizations are observed as the north ore deposit at the north slope and as the south ore deposit in south slope.

The north ore deposit was emplaced at the folding axis of the limestone. The ore deposit consists of five northeast trending veins with several ore bodies of about 10 meters in length and about 10 centimeters in width are assumed. The results of chemical analysis of the samples were taken from the outcrop are shown Cu: 0.4% ±, Pb: 8% ±, Zn: 8 ∿ 10%, and Ag: about 100g/t. The south ore deposit was observed in the tight folded limestone trending north-south. Mineralizations of the south ore deposit are observed as a vein along the north-south fault and as the intercalated bed in the limestone near the fault. The ore deposits are 10 ∿ 50 centimeters in width and 10 ∿ 20 meters in length in vein-type, and about 30 centimeters in width and about 10 meters in length in stratiformed types. It is estimated that grades of ore deposits should be Cu: 0.8% ±, Pb: 2% ±, Zn: 7 ∿ 10%, and Ag: about 90 g/t.

3) Results of geochemical survey

Geochemical surveys in this sector by soil were carried out in this sector contains the outer zone of known mineralized zone in the first phase, and in the confined grid area connecting above two ore deposits.

According to the results of the geochemical survey by the soil samples in this phase, it was revealed that Cu, Pb, and Zn indicated almost similar behaviors and the anomalies of above element are concentrated in the north

and in the south ore deposits. It has a tendency to indicate the strikes of the veins. However, the anomalies were found to correspond to the fold axis of the limestone in the circumference of the north deposit and to the distributions of limestone which were cut by faults near the south ore deposit, that is, they are coincide with the distribution of the host rock of ore deposits in this sector. Therefore, the long distinct continuity of anomalous values to connect between both of the ore deposits was not recognized.

4) Results of the CSAMT survey

According to the results of geophysical explorations applying CSAMT method carried out in the northern part, the area was classified into the three unit, the west side of Erdouz Fault of NE-SW trend (4 layers structure, indicated high resistivity), the east side of Erdouz Fault (3 layers structure, indicated moderate resistivity), and the circumference of the north ore deposit (2 layers structure, indicated low resistivity). Such differences of resistivities, especially between the east side and the west side of Erdouz Fault, might indicate difference of nature of constituent rocks caused by block movements of faults in this area. It is considered that charactristic low resistivity structure in the circumference of the north ore deposit should suggest the axis zone of folded structures and complicated folded structure zones of limestone, which is the host rock of the ore deposit, or the fault-aggregated zone rather than directly suggesting the mineralizations and alteration zones. It is not comfirmed that the low resistivity zone in the circumference of the north ore deposit, regarded as the changeable layer into the host rock, has the indication of the continuity to the south ore deposit.

Based on the results of these surveys, it has been considered that the geological control factors of mineralization are the selection of host rock, fissure system and folded structure. Therefore, each of the north ore deposit and the south ore deposit has been formed isolative ore deposit, and it is presumed that the both ore deposits are not connected each other.

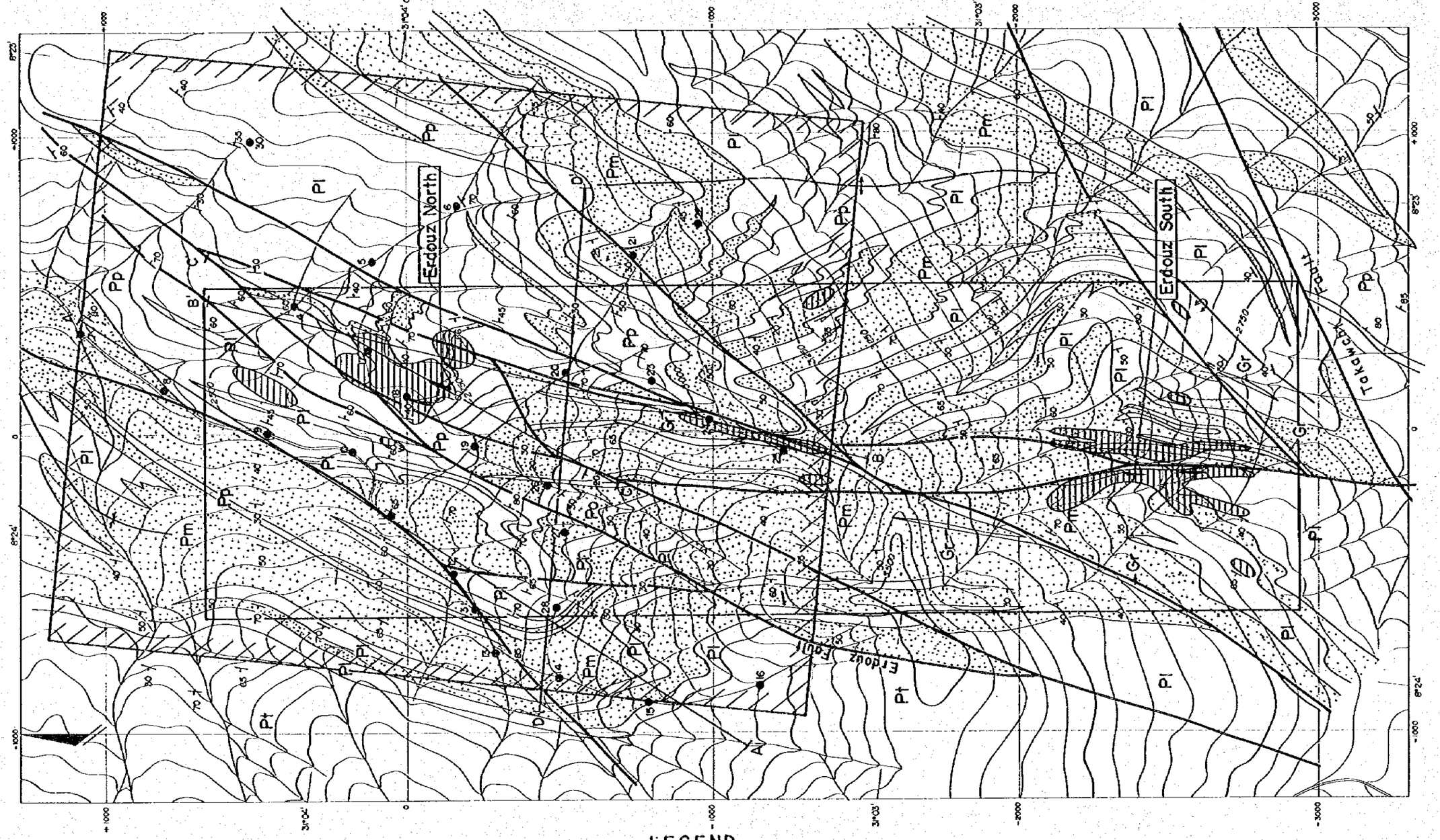


Fig.7 Index Map of Erdouz Sector.