

**REPORT  
ON  
THE MINERAL EXPLORATION  
IN  
THE KRIB-MEJEZ EL BAB AREA  
THE REPUBLIC OF TUNISIA  
  
CONSOLIDATED REPORT**

**MARCH 2002**

**JAPAN INTERNATIONAL COOPERATION AGENCY  
METAL MINING AGENCY OF JAPAN**

## Preface

In response to the request of the Government of the Republic of Tunisia, the Japanese Government decided to conduct a Mineral Exploration in the Krib-Mejez el Bab Area Project and entrusted the survey to the Japan International Cooperation Agency (JICA) and the Metal Mining Agency of Japan (MMAJ).

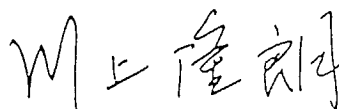
The JICA and MMAJ sent to the Republic of Tunisia a survey teams consisting of geologist and geophysicists in 1999, 2000 and 2001.

The team conducted a field survey in the Krib-Mejez el Bab Area and completed it in cooperation with the Ministry of Industry and National Office of Mines.

We hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

We wish to express our deep appreciation to the officials concerned of the Government of the Republic of Tunisia for their close cooperation extended to the team.

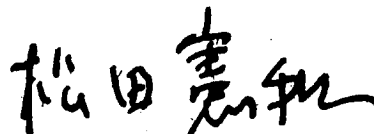
February 2002



Takao KAWAKAMI

President

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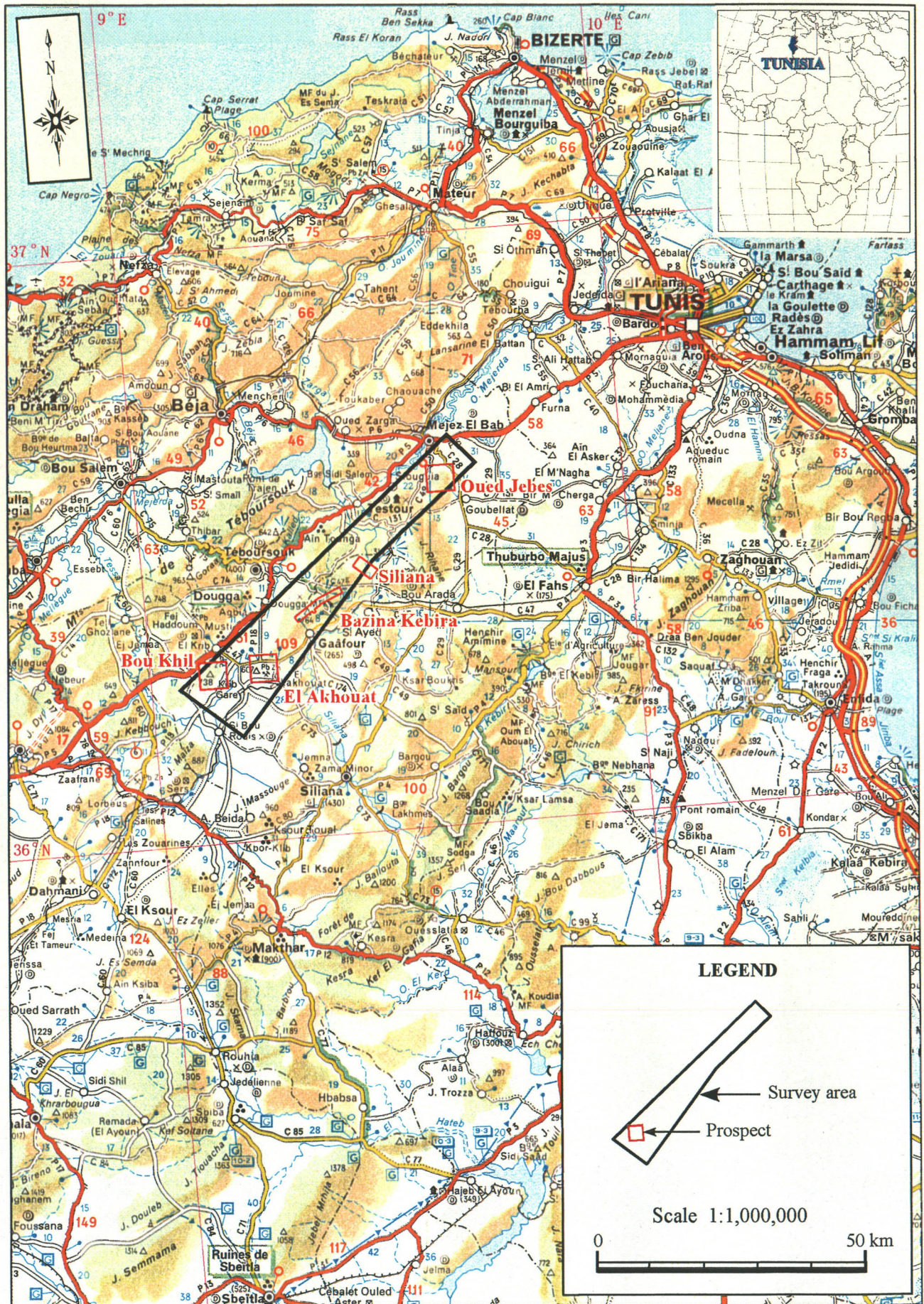


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Location map of survey area



## Summary

This report is prepared to comprehensively collect the results of the 3 Year-period Campaigns of the Mineral Exploration Project for the Krib-Mejez el Bab Area, the Republic of Tunisia.

The on-site investigations were carried out in the periods between February 7 and March 17, 2000 for the 1st Year, September 12, 2000 and March 5, 2001 for the 2nd Year, and August 26, 2001 and January 25, 2002 for the 3rd Year, by the Survey Team dispatched by Japan International Agency and Metal Mining Agency of Japan, in cooperation with the Ministry of Industry, the Republic of Tunisia.

The 1st Year Campaign comprised collection-compilation of existing data, satellite image analysis, geological investigation and geophysical prospecting (gravity, IP and magnetometric methods). The collection-compilation of existing data and the satellite image analysis covered an area of 550 km<sup>2</sup> for the Krib-Mejez el Bab Area. According to the results of these preparatory works, 4 target prospects were selected for the field investigations, namely the Bou Khil(25 km<sup>2</sup>), the El Akhouat-Argoub Adama(25 km<sup>2</sup>), the Bazina Kebira(25 km<sup>2</sup>) and the Oued Jebes(25 km<sup>2</sup>) Prospects. The geological investigation and the air-photo analysis were made for all the 4 selected prospects. The geophysical prospecting was conducted on the Bou Khil and the El Akhouat-Argoub Adama Prospects, which resulted in locating a number of geophysical anomalies that suggested possible subsurface mineralization.

The 2nd Year Campaign comprised geophysical prospecting (gravity and IP methods) and drilling investigation. The geophysical prospecting was conducted in the Bazina Kebira and the Siriana prospects for areas of 11.25 and 7.0 km<sup>2</sup> respectively, which included known mineral indications. The drilling investigation was carried out in the Bou Khil and the El Akhouat-Argoub Adama prospects for the targets that had been identified based on the result of the 1st Year Campaign. Six drill holes, totaling 1933.50m in length, were completed during the 2nd Year Campaign. Of the six holes, the hole MJTK-L2 encountered three mineralized zones with the widths of 16.0m (the average grade of 4.27 % Pb+Zn), of 11.8m (the average grade of 6.30 % Pb+Zn) and of 32.0m (the average grade of 4.14 % Pb+Zn) in the host rocks of Cretaceous carbonates.

The 3rd Year's exploration work comprised the geophysical prospecting (gravity and IP methods) and the drilling investigation. The geophysical prospecting was conducted in the Oued Jebes and the El Akhouat-Argoub Adama prospects for the total area of approximately 8 km<sup>2</sup>, which included known mineral indications. The drilling

investigation was carried out in the Siriana, Bazina Kebira and the El Akhouat-Argoub Adama prospects for the targets that were selected based on the results of the 2nd and 3rd Year Campaigns. Five drill holes, totaling 1487.10m in length, were completed during the 3rd Year Campaign. The drilling exploration resulted in locating new zones of weak mineralization in association with Cretaceous carbonate rocks in 5 holes, MJTK-A1, MJTK-C1, MJTK-L5 and MJTK-O1 in the Siriana, the Bazina Kebira, the El Akhouat-Argoub Adama and Oued Jebes Prospects respectively.

The mineralization in the Project Area is of a Mississippi Valley or Carbonate Hosted Pb-Zn type. Subsurface structures were interpreted by combining the geology and the geological structures based on the geological investigation with the gravity basement and resistivity structures based on the geophysical prospecting. According to this interpretation, it was assumed, as a working hypothesis, that the mineralization would be indicated by high chargeability anomalies superimposing gravity basements with high to moderate resistivity. This hypothesis led to locating new mineralized zones in the El Akhouat-Argoub Adama by the drilling exploration in the 2nd Year Campaign. This discovery of the new mineralization zones proved that the geological investigation and the geophysical prospecting combining the plural number of techniques were effective to locate possible mineralization concealed in the subsurface in the Project Area. This prospecting approach are being established theoretically and practically for future application to the exploration of the similar type of mineralization concealed in the subsurface in the general area.

The potential of the Project Area for the mineralization is proved to be significant, as the result of locating the mineralization, regardless of its strength and extent, in all the target prospects in the course of the current Project. Some of geophysical anomalies and mineral indications remain untested by the drilling exploration of the current project. Accordingly, there will be still chances for locating new mineralization in the Project Area. For example, no drilling exploration is conducted on the Bou Mous and Rag el Bagrat showings in the Oued Jebes Prospect, even though chargeability anomalies have been identified in association. In addition, the Dar Chebka showing of this prospect, where drill-explored in the current campaign, is worth for further exploration. Further, it will be a recommendable exploration strategy to conduct follow-up investigations for the new mineralization zones in the El Akhouat-Argoub Adama Prospect, in order to verify their shapes, sizes and degrees of mineral concentrations and to establish a guide for the future exploration.

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# Chapter 1 Introduction

## 1.1 Outline of Project

### 1.1.1 Background and Objectives

In response to the request by the Government of the Republic of Tunisia, Japanese Government decided to execute a mineral exploration project in the Krib- Mejez el Bab Area in accordance with the Scope of Work agreed upon between the two Governments on the day of 17<sup>th</sup> December 1999. The details of implementation program were further discussed between the two Governments, represented by Japan International Cooperation Agency (JICA) and Metal Mining Agency of Japan (MMAJ) for Japanese side and by Ministry of Industry and National Office of Mines for Tunisian side, and were signed by both sides upon agreement. The Mineral Exploration Project in the Krib- Mejez el Bab Area was commenced according to the agreed implementation program ending February 28<sup>th</sup>, 2002.

The objectives of the Project are to comprehend the geology and mineralization in the Krib- Mejez el Bab Area and to transfer technology for mineral resource development to engineers and scientists of pertinent institutions of the Republic of Tunisia.

### 1.1.2 Project Area

The Project Area is located approximately 50 km southwest of Capital, Tunis, in the northern part of the Republic of Tunisia (Figure 1). It occupies an area of about 500 km<sup>2</sup> bounded by the latitudes of 36° 10' and 36° 39' N and by the longitudes of 09° 03' and 09° 43' E.

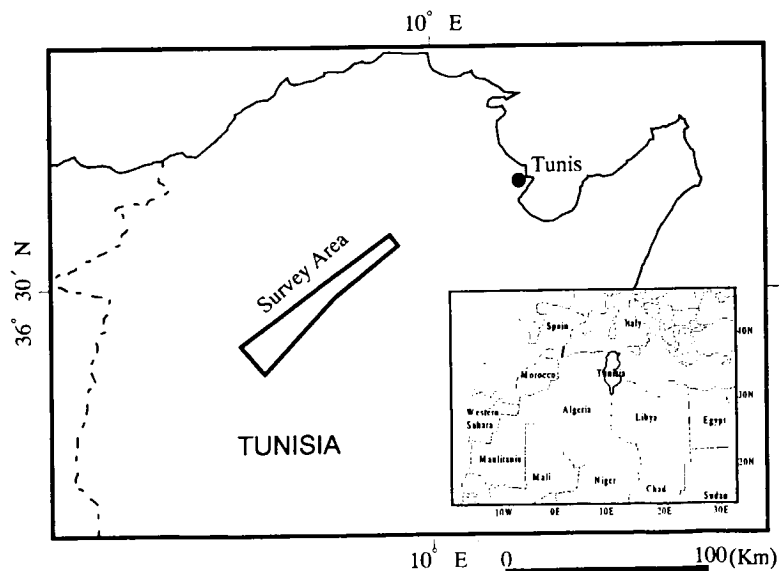


Figure 1 Location map of the survey area

### 1.1.3 Implementation Program

The satellite image analysis, the air photo interpretation, the compilation of existing documents, the geological investigation, the geophysical prospecting and the drilling investigation were implemented. The kinds and amounts of work implemented in each phase are presented in Table 1. The flow sheet of those kinds work and the flow chart

Table 1 Kinds and Amount of work

Kind of Work		Amount		
1st	(1) Satellite Image Analysis	Analyzed Area		
	Landsat TM Image Analysis	550km <sup>2</sup>		
	JERS-1 SAR Image Analysis			
	(2) Airphoto Interpretation	Interpreted Area		
	Bou Khil, El Akhouat-Argoub Adama, Bazina Kebira & Oued Jebes Prospects	100km <sup>2</sup>		
	(3) Geological Investigation	Prospecting Area	Total Traverse Length	
	Bou Khil, El Akhouat-Argoub Adama, Bazina Kebira & Oued Jebes Prospects	100km <sup>2</sup>	20km	
	(4) Geophysical Prospecting (Gravity survey)	Survey Area	Grid	Station
	Bou Khil, El Akhouat-Argoub Adama prospects	6km <sup>2</sup>	250m×250m	96
	(5) Geophysical Prospecting (IP survey)	Survey Area	Total Traverse	Measurement
	Bou Khil, El Akhouat-Argoub Adama prospects	6km <sup>2</sup>	18km	524
	(6) Geophysical Prospecting (Magnetic survey)	Survey Area	Grid	Station
	El Akhouat-Argoub Adama prospect	3km <sup>2</sup>	50m×250m	240
	(7) Laboratory Test			
	Thin Sections, Polished Sections	8 samples, 12 samples		
	X-ray Diffraction Analysis	8 samples		
	Chemical Analysis (Cu, Pb, Zn, Fe, Mn, Cd, Mg, Ca, Sr, Ba)	20 samples		
Density, Resistivity & Chargeability Measurement	20 samples, 30 samples			
Natural Remanent Magnetization, Magnetic Susceptibility	10 samples each			
2nd	(1) Drilling Investigation (Total Depth: 148)	Drill Hole	Depth	Inclination Direction
	Bou K'hil prospects	MJTK-B1	216.8m	-70° 158°
		MJTK-B2	142.1m	-90° -
	El Akhouat-Argoub Adama prospects	MJTK-L1	400.1m	-75° 118°
		MJTK-L2	400.0m	-60° 118°
		MJTK-L3	374.5m	-70° 298°
		MJTK-L4	400.0m	-60° 118°
	(2) Geophysical Prospecting (Gravity survey)	Survey Area	Grid	Station
	Bazina Kebira, Siliana & El Akhouat-Argoub Adama prospects	11.25km <sup>2</sup>	250m×250m	810
		-	250m×250m	10
	(3) Geophysical Prospecting (IP survey)	Total Traverse		Measurement
	Bazina Kebira, Siliana & El Akhouat-Argoub Adama prospects	38km		1,254
		2km		60
	(4) Laboratory Test			
	Thin Sections, Polished Sections	10 samples each		
	Chemical Analysis (Cu, Pb, Zn, Fe, Mn, Cd, Mg, Ca, Sr, Ba)	100 samples		
	Density, Resistivity & Chargeability Measurement	30 samples each		
3rd	(1) Drilling Investigation (Total Depth: 148)	Drill Hole	Depth	Inclination Direction
	El Akhouat-Argoub Adama prospect	MJTK-L5	242.1m	-65° 118°
		Bazina Kebira Prospect	MJTK-C1	311.2m
	MJTK-C2		385.0m	-65° 120°
	Siliana Prospects	MJTK-A1	198.8m	-70° 33.5°
	Oued Jebes Prospect	MJTK-O1	350.0m	-80° 125°
	(2) Geophysical Prospecting (Gravity survey)	Grid		Station
	Oued Jebes, El Akhouat-Argoub Adama prospects	250m×250m		105
	(3) Geophysical Prospecting (IP survey)	Total Traverse		Measurement
	Oued Jebes, El Akhouat-Argoub Adama prospects	22.5km		648
	(4) Laboratory Test			
	Thin Sections, Polished Sections	5 samples each		
	Chemical Analysis (Cu, Pb, Zn, Fe, Mn, Cd, Mg, Ca, Sr, Ba)	60 samples		
	Density, Resistivity & Chargeability Measurement	15 samples each		

of extracting the high potential zones for ore deposit are presented in the appendix in the end of this report.

#### 1.1.4 Project Duration and Team

The project duration in each phase is shown in Table 2. The participant members in this project are presented in Table 3 for the project planning and coordination and in Table 4 for the field operation team in each phase.

Table 2 Project duration in each phase

	Phase 1	Phase 2	Phase 3
Project duration	February 2000 – March 2000	September 2000 – March 2001	August 2001 – February 2002

Table 3 Participant members for the project planning and coordination

	Japanese side	Tunisian Side
1999	Shinya Aoki (MMAJ)	Monsieur Lajimi (Ministry of Industry)
	Koji Yamashita (JICA)	Larbi Cherif (Ministry of Industry)
	Noboru Fujii (MMAJ)	Neila Govngi (Ministry of Industry)
	Nobuyasu Nishikawa (MMAJ)	Adel Benahmed (National Office of Mines)
		Habib Mahjoubi (National Office of Mines)
		Rachid Sahli (National Office of Mines)

Table 4 Participant members for the field operation team

	Japanese side	Tunisian Side
Phase 1	Atsushi Takeyama (Sumiko Consultants)	Hammami Mongi (National Office of Mines)
	Akihiko Chiba (Sumiko Consultants)	Sellami Ahmed (National Office of Mines)
	Takumi Onuma (Sumiko Consultants)	Arfaoui Mohamed (National Office of Mines)
	Noboru Matsumoto (Sumiko Consultants)	Gharasallah Hedi (National Office of Mines)
	Koji Hirai (MMAJ)	Djebbi Mongi (National Office of Mines)
Phase 2	Atsushi Takeyama (Sumiko Consultants)	Hammami Mongi (National Office of Mines)
	Akihiko Chiba (Sumiko Consultants)	Sellami Ahmed (National Office of Mines)
	Akira Kikuchi (Sumiko Consultants)	Gharasallah Hedi (National Office of Mines)
	Noboru Matsumoto (Sumiko Consultants)	Djebbi Mongi (National Office of Mines)
	Yasunori Nuibe (MMAJ)	
Phase 3	Atsushi Takeyama (Sumiko Consultants)	Hammami Mongi (National Office of Mines)
	Akihiko Chiba (Sumiko Consultants)	Sellami Ahmed (National Office of Mines)
	Takao Ogawa (Sumiko Consultants)	Kahlifa Faiheim (National Office of Mines)
	Norizo Saito (Sumiko Consultants)	Gharasallah Hedi (National Office of Mines)
	Yasunori Nuibe (MMAJ)	

## 1.2 Geography of Project Area

### 1.2.1 Location and Access

The base for the field campaign was set in the town of Gaafour, approximately 90 km south east of Tunis. The national route No. 4, as well as associated trunk roads, runs through from Tunis to Gaafour, via El Fahs. It takes about one and a half hours from Tunis to Gaafour by driving. Trunk roads are available for the accesses from Gaafour to each prospect. It takes about 45 minutes for a distance of 45 km to Oued Jebes to the

northeast, about 25 minutes for a distance of 25 km to Siliana to the northeast, about 10 minutes for a distance of 5 km to Bazina Kebira to the north, and about 15 minutes for a distance of 10 km to Lakhout-Argoub Adama to the southwest, from Gaafour by driving (see the location map of the survey area).

### 1.2.2 Topography and River System

The Project Area consists of mountainous or hilly areas, composed mainly of Triassic and Cretaceous systems, and low, flat lands. The mountainous-hilly areas are divided by major water courses into three districts, namely Jebel Ech Chied, Jebel Bou Khil and Jebel Mourra. Peaks of these mountainous-hilly areas range from 400 to 750 m in their elevations, with elevation differences of 200 to 550 m from their bottoms. The highest peak is the triangulation point of Jebel Ech Cheid at an elevation of 764 m above mean sea level, which is located in the southwestern corner of the central part of the Area. Taluses and colluvial slopes are often formed at foothills, while low, flat lands are largely composed of alluvial deposits.

Oued Silana, Oued Khllau and Oued Malah are major rivers in the Area, which take considerably meandering courses. Oued Silyana runs northward for a distance of more than 6 km within the Area, changes its course eastward and then joins Oued Madjerda to the northeast. Oued Khllau flows northeastward along the northwestern flank of Jebel Ech Cheid and also joins Oued Madjerda. Oued Malah takes, on the contrary, a southeasterly course along the northwestern flank of Jebel Bou Khil (Figure 2).

### 1.2.3 Climate and Vegetation

The land of the Republic of Tunisia is divided into four climatic regions, namely Tell Atlas, the northwestern axial range, the eastern steppe and the southern desert. The Project Area, belonging to Tell Atlas, is characterized by a number of hills with affluent vegetation. Its climate is typically Mediterranean with the hot-dry summer and mild-wet winter. Rainfall is annually totaled to 400 mm or more, with monthly precipitation exceeding 50 mm for the period from October to February and declining to 10 mm or less in the three month period of summer. Seasonal average temperatures are 24°C for spring, 30°C for summer, 25°C for autumn and 16°C for winter. The climatic record in Tunis is shown in Table 5.

The vegetation is typically of a wet-winter climatic zone, characterized by evergreen, broad leaf species. Although individual trees may shed their leaves for a week or two in a year, no defoliation of forest as a whole is observed. The Project Area is generally well vegetated except in the circumstances of abandoned mine sites. Reforestation is being vigorously practiced around such mine sites.





Table 5 Climatic Record in Tunis

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp. (°C)	11.4	11.8	13.2	15.4	19.1	22.9	26.3	26.6	24.1	20.1	15.8	12.4
Precip. (mm)	56.4	59.0	45.3	38.2	24.3	10.7	2.4	6.3	35.3	69.8	57.8	61.9

Temp.: Monthly average temperature of daily mean

Precip.: Monthly total precipitation