

## **Appendix II**

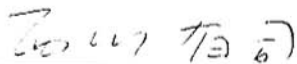
1. Memorandum of Implementation plan of supplementary geological survey
2. Minutes of the 1<sup>st</sup> Steering Committee Meeting
3. Minutes of the 2<sup>nd</sup> Steering Committee Meeting
4. Minutes of the 3<sup>rd</sup> Steering Committee Meeting
5. Minutes of the 4<sup>th</sup> Steering Committee Meeting
6. Minutes of the 5<sup>th</sup> Steering Committee Meeting
7. Photos of the Meetings and Office Works
8. Equipment Provided to the Mauritanian Side

## Mémoire concernant les études géologiques supplémentaires

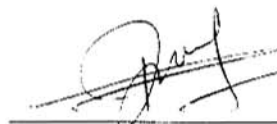
Suite à une série de discussions tenues entre l'OMRG et l'Equipe d'Etudes de la JICA (ci-après appelé 'l'Equipe d'Etudes'), les deux parties sont parvenues à un accord sur les points suivants :

1. L'OMRG a donné son accord à l'Equipe d'Etudes sur la teneur du « Plan de l'exécution des études géologiques supplémentaires » selon lequel l'Equipe d'Etudes exécutera ses études.
2. Le plan sera modifiable après l'avoir revu suivant les résultats des études et les situations locales. L'OMRG et l'Equipe d'Etudes devront consentir à la modification éventuelle.
3. L'OMRG mettra à la disposition de l'Equipe d'Etudes les informations locales (infrastructure routière, circulation, lieu de ravitaillement en carburant, hôtel ), les données et documents sur les gisements miniers et la géologie des zones d'études.
4. L'OMRG et l'Equipe d'Etudes prendront les mesures convenables à assurer la sécurité des études en créant un réseau de communication étroit entre les deux parties. Il sera donc indispensable de mettre 2 téléphones satellites Thuraya à la disposition de l'OMRG.
5. Dans le cadre de ce projet, l'OMRG a demandé à l'Equipe d'Etudes l'augmentation du nombre d'échantillons en vue d'avoir des résultats les plus significatifs. L'Equipe d'Etudes lui a promis de soumettre cette question à la JICA.

Le 4 décembre 2003



Yuji Nishikawa  
Chef de la Mission JICA



Djimera Oumar  
Directeur Général de l'OMRG



Masaharu Marutani  
Géologue



Haiba Sidi Ould Teiss  
DIRECTEUR GENERAL  
Directeur Adjoint de l'OMRG

# Implementation Plan of Supplementary Geological Survey

## 1. Purpose

- Supplementary geological survey will be implemented in potential areas of mineral resources in order to promote investment in mining industry by domestic or foreign capitals.

## 2. Subjects

- Selecting promising areas for mineral exploration and development
- Making geological map showing the potential of mineral resources
- Making mineral deposit models
- Establishing metallogenic provinces
- Writing a manual of geological/geochemical survey
- Establishing the methodology, strategy and guideline of mineral exploration
- Evaluating the mineral-resource potential

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## 3. Steps

### (1) The 1st Phase Geological Reconnaissance

#### a) Period

- January to March 2004 (60 days)

#### b) Positioning

- General geological reconnaissance of 14 survey areas selected out of the 28 ore-deposit/ manifestation areas
- Creating a rough image of each ore deposit/manifestation

#### c) Subjects and points

- Analyzing LANDSAT images
- Selection of 14 survey areas out of the 28 ore-deposit/manifestation areas

→ Points:

- 1) Covering the 4 geological provinces
- 2) Covering various types of mineralization that took place in the whole territory of Mauritania
- 3) Giving priority to areas clearly exhibiting mineral potential based on existing data and promising areas suggested by the results of remote-sensing analyses
- 4) Considering gold-bearing banded-iron-formations in the Regueibat shield and copper-gold deposits in the greenstone

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belt of the Mauritanides as important

5) Considering various geological elements

6) Considering the current status of infrastructure (especially water supply and roads) and possibility of its improvement

● Conducting field surveys in 5 selected survey areas

General geological reconnaissance

Ground truth

→ Points:

1) Improving interpretation accuracy of remote sensing analysis

2) Spatial relation between ore deposit(s)/ manifestation(s) and lineament(s)/fracture(s) extracted through LANDSAT-image analysis

Geochemical mapping

→ Point:

1) Locating anomalous points by determining the threshold between anomaly and background for each chemical components

Bulk-rock chemical analyses

→ Point:

1) Classification of igneous rocks

Microscopic observations of polished thin sections

→ Points:

1) Identification of ore minerals and gangue minerals

2) Description of occurrence mode of ore minerals

X-ray analyses

→ Points:

1) Identification of alteration minerals

2) Locating alteration zones

Dating

→ Points:

1) Collection of data useful for determining or inferring time of mineralization

● Interviews of BRGM geologists

→ Points:

1) Geological data obtained recently and BRGM's policies concerning their mineral-resource surveys in Mauritania

2) Contents of the interview will be reflected in the progress-report description

## (2) The 2nd Phase Geological Reconnaissance

### a) Period and number of days

- October to November 2004 (60 days)

### b) Places

- Determining the image of each ore deposit/manifestation
- Creating rough images of mineral deposit models and metallogenic provinces

### c) Subjects and points

- Analyzing ASTER images
- Ground truth
- Extracting promising areas for mineral exploration and development

→ Points:

- 1) Considering the current status of infrastructure (especially water supply and roads) and possibility of its improvement

- Determining image of mineralization of each ore deposit

→ Points:

- 1) Describing the geological structure
- 2) Describing the mode of occurrence of ore
- 3) Grasping the characteristics of alteration zone
- 3) Making a geological map

- Conducting field surveys in 6 selected survey areas

## (3) The 3rd Phase Geological Reconnaissance

### a) Period

- January to March 2005 (45 days)

### b) Places

- Determining images of mineral deposit models
- Final supplementary geological reconnaissance

### c) Subjects and points

- Concreting image of mineralization of each ore deposit

→ Points:

- 1) Grasping the characteristics of each ore deposit
- 2) Determining the various elements (e.g., process, conditions and geological control factor) of mineralization in each ore deposit

- Determining mineral deposit model

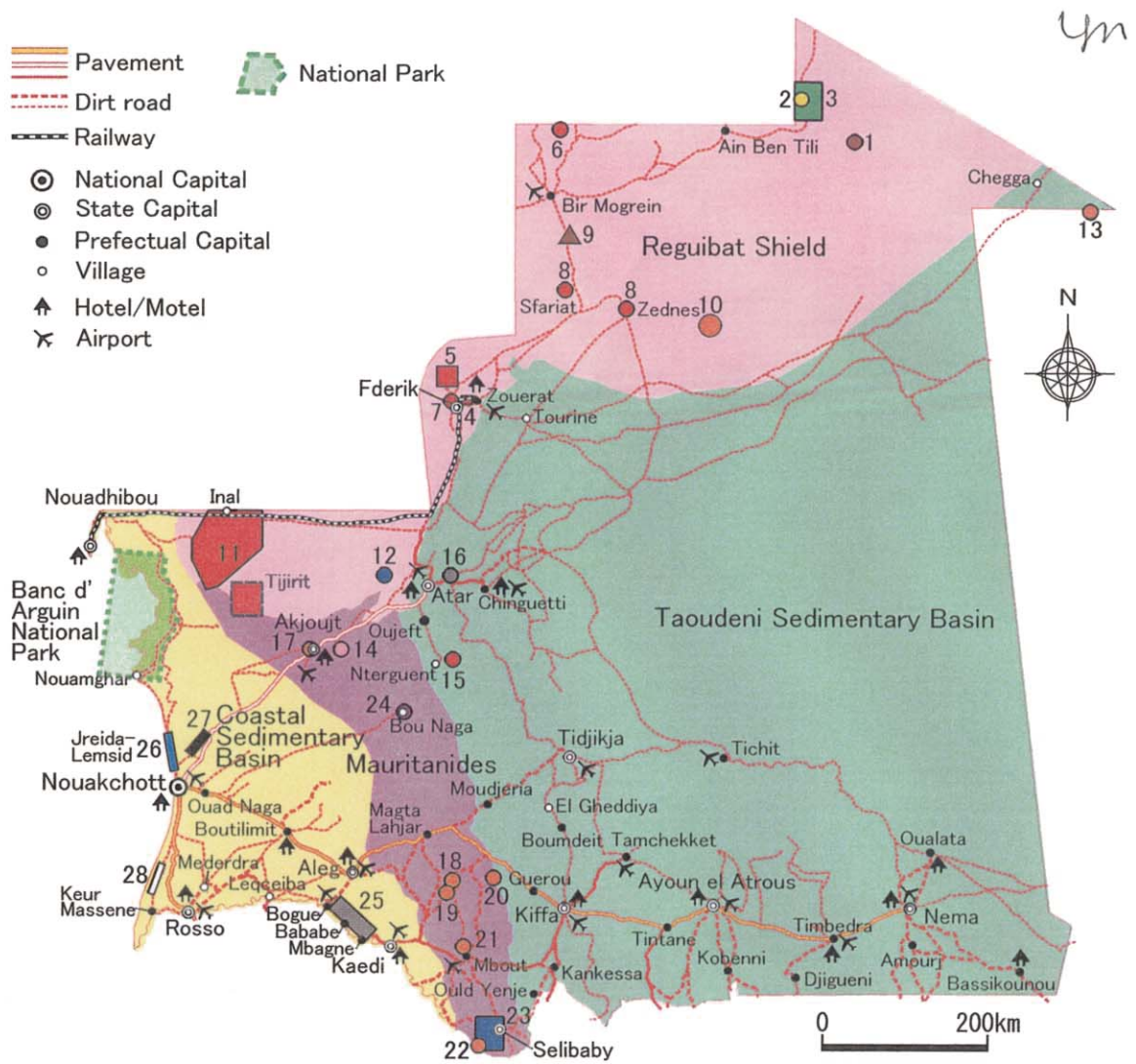
- Extracting promising areas for mineral exploration and development

→ Point:

- 1) *Extracting areas with relatively high economical potential for mineral resources*

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- Au
- Cu
- Pb Zn Cu
- ▲ Y Th
- ▲ Cr
- ▲ Sn
- ▲ W
- Fe
- ▲ P
- Ti
- ◆ Gypsum
- ◇ Rock Salt

#### Reguibat Shield

- 1 Catherine (Sn Cu)
- 2 Conchita-Florence (Au)
- 3 Yetti (Pb Zn Cu)
- 4 Koedia Idjill (Fe)
- 5 Tiris (Fe)
- 6 Gara Bouya Ali (Fe)
- 7 F'Derik (Fe)
- 8 Sfariat-Zednes (Fe)
- 9 Tourassin-Aneinat (Sn)
- 10 Ghallamane Sebkhas (Cu)
- 11 Tasiast (Fe Au)
- 12 Amsaga (Cr)

#### Taoudeni Sedimentary Basin

- 13 Chegga (Cu)
- 15 Akka Denach (Fe)
- 16 Bathat Ergil (P)

#### Mauritanides

- 14 Tabrinkout (W)
- 17 Inchiri (Guelb Moghreïn) (Cu)
- 18 Kadiar (Cu)
- 19 Indice 78 (Cu Au)
- 20 Oudelemgil (Cu Au)
- 21 Mbout (Cu Au)
- 22 Diagouli (Cu)
- 23 Guidimaka (Cr)
- 24 Bou Naga (Y Th)

#### Coastal Sedimentary Basin

- 25 Kaedi-Aleg-Bogue (P)
- 26 Jreida-Lemsid (Ti)
- 27 Nouakchott (Gypsum)
- 28 Aftout es Saheli (Rock Salt)

## Locations of Ore Deposits and Manifestations

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Table Characteristics of the 28 ore deposits/manifestations

Adoption as Survey Area	Geol. Prov.	Name of ore deposit/prospect	Metal(s)	Access		Country Rock	Grade	Reserve	Ore Mineral	Ore deposit		Type	Vol. of existing literatures	Others
				Nearby Village	Off-road (km)					Yield of metal(s) with high priority in the geol. prov. concerned	Unique type in the geol. prov. concerned			
X		1 Catherine	Sn Cu	Ain Ben Till	110	migmatitic granite	Sn 300ppm Cu 0.31-0.64%	X	Cassiterite, stannite, chalcocopyrite			pneumatolytic (-hypo-thermal) type, quartz-rich greisen	O	Extremely low grade and reserve
Δ		2 Conchite-Florence	Au	Ain Ben Till	120	Lepiditic magnetite and amphibolic magnetite of the Hassi el Fogra series (Precambrian)	Au <10g/t	400-500kg	Native gold, quartz, pyrite	Au		Vein	O	
Δ		3 Yeti	Pb Zn Cu	Ain Ben Till	50	Hydrothermal-vein zone along N-S fracture system			Sphalerite, galena, chalcocopyrite			Vein	O	
O		4 Koedia Igili	Fe	Fdenik	0	Ilabirite (0.3-2cm in outcrop), quartzite, schist, ferruginous quartzitic breccia (Tiris-Precamb. D)	Fe 63-64%		Hematite, goethite	B.I.F.	B.I.F. Gp (1/6)	Sedimentary	O	
O		5 Tiris	Fe	Fdenik	30	Ferruginous quartzite in mesozonal gneiss (old Archaean)	Fe 37%	2,000Mt	Magnetite	B.I.F.	B.I.F. Gp (2/6)	Sedimentary	O	
X		6 Gara Bouya Ali	Fe	Bir Mograin	80	Conglomerate, mudstone, quartzose sandstone of upper Cambrian - Ordovician	Fe:O <sub>3</sub> 46%	39,300Mt	Goethite	B.I.F.	B.I.F. Gp (3/6)	Sedimentary	O	
X		7 F'Denik	Fe	Fdenik	20				Hematite	B.I.F. (Banded Hematite Quartzite)	B.I.F. Gp (4/6)	Sedimentary	O	
X		8 Sfarial-Zednes	Fe	Bir Mograin	130		35-35% 68-69	30Mt 300Mt	Hematite, magnetite	B.I.F. and Iron Cap	B.I.F. Gp (5/6)	Sedimentary	O	
Δ		9 Tourassin Aneinat	Sn	Bir Mograin	60		875-225-125ppm		(Geochemical anomalies)			Associated with mylonitized vulcanite	X	
X		10 Ghallamane Sebkhass	Cu	Zouerat	240	Volcano-sedimentary complex (Precamb. D,C)	70-160-280 ppm		(Geochemical anomalies)				X	
O		11 Tasiast	Fe Au	Nouadhibou	190	The Amsaga Group (Archaean basement)	Fe:O <sub>3</sub> 30%		Laterite	Au B.I.F. 1-4m thick lateritic cap on sedimentary ferruginous quartzite	B.I.F. Gp (6/6)	Sedimentary	O	Laterite ore
X		12 Amsaga	Cr	Atar	100	Occur with serpentine, Anorthosite complex (Precambrian)	Cr:O <sub>3</sub> 30-36%		Chromite, magnetite			Ortho magma	O	
X		13 Chegga	Cu	Chegga	0	Fine-grained ferruginous sandstone (Intra-Camb. Sup.)	Cu 0.21-0.82%		Malachite, cuprite, covellite				O	Access via Mali
X		15 Akka Denach	Fe	Atar	110	Hematite concentrate in upper Ordovician sandy/muddy rock			Hematite			Sedimentary	O	
X		16 Bathat Ergi	P	Atar	40	Occur in quartzitic sandstone of base of the Atar Group (Precambrian)			Phosphate minerals			Sedimentary	O	
O		14 Tabrikout	W	Akjout	0	Pneumatolytic type, occur with quartz veins (5-20cm thick) cutting lenses of crystalline carbonate rock	WO <sub>3</sub> <0.06%		Wolframite			Pneumatolytic	O	Window opened within covering Mauritandest?
O		17 Inchir (Gueb Moghrein)	Cu Au Co (Ni,Te,Mo)	Akjout	4	Carbonate (rich in Fe&Mg)-magnetite lense interstratified in epimetamorphic volcano-sedimentary series of Akjout	Cu 2.7% Au 2.5g/t Cu 1.8% Au 1.3g/t	270kt (oxide ore) 114kt (sulfide ore)	Malachite, chrysocolla, native gold	Cu	Cu Gp (1/3)	Lense, dissemination	O	
O		18 Kadiar	Cu (Ni,Cr,Co,Ag,Zn,Au)	Aere	0	Prasinite, chlorite shist, mica shist, carbonate rock of the Gadiel series	Cu 1.5% Cu 0.8% Au 0.2-25g/t (max174ppb) Cu <35.5%	9.5kt (oxide ore) 2.5kt (sulfide ore)	Malachite, chalcocopyrite	Cu	Cu Gp (2/3)	Dissemination	O	
O		19 Indice 76	Cu Au	Aere	0	Mela-andesitic tuff			Malachite, covellite, native gold	Cu Au	Cu Au Gp (1/3)	Dissemination	O	
O		20 Oudlemgji	Cu Au	Kaedi	140	Volcano-sedimentary rocks (metagabbro, metabasalt, agglomerate, quartzite, schist)	Cu 35.5% (Ponctual) Au 40ppb	138kt (3% Cu)	Malachite, Chalcocopyrite	Cu Au	Cu Au Gp (2/3)	Dissemination	X	
X		21 Mibout	Cu Au	Kaedi	110				Malachite, chrysocolla	Cu Au	Cu Au Gp (3/3)	Dissemination	X	
O		22 Diagull	Cu	Selbaby	40	Chlorite shist, jaspilite and siltstone of the Gadiel series, and lenticular serpentinite intruding into the Gadiel series	Cu 1.5%		Malachite, chrysocolla	Cu	Cu Gp (3/3)	Dissemination	O	
O		23 Guidmaka	Cr	Selbaby	10	Serpentinite	Cr:O <sub>3</sub> 26-34%	3.6kt	Chromite			Ortho magma	O	
X		24 Bou Naga	Y Th	Bou Naga	0	Syenite of precambrian Bou Naga alkaline subvolcanic complex	Y:O <sub>3</sub> 4% Th <1%	1kt (oxide ore)	Xenotime, thorite			Vein	O	Low market price
X		25 Kaedi-Aleg-Bogue	P	Aleg	0	Dolomite-limestone Eocene series	P:O <sub>3</sub> 22%		Phosphate minerals			Sedimentary	O	
O		26 Jreida-Lemaid	Ti	Nouadhibou	140		TiO <sub>2</sub> 2.7%	87kt (ilmenite)	Ilmenite			Placer	O	
X		27 Nouakchott	Gypsum	Nouakchott	60	Gypsum bed		17.5Mt	Gypsum			Sedimentary (dune)	O	
X		28 Allout es Sahel	Rock salt	Nouakchott	120			150kt	Halite			Evaporite deposit originated from sea water pooled in lowland behind dune	O	

**2 Minutes of the First Steering Committee Meeting**  
**The Study on the Strategic Plan of Mineral Resources Development in the Islamic**  
**Republic of Mauritania**

1. Place, date, time

Office Mauritanien des Recherches Geologiques(OMRG)

December , 2003 at 10:00-12:00

2. Participants

(1)Mauritania side

OMRG

.Djimera Oumar, Director General, Chairman of The Steering Committee Meeting

.Sidi Haiba Ould Teiss, Deputy Director General

PRISM

.Samory Ould Souedat, Director

DMG

.Wane Ibrahima, Director

MMI

.Dia Souleye Aly, Conseiller Technique

(2)Japanese side

.Yuji Nishikawa, Team Leader/Mineral Resources Evaluation

.Richard T. Thompson, Promotion of Investment

.Masaharu Marutani, Geology

.Masami Higashihara, Geology

.Richard M. Teeuw, Remote Sensing Analysis

.Kazuki Shingu, Environmental Consideration

.Kazushige Wada, GIS Database Design

.Atsushi Ito, Japanese/French Translator

.Toshio Inoue, Coordinator

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### 3. Agenda

- (1) Chairman's greeting
- (2) JICA Team Leader's address
- (3) Explanation of the Inception Report
- (4) Explanation of Supplemental geological site survey implementation Plan
- (5) Explanation of the World Bank PRISM Project
- (6) Discussion
- (7) Chairman's concluding remarks
- (8) Conclusion

### 4. Important Points of the Agenda

#### (1) Chairman's greeting

- Mining is very important for the Mauritania economy.
- This project will make a strategic promotion plan for exploration.
- Mauritania Government institutions expect to have joint work with the Japan team through this project and, thus improve its survey method and technology
- Mauritania Government institutions do further appreciate that JICA introduced in Mauritania the Study on the Strategic plan of Mineral Resources Development (SPMRD).

#### (2) JICA Team Leader's address

- This project's target is to promote exploration by foreign investors of Mauritania's mineral resources.
- Targets of the project are especially to clarify the extend of non ferrous metals such as Cu and Au etc..
- Mauritania has real potential mineral resources. Through this project the potential will be clarified.
- Security should be kept for the implementation of the survey. The team needs to exchange information about security related matters..
- The project should, thus, be carried out by maintaining security with cooperation between the Japan and Mauritania teams.

#### (3) Explanation of the Inception Report

- This project extends itself over a period of two and half years and is made of two stages. The Japan team will visit Mauritania 6-to-7 times during the life-time of the project to undertake joint work together with their Mauritania counterparts.

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- This project is composed of the investigation stage as well as stages for making the development strategic plan. Thus, through gathering information, analysis, discussion with Mauritania side and field survey results, this project will make a development strategic plan for the promotion of exploration using mineral resources.
- One of the tools for promotion is to establish a GIS Database and Web site, and make a presentation appealing for investment in exploration at an international seminar, convention, etc..

(4) Explanation of supplemental geological survey plan

- Three surveys are planned, namely, first survey is for reconnaissance, second survey is for resourcefully considered sites and important locations and third survey is to create deposit models.
- Survey for the selected area will bring a promising area, mechanism of mineralization and deposit model. These results will be useful for the promotion of exploration, especially for foreign investors.
- Most survey areas are in severe environments, so it is important to maintain security and the health of the team.

(5) Explanation of The World Bank PRISM project

- As conceived JICA project needs to have relations with the PRISM Project. The World Bank recognizes the importance and the usefulness of the realization of a strategic development plan. However overlapping between the two strategic projects needs to be avoided.
- The Japan team can use The World Bank PRISM database
- The World Bank wishes to cooperate with this project for strengthening the mining sector capability.

(6) Discussion

- The Steering Committee as a whole considers the implementation of all components of this project to be extremely important for the years to come. The realization of GIS, the identification of potentially resourceful areas and the construction of a Web site to attract both international and domestic investors, will certainly provide Mauritania with invaluable tools to knowingly operate in the world.
- Emphasis was put also clearly on OMRG's request addressed to JICA to acquire an Atomic Absorption equipment because of the existing equipment which is at OMRG's Laboratory and superannuated.

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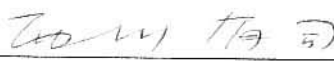
(7) Chairman's concluding remarks

- Based on the Japan side explanation, this project will be carried out as conceived.
- This project needs the cooperation of the Japan and Mauritania sides for successful results.

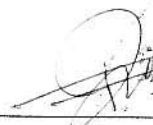
(8) Conclusion

- 1) The Steering Committee approved the Inception Report.
- 2) The Steering Committee supports the JICA team.
- 3) The World Bank's project PRISM supports and accepts to cooperate with the JICA team and Mauritania team as well.
- 4) The Steering Committee approved the plan of the survey and geological supplemental survey
- 5) JICA will consider to provide OMRG with an Atomic Absorption Equipment, a chemical Analyser for its laboratory operations.

Date: 01 Dec. 2003  
JICA Mission of the Study on  
The Strategic Plan of Mineral  
Resources Development in the  
Islamic Republic of Mauritania

  
\_\_\_\_\_  
Yuji Nishikawa

Chairman of the Steering Committee

  
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Djimera Oumar

