REPORT
ON
THE COOPERATIVE MINERAL EXPLORATION
IN
SHEBENIK AREA, THE REPUBLIC OF ALBANIA

PHASE I

MARCH 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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PREFACE

In response to a request by the Republic of Albania the Japanese Government decided to have a cooperative mineral exploration carried out in the Shebenik area of southeastern Albania for confirmation of possible mineral resource endowments and charged the Japan International Cooperation Agency (JICA) with that task. Since the surveys involved the specialized fields of geology and mineral resources, JICA decided to commission the Metal Mining Agency of Japan (MMAJ) to undertake them.

The surveys were started in 1995 as the first year, during which a geological survey and geophysical prospecting (magnetic prospecting) were carried out.

For that first year of the surveys MMAJ formed a survey team consisting of 7-person, 4-geologists and a 3-geophysicists, and sent it to that country. With the cooperation of Albanian Ministry of Mineral Resources and Energy (MMRE) and the Albanian Geological Survey (GJEOALBA) the mission completed its task as scheduled.

The present report covers the findings of the satellite image analysis, pre-existing data analysis, geological survey and geophysical survey carried out in that first year and will constitute a part of the final report on the whole project.

Finally, we would like to take this opportunity to express our heartfelt gratitude to those at the Albanian government agencies concerned, Japan's Ministry of Foreign Affairs and Ministry of International Trade and Industry and the Japanese Embassy in Austria who have cooperated in implementation of the surveys and to those others in Albania and Japan who have furnished direct and indirect assistance in the project.

February 1996

Kimio FUJITA
President
Japan International Cooperation Agency

Shozaburo KIYOTAKI
President
Metal Mining Agency of Japan

SUMMARY

The present survey corresponds to the first year (phase I) of the "Cooperative Mineral Exploration in Shebenik Area of the Republic of Albania" started on the basis of the "Scope of Work" exchanged between the Japan International Cooperation Agency and the Metal Mining Agency of Japan, on the one hand, and the Ministry of Mineral Resources and Energy of the Republic of Albania and Albanian Geological Survey, on the other hand. In the first year a satellite image analysis (12,000 km^2), a geological survey (270 km^2) that included analysis of existing data and magnetic survey (9.8 km^2, 98.9 line-km) were carried out. The satellite image analysis concerned almost the entire Internal Albanides, the geological survey covered the Shebenik area located in the southeastern part of the Internal Albanides, and the magnetic survey was done in the Pishkash and Kotodesh zones, which were extracted taking into account the zones where geophysical prospecting has already taken place in the past.

The Internal Albanides is a region that was strongly subjected to the Alpine orogeny in the Mesozoic and the Cenozoic, particularly the intense and large-scale deformation caused by the Alpine orogeny that began in the Mesozoic and the geological restructuring caused by collision of the Eurasian and African plates in the Jurassic. It is divided into the Gash zone at the northern end of Albania and the Korabi-Mirdita zone widely distributed in the eastern mountainous region. The western and eastern zones of ultrabasic massifs extend in two rows in the Korabi-Mirdita zone, their distribution being easily interpreted on the LANDSAT TM images. In that eastern zone are located many chrome, copper, nickeliferous laterite and other metal deposits.

The ultrabasic rocks of the eastern zone have the petrochemical characteristic of depletion of melt constituents. They are accompanied by chrome spinel consisting mainly of magno-chromite, and many chromitite deposits are to be found in them. The Shebenik area includes the Shebenik-Pogradec ultrabasic massif located to the south end of the eastern zone of ultrabasic massifs, and many chrome deposits and nickeliferous laterite deposits that occurred in connection with the ultrabasic rocks are distributed in it. On the other hand, in the ultrabasic rocks of the western zone there is occurrence of chrome spinel consisting mainly of alumino-chromite, and those ultrabasic rocks are accompanied by copper and platinum group elements mineralizations.

The geology of the Shebenik area comprises the Lower Triassic to Lower Jurassic (limestones, volcano-sedimentary sequences, schists), the Shebenik-Pogradec ultrabasic massif, Cretaceous limestones covering them unconformablely the Tertiary (mainly conglomerates) developed by filling the intermountain lowlands, which can be divided into the Eocene, the Oligocene and the Neogene.

The Shebenik-Pogradec ultrabasic massif can be geographically divided into the Shebenik massif northern part and the Pogradec massif southern part, both massifs consisting of ultrabasic rocks in turn consisting mainly of harzburgite. By rock facies it can be divided into a lower member characterized by harzburgite accompanied by dunite, a middle member consisting of harzburgite accompanied by dunite intercalations and an upper member of harzburgite accompanied by pyroxenite, gabbro, lherzolite, etc., the lower member being distributed mainly in the southern part of the Shebenik massif and in the Pogradec massif, the middle member mainly in the eastern half to the

northern part of the Shebenik massif, and the upper member mainly in the northwestern part of the Shebenik massif.

More than 300 chromitite deposits and showings have been discovered in the ultrabasic rocks of the middle and lower members. They are distributed practically throughout the area, except for the northeastern part of the Shebenik massif, and particularly in the Shebenik massif south of the area around the Bushtrice River and in the Pogradec massif, the larger ones being found mainly in the western half of those massifs. Those deposits and Cr-showings consist of chromitite of the podiform type in dunite hosted by the harzburgite, the mode of occurrence of chromitite are massive, nodular, banded and disseminated form.

In the systematic prospecting up to 1991 thirty-three deposits with total ore reserves of approximately 1.7 million t (average Cr_2O_3 grade of 32.2%) were confirmed. The scales of the largest deposits in the project area, the Katjel and Pojske deposits, are about 820,000 tons (average Cr_2O_3 grade of 42%) and about 440,000 tons (average Cr_2O_3 grade of 35%), respectively, both lying in the Pogradec massif. In addition, chromitite deposits in size of tens of thousands of tons have been discovered in both massifs, including Memlisht-4, Masha e Kolekut and Cervenake in the Pogradec massif. In the Shebenik massif have been discovered the Bushtrice deposit (average Cr_2O_3 grade of 32%) and the Menik deposit (average Cr_2O_3 grade of 21%), with ore reserves of about 80,000 tons each, as well as many deposits with ore reserves of tens of thousand of tons each, including Perroi i Govates, Vath Pele, Guri i Pishkashit, Fund Fushe and Kudenishti Perendimor etc.

The results of the laboratory tests under the microscope of the samples taken from the chromitite deposits and showings of the Shebenik-Pogradec ultrabasic massif show that most of the harzburgite is characterized by depletion of melt constituents, except for the lherzolitic harzburgite of the northwestern part of the Shebenik massif. In general the ultrabasic rocks are intensely serpentinized, but some of the samples have been recognized as having retained their primary information. It has also been confirmed that one of harzburgite sample of the northeastern part of the Shebenik massif is accompanied by extremely small quantities of chalopyrite, pentlandite, pyrrhotite and other sulfide minerals.

The chemical analyses of rocks and ores have shown that the harzburgite, the dunite and the chromitite all have different chemical characteristics, the harzburgite being a little higher in Al_2O_3, Fe_2O_3, SiO_2 and CaO and a little lower in Cr_2O_3 and MgO than the dunite and the chromitite being very high in Cr_2O_3 and very low in Al and Fe than the harzburgite and dunite. Furthermore, the harzburgite and the dunite have Ni and Co contents of 0.2 to 0.25% and 0.01 to 0.02%, respectively, the chromitite being the Ni content of the range of 0.05 to 0.37%, showing those ultrabasic rocks are comparatively high in Ni content. As for platinum group elements, for the chromitites of the Bulqiza and Shebenik-Pogradec ultrabasic massifs of eastern zone they are extremely low, however, in the chromitite of the ultrabasic rocks to the west of Korce belonging to the western zone the Pt, Pd, Os and Au concentrations are very high, as much as Pt 3.8 g/t and Os 4.34 g/t in some samples, which contrasts the ultrabasic rock of the western zone with that of the eastern zone.

As a result of the EPMA tests concerning chrome spinel, the Cr# of the harzburgite and the TiO_2, Fe^{+3}# and V_2O_3-Cr# of the harzburgite and dunite were identified as important indices for indication of large concentrations of chromitite. The frequency of favorable values of those indices in the samples was high for the area on both sides of the Bushtrice River, including Gobilla and Govates, in the southern part of the Shebenik massif and for the Pogradec massif. Furthermore, for the sake of comparison, it was found to be extremely high in the samples taken from the Bulqiza mine. The highest frequencies of favorable values for those indices were shown by the samples from the Bushtrice and Menik deposits and the Bregu i Pishes and Shulleri i Kaprit showings, followed by the Qarri i Zi deposit and the Mbi Shtepite e Celes showing, the Guri i Pellumbit showing, the Qershori Pojske deposit and the Cervenake and Kroi i Farkuar showings, in that order, all of which are located in the western half of the Shebenik-Pogradec ultrabasic massif.

The conclusion drawn from those indices for the Shebenik area is that although the probability of finding chromitite deposits in the project area of a scale the same as or greater than the Bulqiza mine is low, however, if there are zones in which there is wide distribution of harzburgite with the same Cr# in the vicinity of deposits and showings with values for the above-mentioned indices that are favorable to a chromitite deposition and in the vicinity of points where the Cr# of the harzburgite is below 0.6 and if dunite also occurs in abundance in those zones, it is possible that those zones are endowed with ore bodies comparable to that of the Bulqiza mine.

The fact that a positive magnetic anomaly was clearly detected directly above the Katjel deposit corroborates the effectiveness of magnetic method for chromite exploration.

In the Pishkash area a short-wave anomaly cluster was detected in the northwestern part of the area, and high and low magnetic anomalies running in the north-south direction and including Guri I Pishkashit were also detected. It is considered highly probable that the short-wave anomaly cluster reflects variation in magnetic susceptibility due to the chromitite mineralization of the No. 48 and No. 49 showings, the Pishkash-5 deposit and others, and that those high and low anomalies, too, are very probable an expression of variation of magnetic susceptibility in connection with chromitite mineralization since they are recognized to be similar to the short-wave anomaly cluster of the northwestern part in terms of magnetic susceptibility distribution pattern. Furthermore, the results of measurement of remnant magnetization show that the rocks of the Pishkash area are magnetized in two directions, -80° and 39°, and that the area is geologically divided into blocks.

The results of the Kotodesh area show a clear division of the area into an eastern half with high anomalies and a western half with low anomalies. In the eastern half particularly high anomalies running in the NW-SE direction were noted at three places, but since there was no appreciable difference in magnetic susceptibility, it is considered that they are a reflection of highly magnetic rock bodies lying at shallow depths. As for the western half, as in the case of the Pishkash area, it is considered to be highly probable that the short-wave anomaly cluster detected in the northwestern part of the area reflect variation in magnetic susceptibility connected with chromitite mineralization since many chromitite showings have been discovered in that vicinity.

In comprehensive analysis concerning the chromitite of the Shebenik area as based on the origin of chromitite of the Alpine podiform type, which holds that interaction occurred between the rock and the melt when the melt introduced into the host-harzburgite, causing the orthopyroxene containing Cr in the harzburgite of melting out into the melt, which changed the composition of the melt to higher SiO_2 and Cr and that subsequently supplied, more primitive melt mixed with that melt, resulting in precipitation and concentration of chromitite when the composition of mixed melt shifted to the precipitation domain of chrome spinel.

According to the hypothesis, a harzburgite with higher Cr in orthopyroxene and melts with a larger range of rock-melt interaction were capable of resulting in greater concentration of chromitite, and places with a deep structure capable of producing melt continuously had better conditions for precipitation and concentration of chromitite. Furthermore, it is hoped that the range of such rock-melt interaction can be identified by the range of the harzburgite containing chrome spinel with intermediate values of Fe^{+3}#, TiO_2 and V_2O_5-Cr#, and for those reasons Cr#, Fe^{+3}#, the TiO_2 and V_2O_5-Cr# are considered to be important indices for concentration of chromitite.

On the other hand, Albania's experience and achievements in exploration and exploitation show that the harzburgite accompanied by intercalation of dunite and the harzburgite accompanied by dunite below the cumulate member, particularly the upper part of the latter harzburgite have conditions favorable to concentration of chromitite. This fact suggests the possibility that the Cr content of the orthopyroxene in harzburgite in ultrabasic massifs of the eastern zone is heterogeneous, i.e. that harzburgite rich in Cr existed at particular positions in the upper mantle. Furthermore, it is considered that the ultrabasic rocks of the eastern zone have more depleted petrochemical characteristics in melt compositions is richer in Cr.

The followings are the conclusion and recommendation for the future exploration in the project area arrived at on the basis of the results of the surveys and analyses oh the phase I:

The Shebenik-Pogradec ultrabasic massif is endowed with many deposits and showings of chromitite of the podiform type that resulted from pyrogenic activity that produced dunite, and in view of the Cr# of chrome spinel of harzburgite and other factors, there is considerable possibility that new large chrome deposits will be discovered in the project area.

Almost all of the main deposits thus far discovered are located in the southern part of the Shebenik massif and the western half of the Pogradec massif, and favorable values for the indices by EPMA were obtained roughly for the same areas. Considering as well the past exploration and exploitation in the area, it is concluded that zones with lithofacies ranging from the harzburgite with intercalation of dunite to the harzburgite accompanied by dunite and below them are zones with conditions favorable to concentration of chromitite and that it is therefore desirable to carry out the further exploration in those zones.

In continuing surveys in those areas full consideration should be given to the exploration that have been done in the past.

On that basis the following is recommended in the way of the future exploration in the project:

1) Semi-detailed geological and geophysical (magnetic) surveys;

a) Southern part of the Shebenik massif on the north side of the Bushtrice River (Area: geological survey: approx. 22 km², magnetic survey: approx. 12 km²)

Reason for selection: This area corresponds to the northern extension of the zone extending from the western part of the Pogradec massif through Pishkash and on to the Bushtrice deposit in which many chromitite showings are distributed. Furthermore, many favorable indices by EPMA have been obtained for those showings and deposits.

b) Western side of southern half of the Pogradec massif (Area: geological survey: approx. 10 km²; magnetic surveys: approx. 5 km²)

Reason for selection: There are many showings along the western edge of the Pogradec massif, and favorable indices were obtained by EPMA from 3 samples within a restricted zone. The zone, however, has not yet been sufficiently explored for chromitite, because the ultrabasic massif is partly covered by nickeliferous laterite and limestone.

2) Drilling explorations;

There is still considerable room for further exploration in this area. It has already undergone various surveys including trenches, shallow galleries and drillings as a promising zone, but there are showings where there is still room for exploration as well as some deposits whose shallow parts have been exploited but for which lower prospecting has not been carried out, some showings which have not been explored by drilling to make impossible to evaluate their potential, and other showings where magnetic anomalies have been noted nearby. It is therefore considered to be necessary to continue drilling exploration, the most important places in that respect being as follows:

a) Cr-showings that have been surveyed but for which there is still room for exploration:
Bregu i Pishes, Fusha e Madhe, Shesh Bush No. 1, Pojske Perendimor, Perroi Dardhas, Hija e Zeze, etc.

b) Deposits which have been developed to a shallow depth but for which prospecting farther down has not yet been undertaken: Qarri i Zi and others.

c) Zones whose potential cannot be evaluated because deep prospecting has not been carried out: Gjashte Lis and many other Cr-showings in the vicinity of Rajce.

d) Indications for which anomalies have been noted in magnetic survey:
Mbi Skroske, Pishkash-5, Guri i Pishkashit, Murriq, etc.

Of them, favorable indices have been obtained by EPMA for Qarri i Zi and Bregu i Pishes. It might be added that the Bregu i Pishes, Fusha e Madhe, Shesh Bush No. 1, Pojske Perendimore, Hija e Zeze are all located within a zone about 2 km wide and 3 km long.

Furthermore, in view of the special nature of chromitite exploration, it is considered important to adequately include chemical analyses and petrochemical study by EPMA of rock and ore samples in carrying out such surveys so as to make the project as fruitful as possible.

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Chapter 1 Introduction

Chapter 1 Introduction

1-1 Project Summary

1-1-1 Background

The present project corresponds to the first year of the 3-year project of "Cooperative Mineral Exploration in Shebenik Area, the Republic of Albania", to be implemented on the basis of the "Scope of Work" signed on July 5, 1995, between the Japan International Cooperation Agency and the Metal Mining Agency of Japan, on the one hand, and the Albanian Ministry of Mineral Resources and Energy (MMRE) and Albanian Geological Survey (GJEOALBA), on the other.

1-1-2 Objectives

The purposes of the project are to discover new deposits through elucidation of the geological conditions and state of deposit endowment in the Shebenik area and at the same time to accomplish technology transfer to the Albanian side.

1-1-3 Scope of Work

In the first year the project comprises geological survey including satellite image analysis and pre-existing data analysis and magnetic survey. Fig.1-1-1 and Fig.1-1-2 give the respective areas of those surveys, and Table 1-1-1 shows the respective quantities of work involved.

Table 1-1-1 Survey Works in 1995 Fiscal Year

(1) Field works

Type of Survey	Area(km^2)	Total Distance of Survey Route (km)	Number of Samples or Measured points
- LANDSAT TM Image Analysis	12,000	0	0 pcs.
- Geological Survey	270	481.5	100 pcs.
- Magnetic Survey	9.8	93.9	5,022 points

(2) Laboratory tests and Measurements

Item	Number	Remarks
- Thin Section of Rocks	50 pcs.	
- Polished-thin Section of Ores	121 pcs.	
- Quantitative Analysis by EPMA	121 pcs.	TiO_2, Al_2O_3, Cr_2O_3, Fe_2O_3, V_2O_3, FeO, MnO and MgO
- Chemical Analysis of Rocks	40 pcs.	Al, Ba, Be, Bi, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, K, Ag, Na, Sr, Ti, W, V and Zn
- Chemical Analysis of Ores	60 pcs.	SiO_2, Al_2O_3, Fe_2O_3, MnO, CaO, Na_2O, MgO, K_2O, P_2O_5, TiO_2, Cr_2O_3 and LIO
- Natural Magnetic Remnant	20 pcs.	
- Magnetic Susceptibility	98 pcs.	

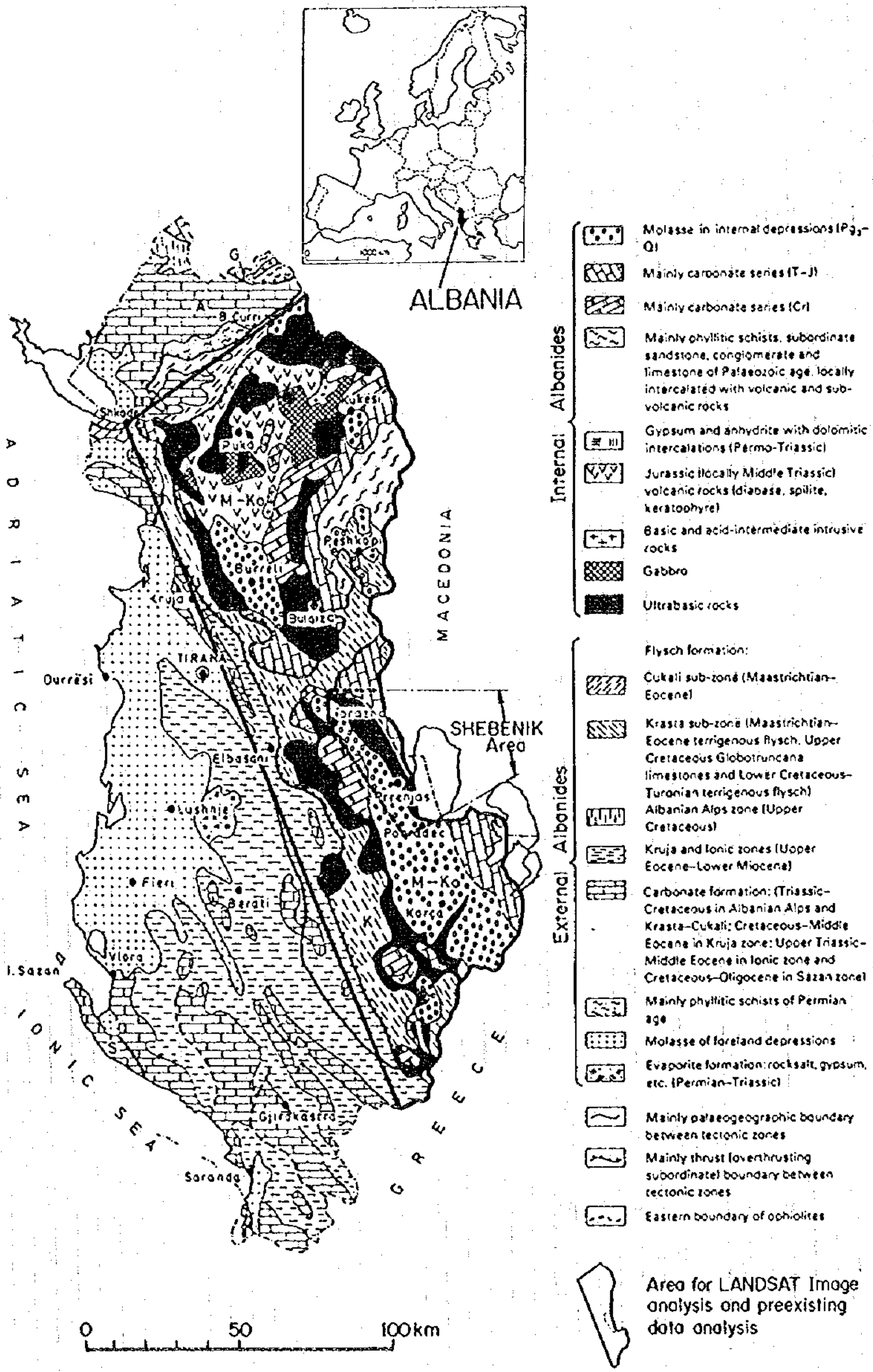


Fig. 1-1-1 Location map of the survey area

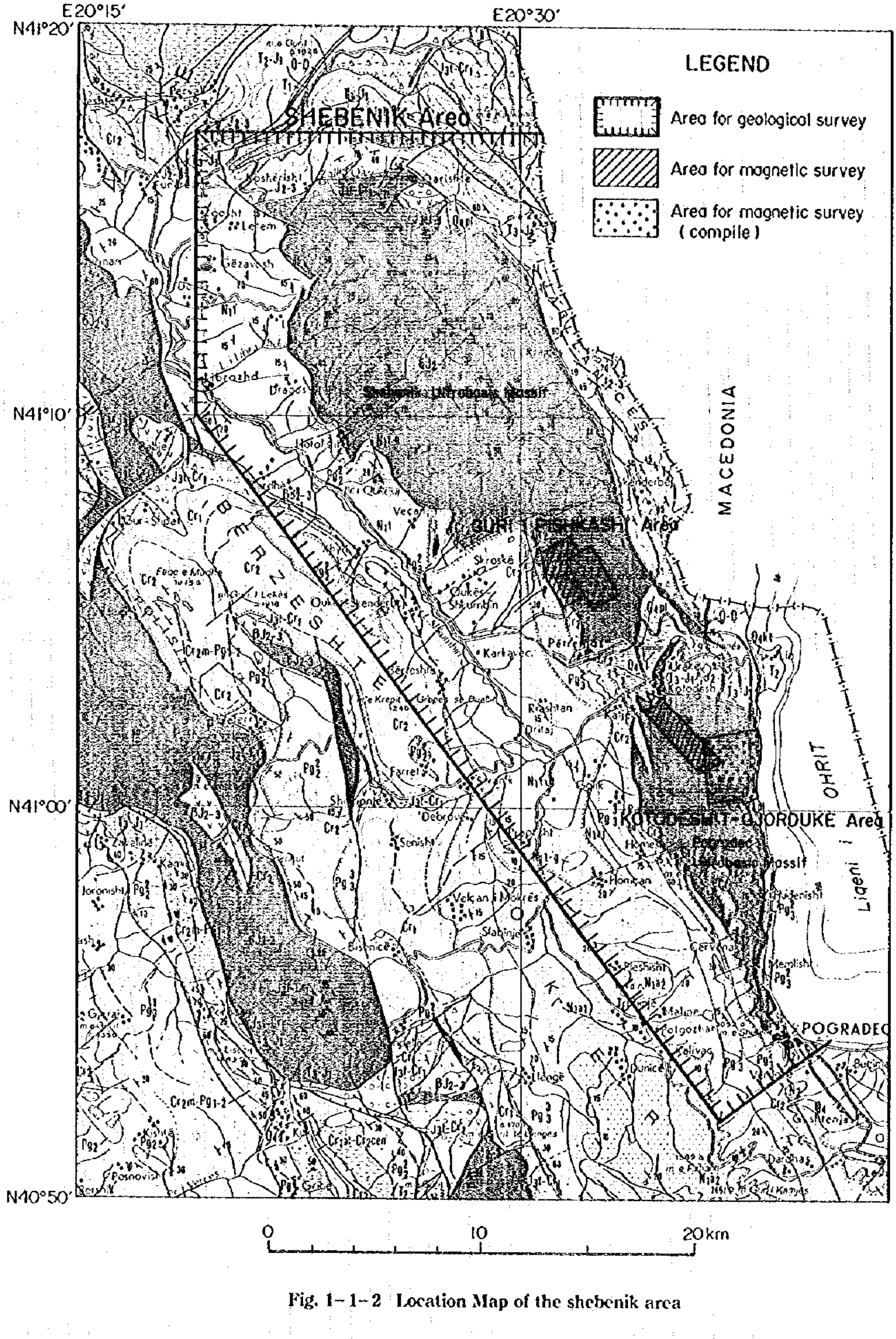


Fig. 1-1-2 Location Map of the shebenik area

Table 1-1-2 gives information on the path and row data used in the satellite image analysis.

Table 1-1-2 LANDSAT Data

Path	Row	Date
186	31	7 Oct. 1992
185	32	27 June 1991
185	31	27 June 1991

1-1-4 Duration of the Works

The periods covered by the different types of work done in the first year were:

- Satellite image analysis: Aug. 25 - Nov. 25, 1995
- Geological survey (field survey): Sept. 4 - Nov. 13, 1995
- Magnetic prospecting (field survey): Oct. 30 - Dec. 2, 1995
- Laboratory testing and preparation of report: Dec. 3 - Feb. 23, 1996

1-1-5 Membership of Project Team

Table 1-1-3 indicates the personnel who took part in the negotiation mission and those who comprised the field surveys teams.

Table 1-1-3 Personnel

Japanese Side	Albanian Side
-Negotiation Mission	
Mr. Toyo MIYAUCHI, MMAJ	Mr. Vasil GRILLO, GJEOALBA
Mr. Yoichi FUJIIE, MFA	Mr. Adil NEZIRAJ, MMRE
Mr. Nozomu KIKUCI, MITI	Mr. Vaxhid TAHSINI, GJEOALBA
Ms. Kazuko MATSUMOTO, JICA	Mr. Alaudin KODRA, Geological Institute, GJEOALBA
Mr. Yoshiaki IGARASHI, MMAJ	Mr. Spartak KASAPI, Geoph.& Geoch, C., GJEOALBA
-Field Survey Teams	
Mr. Hiroshi MIYAJIMA(Leader), SMC	Mr. Kristaq DHIMA, Geological Institute, GJEOALBA
Mr. Kazuo SANO(Subleader), SMC	Mr. Fatmir BLACERI, Pogradec Enterprise, GJEOALBA
Mr. Eitaro SATO(Geologist), SMC	Mr. Besnik POJANI, Korce Enterprise, GJEOALBA
Mr. Michihiro NAGANO(Geologist),SMC	Mr. Agim MAZREKU, Geophysical Center, GJEOALBA
Mr. Takao OGAWA(Geophysicist),SMC	Mr. Petrika KOSHO, Geophysical Center, GJEOALBA
Mr. Mitsuru KATSUDA(Geophysicist),SMC	Mr.Gezim KALLOANI, Geophysical Center, GJEOALBA
Mr. Koji MORIMOTO(Geophysicist),SMC	Mr. Apollon DILO, Geophysical Center, GJEOALBA
	Mr. Gani SHEFU, Geophysical Center, GJEOALBA
	Mr. Xhevair QERAJ, Geophysical Center, GJEOALBA
	Mr. Ali HASA, Geophysical Center, GJEOALBA
	Mr. Ali HIBI, Pogradec Enterprise, GJEOALBA

Note: MFA: Ministry of Foreign Affair Japan, MMRE: Ministry of Mineral Resources and Energy,
MITI: Ministry of Trading and Industry Japan, GJEOALBA: Albanian Geological Survey,
SMC: Sumiko Consultants Co., Ltd.

1-2 General Description of the Project Area

1-2-1 Location

The Shebenik area lies in southeastern Albania in a eastern mountainous region as shown in Fig. 1-1-1 and Fig. 1-1-2. On the east the area faces on the border with Macedonia and Ohrit Lake. It embraces the entire Shebenik-Pogradec ultrabasic massif, which runs approximately 55 km in the NNW-SSE direction and varies in width from 1 to 15 km in the east-west direction. At the west end of the northern part of the area lies the town of Librazhd, and at the south end lies the town of Pogradec.

1-2-2 Access

Pogradec, which served as the base for the surveys, is situated about 84 km southeast of Tirana as the crow flies, as shown in Fig.1-2-1. It takes 3 to 4 hours to get there from the capital by car through the two-lane, allweather paved highway leading to the borders with Macedonia and Greece via the large industrial city Elbasan and Librazhd and Prenjas towns. Korce, which has a population of about 80,000 and is the administrative center of the region, lies 32 km south-southeast of Pogradec.

There is also railroad (wide gauge) access to Pogradec. The line runs from Tirana to Durres, the country's largest seaport, from there along the Shkumbin River to Elbasan and Librazhd and on to Prenjas and Pogradec. Besides passenger traffic, the line is a major freight route, formerly for nickeliferous laterite ore and presently for chromium ore and other cargoes. Additionally there is longdistance bus service from Tirana to Pogradec as well as local bus service linking the different towns and villages of the region.

The above-mentioned highway is the only paved road in the Shebenik area. There are also other roads that are negotiable by motor vehicle traffic, such as the ones between Librazhd and Qarrishte at the north end of the area, between Prenjas and Skenderbej in the east central part and between the highway and Dragostun and Hotolisht, but the road surface is generally in rather bad condition. Even vehicles with four-wheel drive have trouble negotiating many sections in the rainy season.

1-2-3 Topography

The Shebenik area is in the mountainous region of eastern Albania that is a southern extension of the Dinaric chain of western ex-Yugoslavia. It is characterized by extremely steep mountainous terrain in the stage of maturity in the mountains running in the NNW-SSE direction and intermontane lowland terrain lying between such mountainous terrain.

Most of the Shebenik mountains in the northern part of the project area is occupied by the Shebenik ultrabasic massif. The highest elevation there is 2,262.0 m, and there is mountainous terrain with a relative height of more than 1,560 m. In some parts of the mountains exceeding 1,500 m in elevation there is remaining glacial landforms. The southern part of the area, most of which is occupied by the Pogradec ultrabasic massif, faces on Ohrit Lake and has mountainous terrain with a maximum elevation of 1,530.3 m and a relative height of more than 830 m. Between those two ultrabasic massifs lies a flat land extending from Prenjas to Kotodesh.

To the west of the Shebenik-Pogradec ultrabasic massif lies a intermontane lowland running in the NNW-SSE direction. Along that lowland flows the Shkumbin River toward the north-northwest. It is one of Albania's largest Rivers. At Librazhd it turns west. After cutting across the ophiolite of the western zone, it passes through the city of Elbasan and eventually runs into the Adriatic Sea.

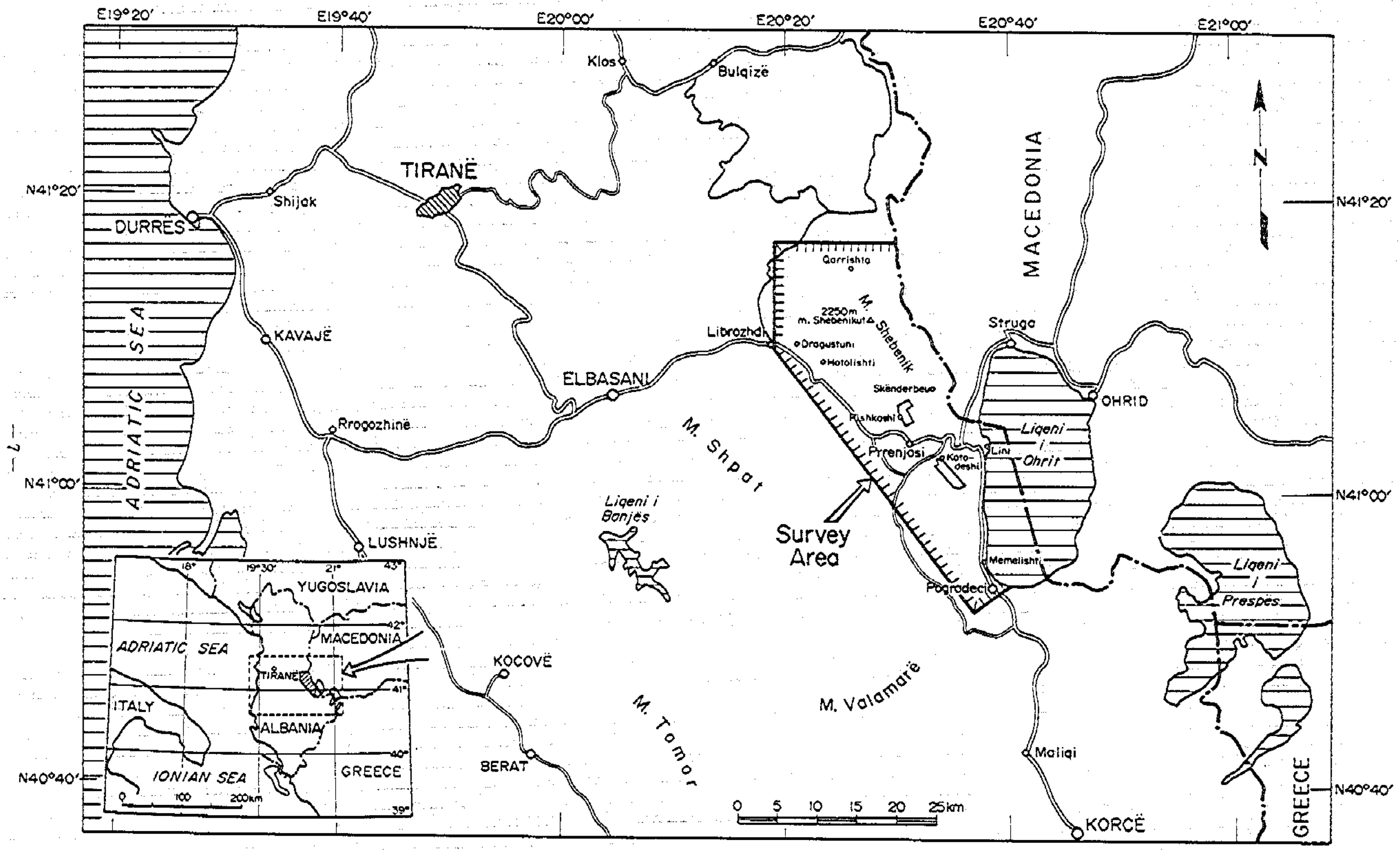


Fig. 1-2-1 Accessibility map

All of the drainage systems of the Shebenik area except for a short drainage system running into Ohrit Lake belong to the drainage system of the Shkumbin River. The main such drainage systems include that of the Qarrishte River, which marks the northern edge of the Shebenik ultrabasic massif, that of the Bushtrice River, which cuts across that massif in the east-west direction after running southward along its eastern edge and tributaries of the Shkumbin River that collect small drainage systems on the west side of the Pogradec ultrabasic massif.

Those main rivers are subject to strong structural control in the NNW-SSE and ENE-WSW directions and to pronounced downward erosion. Along them there are frequent steep slopes and even cliffs with a relative height of 1,000 m. The tributaries that flow into them are also such to structural control in the same directions and pronounced downward erosion.

1-2-4 Climate and Vegetation

Most of the territory of Albania belongs to the Mediterranean climatic zone. It is hot and dry in the summer and mild in the winter. Table 1-2-1 gives the mean monthly temperature, relative humidity and precipitation of the capital, Tirana.

Table 1-2-1 Monthly Averages of Temperature, Humidity and Precipitation

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Temperature °C	6.2	7.7	9.6	13.3	17.6	21.9	24.2	23.6	20.1	15.6	11.6	8.4	15.0
Humidity %	74	73	70	72	71	69	62	64	71	70	76	79	71
Precipitation mm	164.9	144.4	93.3	96.2	106.6	66.7	32.1	37.9	76.8	102.8	158.2	160.9	1,238.6

Note: Statistical period; temperature and precipitation :1951-1968, relative humidity :1963-1967.

The highlands of the eastern mountainous region, on the other hand, are included in the mild humid zone, and at high elevations there is considerable snowfall in the winter. As can be seen from Table 1-2-1, there is normally little precipitation in July-September but a considerable amount in October-February. The year 1995, the first year of the project, was a year of abnormal weather conditions. It rained a lot in the summer, and there was fine weather during the last ten days of September and throughout October. Not until November was there rain and snow.

The vegetation of the Shebenik area is characterized by a mixture of deciduous and coniferous trees, with special species of the temperate zone. In the highlands of the Shebenik mountains with an elevation of 1,500 to 1,800 m there remain abundant natural forests. The forest line in the area is at about 1,800 m above sea level. The vegetation of the high-elevation highlands above that consists mainly of low shrubs and lichen. In the mountains grazing is widely practiced, particularly grazing of sheep, goats and cattle.

1-2-5 Geology of the Project and Surrounding Areas

As indicated in Fig. 1-1-1, the geology of Albania can be roughly grouped into the External Albanides occupying the western coastal zone and the Internal Albanides occupying the eastern mountainous zone.

(1) External Albanides

The External Albanides is a zone in which Permian to Cretaceous sediments and Tertiary formations occur on top of folded Silurian and Devonian formations. In particular, there is wide distribution of calcareous rocks as a result of broad marine transgression in the Cretaceous period.

The External Albanides is subdivided into the Albanian Alps zone (Permian-Triassic terrigenous sediments), the Krasta-Cukali zone (Lower Triassic volcanics and schists, Middle Triassic-Cretaceous carbonate rocks and Upper Cretaceous-Eocene terrigenous flysch), the Kruja zone (Upper Cretaceous-Upper Eocene calcareous rocks and Upper Eocene-Oligocene flysch), the Ionian zone (Permian-Lower Triassic (?) gypsiferous sedimentary rocks, Mesozoic-Eocene limestone and Upper Eocene-Oligocene littoral flysch) and the Saranda zone (Cretaceous-Paleogene limestone and Lower Miocene flysch).

The External Albanides is characterized by gently folded monotonous sedimentary rock facies and low in metamorphic grade. It yields mainly superficial mineral deposits such as bauxite, rock salts, phosphates, heavy metal placer deposits, silica sand and fossil fuel resources.

(2) Internal Albanides

The Internal Albanides is a region that was strongly subjected to the metamorphism and deformation caused by the Alpine orogeny from the Mesozoic to the Cenozoic, particularly the large-scale Alpine orogeny during the Mesozoic period, and by the geological restructuring resulted from the collision of the Eurasian and African plates in the Jurassic period. It is obduced over the Cukali zone of the External Albanides by a thrust fault gently sloping eastward.

Geographically, it is subdivided into the Gash zone distributed at the northern end of Albania and the Korabi-Mirdita zone widely distributed in the eastern mountainous region. The Gash zone consists of Paleozoic (?) diabase and dacitic schist and Carboniferous-Permian phyllite of shallow-sea sediments. The Korabi-Mirdita zone consists of Jurassic ophiolite and Paleozoic phyllite-schist, sedimentary rocks, limestone, volcano-sedimentary rocks, etc. The ophiolite of the Korabi-Mirdita zone is associated with ultrabasic massifs arranged in two rows: a west zone and an east zone. The ultrabasic massifs have a general sequence, from bottom to upward, of harzburgite associated with dunite, cumulates with pyroxenite and dunite, gabbro with a cumulate structure, massive basalt to basalt dike swarm and pillow lava.

The ultrabasic massifs of the east zone comprise the Tropoja, Kukes, Bulqiza and Shebenik-Pogradec massifs. They are generally accompanied by chrome spinel mainly of magno-chromite, and are famous for production of metallurgical-grade chromite ore, and they also have nickeliferous laterite deposits. Furthermore, the volcano-sedimentary rocks of the Gash and Korabi-Mirdita zones are associated with copper and other base metal mineralizations.

On the other hand, the ultrabasic massifs in the west zone contains chrome spinel consisting mainly of alumino-chromite and is associated with copper and platinum group elements mineralization.

To summarize, the Internal Albanides region is characterized by considerable copper, nickel, chromium and other mineralization.

Chapter 2　Results of Work

Chapter 2 Results of Work

2-1 Satellite Image Analysis

2-1-1 Summary

Over the area shown in Fig. 2-1-1 LANDSAT TM images were interpreted photogeologically for the purpose of determining the geology and geological structure of the Internal Albanides and the relationship between them and mineral deposits. The satellite data were LANDSAT TM false color images. For the interpretation reference was made to existing geological maps on a scale of 1:200,000.

(1) Geological Interpretation

Photogeologically it is possible to divide the area into 22 units. Of the units composing the Internal Albanides, it is easy to distinguish sedimentary rocks consisting mainly of flysch from massive rocks such as ultrabasic massifs and carbonate rocks. It is, however, difficult to interpret small-scale units with a diameter of less than a few kilometers from the surroundings. Although it is basically possible to distinguish ultrabasic rocks from carbonate rocks, there are some places that are not so clear.

(2) Geological Structure

It is possible to easily interpret the structure of ultrabasic massifs distributed in approximately the north-south direction and the Tertiary sedimentary basins of the Internal Albanides. However, the trace of the thrust fault between the Internal and the External Albanides is not so clear. The interpreted lineaments were mostly in the directions from N 20° W to N 70° E, and there were few in the east-west direction.

(3) Relationship Between Mineral Deposits and Geology and Geological Structure

Of the copper deposits distributed in northern Albania, those of the Mirdita zone are on lineaments in the north-south direction and the extensions thereof, which leads one to believe that there is a close relationship between the fault system and mineralization in that case. On the other hand, there does not appear to be any particular relationship between lineaments and chrome and nickeliferous laterite deposits.

2-1-2 Satellite Image Data

The image data used in the analysis comprises 3 scenes of LANDSAT TM data given in Table 1-1-2 above. The images used for photo-geological interpretation are false color prints on a scale of 1:200,000 prepared from the image data of Table 1-1-2, allocating blue, green and red to 2, 3 and 4 bands respectively.

The quality of images were good, with few clouds.

2-1-3 Photogeological Units

Photogeological interpretation was done by visual observation from the false color images, with preparation of photogeological interpretation maps on a scale of 1:200,000 (PL.2-1-1).

Photogeologically the area can be divided into 22 units on the basis of such features as tone, texture and such topological features as drainage systems and difference in rock resistance against

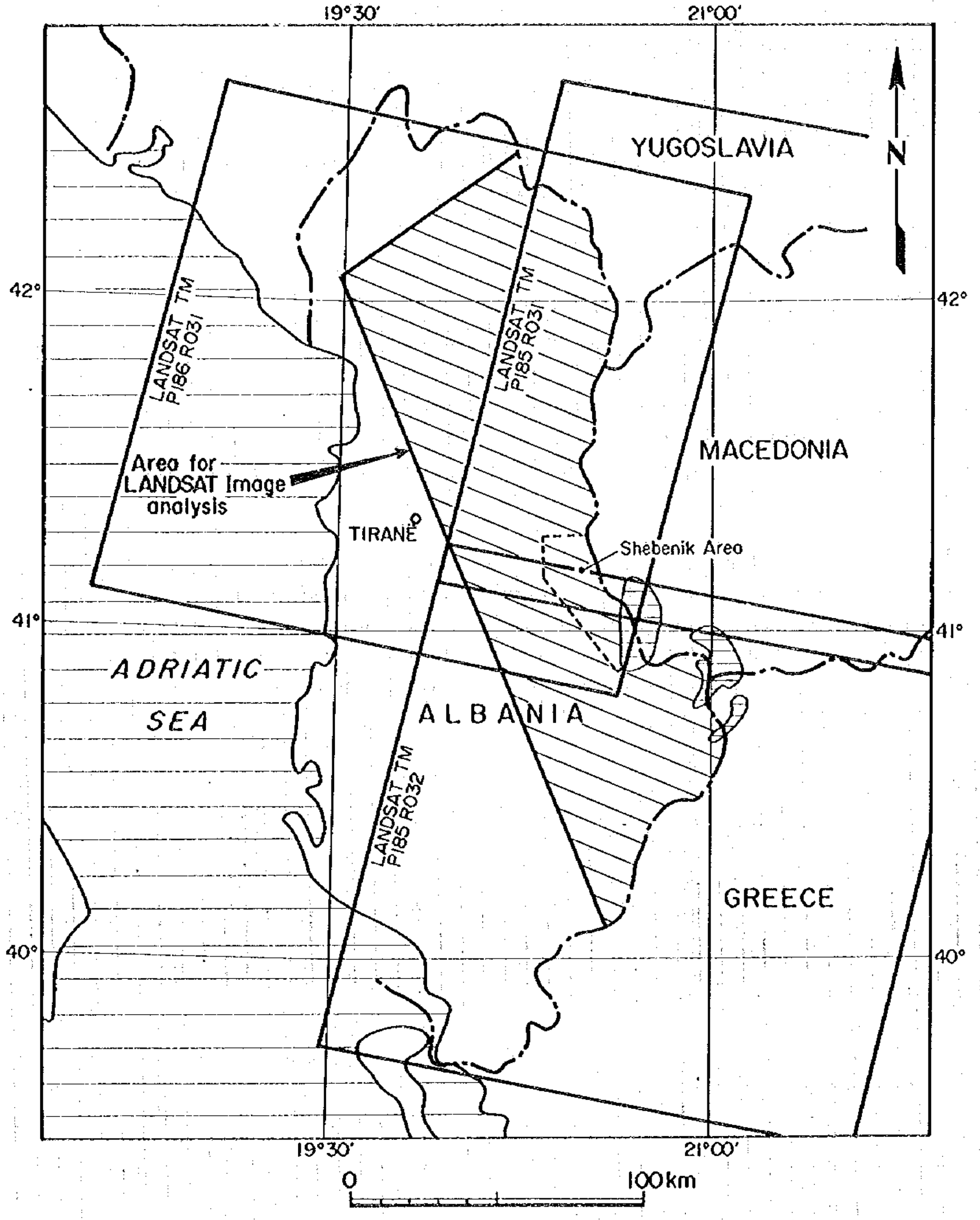
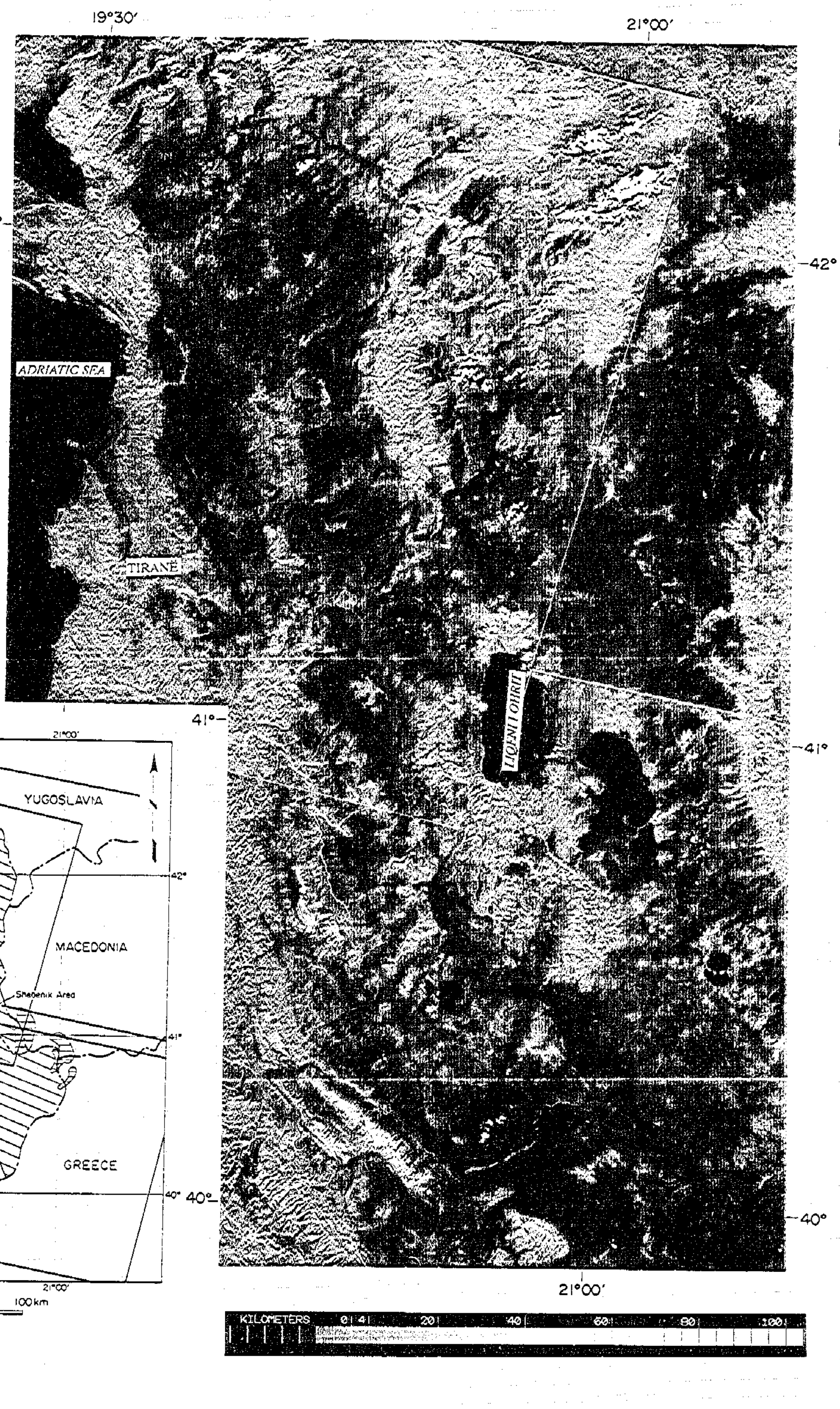


Fig. 2-1-1 Map showing the study area for photogeological interpretation



List of LANDSAT TM data

PATH	ROW	DATE
186	31	07 AUG 1992
185	32	27 JUN 1991
185	31	27 JUN 1991

R, G, B = 4, 3, 2

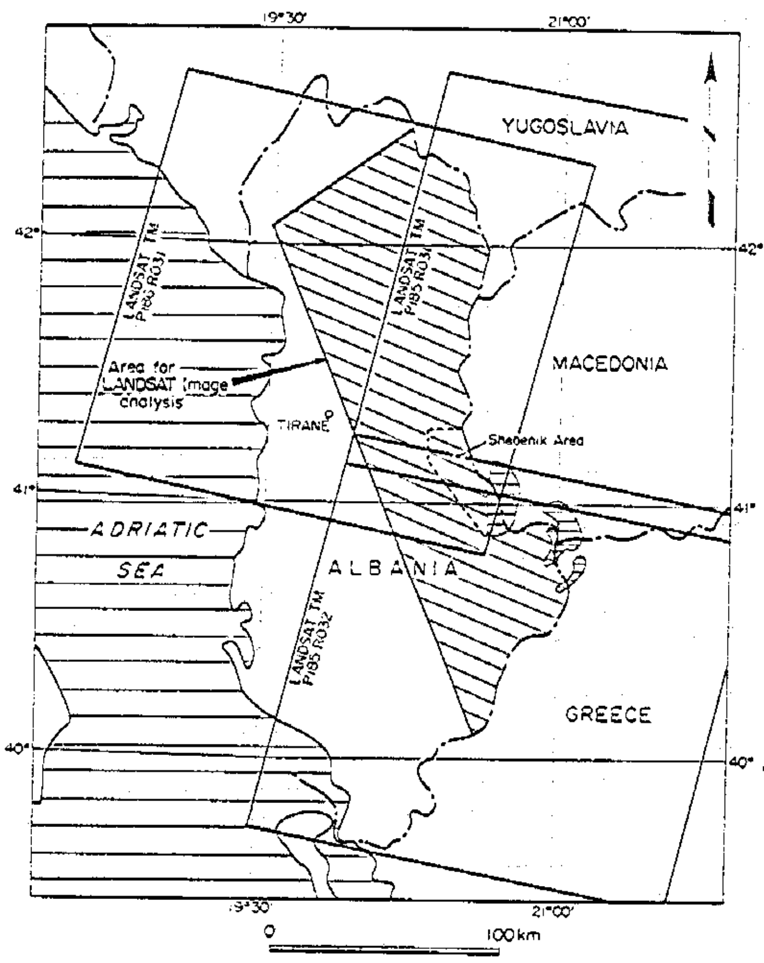
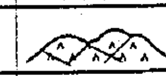
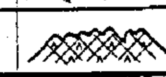


Fig. 2-1-2 LANDSAT TM mosaic image of the study area

Table 2-1-1. Photogeologic interpretation chart of LANDSAT TM image

Photogeologic Unit	Imagecharacteristics		Geomorphologic features						Vegetation	Correlation with pulished map
	Tone	Texture	Drainage		Rock resistance	Bedding	Crosssection			
			Pattern	Density						
Q_4	pale blue green	very fine	meandering	high	very low	none			sparse	flood plain
Q_3	colorful	very fine	meandering	low	very low	none			common cultivation	alluvial deposit
Q_2	yellowish beige	fine	parallel	high	low	partly bedded			moderate	terrace depoit
Q_1	pale green	fine	parallel	medium to high	low	none			sparse	talus deposit
N-Q	pale blue green reddish pink	fine to medium	parallel	high	low	partly bedded			sparse	N_2-Q_1, Pliocene to Quaternary; conglomerate, sandstone, claystone
Tc	light green, deep red, vivid reddish orange	coarse to medium	dendritic	medium to high	low	partly bedded to well bedded			dense to moderate	N_1t, N_1a, Pg_3, etc. Paleogene to Neogene; flysch deposit, sedimentary rocks mainly distributed in Internal Albanides
Tb	dull reddish orange, pale green	medium to coarse	dendritic to parallel	dense	low	well bedded			dense to moderate	N_2, N_1, Pg_3, etc., Paleogene to Neogene; flysch deposit, sedimentary rocks, mainly destributed in external Albanides
Ta'	bright blue green, deep red	medium	dendritic	medium to high	moderate to low	partly bedded			moderate to dense	Pg_2, Paleogene; flysch deposit
Ta	bright blue green, dark red	coarse	parallel to dendritic	medium to high	moderate to low	partly bedded			moderate to dense	Pg_3, Paleogene; flysch deposit
J-Km	bright reddish orange, light green	medium to coarse	dendritic	low to medium	low to moderate	none			moderate to dense	J_3t-Cr_1, Upper Jurassic to lower Cretaceous; melange, flysch deposit
Jv	light green, bright reddish orange	coarse to medium	rectangular to dendritic	medium	moderate	none			dense to moderate	J_3ef-s, λJ_3, $\beta J_{2\text{-}3}$, Middle to upper Jurassic; volcanic rocks
μ	reddish orange	fine	dendritic	medium	low	none			sparse	μ; Amphibolite, etc.
Lma	light grey, light blue green, deep red	medium to fine	parallel to rectangular	medium to high	moderate to high	partly bedded			sparse to dense	limestone, marlstone, dolomite, etc.
Lmb	light grey, light blue green, deep red	medium to coarse	parallel to rectangular	low to medium	high	partly bedded			sparse to dense	limestone, marlstone, dolomite, etc.
K-T	pale blue green, light reddish orange	medium	parallel to dendritic	medium	moderate	partly bedded			moderate to dense	Cr_{2m}-$Pg_{1\text{-}2}$, $Cr_{2\text{-}m}$, Upper Cretaceous to Paleogene; flysch deposit
P-Tre	light greyish yellow, bright red	fine	radial	low	moderate to high	massive			sparse	P-T_1, Permian to Triassic; evaporite
O-D	light yellowish orange, light blue green	fine to medium	parallel to dendritic	medium to low	high	massive			sparse	O-D, etc., Ordovician to Devonian, etc.; schist, quartz porphry, etc.
Gr	dark reddish orange, pale green	coarse	dendritic	medium	moderate	partly bedded			moderate to dense	γJ_3, Jurassic; granite, diorite, etc.
Gba	reddish pink, pale green	medium to coarse	dendritic	medium	high to moderate	massive			moderate to dense	$\nu J_{2\text{-}3}$, Jurassic; gabro, norite, etc.
Gbb	pale green, light grey, reddish pink	coarse	dendritic	medium to high	moderate to low	none			sparse	$\nu J_{2\text{-}3}$, Jurassic; gabro, norite, etc.
Uma	dark blue green, deep red	fine to medium	dendritic	low	moderate to high	massive			sparse to moderate	$\sigma J_{2\text{-}3}$, $\psi J_{2\text{-}3}$, Jurassic; ultramafic rocks
Umb	dark blue green, deep red	fine to medium	dendritic	medium	moderate	massive			sparse to moderate	$\sigma J_{2\text{-}3}$, $\psi J_{2\text{-}3}$, Jurassic; ultramafic rocks

erosion. Comparison with geological maps on a scale of 1:200,000 showed good correlation between those photogeological units and the geological divisions on the geological maps.

The characteristic features of the different photogeological units and the results of comparison with geological maps are given in Table 2-1-1.

(1) Units Uma and Umb

These units correlate to ultrabasic rocks of the geological maps and form mountainous zones with elevations around 2,000 m. Their tone is dark bluish green and deep red, and their texture is fine to medium. Their drainage is dendritic with low to medium density. There is no noticeable occurrence of bedding other than a pale green zone with a width of about 200 m and consisting of several strips in the vicinity of Mt. Shebenik in the northern part of the Shebenik area. That zone extends approximately south-southeast from the south slope of Mt. Shebenik to the upper reaches of Govates.

Although they are very similar, they can be divided into unit Uma and unit Umb on the basis of ridge shape. Unit Uma has rounded ridges, whereas those of unit Umb are sharp. Unit Uma is widely distributed in ultrabasic rock of the eastern zone, and unit Umb tends to be widely distributed in the western zone. There are also massifs with features intermediate between the two, such as the Bulqiza massif.

(2) Units Gba and Gbb

These units correlate to gabbroic rocks of the geological maps. As in the case of ultrabasic rocks, these units also form rugged mountainous zones. They are very similar, they can be divided into unit Gba and unit Gbb on the basis of topological characteristics.

The tone of unit Gba is reddish pink and pale green, and its texture is fine to medium. It has dendritic drainage of medium density. It has higher rock resistance than unit Gbb and forms higher mountains. The tone of unit Gbb is pale green, light grey and reddish pink, and its texture is coarse. It has dendritic drainage of a density higher than that of unit Gba. Its rock resistance is low, and it forms hilly land with advanced dissection. The form of its ridges is rounder than in the unit Gba.

(3) Unit Gr

This unit correlates to Jurassic granites and diorites. It is distributed over only a small range in northern Albania. Except for a few cases, it is difficult to distinguish it from units Jv and Gb distributed around it.

Its tone is reddish orange and pale green, and its texture is coarse. It has dendritic drainage of medium density.

(4) Unit O-D

This unit is distributed in cluster in northeast Albania near the border. It correlates to formations consisting mainly of Paleozoic schists, quartz porphyry and sedimentary rocks.

Its tone is light yellowish orange, light bluish green and bright red, and its texture is fine to medium. It has parallel to dendritic drainage of medium to low density. Its ridges are rather round, but it forms comparatively high mountainous zones.

(5) Unit P-Tre

This unit correlates to Permian to Triassic evaporite and is distributed near the border in north-eastern Albania. Its tone is light grey and bright red, and its texture is fine. It has radial drainage and medium to high rock resistance and forms tableland.

(6) Unit K-T

This unit correlates to Cretaceous (including some Jurassic) to Paleogene flysch sediment. It is widely distributed in the Internal Albanides, particularly along the boundary between that region and the External Albanides.

Its tone is pale bluish green and light reddish orange, and its texture is medium. It has some occurrence of bedding and a drainage system pattern of parallel to dendritic and of medium density. Its rock resistance is medium, and it forms somewhat sharp ridges.

(7) Units Lma and Lmb

These units are widely distributed in both the Internal and the External Albanides and correlate to carbonate rocks consisting mainly of limestone. They are similar to one another but can be classified as Lma and Lmb on the basis of their topological features. All sorts of limestones ranging from Paleozoic to Cenozoic are distributed in both the Internal and the External Albanides, but it is difficult to classify them in detail on the satellite images.

The tone of unit Lma is light grey, light bluish green and deep red, and its texture is medium to fine. This unit is characterized by karst with parallel to rectangular drainage of fairly high density. Unit Lmb has the same tones as unit Lma, but its texture is medium to fine, and it has occurrence of tableland and mountains as well as low drainage density.

(8) Unit μ

This unit may correlates to Jurassic (?) amphibolite. On the geological maps amphibolite is distributed in periphery of ultrabasic massifs, but the size is small in all cases, making it difficult to distinguish it on the satellite images. Amphibolite on a fairly large scale located in the northern part of the area, however, is distinguishable as an independent photogeological unit.

The tone of this unit is reddish orange, and its texture is fine. It has low rock resistance and forms hilly terrain.

(9) Unit Jv

This unit correlates to Jurassic volcanic rocks widely distributed in the northern part of the Internal Albanides.

Its tone is light green and light yellowish orange, and its texture is coarse to medium. It has rectangular to dendritic drainage of medium to high density. It has occurrence of rather sharp ridges at close intervals.

(10) Unit J-km

This unit correlates to Jurassic to Cretaceous melange and flysch and is distributed at periphery of ultrabasic massifs, limestone massifs and Jurassic volcanic rocks.

Its tone is bright reddish orange and light green, and its texture is medium to coarse. It has dendritic drainage of high density. In comparison to the ultrabasic massifs and limestone massifs in its vicinity it forms intensely dissected terrain, and its ridges are generally roundish.

(11) Unit Ta

This unit correlates Paleogene deposits distributed in the External Albanides south of Elbasan.

Its tone is light bluish green and dark red, and its texture is coarse. It has parallel to dendritic drainage of medium to high density. It has some occurrence of bedding and somewhat sharp ridges.

(12) Unit Ta'

This unit correlates to Paleogene deposits distributed in the Internal Albanides. Its features are quite similar to those of unit Ta, but it is characterized by ridges somewhat more roundish.

Its tone is light blue green and deep red, and its texture is medium. It has only some local occurrence of bedding. It has dendritic drainage of medium to high density.

(13) Unit Tb

This unit correlates to formations consisting of Paleogene to Neogene flysch and sandstone and marl and is distributed in the External Albanides north of Elbasan.

Its tone is dull reddish orange and pale green, and its texture is medium to coarse. It is well bedded with some cuesta terrain. It has dense dendritic to parallel drainage. There is also some folding with axes of NNW-SSE direction. Its rock resistance is low, and it forms dissected low mountains and hilly land.

(14) Unit Tc

This unit correlates to terrigenous and other formations consisting of Paleogene to Neogene deposits such as sandstone and conglomerate. It is distributed around Burrel and in the area from Librazhd to Korçe in the Internal Albanides and forms a large sedimentary basin extending NNW-SSE.

Its tone is light green, deep red and reddish orange, and its texture is medium to coarse. It is well bedded with some cuesta landform and dense dendritic drainage. Its rock resistance is low, and its ridges are roundish and dense.

(15) Unit N-Q

This unit correlates to formations consisting of Neogene to Pleistocene sandstone and marl and is distributed over a small area of intermontane lowland terrain in the Internal Albanides.

Its tone is light bluish green and reddish pink, and its texture is fine to medium. Its has dense parallel drainage and forms gently sloping hilly land.

(16) Units Q1, Q2, Q3 and Q4

These units correlate to Quaternary unconsolidated sediment and are distributed at river flood plains, plains, etc. They differ somewhat from one another in terms of their topological features.

Unit Q1, which can be considered to correspond to talus deposits, is distributed at the skirts of mountains. Its tone is pale green, and its texture is fine. It has dense parallel drainage. Unit Q2 is distributed along rivers and forms well dissected hilly land. Its tone is yellowish beige, and its texture is fine. It has dense parallel drainage and correlates to terrace deposits. Unit Q3 is widely

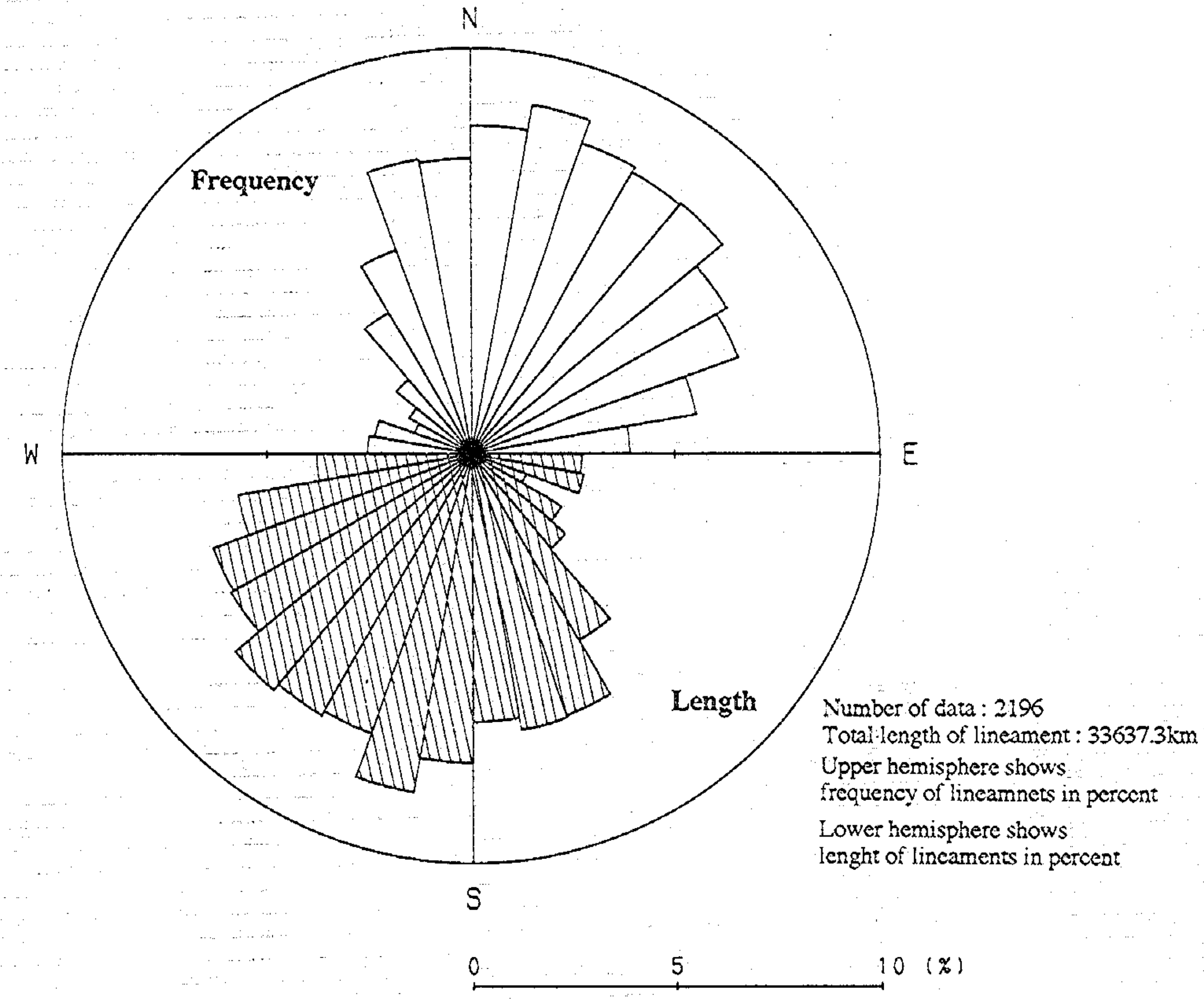


Fig. 2–1–3 Rose diagram of lineaments

distributed on alluvial plains in the coastal region, the Korce inland area and elsewhere. It has all varieties of tones since its terrain is utilized to a considerable extent for irrigated and unirrigated agricultural fields and other purposes. Unit Q4 consists of river flood plains and is distributed along rivers. Its tone is pale bluish green, and its texture is very fine.

2-1-4 Geological Structure

Lineaments were extracted by visual observation on false color images, and lineament analysis maps on a scale of 1:200,000 and a rose diagram were prepared (see Pl.2-1-2 and Fig. 2-1-3).

The lineaments of the area were mostly in the directions between N 20° W and N 70° E, there being few in the east-west direction. In southern to central Albania lineaments in the direction NNW-SSE are predominant, whereas in northern Albania the direction of predominance changes to NNE-SSW. As for the individual lengths, few of the lineaments can be traced uninterrupted for more than 10 km, and most of them have a length of less than 5 km.

At some places it is possible to interpret the thrust fault separating the Internal Albanides from the External Albanides as short lineaments, but at most parts it is not easy to trace them continuously. Lineaments are relatively rare inside ultrabasic massifs. Rather, they occur most often at the boundary between ultrabasic massifs and surrounding formations. There are not many lineaments in areas of Jurassic to Cretaceous melange sediments. In the Neogene sedimentary basin of the Internal Albanides lineaments that intersect the direction of extension of the sedimentary basin at a high angle are conspicuous, whereas in the External Albanides long lineaments in the NNW-SSE direction are predominant.

2-1-5 Relationship Between Lineaments and Mineral Deposits

Many of the copper deposits distributed in the Mirdita zone of the northern part of the Internal Albanides occur on lineaments in the N-S and NNW-SSE directions or on the extensions thereof. Since there is no detailed information available on individual deposits, the relationship between lineaments and types of copper deposits is not clear, however, it is surmised that there is a close relationship between fault system represented by lineaments and the copper mineralization.

Of the copper deposits in the Mirdita zone, the Paluce, Tuc, Spac and Kurbnesh deposits are located on two parallel lineaments distributed intermittently in the N-S direction or the extensions thereof. Furthermore, the Derven and Rbubik deposits are distributed on a lineament running NNW-SSE, and the Thirre deposit is situated on a lineament running NNE-SSW.

Although there is not a clear relationship between chrome deposits and lineaments, there are several chrome deposits known to be located on lineaments. As for nickeliferous laterite deposits, there is no notable relationship between them and lineaments.

2-2 Pre-existing Data Analysis

2-2-1 General

Prior to the geological surveys in field pre-existing data on mineral resources in Albania and the geology and chromite deposits in the Shebenik area were collected and analyzed in order to formulate the policies for carrying out the geological survey in field.

Activities concerning Albania's natural resources are under the control of Albanian Ministry of

Mineral Resources and Energy. Governmental organization concerning natural resources in Albania and the organization of Gjeoalba are shown in Fig.2-2-1 and Fig.2-2-2 respectively.

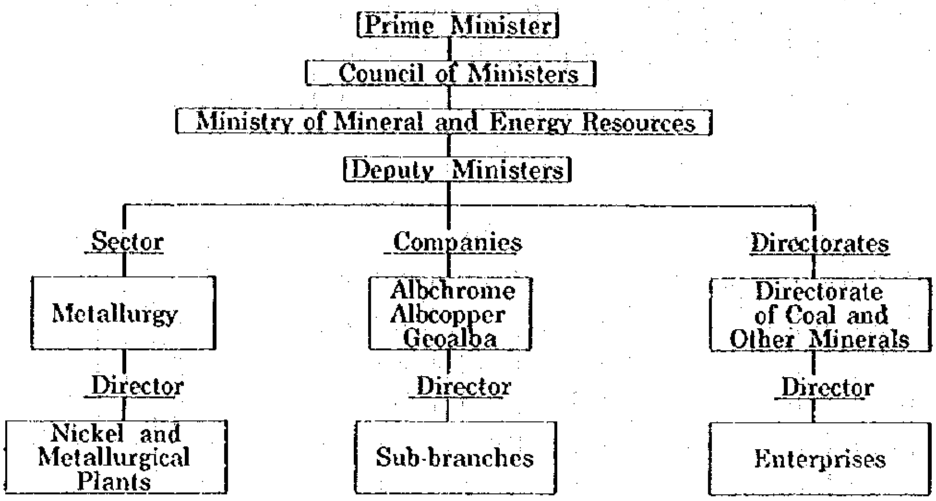


Fig.2-2-1 Governmental Organization on Mineral and Energy Resources in Albania

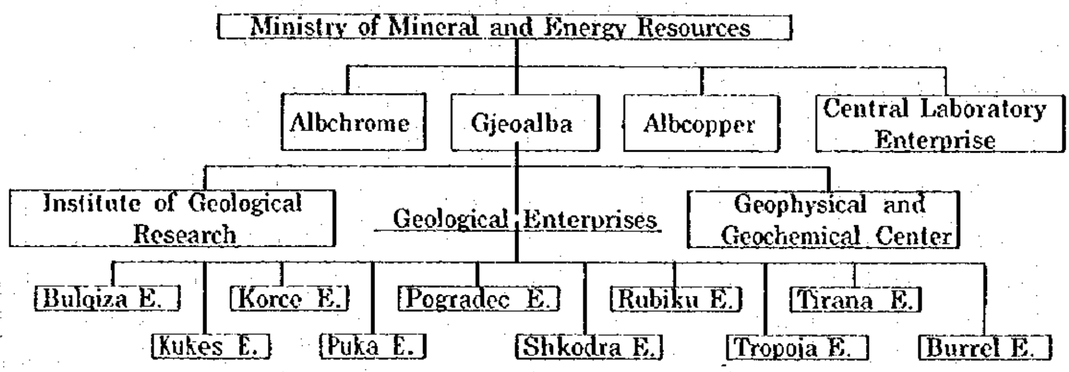


Fig.2-2-2 Organization of Gjeoalba

Of those organizations, available data were collected from the Institute of Geological Research, the Geophysical and Geochemical Center and Pogradec Enterprise, all under Gjeoalba, and the Prenjas Mine, Pojske Mine and others under Albchrome. Geological data and exploration data concerning chromitite deposits and showings in the Shebenik area were collected from organizations under Gjeoalba except the data transferred to Albchrome's jurisdiction, and data on deposits under development or developed in the past, including the Katjel, Pojske and Pishkash-4 mines, were collected from mines under Albchrome. Furthermore, information on the Internal Albanides and the latest statistics on mining products were furnished by Gjeoalba and the Institute of Geological Research. Apx.1 lists the collected data, and statistics on the main mining products are give in the Table 2-2-1.

2-2-2 Mineral resources in the Internal Albanides

The Internal Albanides are endowed with various mineral resources of chrome, copper, nickeliferous laterite, titaniferous magnetite and other metallic resources and also with non metallic resources as well as asbestos, talc, kaolin, gypsum, anhydrite etc.

Table 2-2-1 Annual Main Industrial Production of Albania 1970-1994 (in '000t)

Item	1970	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Chrome ore	466	1003	1110	1159	1075	1109	1199	1011	587	322	281	223
Rich chrome ore	351	501	500	559	419	346	314	316	121	56	82	107
Chrome concentrate	117	170	186	164	160	172	156	88	50	33	12	–
Copper ore	339	768	988	1011	1166	1087	1135	930	561	239	239	177
Copper concentrate	8	26	41	50	55	55	62	49	20	7	14	8
Blister copper	5	9	11	13	13	14	15	11	4	2	2	1.5
Copper wire & cables	3	6	9	10	11	11	12	8	2	0.4	0.5	0.4
Iron-nickel	401	597	905	829	972	1067	1179	930	0	0	0	0
Rolled wrought steel	33	96	107	93	101	96	93	64	–	–	–	–
Steel ingot		134	126	116	126	114	112	79	–	–	–	–
Carbonic ferrochrome		12	12	26	26	38	38	23	–	2.1	34	34
Lignite	605	1418	2100	2166	2134	2184	2193	2070	654	216	133	120
Coal concentrate		146	254	26	274	285	282	267	–	–	–	–
Bitumen grit	26	28	102	94	108	84	98	95	–	–	–	–
Pyrites	38	71	92	54	54	51	48	48	23	9	7	3.3
Refractory bricks	3	4	27	24	28	30	26	25	–	–	–	–

Remarks; 1970-1990: from Mineral Industry in Albania(1992). 1991-1994: from GJEOALBA.

(1) Chrome Ore

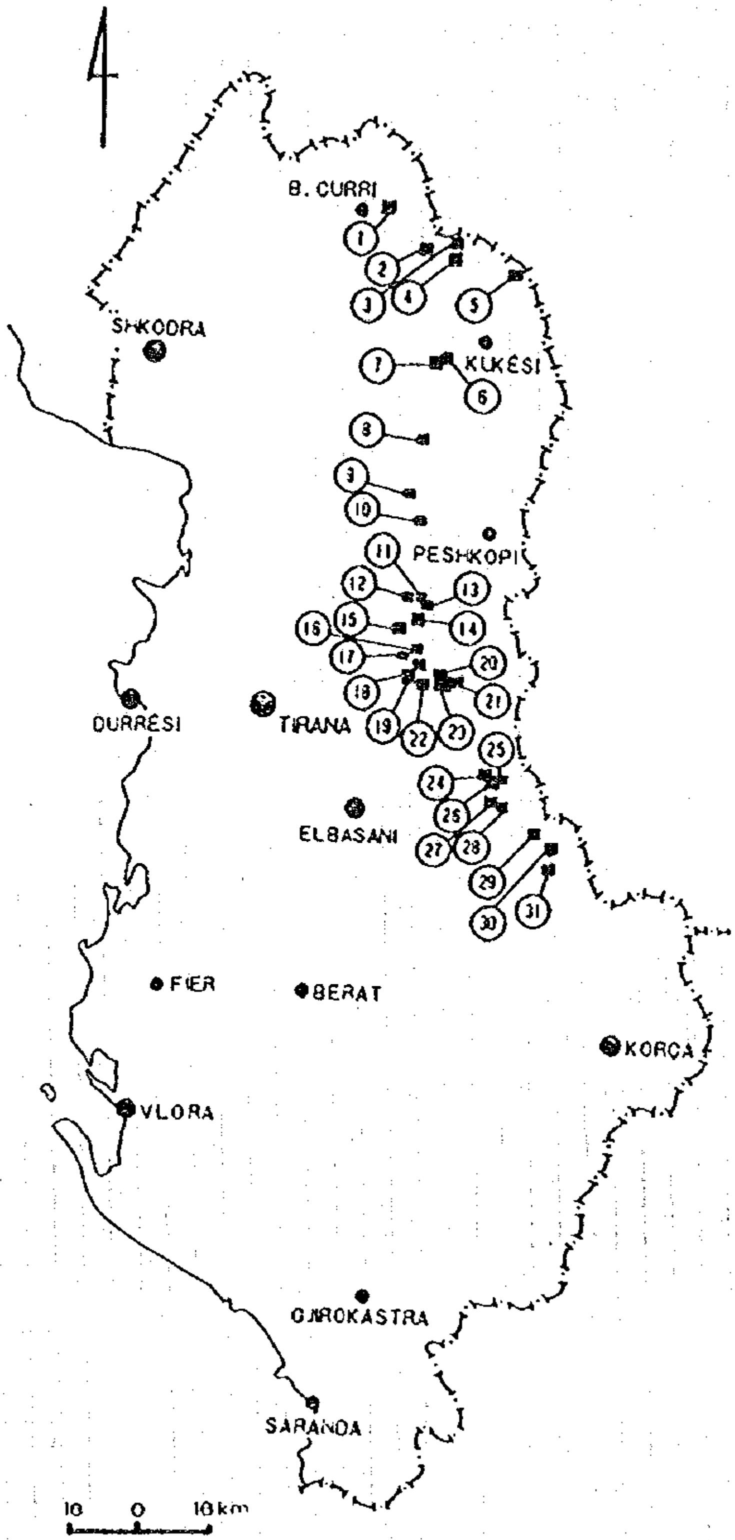
Fig. 2-2-3 indicates main chrome mines exploited within the Tropoja, Kukes, Bulqiza and Shebenik-Pogradec ultrabasic massifs of the eastern zone in the Internal Albanides, Table 2-2-2 gives past productions, Table 2-2-3 the breakdown of the production by the individual mines, and Table 2-2-4 ore reserves as of 1991.

Table 2-2-2 Annual Chromite Production in Albania 1986-1994 (in '000t)

Specification	1986	1987	1988	1989	1990	1991	1992	1993	1994
Total Production	1157.2	1072.6	1108.3	1199.8	1004.2	1586.8	1324.4	281.0	223.0
Lump ore 10-300mm									
41.6% Cr_2O_3	542.3	337.6	347.1	315.8	300.9	124.7	66.5	82.1	107.0
39-40% Cr_2O_3	3.9	8.4	15.1	38.9	7.3	58.5	28	-	-
36-38% Cr_2O_3	12.2	79.3	28.9	52.9	53.7	58.5	28	-	-
30-34% Cr_2O_3	107.3	125.5	182.1	159.9	88.6	60.2	49	-	-
Concentrate	186.1	164.4	160.3	172.3	156.8	87.9	49	33.0	12.0
High Carbon Fe-Cr (63%Cr)	26.0	26.3	38.7	38.8	23.9	25.5	21.6	35.0	33.0

Remarks; 1986-1992 are from Mineral Industry in Albania(1992).
1993-1994 are from GJEOALBA.

During the Second World War exploration of chrome deposits in Albania was undertaken by Italian authorities, and small-scale development of a few thousand tons a year ensued. Systematic exploration of chrome deposits in the Internal Albanides began after the war, resulting in new discoveries of a series of deposits in the ultrabasic massifs of the eastern zone. In the period 1985-1990 Albania ranked the third world producer in chrome ore at an annual production of a million tons, and ore reserves reached 37 million tons up to 1991. Chromite ore production, however, has declined



No	DEPOSITS
1	BRAGAM
2	KAM
3	ZOGAJ
4	KEPENEK
5	VLAHEN
6	SURROI
7	KALIMASH
8	LAJTHIZE
9	HUROHA TOLLES
10	VANAS
11	SELISHTA
12	MANASOREN
13	LIQ. DERVISHIT
14	SHKALLA
15	CERRUJE
16	SULOIZE
17	Q. BUALL
18	BATER
19	LUGU I DERSHISE
20	LUGU I GJATE
21	TERNOVE
22	KRASTA
23	THEKNA
24	LUGU I BATRES
25	GOVATE
26	GOBILLE
27	BUSHTRICE
28	PISHKASH
29	KATVEL
30	POISKE
31	MEMLISHT

Fig. 2-2-3 Location of main chromite deposits in Albania

Table 2-2-3 Annual Chromite Production from Mines 1986-1994 ('000t)

Mine	1986	1987	1988	1989	1990	1991	1992	1993	1994
Kalimash	165.8	186.2	201.0	202.6	194.0	124.2	81.1	44.4	20.1
Kam Tropoja	46.1	67.6	77.0	77.2	54.8	24.0	17.1	14.3	9.6
Bulqiza	475.5	404.1	392.4	343.1	302.3	–	80.6	116.7	105.4
Ternove	4.8	2.4	30.0	41.0	41	–	8.0	9.3	6.3
Bater	380.7	357.8	333.1	410.7	294.9	–	40.6	47.6	45.8
Klos	45.7	26.2	29.1	28.4	44.2	–	11.6	11.5	11.4
Katjel	36.1	28.1	36.7	40.9	37.6	36.4	27.5	21.0	12.8
Pojske	–	–	–	56.2	58.0	35.2	11.7	16.3	11.5

Table 2-2-4 Chromite Ore Reserves of Mines and Projects in 1991 ('000t)

Zone	Mine/Project	Ore Reserves			
		Total	High Grade		Low Grade
			>42% Cr_2O_3	42-38% Cr_2O_3	38-18% Cr_2O_3
North	Kalimash	6,439	-	-	6,439
North	Vlahne	2,848	139	-	2,709
North	Surroj	844	-	-	844
North	Leshnicej	208	-	-	206
North	Rragonni	215	-	-	215
North	Kajenete	735	-	10	725
North	Zogaj 1 to 8	954	15	-	939
North	Kam	185	-	3	182
North	Lugu i Cijinit	305	-	-	305
North	Hija Bushit	662	17	-	645
North	Lajthize	198	161	6	31
North	Qafe Perroraj	523	79	46	398
North	Lugu i Zanit	135	-	-	135
North	Objekte te Tropoja	848	88	65	697
North	Hajdalmatej	21	-	-	21
North	Tpia	90	90	-	-
North	Shepati Yishise	11	-	-	11
Center	Bulqiza	6,651	3,357	863	2,431
Center	Terori-Qaf Bual	1,501	680	285	539
Center	Ternove	500	245	12	243
Center	Pikat	164	57	-	107
Center	Selishte	249	123	-	148
Center	Lure	904	31	-	373
Center	Qafe Lame	257	-	-	257
Center	Livadhi Dashit	249	-	-	249
Center	Batrs+Batra Jugore	2,564	187	369	2,098
Center	Kraste	2,807	-	-	2,807
Center	Maja e Lugit	409	-	-	409
Center	Qafe Burrelit	161	5	7	149
Center	Lugu i Cjate & 10 Korriku	399	61	31	307
Center	Maja e Knores	598	23	-	575
Center	Thekna	1,036	457	40	539
Center	Shkalle	280	124	20	136

Continued

Zone	Mine/Project	Total	High Grade >42% Cr_2O_3	High Grade 42-38% Cr_2O_3	Low Grade 38-18% Cr_2O_3
Center	Cervja	471	-	-	471
Center	Fushe Lope	247	184	-	83
Center	Liqini i Lape	30	30	-	-
Center	Lugjete Kamares	108	-	-	106
Center	Lucane	60	-	44	16
Center	Kaptina	222	-	-	222
Center	Vanas	78	78	-	-
Center	Krasta ne Thelles	224	88	-	136
Center	Maja e Theknes	44	-	-	44
South	Katjel	944	304	229	411
South	Bushtrice Menik	149	6	-	143
South	Pojske	300	49	-	251
South	Cervenatea	37	-	-	37
South	Memlisht	16	-	-	16
South	Cecote	70	7	-	83
South	Pishkash	45	11	-	34
South	Objekte te Shebenik	144	13	9	122
South	Qafe Mesi	7	-	-	7
South	Perroj Lopes	9	-	-	9
South	Objekte te Nemasive	489	-	-	489
South	Mahaite e Epeseme	70	-	-	70
South	Trovice 1 to 2	17	3	-	14
South	Objekte te Prenjas	16	-	-	18
TOTAL		37,338	6,690	2,039	28,609

Remarks; North: Tropoja and Kukes Massifs, Center; Bulqiza Massif, South; Shebenik-Pogradec Massif

since 1991, because of the economical and other difficulties caused by transition to the free-marketing system in 1991, of obsolescence of production facilities, of extraction at deeper levels and of other reasons. In 1994 total ore output is approximately 230,000 tons, most of which now being shipped to domestic ferro-chrome plants.

The main chrome deposits discovered in the Internal Albanides are all to be found in ultrabasic massifs of the eastern zone, and they are classified as Alpine podiform type deposits.

On the other hand, the ultrabasic massifs of the western zone are characterized by chrome spinel of alumino-chromite and some chrome deposits are found in them, indicating their potential is not low. The chrome deposits in the western zone, however, have generally been small in scale and high in aluminium content, therefore, none of them have been exploited economically until now.

Table 2-2-5 shows chemical compositions of chrome spinels from the west and the east zones.

Table 2-2-5 Average Composition of Spinel from Eastern and Western Ophiolite Belts

Ore Type	Cr_2O_3	Al_2O_3	Fe_2O_3	FeO	MgO	Cr/Fe	Cr/Al
Eastern Belt Magno-chromite	50%	10%	5%	14%	13%	3-4	5-6
Western Belt Alumino-chromite	40%	23%	4%	13%	16%	3	2

After Mining in Albania (Mining Journal Research Service and Albanian Ministry of Industry,Mines and Energy, 1992)

(2) Copper Ore

Albania has a long tradition of development and processing of copper, and particularly the ancient Pirsts were famous as being outstanding in extraction, smelting and processing copper ore. But before the Second World War copper was being produced there only by primitive extraction methods at just a few mines. It was not until after the Second World War that systematic exploration and development were undertaken, resulting in unprecedented progress of the Albanian copper industry.

Fig. 2-2-4 shows the distribution of Albanian's main copper deposits, Table 2-2-6 figures on quantities shipped every five years since 1956 and the grades thereof, and Table 2-2-7 actual production figures for copper ore and related products since 1986.

Table 2-2-6 Copper Ore Output in Albania ('000 t)

	1956-'60	1961-'65	1966-'70	1971-'75	1976-'80	1981-'85	1986-'90
Copper Ore '000t	355	725	1,446	2,277	3,390	4,567	5,320
Cu content %	1.86	1.97	2.15	1.81	1.67	1.55	1.42

After Mineral Industry in Albania(1992).

Table 2-2-7 Annual Production and Export of Copper Products in Albania 1986-1994

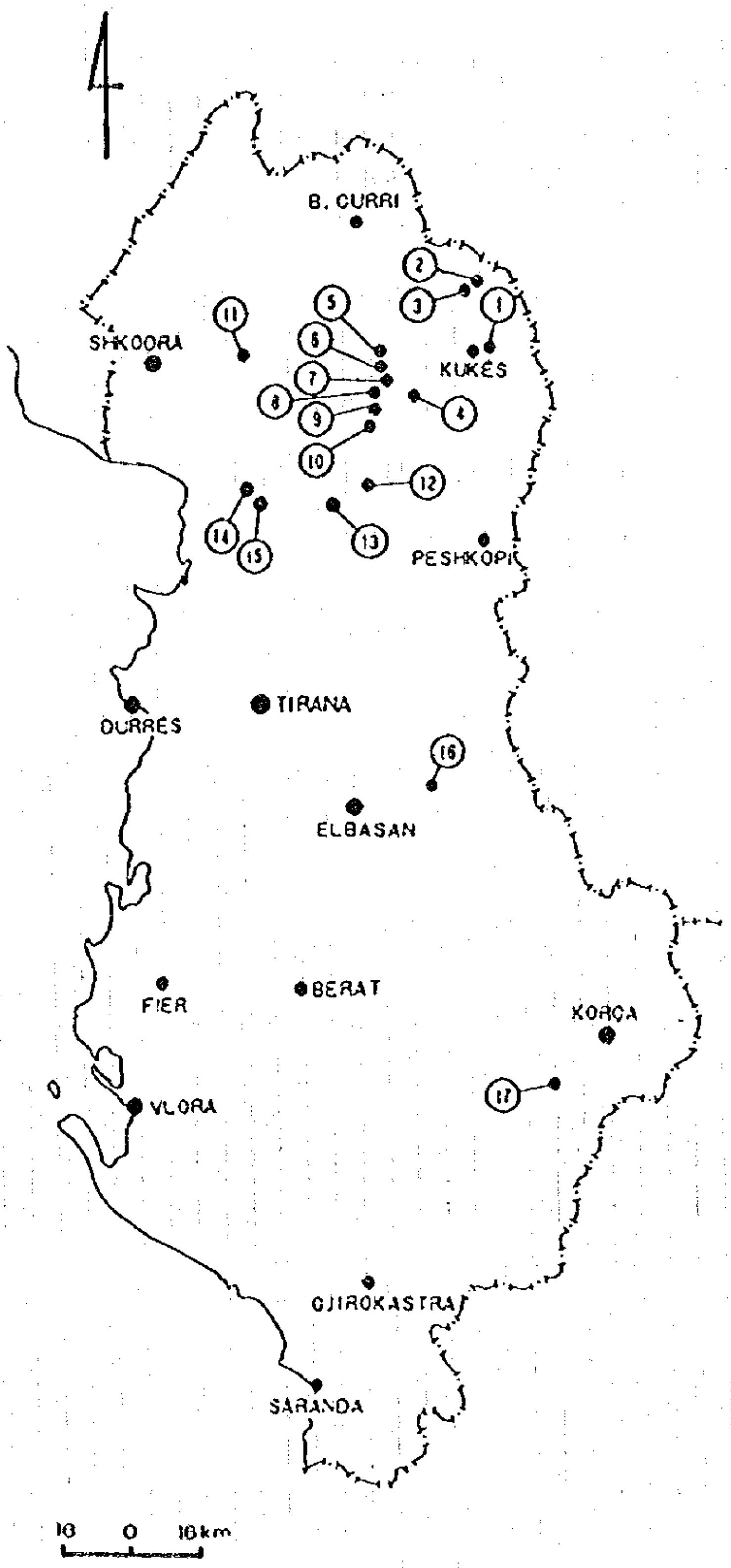
	1986	1987	1988	1989	1990	1991	1992	1993	1994
-Products('000 t)									
Copper Ore	1011.5	1166.2	1087.1	1135.7	930.8	565.5	240.0	239.0	177.0
Copper Conc.	50.2	55.4	55.5	62.5	49.2	16.5	7.8	14.0	8.0
Pyrite Conc.	79.2	72.9	86.1	56.0	49.2	16.5	7.8	7.0	3.3
Pyrite Ore	54.0	54.7	50.9	48.8	48.7	24.2	9.5	-	-
Raw Copper	13.0	13.9	14.8	15.3	11.6	4.8	2.3	-	-
Electolitic Copper	12.3	12.8	14.1	14.5	10.9	4.3	2.1	-	-
Sulphuric Acid	85.0	80.0	81.0	82.0	68.0	20.8	1.1	-	-
Cu Wires & Cables	10.8	11.1	11.6	12.3	8.7	2.2	0.5	0.5	0.4
-Export('000 t)									
Copper Cathode	0.55	0.86	0.84	1.00	1.19	0.63	1.06	-	1.71
Wires & Cables	8.70	9.13	9.32	10.24	6.61	0.74	1.06	-	-
Pyrite Conc.	66.74	62.64	61.42	36.40	0.99	14.66	1.06	-	-
Copper slug	3.35	16.78	13.39	19.50	20.73	14.3	4.21	-	-

After Mineral Industry in Albania(1992).

The copper ore reserves as of January 1, 1991 are 34.4 million tons in category B plus category C_1 and 17.8 million tons in category C_2, for a total of 52.2 million tons, 80% of which is presently under development (MMRE, 1992).

Those copper deposits are geographically distributed in the Has-Kukes, Puke, Mirdita, Shkoder and Korce areas of the ophiolite zone of the Internal Albanides. The most important deposits are located in the area of the central part of the Mirdita zone where volcanics are widely distributed.

The Has-Puke area has many copper deposits, including those of Munelle, Tuc, Qaf Bari, Rruga



No	DEPOSITS
1	GJEGJAN
2	NIKOLIQ
3	GOLAJ
4	THIRRE
5	PALUCE
6	LAK ROSHI
7	TUC
8	QAF BARI
9	MUNELLE
10	SPAÇ
11	PALAJ
12	KURBNESH
13	PERLAT
14	RUBIK
15	DERVEN
16	BASJE
17	REHOVE

Fig. 2-2-4 Location of main copper deposits in Albania

e Rinse, Keire, Paluce, Lak Roshi and Fush Arez, and in the Mirdita area lie the Spac, Gurth, Laj, Kulleshi, Kurbnesh, Perlat, Drenove, Derven Rubik and other important copper deposits. The copper deposits of the Has-Kukes area include the Golaj, Nikoliq, Krume, Gjegjan, Shenmeri and Gdheshte deposits, those of the Korce area the Rehove and Bregu i Geshtenjes deposits, and those of the Shkoder area the Palaj, Karma and Turec-Vig deposits.

The figures for the ore reserves and grades thereof of those different areas are as follows (MMRE, 1992). Kukes area: 7 million tons (1.54% Cu). Puke area: 20 million tons (1.48% Cu). Mirdita area: approx. 20 million tons (1.4% Cu). Shkoder area: approx. 4.2 million tons (2.35% Cu). Korce area: 2.4 million tons (1.99% Cu).

Those copper deposits are thought to have been formed in connection with intrusion and extrusion of basic to intermediate to acidic magma, and the mineralization can be broadly divided into two categories: that accompanied by iron sulfides and vein/vein type metasomatic deposits. A further subdivision is possible for the former into (1) volcano-sedimentary deposits and (2) massive sulfide deposits and the latter into (3) deposits accompanied by small quantities of pyrite, calcite, serpentine minerals and chlorite but the main constituents of which are pyrrhotite and chalcopyrite and (4) deposits consisting of chalcopyrite, pyrite, quartz and chlorite is possible.

The volcano-sedimentary deposits, i.e. (1) above, (e.g. the Gjegjan copper deposit) are connected with the igneous activity of basic extrusive rocks interbedded with metamorphosed sedimentary rocks and are covered by late Triassic to Jurassic carbonates. The deposits show a lenticular form of various size, and they generally occur at the boundary between extrusive rocks and siliceous to aluminous sedimentary rocks in concordance with those structures. They may correspond to the Kieslager so-called Besshi-type deposits in Japan.

The ore of the Gjegjan deposit is mainly composed of pyrite, chalcopyrite and hematite, accompanied by small quantities of magnetite and sphalerite. Besides sulfides, there are quartz, chlorite and sericite. The texture of the ore varies considerably as massive, vein, brecciated and other textures, and ore bodies are frequently faulted in blocks after copper mineralization.

The massive sulfide deposits, i.e. (2) above, all occur in the volcanic rocks such as diabase, spilite and keratophyre of the central part of the Mirdita zone. This type of copper deposits is characterized by presence of folded structures and hydrothermal alteration, and are considered to have been formed in the Jurassic period. The Spac and Rehove and other copper deposits related to such volcanic rocks have a mode of occurrence of lenticular to disseminated form, consisting of pyrite, chalcopyrite, marcasite, sometimes sphalerite and small quantities of galena. Those deposits may correspond to the Cyprus type copper deposits.

The vein type to vein type metasomatic deposits, i.e. (3) and (4) above, are considered to be related to basic to intermediate intrusive rocks in Jurassic period. They occur in various geological conditions as vein form deposits. Thickness of ore body vary from several millimeter to several meters, and the zone of mineralization continues for several hundred meters. Such deposits are considered to have been formed in a wide range of temperature, however, the main mineralization probably occurred under mesothermal condition. The ore shows characteristically massive, brecciated and disseminated texture. The main constituent mineral is quartz, accompanied by small quantities of pyrrhotite, chalcopyrite, pyrite and calcite and sometimes sphalerite, magnetite and cobaltite.

Recently existence of poli-metal mineralization has been discovered in northeastern Albania. The ore consists fine-grained pyrite, galena and sphalerite accompanied by small quantities of chalcopyrite. It is surmised that such mineralization is of the pyrite vein type.

Development of all those copper deposits is being undertaken in the Has-Kukes area by the Golaj and Gjegjan mining enterprise and the Fush Arez, Spac, Kurbnesh, Rubik and other mines, in the Shkoder area by the Shkoder mine, and in the Korce area by the Rehove and other mines, including both mining and dressing. The dressed concentrate is smelted and electrolyzed at the Kukes, Rubik and Laci smelters, and the electrolytic copper is processed into wire and electric cable at the Shkoder plant.

(3) Nickeliferous Laterite and Silicate-Nickel Ore

Fig. 2-2-5 shows the distribution of nickel deposits in Albania. Nickeliferous laterite is one of the richest mineral resource endowments in Albania. Geologically they are closely related to ultrabasic massifs of the eastern zone of the Internal Albanides. Almost of all exploited deposits are distributed in the Kukes and the Shebenik-Pogradec ultrabasic massifs with one exception of the Bitincke deposit in the Korce area.

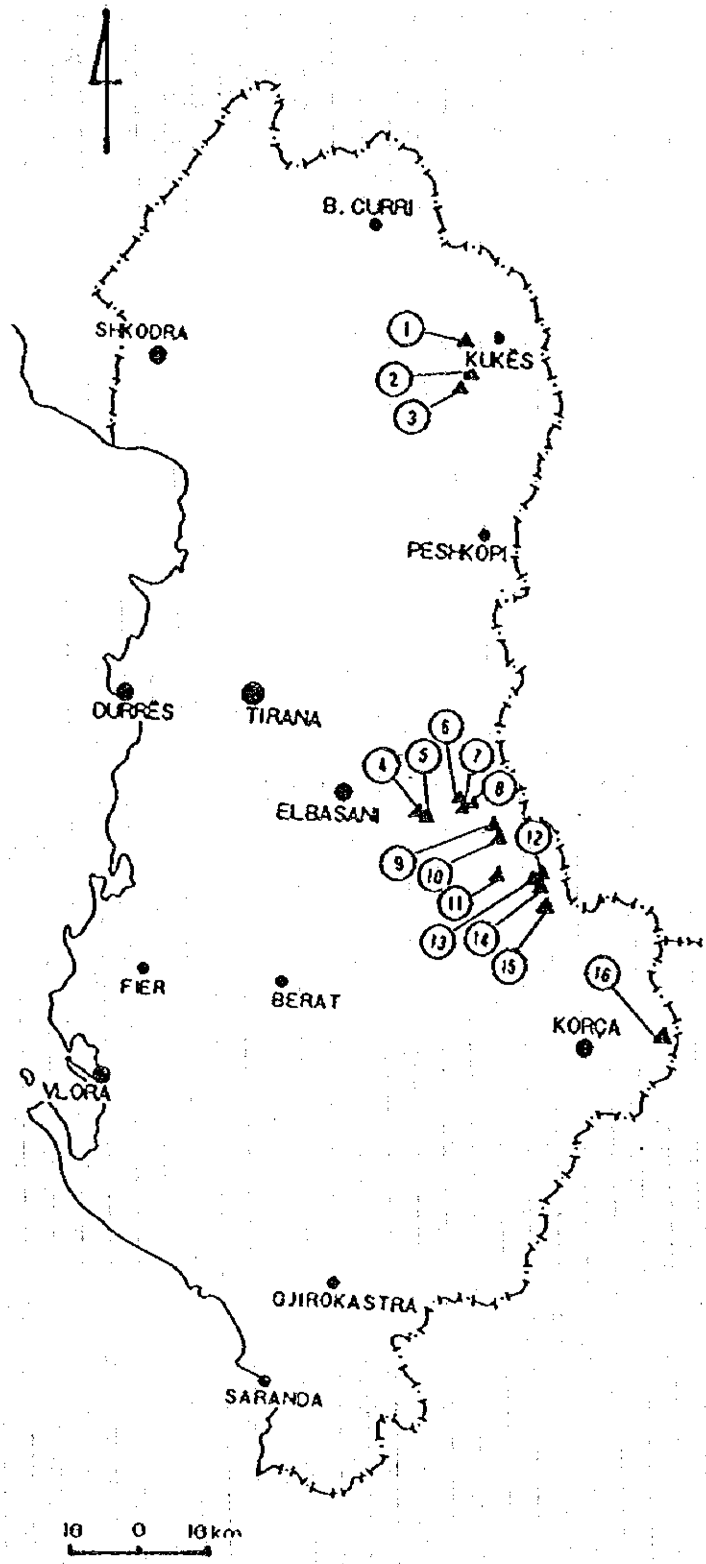
The confirmed ore reserves of the Kukes, Shebenik-Pogradec and Korce ultrabasic massifs as of 1991 reach more than 368 million tons in total as shown in Table 2-2-8.

Table 2-2-8 Ore Reserves of Ni-Fe and Ni-Silicate deposits in Albania

Ore Deposit	Ore Reserve '000 t	Content (%)			
		Fe	Ni	SiO_2	Co
(1) Ni-Fe Deposits	266,577	42.33	0.98	12.78	0.063
Prenjas	35,839	46.76	1.03	9.66	0.059
Bushtrice-Skroske	41,657	48.02	1.02	5.3	0.071
Katjel	602	32.9	1.22	28.65	0.065
Rodokal	122	50.8	1.08	6	0.065
Guri i Pishkash	70	48.61	0.99	5.74	0.060
Gradishte	264	46.6	0.73	3.91	0.051
Guri i Pergjegjur	201	48.05	1.02	6	0.060
Guri i Kuq	60,872	42.14	0.097	17.22	0.063
Cervenake	16,534	44.18	0.93	14.11	0.065
Bitinke	52,277	41.87	1.12	9.61	0.076
Xhumage-Liqeni i Kuq	30,279	35.38	0.67	16.1	0.047
Truli-Shroj-Mamez	24,654	34.5	1.01	21.3	0.052
Nome(Kukes)	420	33	1	20.3	0.050
Hudenisht	2,583	49.71	0.82	4.94	0.069
Berzhite	200	42.3	0.84	7.3	0.055
(2) Ni-Silicate Deposits	102,328	18.28	1.13	36.92	0.013
Bitincke	50,224	16.38	1.28	24.10	0.038
Trull-Suroj-Mamez	48,880	20.0	0.98	39.61	0.018
Nome(Kukes)	3,224	21.75	1.22	40.03	0.019

After Mineral Industry in Albania(1992).

Those deposits were formed as a weathered crust of the ultrabasic rocks and occur as laterite with secondary nickel enrichment or as intensely decomposed rock with garnierite. The deposits are covered by Cretaceous limestone or Eocene calcareous molasse, clearly separated from them, however, the foot wall side of the deposits is generally unclear and gradual transition to weathered ultrabasic rocks. Normally from down to upper it changes gradually from serpentinized ultrabasic rocks to



No	DEPOSITS
1	VRANISHT
2	MAMEZ.
3	SUROJT
4	LIQENI I KUQ
5	XHUMAGE
6	BUSHTRIÇE
7	BUSHTRICE
8	SKROSKË
9	GUR- PISHKASH
10	PRENJAS
11	DEBROVE
12	HUDENISHT
13	GURI I PERQJEQJUR
14	ÇERVENAKE
15	GURI I KUQ
16	BITINCKE

Fig. 2–2–5 Location of main Fe–Ni and Ni–Silicate deposits in Albania

intensely weathered ultrabasic rocks with or without silicate-nickel mineralization then to laterite with nickel mineralization. Silicate nickel is concentrated mainly in the Korce and Kukes areas.

Those deposits had been operated at the Prenjas, Guri i Kuq, Bitincke and other mines. A part of the ore had been exported to Czechoslovakia, and the rest refined at the Elbasan metallurgical plant after dressing at the Guri i Kuq mine, but after the transition to a free-market economy the Elbasan nickel metallurgical plant was closed down, and exports to Czechoslovakia, the main export market since 1959, were stopped in 1990. Subsequently, all of the mines involved in development of nickeliferous deposits were closed down.

Table 2-2-9 shows the ore output and production rate of concentrate up to 1990.

Table 2-2-9 Fe-Ni Production in Albania 1986-1990 ('000 t)

Item and Mine	1986	1987	1988	1989	1990
(1) Fe-Ni Ore	828	973	1,067	1,179	931
Prenjas	404	482	521	582	534
Guri i Kuq	357	420	446	515	367
Bitincke	67	71	100	82	30
(2) Fe-Ni Concentrates	310	326	334	421	208

(4) Other Mineral Resources

Besides the above metallic deposits, the Internal Albanides are abundantly endowed with titaniferous magnetite, nickeliferous sulfides, gold, platinum group metals and other metallic deposits related to the ultrabasic rocks of the Internal Albanides.

Titaniferous magnetite is concentrated in the ultrabasic rocks of the western zone of the Kashinjet area, the ore reserves of whole the area being estimated at about 1.37 million tons (grade: 6% TiO_2, 18% Fe_2O_3, 0.2-0.3% V_2O_3). Those deposits occur as outcrops and have a thickness that varies between 10 m and 200 m. Since many of them are thick deposits, there are high expectations as to the possibility of developing them in the future.

As nickeliferous sulfide deposits, approximately 0.5 to 1.5 million tons have been discovered in the ultrabasic rocks of Qaf Dardhe, Krasta, Lumth and elsewhere. Those deposits contain 0.5 to 0.6% Ni, 0.2 to 0.3% Cu and 0.1 to 1.5 g/t of platinum group elements and also include some Se, Te, Au, etc.

Gold occurs in sulfide deposits, especially those accompanied by zinc and arsenic, and is recovered as a byproduct in copper smelting. It is also found in quartz sulfide deposits occurring between the ultrabasic rocks and basic volcanic rocks of the ophiolites. The gold mineralization discovered so far is of low grade, about 2-3 g/t. Neither large-scale nor high-grade deposits have yet been discovered.

It has long been a well-known fact that Albania's chrome ore contains platinum group elements as traces. Recent research on such platinum group elements has revealed the following four types of mineralization of platinum family elements:

a) Mineralization of Ru, Os and Ir occurring in chromite deposits produced in the deep mantle.

b) Mineralization of Pt occurring in chromite deposits produced in the upper part of the mantle.

c) Mineralization of Pd related to sulfides among dunites in cumulates.

d) Mineralization of Pt related to chromitite at the boundary between dunite and pyroxenite.

Platinum group deposits that can be classified as type d) above have recently been discovered in the Tropoja ultrabasic massif distributed in northeastern Albania, and attention is being drawn to them as possible future metal resources for the country.

Besides the above metal resources, there has been discovery of the following industrial mineral resources in the ultrabasic massifs of the Internal Albanides: olivinite (e.g. the Kalimash deposit in the Kukes area: 60 million tons of ore reserves, 47.5-48% MgO, other large deposits at Shkalle, Gjinar, Iballe and elsewhere), dolomite, gypsum, clay, etc. There are also abundant coal resources consisting mainly of peat in the Tertiary sedimentary basins developed by filling intermontane lowlands that have been exploited as fuel resources. For instance, although far less imposing in terms of quantity of ore reserves than the Tirana-Durres basin, the Pogradec and Korce basins have confirmed ore reserves of 33.4 million tons (3,100 kcal/kg) and 32.4 million tons (2,770 kcal/kg), respectively, and some extraction is still continuing there.

2-2-3 Previous Surveys of the Shebenik Area and Chromite Deposits

(1) Previous Surveys

As already mentioned, numerous chromite, nickeliferous laterite and other deposits have been discovered and exploited in the Shebenik-Pogradec ultrabasic massif of the Shebenik area. Up to 1990 that area prospered as Albania's largest producer of nickeliferous laterite, however, the mines and dressing plants concerned the nickeliferous laterite deposits have been closed down, leaving lately in operation only the Prenjas and Pojske chromite mines of Albchrome.

As an area well endowed with mineral resources, the area has in the past seen a great deal of organized exploration. Fig. 2-2-6 indicates the areas of the main surveys together with the major chrome deposits involved.

During the Second World War Italian authorities carried out prospecting for chromite and nickeliferous deposits by trenches and galleries in the area, but very fragmentary information remains.

After the war many systematic surveys were carried out in view of the high mineral potential of the Internal Albanides. In the fifties comprehensive surveys of the Shebenik-Pogradec ultrabasic massif, including geochemical explorations by mean of groundwater, stream sediments, heavy minerals etc., and geological surveys were undertaken with the assistance of the former Soviet Union, and a report on them was compiled around 1960. Those works revealed high potentiality of the area in chrome and nickeliferous laterite and also revealed the possibility of platinum group elements, leading to the beginning of the rapid development of nickeliferous laterite deposits and new discoveries and development of chrome deposits in the Librazhd and Pogradec areas that took place in the sixties and subsequent years.

Comprehensive surveys, including magnetic and geochemical exploration, geological surveys and drilling, were undertaken by what is now Gjeoalba and its Librazhd and Pogradec branch offices in the Shebenik-Pogradec massif, resulting in elaboration of the geological maps on a scale of 1:25,000 (1983) and 1:10,000 (1985), and in geological maps on a scale of 1:50,000 printed and published in 1994 on the basis of those previous works. Also a geological map in the central part of the Shebenik massif to the north of the Bushtrice River on a scale of 1:10,000, which indicates structures of harzburgite and classification of the massif by percentage of dunite in the harzburgite, was prepared in 1991.

In coordination with those regional surveys ongoing surveys on scales of 1:5,000, 1:2,000, 1:1,000 and 1:500 have been and are continuing to be carried out in parallel with them in promising areas. Table 2-2-10 indicates the main projects carried out by the Pogradec Enterprise.

Table 2–2–10 Exploratory Works Conducted in Shebenik – Pogradec Ultrabasic Massif

No.	Resist. Number	Year	Area km²	Scale	Item	Organization	Method and Remarks
1	189	'68-'71		Project Finding	Cr	GEP	Data collection Sheb.-Pog.Msf.
2	211	'71-'72	270	1:50,000	Cr etc.	GET	Revise on Str-geol. Sheb.-Pog.Msf
3	177	'70-'71		Reserv. Calc.	Cr	GEP	Drill;232m,Gallery;343m Memlisht Dep. Trench;1,425m³, Scale 20m×3m×45m
4	320	'72		Revise Deposits on PGE		GET	Revise on Fe-Ni & Cr deps. in the area.
5	209	'73	20	1:10,000	Cr	GEP	Str-geol. Govata & Gobilla
6	261	'74		Reserve Calc.	Fe-Ni	GEP	Revise,B+C1+C2=711,246t Gradishte Dep.
7	268	'74		Reserve Calc.	Fe-Ni	GEP	Revise,B+C1+C2=7,806,353t Bushtrice
8	7/d2	'74-'79	15	1:10,000	Cr	GEP	Geol. Katjel-Sheshbush-pojske
9	297	'79		Reserve Calc.	Cr	GEP	Drill;7,253m,C1+C2=83,272t for Katjel
10	318	'76-'80	34	1:10,000	Cr,PGM,Cu	GEP	Geol. Qaf Shul-Guri i Korbit
11	420/d1	'78-'80	40	1:10,000	Cr etc.	GEP	Geol. Katjel-Bushtrice
12	349	'81		Reserve Calc.	Fe-Ni	GEP	Revise,B+C1+C2=3,068,397 Cervenake
13	409	'83-'85	270	1:25,000	Cr	GI,GEP	Geol, Geoph, Geoch. Sheb.-Pog.Msf
14	526	'88		Reserve Calc.	Fe-Ni	GEP	Guri i Pergjegjur Dep.;Drill 1,736.8m Gallery 149.0m, B+C1+C2=1,297,754t Cervenake Dep.: Drill 16,723.1m B+C1+C2=3,982,529t
15	479	'88-'89	32	1:10,000	Cr,PGE	GI,GEP	Geol,Geoch,Mineralo Katjel-Cervenake
16	527/d	'89		Reserve Calc.	Cr	GEP	Drill;11,387m, Shaft;38.3m, Gallery;5.8m, Trench;865m C1+C2=346,812 t at Pojske Deposit
17	506	'89-'91	270	1:50,000	Cr	GI,GMF,GEP	Geol,Petrol,Min. Sheb.-Pog.Msf.
18	?	'91	150	1:10,000	Cr	GEP	Geol,Str-Geol,Min. Central Shebenik

Remarks; Regist.Number; Registered number of Pogradec Enterprise's Archive,
GEP;Geological Enterprise Pogradec, GET;Geological Enterprise Tirana,
GI;Geological Institute, GMF;Geology-Mine Faculty,
Geol.;Geological survey, Geoph.; Geophysical survey, Geoch.;Geochemical survey,
Str-Geol.;Structural geological Study, Petrol.;Petrological study,
Min.;Mineralogical study, Sheb.-Pog.Msf.;Shebenik-Pogradec Massif, Dep.;Deposit

In the case of nickeliferous laterite deposits, after the geological surveys a deal of drillings were carried out on a 200 m x 100 m grid in areas where ultrabasic rocks were covered by Cretaceous and Eocene formations particularly weathered ultrabasic rock covered by Eocene calcareous molasse, and then ore reserves were precisely calculated.

As for chrome deposits, comprehensive surveys, including geological survey and magnetic and gravimetric explorations, were carried out in the semi-detailed stage on scales of 1:5,000, 1:2,000 and 1:1,000, and in the detailed stage exploration by mean of trench, gallery, shaft and drilling were carried out to prepare geological data on a scale of 1:500 to serve as a basis for subsequent ore reserves calculation. Up to date 33 chromite deposits are calculated their ore reserves.

That enormous quantity of survey information passed to the Pogradec Enterprise, which is presently keeping it, after the Librazhd branch office of Gjeoalba, which was responsible for

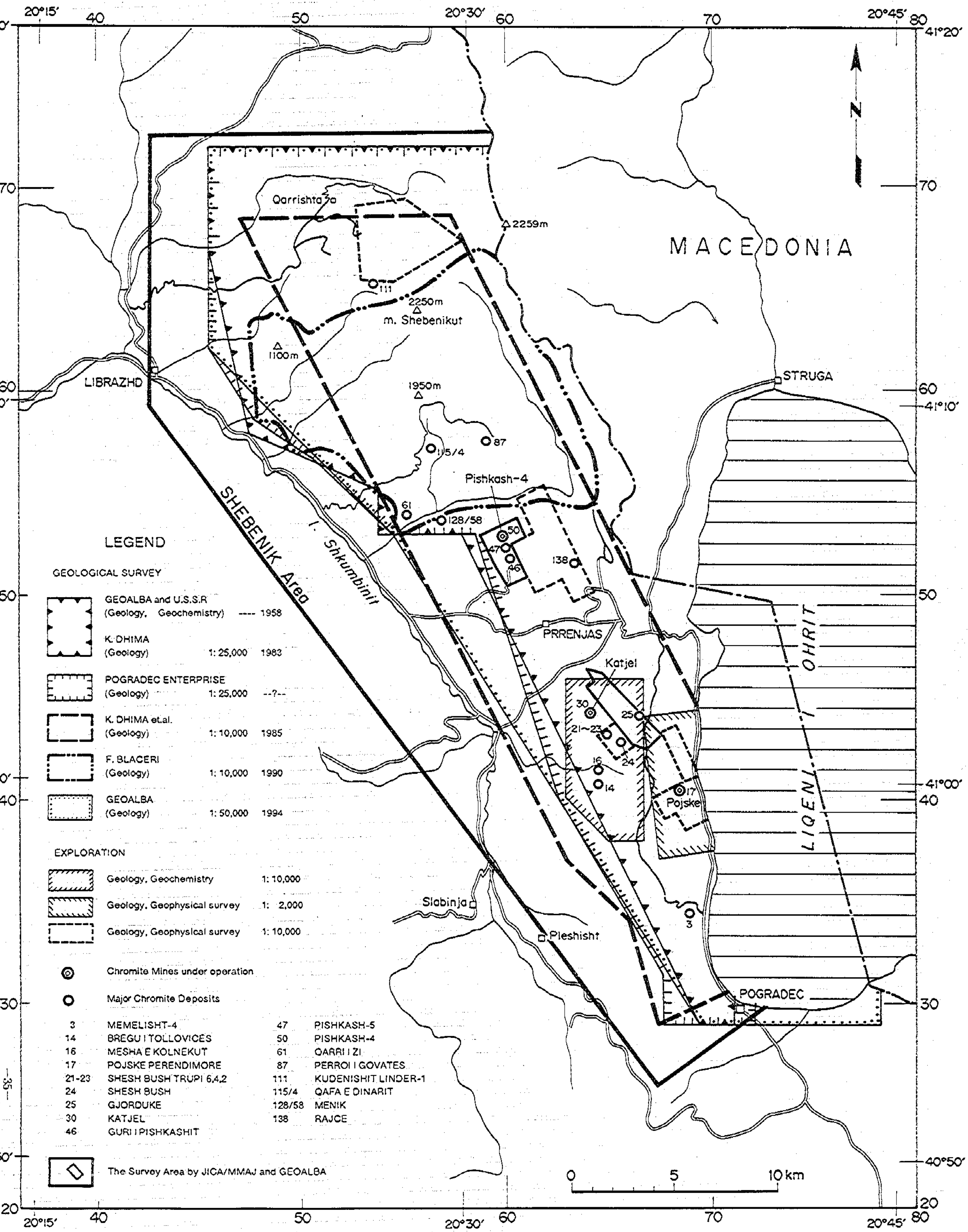


Fig. 2-2-6 Previous exploratory works in the Shebenik area

exploration of the Shebenik massif, closed down. But the documents and records on projects in which Tirana Enterprise did the exploration directly, projects undertaken by the Geophysical and Geochemical Center and areas for which exploration and development was transferred to Albchrome are being kept by those respective organizations.

For the data analysis purposes of the present project the organizations keeping information on the Shebenik area were visited for collection of data, however, such collection being limited to general geology and chrome deposits in view of the fact that the purpose of the present project is exploration of chrome deposits and that such an enormous volume of information is being kept by those organizations.

(2) Chromite Deposits

As already mentioned, a very great many chrome deposits and showings have been discovered within the area of the Shebenik-Pogradec massif. The survey findings and records concerning each of them are controlled by identification number and indication name. Since all those records and findings are in the Albanian language, in the pre-existing data analysis items were selected taking into account the contents of the documents being kept, and hearings were held on the basis of the documents for the purpose of compiling the results in tabular form. Besides that, copies were made of the maps compiled on the basis of information on developed deposits and the results of exploration of main deposits.

Apx.1 is a list of the documents and data collected on the Shebenik area, and Table 2-2-11 (1) and (2), is the results of the hearings on chrome deposits and showings in the Shebenik-Pogradec massif. The location, ore reserves, amount of extracted ore, size of ore deposit, quantity of survey, etc. are indicated in Table 2-2-11 (1) for which the ore reserves were calculated.

Of the deposits for which ore reserves have been calculated, following deposits have actually produced chrome ores: Guri i Pishkashit, Pishkash-4, Bushtrice, Menik and Qarri i Zi in the Shebenik massif and Memlisht-4, Cervenake, Qershori Pojske and Katjel in the Pogradec massif. Of those, three are still under operation, that is, Pishkash-4, Qershori Pojske and Katjel. The total past production of those mines has been approximately 700,000 tons, of which about 530,000 tons, approximately 75% of total production, has been mined from the two mines Pojske and Katjel. A small production might yield during the exploration from Kudenisht, Qafa e Dinarit, Govates, Gobilla and elsewhere along the Bushtrice River in the Shebenik massif and from the Gjorduke, Memlisht and other deposits in the Pogradec massif.

In 1985 Gjeoalba made an exploratory conclusion and recommendation (Cili et al., 1985) for the chrome exploration in the Shebenik-Pogradec ultrabasic massif based upon the results obtained up that time. Those are summarizes together with the present survey as follows;

(1) The Shebenik-Pogradec ultrabasic massif has an anticlinolium structure, and in the axial part and deeply eroded part of the anticlinilium are composed mainly of tectonites while the northern part of the massif, an upper part, is of cumulates.

(2) Among lower par of the tectonites the following three horizons are distinguished, from lower to upper, (a) a hurzburgite, (b) a serpentinized hurzburgite with dunite, and (c) a serpentinized hurzburgite with dunite intercalation. The mineralized zone of the Fushe e Madhe - Gjorduke deposits are discovered in the first horizon near the contact with the second, Katjel - Gobilla deposits were in the lower part of the second horizon, Tollovice - Bushtrice

Table 2-2-11(1) Chromite deposits in Shebenik-Pogradec ultrabasic massif

Ser. No.	No. on Map	Deposit, Object of Ore Bodies	Location Long X	Location Lat Y	Location Alti Z	Ore Texture	Ore Reserves (t) A+B	C1	C2	Total	Extract. Reserve	Residual Reserve	Cr2O3 Ave. Cont.%	Dimension (m) in Strike	in Dip.	Aver. Thick.	Elements (°) Strike Dir.	Dipping Angle	Plunge Dir.	Plunge Dip	Discovery and Notes
		POGRADEC																			
1	3	Memelisht-4	68,999	34,620	840	Msv, Dsm	12,000	11,500	1,500	25,000	12,000	13,000	35.8	30	20	0.8	30	90	0	-	
2	200	Cervenake	66,530	36,830	1,330	Msv, Dsm		11,500	5,500	17,000	10,000	7,000	27.7	40	30	1.0	150	90			
3	5	Gradishte	68,360	37,630	1,110	Msv, Dsm		2,000	500	2,500		2,500	42.0	5	10	0.4	130	85 NE			
4	120	Hudenisht(Polje)	69,970	38,310	750	Msv,Bnd, Dsm		2,000		2,000		2,000	36.0	17	15	0.7	20	80 SE			
5	126	Mocal	65,780	38,400	1,300	Bnd		3,000		3,000		3,000	18.0	40	20	0.9	100	67 S			
6	7	Kalishte	64,510	39,320	1,032	Bnd, Dsm		1,000	1,000	2,000		2,000	32.0	12	20	0.8	220	80 SE			1982-83
7	212	Shkembi Mivres	63,760	39,800	1,100	Msv, Dsm		2,000	300	2,300		2,300	30.0	25		2.8	20	76 SE			
8	11	Kosharishte-1	68,690	39,970	986	Msv, Dsm		500		500		500	24.0	10		0.3	160	80 NE			
9	14	Bregu i Tollovices	64,600	40,850	1,100	Msv, Dsm		4,666	3,222	7,888		7,888	21.5	80	30	0.6	135	65 NE	300	30	
10	15	Guri i Pellumbit	63,470	41,420	785	Msv, Dsm		700		700		700	45.0	14	10	0.8	105	80 SW			
11	16	Masha e Kolnekut	64,490	41,510	1,050	Msv, Dsm		9,700	10,500	20,200		20,200	28.0	70	30	0.7	133	73 NE			
12	17	Pojske Perendimore	68,430	41,960	1,000	Msv, Dsm		6,800	400	7,200		7,200	25.2	60	50	0.8	153	85 NE			
13	17/1	Pojske "I Qershori"	68,520	42,160	940	Msv, Dsm		427,200	15,900	443,100	190,382	252,718	35.7	130	100	3.0	150	70 NE	330	25	now working
14	24	Shesh Bush (Trupi No.1)	65,800	42,875	1,210	Nod,Bnd, Dsm		2,000		2,000		2,000	40.0	35	10	0.7	150	85 SE			1957
15	211	Bregu i Mellenzes	63,220	43,000	800	Bnd, Dsm		1,800	1,200	3,000		3,000	20.0	7-10	10	1.0	125	80 NE			
16	25/1	Gjorduke (Fusha e Madhe)	66,400	43,930	1,250	Msv.Bnd, Dsm		14,699		14,699	4,553	10,146	33.0	40	30	0.6	150	60 NE			
17	27	Katjeli	63,700	44,970	860	Msv, Dsm		660,125	160,548	820,673	339,177	481,496	42.1	350	300	1.0	150	70 NE	115	25	now working
		SHEBENIK																			
18	46	Guri i Pishkashit	60,110	51,730	980	Msv		11,674	4,171	15,845	15,845	0	45.2	100	60	1.0	150	40 NE	330	30	Mine out
19	135	Mbi Pishkash Veri	59,990	52,270	1,040	Dsm		3,500	900	4,400		4,400	23.5				130	60 NE			
20	215	Bushtrice	65,760	52,780	400	Msv, Dsm		50,000	10,000	60,000	10,000	50,000	33.9	80		1.1	17	90			
21	57	Bushtrice II	56,570	53,500	875	Bnd,Dsm		40,974	2,061	43,035		43,035	32.5	3		2.0	65	SE			
22	128/58	Menik	56,760	53,800	600	Bnd,Dsm		67,242	17,045	84,287	82,215	2,072	28.6	300	80	1.0	24	90			
23	50	Pishkash-4	59,870	52,900	1,200	Msv, Dsm	2,680	6,354	2,116	11,150	6,396	4,754	44.6	25	150	1.2	170	40 NE			now working
24	61	Qarri i Zi	55,390	53,960	640	Msv,Bnd, Dsm		1,200	600	1,800	1,600	200	31.0	30	30	1.0	150	90			
25	115/4	Qafa e Dinarit	56,360	56,850	1,280	Msv		2,850	1,680	4,530		4,530	41.0	50		0.8	160	30 SW			
26	87	Perroi i Govates	59,110	57,550	1,550	Msv, Dsm		30,065	8,035	38,100		38,100	37.6	110	40	1.2	170	60 NE	315	30	1973-74
27	164	Kuman	53,500	60,470	1,350	Dsm		6,000	5,700	11,700		11,700	36.0	50		1.2	0	15 W			1988-89
28	161	Vatb Pele	52,630	61,110	1,220	Bnd		?	?	27,000	27,000	0	22.0	100	40	0.7	170	70 SW			
29	97	Fund Fusbe	51,470	61,300	1,240	Dsm		9,900	4,700	14,600		14,600	39.2	15		0.4	100	70 NE			1957-92
30	109	Kudenishti Perendimor 1	52,870	65,575	1,300	Msv,Bnd, Dsm		8,000	4,800	12,800	2,000	10,800	21.6	40	15	0.7	160	70 NE			1957-88
31	111	Kudenishti Linder -1	53,340	65,670	1,870	Msv, Dsm		3,100	800	3,900		3,900	35.0	35	10	1.0	0	80 W			1957-
32	110	Kudenishti Perendimor 2	53,920	65,780	1,850	Msv, Dsm		6,500	2,200	8,700		8,700	24.0	100	15	0.9	160	70 NE			1957-
33	112	Kudenishti Linder -2	54,050	65,900		Dsm		6,500	2,200	8,700		8,700	38.0								
Total Sum			-	-	-	-	14,680	1,415,049	267,578	1,724,307	701,168	1,023,139	-	-	-	-	-	- -	-	-	
Number			33	33	32		2	32	26	33	12	33	33	30	24	31	32	31 -	6	5	
Mean Value			61,422	49,052	1,104	-	7,340	44,220	10,291	52,252	58,431	31,004	32.2	67	47	1.0	116	71 -	232	28	
Maximum Value			69,970	65,900	1,870	-	12,000	660,125	160,548	820,673	339,177	481,496	45.2	350	300	3.0	220	90 -	330	30	
Minimum Value			51,470	34,620	400	-	2,680	500	300	500	1,600	0	18.0	3	10	0.3	0	15 -	0	25	

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Remarks ; Msv: massive ore, Bnd: banded ore, Nod: nodular ore, Dsm: disseminated ore

Pogradec Ultrabasic Massif

Table 2-2-11(2) Known chromite showings in Shebenik-Pogradec ultrabasic massif 1/3

Ser. No.	No. on Map	Deposit Object of Ore Bodies	Location Long X	Location Lat Y	Location Alti Z	Ore Texture	Cr_2O_3 Ave. Cont. %	Dimension (m) in Strike	Dimension (m) in Dip.	Dimension (m) Aver. Thick.	Elements Strik Direc	Elements Dip. Angle	Elements Plunge Dir.	Elements Plunge Angle	Perspect. on Str	Perspect. on Dip	Perspect. on Plu	Exploration Stage Surf. Survey Scale (km²)	Trenching Nos.	Trenching (m³)	Drilling Nos.	Drilling (m)	Adit Nos.	Adit (m)	Shaft Nos.	Shaft (m)	Discovery and Notes
1	1	Memelisht-1 (Llambisteria)	69. 680	32. 450	750	Bnd. Dsm	38. 0	2	-	0. 5	30	80 SE	-	-	+	-	⊙	-		-		1	51		-	1957-58
2	2	Memelisht	68. 940	32. 870	820	Sch	-	-	-	-	170	50 NE	-	-				⊙	-		-					-	
3	3/1	Memelisht	68. 620	34. 640	900	Bnd. Dsm	25. 0											⊙	-		-		-			-	
4	3/2	Mbi Kurburant	69. 520	34. 810	800	Dsm	20. 0											⊙	⊙		-		⊙			-	
5	4	Masha(Çervenakc)	67. 750	34. 925														⊙			-		⊙			-	
6	4/2	Masha(Çervenakc)	67. 950	34. 940		Bnd. Dsm	48. 0	8		1. 1	175	36 NE			-	-		⊙	4		-		-			-	
7	4/1	Guri i shpuar	67. 640	35. 040	1. 175	Dsm	18. 2	20	10	0. 8	90	65 N			-	-		1:500	15	720	3	3. 356	4	630	4	36	
8	119	Ara e Selmanit	69. 270	35. 220														⊙								-	
9	119/1	Guri i Çervenakes	68. 610	35. 700	1. 085	Bnd. Dsm	20. 0	20	10	0. 8	90	65 N						⊙	⊙		-		⊙		⊙		1988-89
10	118	Kroi i Zi	63. 260	36. 860	1. 016	Bnd	22. 0	20	15	0. 4	150	70 SW			+	-											
11	123	Lokatori (Çervenakc)	66. 130	37. 280							15	73 NW															
12	124	Kroi i Farkuar	66. 150	37. 520	1. 263	Msv	40. 0	3		0. 7								1:500	-		-		2	130	2		1982-83
13	125	Kroi i Kaprit (Kroi i Bardhe)	66. 740	37. 940																							
14	201	Maja e Fushes se Madhe	66. 230	38. 250																							
15	7/5	Kalishte	64. 430	38. 840	1. 070	Bnd. Dsm	24. 0				120	76 NE						1:500	1		-		1	30	1		
16	122	Stallat e Grumbullimit	68. 970	38. 940																							
17	202	Shulleri i Kaprit	66. 980	39. 070																							
18	121	Shulleri i Peshkut (Hudenisht-2)	69. 570	39. 170	770	Dsm	38. 7	15		0. 5	160	85 SW			+	-											
19	8	Karishte	64. 320	39. 360	1. 115	Bnd. Dsm	32. 0	8	10	0. 4	130	55 NE			-	+		1:500	4		-		2	165	⊙		
20	11/1	Kosharishte-3 (Hudenisht-3)	69. 090	39. 650	850																						
21	10	Kasollet e Homezhit	67. 560	39. 660	1. 299	Bnd. Dsm	40. 2	4		0. 4	100	45 S			+	-		⊙	2		-		-		-		1983
22	9	Gropa e Bojes (Mbi Homozh)	64. 250	40. 130	1. 200	Dsm	30. 0	10		1. 5	330	75 NE			-	-		1:500	4		-		1	10	1		
23	129	Kroi i Ariut	63. 930	40. 420	1. 033	Dsm	25. 0	6		0. 5								⊙	⊙		-		⊙		⊙		1987
24	12/1	Kodra e Madhe	66. 970	40. 440																							
25	212	Komkické	63. 613	40. 482	1. 121	Dsm		15		1. 0	174	NE						1:500	8		-				⊙		
26	19	Kosharishte-2	68. 940	40. 660	793	Dsm	37. 4	10		0. 3								⊙			-		⊙		-		1957
27	12	Kodra e Madhe	66. 720	40. 670	1. 400	Sch	50. 0	1		0. 1	165	60 NE						⊙	1		-		-		-		
28	19/1	Perroi i Thellë	68. 960	41. 020	795																						
29		Quméshti i Grave	64. 101	41. 593	931																						
30	203	Mbi Gurin e Pellumbit	64. 080	41. 600	930	Bnd. Dsm	22. 0	13		0. 6								1:500	1	132	-	2	67		3	40	
31	130	Gradonat	63. 750	41. 600	930	Bnd. Dsm		10		0. 5	105	65 NE						1:500	3		-		1	60	4		1975
32	127/1	Sntylla e TN	67. 200	41. 730																							
33	204	Bregu i Llukes	63. 530	41. 840																							
34	210	Gropat e Rudes	62. 870	42. 270	760	Bnd. Dsm	30. 6	35	15	1. 3	170	80 NE						1:500	⊙		11	955	2	95	-		
35	209	Perroi i Dardhes	64. 750	42. 350	1. 025	Bnd. Dsm	25. 0	22	8	0. 6	150	78 NE						1:500	⊙		9	154	2	114	3		
36	215	Qafa e Shqerrave	66. 360	42. 630																							
37	18/1	Sheshet e Piskupatit	67. 410	42. 870	1. 125																						
38	23	Shesh Bush Trupi No. 2	65. 320	43. 000	1. 125	Nod. Dsm	35. 0			0. 01	154	80 SE						⊙									no dunite
39	205	Shesh Bush Trupi No. 3	65. 350	43. 130	1. 125	Bnd. Sch	30. 0	15	10	0. 4	156	90															
40	22	Shesh Bush Trupi No. 4	65. 050	43. 130	1. 050	Nod. Dsm	25. 0	20	10	0. 5	150	60 NE			+	-		1:500	2		15	1. 001	-		1		
41	18	Bregu i Pishes	67. 230	43. 200	1. 200	Msv. Dsm	36. 0	30	10	0. 6	150	85 NE			+			1:500	7	130	11	1. 060	3	71	6		
42	206	Shesh Bush Trupi No. 5	64. 870	43. 210	1. 000	Bnd	30. 0	20	10	0. 4	160	60 NE						1:500	2		9	754	-		1		
43	208	Shesh Bush Trupi No. 8	64. 520	43. 420	931	Dsm	28. 0	25	10	0. 5	157	80 NE						1:500		51	9	617	2	170	⊙		
44	21	Shesh Bush Trupi No. 6	64. 700	43. 430	906	Bnd	27. 0	20	10	0. 5	155	80 NE			+	-		1:500	2		6	408	1	35	1		
45	207	Shesh Bush Trupi No. 7	64. 700	43. 430		Dsm	32. 0	30	10	0. 5	155	75 NE															
46		Mbi Fushen e Madhe	66. 193	43. 585	1. 185																						
47	213	Nen Gjordukë	66. 200	43. 590	1. 185	Dsm	20. 3	5										1:500	4		-		2	15	-		
48	214		66. 140	43. 720																							
49	26/2	Shurak	65. 070	44. 050	804	Msv. Dsm	46. 0	34		1. 0	150	70 NE	330	35				⊙	⊙		⊙		2	100	-		1960
50	26/1	Shurak	64. 560	44. 120																							
51	131	Levoz	64. 500	45. 090	815																						
52	132	Levoz	64. 620	45. 310																							
53	132/1	Murrio	64. 440	45. 530	725		35. 0	14	10	0. 3													2	118	-		
54	30	Katjeli	63. 450	45. 940														⊙	⊙		⊙		⊙				
55	29	Kotodesh	64. 270	46. 070	700	Dsm	25. 0	12		0. 4	120	90						⊙	-		-		1	12	-		1957
56	31	Kotodesh	64. 220	46. 320	650	Sch. Dsm		3										⊙					1	5	-		1957

Shebenik Ultrabasic Massif (1)

Table 2-2-11(2) Known chromite showings in Shebenik-Pogradec ultrabasic massif 2/3

Ser. No.	No. on Map	Deposit Object of Ore Bodies	Location Long. X	Location Lat Y	Location Alti Z	Ore Texture	Cr_2O_3 Ave. Cont. %	Dimmension (m) in Strike	Dimmension (m) in Dip.	Dimmension (m) Aver. Thick.	Elements Strik Direc	Elements Dip. Angle	Plunge Dir.	Plunge Angle	Perspect. on Str	Perspect. on Dip	Perspect. on Plu	Surf. Survey Scale (km²)	Trenching Nos.	Trenching (m³)	Drilling Nos.	Drilling (m)	Adit Nos.	Adit (m)	Shaft Nos.	Shaft (m)	Discovery and Notes
1	33	Kostriçan	63.380	49.260	750	Bnd. Dsm	48.0	21		0.5	150	80 NE						◎	2.0		-		1		-		1957
2	33	Rajce Bunker	63.430	49.270	750	Bnd. Dsm	18.0	3		0.6	150	80 NE			-	-		◎	-		-		-		-		1978
3	40/1	Perrenjas	62.625	49.835	835	Bnd. Dsm	20.0	5		0.5	130	60 NE	330	30				◎	◎		-		-		-		
4	39	Lugu i Gjinushit	63.800	49.920	825						130	60 NE								285			2	160		-	
5	38/1	Perrenjas	52.610	49.930			27.0	20	15	0.5	130	60 NE			-	-											
6		Mbi Perrenjas	61.320	49.960	860						130	60 NE															
7	37	Luqinje	61.340	49.990	900	Dsm	37.0	15	10	0.4	25	50 SE			+	-		◎	1		2		1			-	1957-1988
8	38	Luqinje	61.920	50.130	850	Bnd. Dsm	25.0	60	20	0.8	140	60 NE			+	-		◎	9		◎		1		1	25	
9	134	Useku	64.070	50.350	650	Msv	38.0	1	3	0.5								◎	-		-		-		-		1983
10	39	Rajcë	63.800	50.860	800	Sch	46.0	1		0.1	120	74 NE						◎	-		-		-		-		
11	42/1	Rajcë	63.360	51.330	965	Bnd. Dsm	48.0	8		0.5	120	40 NE						◎	1		-		◎		-		1957
12	40	Rajcë	63.460	51.410	925	Sch		1.5		0.05	135	90						◎	-		-		-		-		1957
13	42/1	Lugu i Frongut	63.260	51.450	970						130	60 NE			+	-							2	227		-	
14	41	Rajce	63.470	51.510	950	Bnd. Sch. Dsm	47.0	2		0.05	120	88 NE						◎	-		-		-		-		1957
15	136	Tek Kasollet	61.710	51.570	1.150		22.0	12		0.3	150	68 NE			+	-		◎									
16	42/2	Rajce	63.330	51.720																							
17	43	Lugi i Frangut	62.670	51.860	1.070	Dsm	39.0	10		0.5	140	75 NE			-	-		◎	-		-		-		-		1957
18	135	Pishkash	59.500	51.880								NE															
19	47	Pishkash-5	59.670	52.270	1.180	Msv. Brc	38.0	30	20	0.5	120	70 NE						◎	-		8		◎		-		1957-88, 1961
20	44	Luqinje	61.560	52.430	1.200	Sch. Dsm	20.0	10		0.6	145	40 NE			+			◎	-		-		-		-		1957
21	48	Skroske	59.330	52.530	1.130		28.0	10		0.6	130	50 NE			+	-											
22	49	Skroske	59.250	52.640	1.140		35.9	20		0.7	120	50 NE			+	-											
23	45	Gjashte Lis	62.630	52.915	1.070						140	60 NE															
24	138	Rajco	62.690	52.990														◎									
25	137	Rajco	63.240	53.160	1.000													◎									
26	45	Gjashte Lis	61.960	53.320	1.300	Dsm	28.0	5.5		0.8	150	70 NE			+	-		◎	-		◎		-		-		
27	51	Mali i Skures	59.750	53.490								NE															
28	56	Bushtrice I	56.860	53.600	850	Bnd. Dsm	20.0	13		0.5	150	75 NE			+	-		◎	-		-		-		-		
29	53	Qafa e Lqerve	62.180	53.700	1.200	Bnd. Dsm	16.3	87	1.5	0.34	140	72 NE			+	-		◎	5		◎		1	80	-		1957
30	59	Bushtrice IV	56.870	53.840	800	Bnd. Dsm	25.0	30		0.8	10	53 SE			+	-		◎	-		-		-		-		1959
31	60	Bushtrice V	57.150	54.110	600	Bnd	20.0	12		1.2	150	75 NE			+	-		◎	◎		-		◎		-		1959
32	62	Bushtrice III	55.410	54.270	800	Bnd. Dsm	20.0	4		0.2								◎	-		-		-		-		1957
33	55	Gjashte Lis	60.840	54.480	1.100	Dsm	54.0	10		0.7	0	60 E			+	-		◎	-		-		-		-		
34	63	Gobille	56.780	54.510	700	Dsm	15.0	8		0.4	45	40 SE			+	-		◎	-		-		-		-		1957
35	64	Çingol	57.990	54.620	800	Msv. Nod. Dsm	33.0	15		0.7	120	90			+	-		◎	◎		◎		◎		-		1960
36	65	Ozunet	56.730	54.750	750	Nod. Dsm	26.0	80	30	0.5	10	80 SE			+	-		◎	◎		10		2		-		1957
37	54	Lis (Gjashte Lis)	62.000	54.820	975	Dsm	41.0	25		0.6	170	60 NE			+	-		◎	-		-		1		-		1957
38	73	Mbi Shtepite e Çelës	58.540	55.140	900	Msv. Bnd. Dsm	42.0	10		0.6	35	65 NE			+	-		◎	◎		-			124	-		1957-82
39		Kunji i Ozunit	56.450	55.250	900						10	80 E								235						5	
40	72	Përroi i Gribës	58.335	55.270	1.000	Msv. Bnd. Dsm	28.0	10		0.7	150	90			+	-		◎	◎		-		-		-		
41	66	Varri i Plakes	55.047	55.320	1.150	Msv. Dsm	42.1	5		0.8	140	60 NE			+	-				135	-			44		11	1957
42	68	Gobillë IV, Trestenik	55.750	55.330	1.000	Spt. Dsm	40.0	6		0.5	45	40 SE						◎	2		◎		◎		-		
43	74	Mbi Shtëpitë e Çeles	58.980	55.350	1.000	Msv	40.0	3.5		0.8	80	70 S			+	-		◎	-		-		-		-		
44	139	Rajcë	60.630	55.360								NE															
45	144	Lugu i Thanës	57.750	55.400	1.075	Dsm	36.0	5		0.4	100	80 NE			+	-		◎						41	-		
46	67	Gobille IV, Trestenik	55.470	55.500	1.050	Bnd. Dsm	24.0	10		0.5	140	80 NE			+	-		◎	◎		◎		-		-		1957
47	70	Gobillë V	56.130	55.700	950	Msv	40.0	4		0.3								◎	-		-		-		-		1957
48	71	Gobillë IV, Trestenik	55.340	55.730		Bnd. Dsm	20.0											◎	◎		-		-		-		
49	78	Skenderbej I	61.230	55.850	1.050	Bnd. Dsm	52.0	15		0.5	140	85 NE						◎	1		-		-		-		1957-
50	129	Bushi i Mertirit	56.390	55.930		Dsm	30.0	4.5		0.6	100	40 E						◎	2		-		-		-		
51	79	Skënderbej II	61.610	55.940	1.050	Dsm	49.0	55		0.5	65	60 NE			+	-		◎	-		-		-		-		
52	77	Përroi i Govatës	60.570	56.070	1.150	Msv. Dsm	30.0	15		0.7	135	60 NE						◎	◎		-		◎		-		
53	75	Mbi Shtepitë e Çelës	58.160	56.230																							
54	69	Kunji i Ozunit	55.200	56.320	880	Bnd. Dsm	26.0	12		0.4	10	80 SE			-	-		◎	◎		◎		◎		-		1957-
55	140	Rajcë	62.075	56.360		Dsm																					
56	148	Vulcan	52.635	56.490		Msv																					
57	141	Rajcë	61.740	56.540		Dsm																					
58	145	Muzgarë	54.440	56.560																							

Shebenik Ultrabasic Massif(2)

Table 2-2-11(2) Known chromite showings in Shebenik-Pogradec ultrabasic massif 3/3

Ser. No.	No. on Map	Deposit Object of Ore Bodies	Location Long X	Location Lat Y	Location Alti Z	Ore Texture	Cr_2O_3 Ave. Cont. %	Dimension (m) in Strike	Dimension (m) in Dip	Aver. Thick.	Elements Strik Direc	Elements Dip Angle	Plunge Dir.	Plunge Angle	Perspect. on Str	Perspect. on Dip	Perspect. on Plu	Exploration Stage Surf. Survey Scale (km²)	Trenching Nos.	Trenching (m³)	Drilling Nos.	Drilling (m)	Adit Nos.	Adit (m)	Shaft Nos.	Shaft (m)	Discovery and Notes
59	76	Perroi i Poraves	58.030	56.710	1.230	Msv	52.6	17	10	2	150	62 NE		90	-	-		◎	-		-		◎		-		
60	143	Perroi i Poraves	59.230	56.800							135	60 NE															
61	115	Kryqi i Vakut	56.650	56.850		Msv, Dsm	42.5																				
62	147	Buzgare	54.630	56.990																							
63	146	Buzgare/Perroi i Qukut	54.900	57.060		Bnd, Dsm																					
64	80	Gobillë	57.110	57.330	1.450	Msv, Dsm	45.0	9		0.8	90	54 N			+	-		◎	-		◎		1		-		1982 adit
65	83	Gobillë	57.030	57.330	1.200	Msv	53.0	15		0.8	10	55 SE			+	-		◎			10		2		-		lenticular
66	142	Rajce	62.790	57.343		Dsm																					
67	180	Gura e Stafes	54.340	57.440	1.215	Bnd, Dsm	38.0	15		0.5	140	70 NE			+	-		◎	◎		-		◎		-		
68	146	Perroi i Qukut	54.320	57.450	1.200		37.0	25	10	0.6	130	65 NE	330	40	+	-											
69	65	Sara e Hanit	61.220	57.550	1.320						130	70 NE									2			71		8	
70	86	Gobillë	57.110	57.610	1.500	Msv, Dsm	32.0	14		0.6	150	70 NE			+	-		◎	8		-		1		-		1957
71	85	Gobillë	57.230	57.680	1.550	Msv, Dsm	38.0	10		2	150	50 NE						◎	3		3		1		-		
72	88	Govatë	60.820	57.750		Dsm														40				790		7	
73	82	Ahu i Vetëm	56.040	57.900	1.720	Msv, Dsm	30.7	15		0.6	170	75 NE			+	-		◎	◎		-		◎		-		
74	81	Ahu i Vetëm	56.020	57.940	1.700	Msv, Nod, Dsm	50.5			1								◎	-		-		-		-		1957-82
75	84	Gobillë	57.040	58.030																							
76	177	Stanet e Veçanit	55.270	59.160	1.650	Bnd, Dsm	25.0	40		0.9	40	60 SE			+	-		◎	◎	178	-		◎	212	◎	3	1988-89
77	117	Lugu i Batrës	56.400	58.230	1.810	Nod, Bnd, Dsm	49.0	70	10	0.8	90	56 S			+	-		◎			8		2		3		1960-85
78	99	Bushtrica e Siperme	53.970	58.390		Bnd																					
79	139	Lugu i Bukur	53.570	58.470	1.420	Bnd, Dsm	30.0	60	20	0.5	130	70 NE	320	45	+	-		◎		19	2	123	2	113		5	1960
80	149	Vulçan	51.720	58.512																							
81	90	Lugu i Batrës	53.910	58.550	1.400	Dsm	20.4																				
82	149	Vulçan	52.220	58.820			41.3																				
83	89	Vulçan	49.950	58.950																							
84	116	Morava	59.240	59.020	1.750	Bnd, Dsm	49.0	20		0.5	140	80 NE						◎	3		-		-		-		1957-
85	178	Çerveniku i Vogel	54.310	59.170	1.675	Bnd, Dsm	28.0	40		0.9	40	40 NW			+	-		◎									1988-89
86	92	Guri i Bogës	51.670	59.790	1.650	Bnd, Dsm	20.0	5		0.6	170	83 NE						◎	-		-		-		-		
87		Mekisht	48.200	60.000							150	83 NE															
88	150	Guri i Pikës	56.450	60.170		Bnd	30.6																				
89	94		53570	60300				9		0.2								◎	-		-		-		-		1957
90	153	Mali i Lotë	55.990	60.630		Bnd, Dsm	15.1																				
91		Lugu i Komanit	53.900	60.350																							
92	95	Hotolisht	49.120	61.080		Bnd																					
93		Moileza	55.900	61.300	1.085						120	70 NE								1.745	5			229		41	
94	152	Mali i Lotë	57.260	61.310		Bnd																					
95	153	Pjesa Veriore	56.138	61.600		Bnd, Dsm																					
96	96	Hotolisht	49.090	61.690		Bnd																					
97	98	Guri Baltrezi	53.170	61.920	1.450	Bnd, Dsm	20.0	36		0.6	140	90						◎	-		-		-		-		
98	154	Pjesa Veriore	56.520	61.930		Bnd, Dsm																					
99	155	Pjesa Veriore	56.300	62.110		Bnd, Dsm																					
100	160	Balldre	54.030	62.220	1.660	Msv, Nod, Dsm	46.5	35		0.9	150	70 NE			-	-		◎	◎		-		◎		-		
101	156	Pjesa Veriore	56.330	62.530		Dsm																					
102	101	Maja e Gjelit	53.125	62.972	1.700	Bnd, Dsm		4.5		0.4	60	60 NW						◎	-		-		-		-		1957
103	100	Pjesa Veriore	57.050	63.150	1.850	Bnd, Dsm		20		0.6	170	60 NE						◎	-		-		-		-		1957
104	157	Pjesa Veriore	56.220	63.270		Dsm																					
105	102	Kokrevë	55.150	63.500	2.100	Dsm, Brc	26.0	10		0.7	120	80 NE			+	-		◎	-		-		-		-		1957
106	104	Përroi i Shehut	49.010	63.700	850	Dsm	30.0	13		1.3	135	25 NE						◎	-		-		-		-		1957
107	158	P. Veriore e M. Sleberim	54.970	63.780		Bnd																					
108	103	Dragostunj	48.760	63.910	1.050	Dsm	27.0	6		1								◎	-		-		-		-		1957
109	107	Guri i Korbit	53.770	64.120	1.800	Sch, Dsm		4			110	25 NE						◎	-		-		-		-		1957-88
110	105	Përroi i Librazhdit	52.310	64.220	1.450	Bnd, Sch				0.25								◎	-		-		-		-		1957
111	108/1	Tuma e Llapushit	53.410	64.460	1.700	Msv, Bnd, Dsm		60	10	1.1	0	75 E						◎	◎		◎		◎				1988-
112	106	Përroi i Librazhdit	52.200	64.460		Bnd																					
113	108	Tuma e Llapushit	53.490	64.480	1.900	Dsm	42.0	60	10	1	155	40 NE			+	-		1:2000	◎		7	687	◎		?		1957-
114	113	Kudenisht	54.370	65.620	2.000	Sch		3		0.5	0	30 E						◎	-		-		-				
115	182	Çeçotë	48.750	67.250	800	Bnd, Dsm	27.0	40		0.6	0	45 W			-	-		◎	◎		-		◎		-		1988-89

deposits were in the upper part of the second horizon, and Govates - Shesh Bush No.4 were in the lower part of the third horizon. Particularly the upper of the first to the lower of the second horizon are important for the chromite exploration, actually main chromite deposits such as Katjel - Gobilla to Govates - Shesh Bush No.4 discovered between those horizons.

(3) Therefore, the most prospective areas for chromite mineralization are the axial parts of the Shebenik-Pogradec massif from Katjel to Memlisht and from Pishkash to Gobilla, till to Shpella e Trestenikut, the zone running in direction of NNW-SSE.

Along with those conclusions it was proposed as future exploration, (a) structural drilling in the southeast direction of the plunge of the Katjel deposit, (b) 2 to 3 structural drilling holes at the Gobilla deposit, and (c) to continue exploration of the Memlisht, Kudenisht, Gobilla, Bushtrice and Ozun deposits as well as continuing surveying of the known platinum family element indications in those ultrabasic massifs. In accordance with those conclusions and recommendations, exploration of the chrome deposits in the Shebenik-Pogradec ultrabasic massif has continued to this day.

(3) Policy of the Field Geological Survey

As mentioned above, systematic surveys as well as regional, semi-detailed and detailed surveys have been carried out within the area of the Shebenik-Pogradec ultrabasic massif. Along with most of the chromite showings on the surface have already been discovered, and the main ones were explored by mean of trenching and gallery, and also for the important deposits had been explored to make calculation of ore reserves on the basis of the results of drilling, gallery and shaft explorations.

In view of the fact, as can be seen from the above, that on the whole chrome deposit exploration in the Shebenik area is already in a fairly advanced stage, the field surveys in the first year of this project have been carried out with emphasis laid on field confirmation of past geological survey results and locations and the mode of occurrence of the chrome showings, on collection of laboratory test samples for EPMA analysis and others over the area and on elaboration of the photogeological interpretation maps of the satellite image analysis.

2-3 Geological Surveys

2-3-1 Geology

The geology of the Shebenik area comprises the lower Triassic to lower Jurassic, the Shebenik-Pogradec ultrabasic massif, the Cretaceous, the Tertiary and the Quaternary formations. The Tertiary can be subdivided into the Eocene, Oligocene and Neogene, and the Quaternary into moraine and terrace-alluvial-landslide deposits.

(1) Lower Triassic to Lower Jurassic (Mirdita zone)

The lower Triassic to lower Jurassic, one of the main constituents of the Mirdita zone of the Shebenik area, is widely distributed at the eastern parts of the project area along the border with Macedonia, is also distributed to the north of the Qarrishte River, which flows along the northern edge of the area, and from Prenjas to Lin between the Shebenik massif and Pogradec massif.

The lower Triassic to lower Jurassic has a wide variety of rock facies, including pelitic schist, amphiolite schist, sedimentary rocks such as mudstone and red chert, volcano-sedimentary rocks frequently accompanied by schalstein, diabase, basalt partly with pillow structure and other basic volcanic rocks, and massive and bedded limestones.

In general the formation is considered to be composed of, from bottom to top, a series of sedimentary rocks consisting of schists, mudstone, chert and others; volcano-sedimentary rocks frequently interbedded with basic volcanic rocks; limestone intercalated with volcanic rocks and sedimentary rocks; and a thick limestone possibly top of which may belongs to the Lower Jurassic.

Those rocks in the Mirdita zone come in contact with the Shebenik ultrabasic massif through steeply inclined zone of faults or tectonic melange zone with several hundred meters in width. Within the faults and tectonic melange zones frequently observed intensely foliated serpentinite derived from ultrabasic rocks, pelitic schist, amphibolite, limestone, mudstone etc. as irregular-formed blocks in various size. Therefore there are no good outcrops in the project area by which it would be possible to trace and confirm the above-mentioned order of strata at the surface.

In the zone from Prenjas to Lin between the Shebenik massif and the Pogradec massif, limestones and pelitic rocks are distributed as irregular blocks of a size of tens to hundreds of meters, accompanied by extremely foliated serpentinite. It is a known that such serpentinite sometimes contains alumino-chromite.

(2) Shebenik-Pogradec Ultrabasic Massif

As mentioned above, the Shebenik-Pogradec ultrabasic massif is divided into the Shebenik massif, distributed on the north, and the Pogradec massif, distributed on the south, by the Mirdita zone distributed to the east of Prenjas to Lin.

Both the massifs consist of ultrabasic rocks mainly of harzburgite, accompanied frequently with dunite and at some places such as northwestern part of the Shebenik massif with lherzolite, pyroxenite, gabbro, etc. Those ultrabasic rocks of the Shebenik-Pogradec ultrabasic massif are well known to be characterized by depletion of LIL elements in their chemical composition.

Macroscopically most of the harzburgite, lherzolite and dunite are serpentinized to show dark grey tones similar to one another. Harzburgite and lherzolite, however, has large pyroxene crystals of about 1 cm in size characteristically to show rough-textured surface on the weathered side. Lherzolite differs from harzburgite in greater pyroxene content, but it looks very similar to harzburgite. On

Geologic Age		Formation		Column	Thick-ness	Lithofacies	Mineralization
Quaternary			Q		255	Conglomerate, sandstone etc.	
		Glacial deposit	Qg		15	Gravels(Morainal deposits)	
Tertiary	(Pliocene) ∫ Miocene	Librazhd Suite	Nt_1		250	Conglomerate, sandstone, siltstone etc., Red coloured characteristically, interbedded with calcareous~dolomitic conglomerate beds.	
	Oligocene	Oligocene	Pg_3		500	Mainly composed of conglomerate, rarely inter-bedded with sandstone, rather massive.	
	Eocene	Eocene	Pg_2		80	Sandstone, siltstone etc., with calcareous horizon, stratified.	
Messozoic	Late Cretaceous	Upper Cretaceous	Cr_2		up to 550	Limestone Argillite and sandstone etc. Nickel-Laterite beds	Nickel Laterite
	Jurrassic?	Shebenik-Pogradec massif	T			Mainly composed of harzbergite, with dunite, pyroxenite etc, intruded by gabbro.	Chromite and PGM
	Triassic	Triassic			up to 700	Limestone, interbedded with volcanic sequences.	
					up to 1500	Volcono-Sedimentary rocks of diabase, schalestein, shale, amphybolite, serpentinite basalt etc.	

Fig. 2–3–1 Schematic geological column of Shebenik area

other hand dunite is easily distinguishable in that it does not contain orthopyroxene and has a smooth weathered surface as well as often being fragmented because of low resistance against weathering. Pyroxenite is easily identified by its characteristic appearance and consists of an aggregate of large pyroxene crystals up to maximum 10 cm in size. As for gabbro, it is characterized by presence of plagioclase and has a relatively fine-grained feature.

Fresh harzburgite and dunite show yellowish gray tone characteristically. Their distribution is limited to around Gjorduke in the northern part of the Pogradec massif, north of Skenderbej on the eastern edge of the southern part of the Shebenik massif and a few other places, and they are considered to be representative lithofacies of the lower part of the Shebenik-Pogradec ultrabasic massif.

Lherzolite, pyroxenite and gabbro are few in the Pogradec massif. In the Shebenik massif, however, small dikes of pyroxenite with a thickness of several to ten centimeters are widely distributed in the western half, and in the zone from Hotolisht to Koshalisht in the northwestern part small dikes of pyroxenite frequently appear, with occurrence even of fairly large masses with a thickness of about 100 m. In the northwestern part of that massif, the pyroxene content of the harzburgite is rather high, which gives it a lherzolite like feature, with frequent accompaniment of dike-to-sheet gabbro and pyroxenite. Such a lithofacies with abundant lherzolite, pyroxenite, gabbro, etc. distributed in the northwestern part of the Shebenik massif is considered to correspond to the upper part of the ultrabasic massif. There was no confirmation of existence of basalt or other extrusive volcanic rocks in either of the massifs.

Dunite generally occurs in harzburgite in thickness of several centimeters to tens of meters, and also occurs in vein form along with three dimensional fractures in pyroxenite. Most of the dunite shows a sheet to dike form in harmony with the pyroxene arrangement of the harzburgite, and sometimes a banded to alternating association with the harzburgite is noted. There are, however, many other modes of occurrence of it, including a complex mixture of irregular vein to dike form dunites discordant with the harzburgite structure and intersected dike form dunites in several directions.

On the LANDSAT TM image, a unique banded pattern in the NNW-SSE direction with a width of several hundred meters was interpreted over a range of about 10 km in length and about 5 km in width above the forest line at the east of the Shebenik massif. The results of the field survey revealed that the zone is of an alternative occurrence of ultrabasic rocks of thick harzburgites and thick complex parts with frequent intercalations of dunite of a thickness of tens of centimeters to several meters, and the complex parts rich in dunite having been easily fragmented by weathering and forming depressions. Therefore it is considered that the banded pattern interpreted on the LANDSAT TM image is a reflection of the difference in resistibility against weathering and erosion between the dunite and the harzburgite.

Although the extent of the zone with such a banded pattern cannot be traced on the image at places below the forest line, it is highly possible that it extends to the southern direction up to southern end of the Shebenik massif between the Bushtrice River and Prenjas, and to the northern direction up to the northern part of that massif near Qarrishte, and zones of complicated association of dunite and harzburgite were confirmed in those areas during the field survey. Such thick alternation of harzburgite and dunite-harzburgite complex is considered to occupy the middle part of the ultrabasic massif of the Shebenik area.

Sheet to dike form dunite is distributed throughout the Shebenik-Pogradec ultrabasic massif, particularly in the Shebenik massif it is distributed around Kudenisht and on both sides of the Bushtrice River between Govates and Gobilla and in the drainage basin of those tributaries, and in the central to northern part of the Pogradec massif from Katjel to Pojske and Gradisht. Most of sheet to dike form dunite is in harmony with the harzburgite structure, however, in the Shebenik massif around Kudenisht and on the northern side of the Bushtrice River between Govates and Bushtrice and elsewhere, there are also zones of complex association of the two, including intersected dike form dunites in several directions, and vein form dunites in joint systems of harzburgite and pyroxinite and dunite cuts another dunite etc.

The relationship between dunite and the hosted harzburgite, in most of dike and sheet form dunite, is gradually transition from harzburgite to dunite within an interval of several to tens of centimeter, decreasing the quantity of orthopyroxene. In the case of dunite in pyroxenite, it occurs in vein form along with the three dimensional joints with gradual transition from pyroxenite to harzburgite to dunite within an interval of several centimeters. On the other hand, in the case of banded to alternating dunite, the boundary with harzburgite is comparatively clear, the two coming in contact across a gradual transition zone of several mm.

Such dunite in harzburgite sometimes accompanies chrome spinel in disseminated, banded, massive and nodular form, therefore, many of dunites has been prospected for chrome deposits by mean of trenches, pits and galleries, resulting in discovery of many chrome deposits and showings in the project area as already mentioned.

Within the area of ultrabasic rocks, nickeliferous laterite deposits sometimes with silicate nickel in the depth are distributed to the south of the Bushtrice River in the Shebenik massif and along the western edge of the Pogradec massif. They are resulted from secondary enrichment of both massifs with nickel and iron by weathering as mentioned before.

It is considered that the Shebenik-Pogradec ultrabasic massif, rich in variety of lithofacies and containing chrome and nickeliferous laterite deposits, has resulted from obduction of the oceanic crust over the External Albanides as the Mirdita zone at the time of convergence in the Jurassic period, then upheaval and orogeny in the Mesozoic Alpine orogeny and finally appearance on the surface by the following subsequent erosion.

It is also considered that the chrome deposits were produced during the age when both ultrabasic massifs existed in the oceanic crust/mantle and that the nickeliferous laterite deposits accompanied by silicate nickel were produced superficially after the two ultrabasic massifs appeared on the surface, and they may be reserved because they were covered by sedimentary rock in the Cretaceous to Eocene.

(3) Cretaceous

Along the western edge of the Shebenik-Pogradec ultrabasic massif to the south of the Bushtrice River there are intermittent distributions of limestones covering the massif unconformablely. All of them are classified as Cretaceous. The limestones distributed in the topographical height of the steep slopes on the western side of the Shkumbin River south of Librazhd also are included in that category. Those Cretaceous formations consist mainly of limestones.

The limestones of the western edge of the Shebenik-Pogradec ultrabasic massif in NNW-SSE direction are distributed intermittently in blocks along the western boundary of the massif from the Bushtrice River to Fushe e Madhe at the central part of the Pogradec massif. The Cretaceous distributed from Fushe e Madhe to Pogradec town shows rather continuous distribution along the western boundary, and also their small blocks are distributed in the high elevated terrain and on the eastern flank facing to Ohrit Lake of the massif.

At some places those limestones come in contact with the ultrabasic rocks by fault or through fault zone, but in most cases they cover directly on the intensely lateritized and/or decomposed ultrabasic rocks with unconformity. The distribution of the Cretaceous on the Pogradec massif is intermittent, however, their distributions and structures indicate that it forms an anticlinal structure with an axis running in the NNW-SSE direction, approximately matching to the spine of the Pogradec massif. Between the Bushtrice River and Fushe e Madhe they have a monoclinal structure inclining to the west, indicating the zone is situated on the western wing of the anticline.

On the other hand, the Cretaceous at the upper part of the steep slopes of the western side of the Shkumbin River south of Librazhd covers unconformablely the ultrabasic rocks of the western zone and consist of flysch sediments mainly of terrigenous clastic sediments at bottom and a thick layer of limestone covering them.

Those Cretaceous formations in the area are considered to be deposited during the broad marine transgression in Cretaceous period following subsequent to the Mesozoic Alpine orogeny.

The NNW-SSE anticlinal structure of the Cretaceous in the Pogradec massif indicates that reactivation of the Alpine orogeny and subsequent epeirogeny in Cenozoic period took place in the internal Albanides resulting in formation of the gently folded structures and the marine regression in the area. Those Cenozoic epeirogeny, folding and marine regression may accelerate the deposition of the thick molasse sediments in intermontane synclinal zones in Tertiary period as described below.

(4) Eocene

The clastic sediments characterized by fine-grained sandstone distributed in the vicinity of Pishkash, about 2 km northwest of Prenjas, are classified as Eocene. The sandstone distributed as inlier of the Oligocene and Neogene to the west of the Cretaceous in the Shebenik-Pogradec ultrabasic massif from Hotolisht, southeast of Librazhd, to the west of Pogradec town is also classified in that category.

Such Eocene consists mainly of well-bedded grey to light yellowish grey, fine- to medium-grained sandstone with some intercalations of dolomitic to calcareous conglomerate in lower parts and also accompanied with conglomerate in the lower most. Generally it has a monoclinal structure with inclination 20-30 degrees to the west.

The Eocene in the area might be of molasse under neritic to coastal environment deposited in the intermontane lowlands of the synclinal axis resulting from reactivation of Alpine orogeny in the Cenozoic period.

Based upon the photogeological interpretation of the LANDSAT TM image, it is highly possible that Eocene formations is also distributed on the upper part of the Cretaceous limestones to the west of the Shkumbin River.

(5) Oligocene

The formations characterized by massive conglomerate that occur on both sides of the down-stream of the Bushtrice River are classified as Oligocene. The same type of conglomerate is widely distributed on the west side of the edge of the Shebenik-Pogradec ultrabasic massif south of Hotolisht, where it covers the ultrabasic rock, the Cretaceous and the Eocene formations. Conglomerates locally distributed in the vicinity of Ohrit Lake near Pogradec are also been included in this category.

The Oligocene distributed in those localities except for that in the vicinity of Ohrit Lake generally shows a monoclinal structure with inclination about 20 degrees to the west.

The Oligocene consists of unsorted massive conglomerates including a lot of rounded blocks of various types derived from Triassic formations and Cretaceous limestones, ultrabasic rocks, etc., ranging in its size from several millimeters to 10 cm in diameter cemented by medium- to coarse-grained sandstone.

In terms of rock facies it is analogous to the Neogene, however, it differs from the Neogene formations in the massive mode of occurrence, very few intercalation of sandstone and does not show the reddish brown tone characteristic of the Neogene.

Those formations are considered to be molasse that filled the intermontane lowlands resulted from continuously proceeding relative-submerge subsequent to the Eocene age caused by the Cenozoic Alpine orogeny in Tertiary. The lithofacies of the Oligocene indicates that upheaval of the hinterlands further progressed in the age, exposing the Triassic to Cretaceous formations and some of the ultrabasic rocks to expose under an extremely erosive environment, that at the same time the intermontane lowlands further developed along with faults in the NNW-SSE direction and that the intermontane lowlands characterized by Oligocene sedimentation emerged with the accompaniment of upheaval of the entire Internal Albanides.

(6) Neogene

The red colored terrigenous sediments mainly of alternation of sandstone and conglomerate are widely distributed in the basins of the Shkumbin River and its tributaries south of Librazhd. Those sediments characteristically red colored are classified as Neogene. They are also widely distributed on the western slope of the Shebenik mountain area. They cover the Oligocene and the ultrabasic rocks, and in the vicinity of Librazhd they onlap on the Oligocene.

The Neogene shows a synclinal structure with an axis correspond almost with the upper stream of the Shkumbin River in NW-SE direction south of Librazhd. The eastern side of the synclinal axis has a monoclinal structure dipping 10 to 20 degrees to the west, and the western side generally dips to the east.

The Neogene consists of alternation of sandstone and conglomerate interbedded with dolomitic to calcareous conglomerate in its comparatively lower part. As a whole it is rich in iron oxide, has a characteristic tone of red to reddish brown and is well consolidated. The conglomerate contains large quantities of rounded blocks of limestone, various sedimentary rocks, ultrabasic rocks, etc., and the size is very diverse, from cobble conglomerates to fine conglomerates. The Neogene is accumulated in repetition of sandstone rich and conglomerate rich alternations with a thickness of several meters to tens of meters of sandstone and conglomerate. The parts rich in conglomerate often form dangerous precipices, on the other hand, alternations rich in sandstone often form gentle dip slopes that are used as pasturage or cultivated fields and where villages have developed.

The influence of the hinterland is strongly reflected in the types of blocks in the conglomerate in the lower part of the Neogene. Particularly at the northwestern part of the Shebenik mountain area there are unique basal conglomerates of the Neogene on the Shebenik massif such us, unsorted cobble conglomerate mainly of large blocks of ultrabasic rocks extremely rich in harzburgite, unsorted coarse-grained sandstone to fine conglomerate composed mainly of fragmental pyroxenes derived from the thick pyroxenite nearby and other distinctive conglomerates. On the other hand, along the Shkumbin River far from the source of supply there distributed relatively thick bedded alternation mainly of pebble conglomerate and medium- to coarse-grained sandstone.

The formations that have been classified here as Neogene are classified as the Librazhd suite of Miocene age on the geological map on a scale of 1:200,000 published by Gjeoalba. Their characteristic tone of the Neogene is probably resulted from iron oxides supplied abundantly from the Shebenik-Pogradec ultrabasic massif which forms their hinterland. The characteristic color of the Neogene and the existence of distinctive basal conglomerate at bottom, those suggest that the Shebenik-Pogradec ultrabasic massif had been exposed under an extremely erosive environment in Miocene age.

Such characteristics of the Neogene indicate that not only in the Oligocene age but in the Miocene as well there was continuation of upheaval and development of intermontane lowlands in the project area as a result of the Cenozoic Alpine orogeny. Furthermore, their characteristic tone is considered to indicate that almost all of the Neogene was deposited in a strongly oxidizing terrestrial environment.

(7) Moraine (Quaternary)

The extremely unsorted breccia that occurs in the downstream part of the cirque terrain at elevations above 1,400 m has been classified as moraine.

It consists of large quantities of angular blocks of ultrabasic rocks in various size varied from several centimeters to tens of centimeters and is entirely unsorted. It almost without exception occurs in the downstream of the characteristic cirque terrain distributed in the high-elevation parts of the Shebenik mountain area. Also it is widely distributed on side slopes in the upstream of the Bushtrice River flowing in the direction of NW-SE. Its thickness sometime reaching tens of meters.

Despite of the fact that the Moraine is largely eroded, it is comparatively well consolidated and is presently stable in the Shebenik mountain area. It is considered, however, that the bottom of the Moraine is generally a course of groundwater, therefore it will be necessary to pay attention to its stability when constructing mining and other facilities on it or its downstream.

(8) Terrace-Alluvial-Landslide Deposits (Quaternary)

On slopes and elsewhere along the Shkumbin River south of Qaf Thane and south of Librazhd are distributed conglomerates including rounded pebbles thought to be old terrace deposits.

Weakly consolidated formations of sand and gravel are distributed along the main Rivers of the drainage system of the Shkumbin River and in the down-streams of small Rivers flowing into Ohrit Lake. Furthermore, very weakly consolidated to unconsolidated silt and sand are found in the flatlands in the vicinity of Lin and Prenjas.

Besides that, landslide deposits accompanied by Cretaceous limestones are widely distributed below the precipices of the western side of the Shkumbin River south of Librazhd.

Since those formations are considered to have been deposited in the Quaternary, they have been classified together as the Quaternary (terrace-alluvial-landslide deposits).

2-3-2 Geological Structure and Geological History

The shebenik area was strongly affected by the Alpine orogeny of the Mesozoic (approx. 250