Ex-Post Evaluation of the Project on "Upgrading Exploration Technology of Mineral Resources in the Kingdom of Morocco"

March 31
2006

JICA Morocco Office

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Contents

Abbreviations

JICA:	"*Japan International Cooperation Agency*"
BRPM:	"*Bureau de Recherche et de Participation Minières*"
ONHYM:	"*Office National des Hydrocarbures et des Mines*"
ONAREP:	"*Office National des Recherches et Exploitations Petrolières*"
PDM:	"*Project Design Matrix*"
ICP:	"*Inducted Coupled Plasma*"
POSAM:	"*Portable Specto-Adiometer*"
GIS:	"*Geographic Information System*"
PDM:	"*Development Mining Plan*"
PNCG:	"*National Geological Mapping Plan*"
MEM:	"*Energy and Mining Ministry*"
FDIM:	"*Federation of the Mineral Industry*"

I- INTRODUCTION

I-1 Context

The Japan International Cooperation Agency (hereinafter referred to as JICA), aims to conduct, during December 20th, 2005 – February 26th, 2006, the Ex-post evaluation (hereinafter referred to as the "Evaluation") of the project on "Upgrading exploration technology of mineral resources in the Kingdom of Morocco" (hereinafter referred to as the "Project"), conducted between 1998 and 2002 under the responsibility of the "Bureau de Recherches et de Participations Minières" (hereinafter referred to as BRPM). This evaluation is conducted three years after the end of the Project in order to verify the important issues relating to the project impact and sustainability.

I-2 Succinct Project Description

Background of the Project
The agriculture, fishery and tourism occupy an important portion in the economic structure in Morocco. The Moroccan economic situation largely depends upon the above three sectors.
Upon the Fifth Five-Year National Programme (1988-1992), the Kingdom of Morocco aimed at further stable economic growth with strengthening the mining sector and also promoting export of mineral products through searching for the future possibility of development in mining sector.

The JICA – BRPM cooperation has more than thirty years history. Since 1970s, the Government of Japan implemented the dispatch of experts, the feasibility study and the mini-project to BRPM upon the official request from the Government of the Kingdom of Morocco. Many projects had been operated particularly around specific programs for mineral resources (copper, zinc, lead …) exploration in selected areas on the Moroccan territory (Haouz, Anti Atlas, …). In these projects and programs, the inputs and the contribution of Japanese cooperation are of three aspects:

- Dispatch of long and short term experts to manage the projects, to train BRPM's engineers and to assist BRPM in developing exploration technologies.
- Training of the BRPM's engineers in Morocco under JICA experts' supervision and during trainings in Japan. Hence, before the Project, 25 BRPM engineers had already been trained in Japan to develop technical competencies.
- Donation of equipments for enhancing the technology of exploration surveys.

The Government of the Kingdom of Morocco submitted in 1997 a new official application form for the Japanese technical cooperation to acquire advanced technology of mineral exploration, ore dressing and industrial materials which enables the BRPM engineers to find out the mineral resources hidden in the ground rather than the resources exposed on the surface of the earth.
The Record of Discussion signed in January 26, 1998. The cooperation commenced on April 1, 1998. The Project Design Matrix (PDM, Annex I) gives a global idea on the Project.
As 3 years passed since the end of the Project, JICA Morocco Office implemented an Ex-post Evaluation of the above Project.

Project Overview

With the advanced Japanese exploration technology, this project was implemented to strengthen BRPM capacity to conduct systematical and practical exploration by a transfer of the technology and the enhancement of BRPM mining skills with the special emphasis to:

- Allocate appropriate personnel and facilities to the Staff Section.
- Procure and install advanced exploration equipments.
- Collect and interpret existing data to select prospective areas (model areas).
- Elaborate a geological and geochemical survey plan.
- Transfer comprehensive exploration technology on the basis of the results of geological, geochemical and geophysical exploration activities.
- Organize internal seminars in BRPM with assistance of Japanese experts for sharing the technological information.

Overall Goal of the Project
New mineral resources will be found in Morocco.

Purpose of the Project
BRPM will be able to continuously carry out the systematical and practical exploration.

Outputs of the Project

- The Organization of Exploration Department of BRPM will be improved and it will be operated efficiently.
- Equipment will be efficiently operated and properly maintained.
- Planning method on efficient exploration will be acquired.
- Practical technology on exploration will be acquired.
- Comprehensive exploration technology will be acquired.
- Manual on exploration technology will be ready for use.
- A system of transferring exploration technology will be established in BRPM.

Inputs of the Project

Japanese side

- 7 Long-term Experts.
- 20 Short-term Experts.
- Total cost for this project 500,000,000 Yen
- Equipment 60,090,000 Yen.
- Local cost 15,140,000 Yen.
- 7 Moroccan Trainees received in training in Japan.

Moroccan Side

- 32 Counterparts.
- Local currency 170,600,000 Yen.

Main Activities of the Project
Its achievement was operated around five (05) activities:

1- *Seminars at the BRPM's office*: Representing a major component, 58 seminars related to exploration concept such as geology, metallogeny and ore deposit typology, and technology for instance geochemistry, geophysics and fluid inclusions, were undertaken by short-term and long-term experts of the Project.
2- *Field works*: These works aimed to transfer the Japanese know-how in mining exploration. Two pilot projects were lead by a combined team of Japanese and Moroccan geologists including BRPM's newly recruited engineers.
3- *Technical trainings in Japan*: Seven (07) trainings programs (of one month period on average) were organised for BRPM's engineers. They aimed a direct exchange between BRPM's engineers and mining exploration actors in Japan. The training's activities varied from the visit to the mines and laboratories to the participation to seminars and meetings.
4- *Equipment and related operational training*: The BRPM has benefited of new equipments either to reinforce the existing services or to acquire new technologies. Three mains equipments (ICP – Inducted Coupled Plasma, POSAM – Portable Spectro-Adiometer and fluid inclusion) were donated to BRPM within the framework of the Project, in addition to two four wheel cars.
5- *Exploration manual writing*: Planned in the PDM, this manual presents acquired experiences by BRPM in mineral exploration related to this Project.

I-3 Project Evaluation History

The Project has been the object of two formalised evaluations conducted by two Japanese teams.

- The Mid-term evaluation, from 23rd to 31st of May 2000, to review and to evaluate with the Moroccan side, the achievement of the Project according to the five evaluation criteria (effectiveness, impact, efficiency, relevance and sustainability).

- The Final evaluation has been conducted from 21st of October to 2nd of November 2001 based on the five evaluation criteria.

Three years after the completion of the Project, JICA aims to undertake the ex-post evaluation focalizing on impact and sustainability according to the Terms of Reference (Annex II) and the Contract (Annex III) signed on 20th of December 2005.

I-4 Terms of Reference

The evaluation is expected to verify the important issues relating to the project impact and sustainability observed three (03) years after the project completion. More specifically, the evaluation will seek answers to the following main evaluation questions:

- Questions relating to the situation of mining sector in Morocco;
- Questions relating to Impact;
- Questions relating to Sustainability.

Data and information will be collected through the project site visits and surveys including the following :

- Conduct literature survey to understand the implementation process, the extent of achievement of the project, and to identify further challenges to be dealt with, both at the time of Terminal Evaluation and of the Ex-Post evaluation;
- Conduct interview or questionnaire survey to relevant private mining companies for the purpose of confirming the contribution of BRPM;
- Conduct Key Information Interviews with the relevant officials in the Ministry;
- Conduct interview or questionnaire survey with engineers, administrative and technical counterparts of BRPM;
- Review budgetary documentation to assess whether BRPM secures the adequate quality of exploration activities;
- Conduct direct observation to ascertain the use of equipment and manuals introduced by the project.

JICA requires the consultant to present recommendations and lessons learned through all evaluations studies in the final report. Recommendations should document practical and specific suggestions to improve the project that is subject to evaluation. On the other hand, lessons learned present specific suggestions for the formulation of future projects in a similar context.

II- EVALUATION METHODOLOGY

On the basis of the contract and different meetings with the JICA Morocco office, we elaborate, submit and validate the evaluation methodology with the evaluation logic, the evaluation approach and data collection matrix and tools.

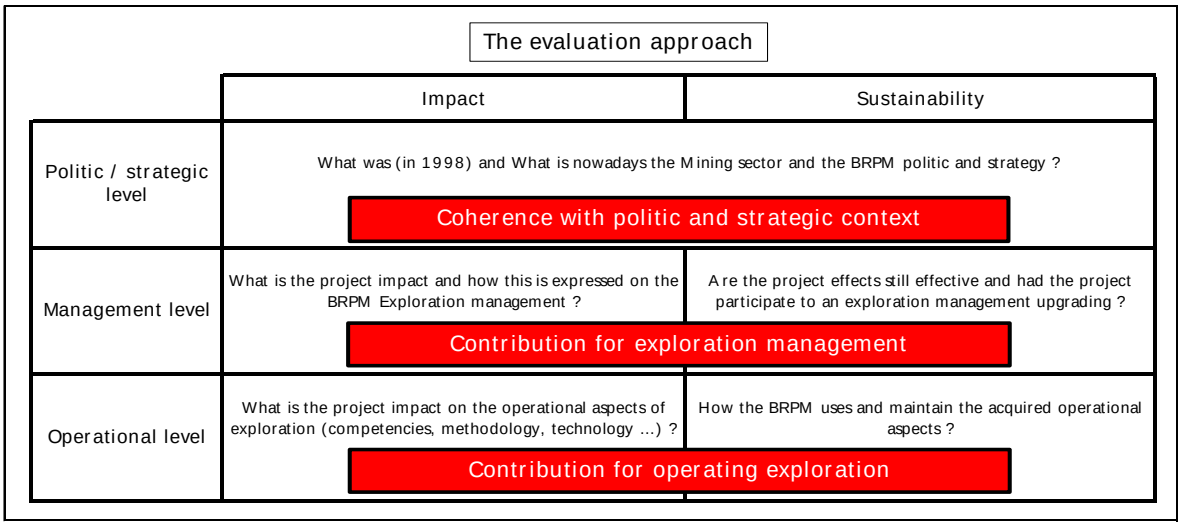
II-1 Evaluation Logic

The ex-post evaluation is conducted three years after the completion of the Project with emphasis on the impact and sustainability. It aims at drawing lessons and recommendations for the improvements of JICA Country programs and for the planning and implementation of more effective and efficient projects in relevant sectors.

The evaluation is taking into account that the Project is based on thirty years technical assistance between JICA and BRPM, so that related direct impact of the Project are equally to be verified on the basis of the indirect impact of this historical bilateral cooperation.

II-2 Evaluation Approach

For data collection and interpretation, an up-down approach is chosen which, for realisation, needs to go through three levels of performance: [1] Strategic level, [2] Management level and [3] Operational level. The purpose is to verify the coherence of the Project with the political and strategic context of the Moroccan mining sector in general, and the vision for BRPM's reorganization in particular, and to evaluate specific contributions of the Project for exploration management and operations. The following matrix shows the questions and puts the objectives dealt with in this approach.



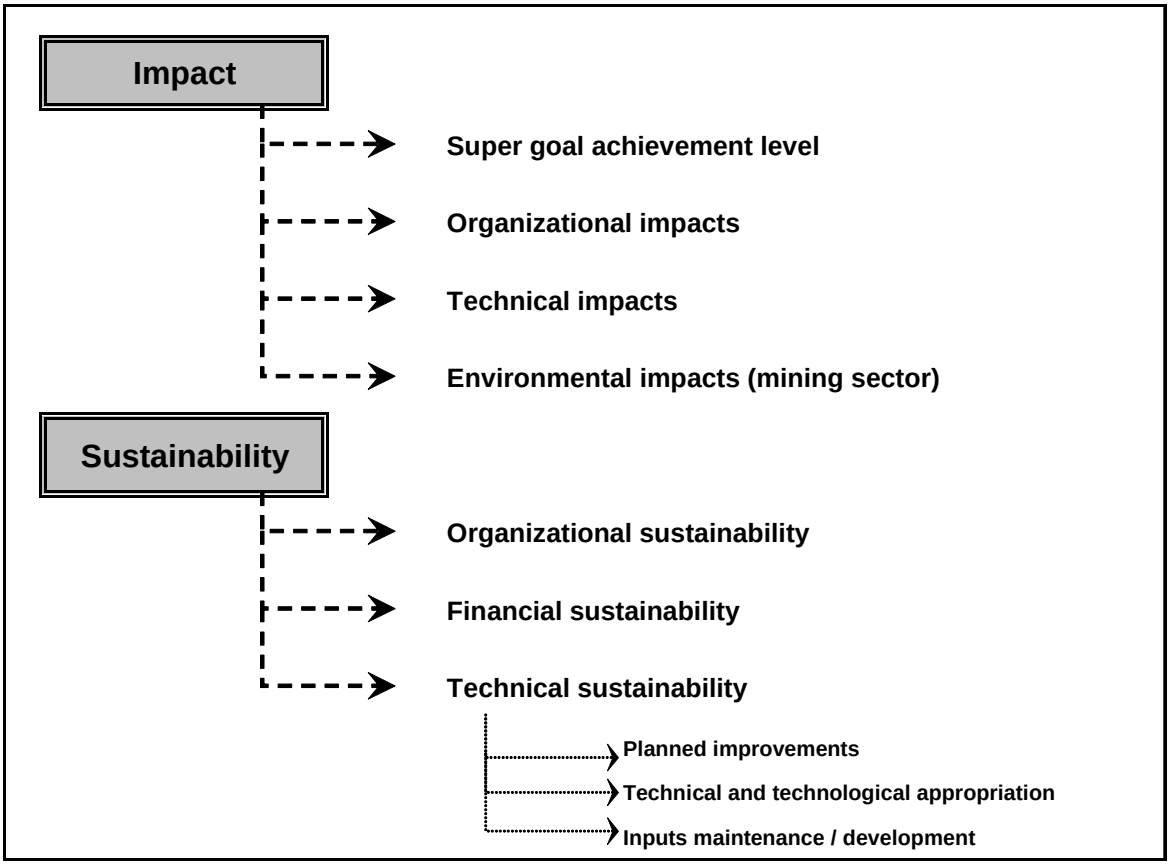
To put this approach into application, many individual and collective interviews were held. They concerned:

- Energy and Mining Ministry officials (Secretary General and The Mining Development Director) ;
- The BRPM General Manager;
- The Secretary General of the Federation of the Mineral Industry (FDIM);
- The BRPM Exploration Managers (Exploration Director, Divisions and Departments Managers) ;
- The BRPM Exploration engineers.

II-3 Evaluation Tools

To implement this evaluation, many tools were prepared and validated by JICA Officials. It concerns the evaluation grid, the data collection matrix and the guide of interviews.

The basic tool for the present survey is the Evaluation Grid (Annex IV) which was built on the basis of pertinent main questions and sub-questions related to explored dimensions: *Impact and sustainability*. The evaluation grid structure was done as shown in the following diagram.



The data collection matrix (Annex V) defines the source of data and the used tools to manage it.
The guide of interviews (Annex VI) constitutes the basic document for conducting personal or collective interviews.

II-4- Evaluation Planning

The realisation of this evaluation was operated in three phases:

- Elaboration and validation of the methodology and evaluation tools;
- Interviews planning and realisation;
- Data exploitation and report writing.

During this Evaluation, many meetings were regularly held with JICA Officials within a co-ordination process and in concert.

The Evaluation was taken under the following agenda:

- Contract validation: 20th of December 2005;
- BRPM Exploration Management: 20th of December 2005;
- Evaluation methodology and tools preparation: 21st to 27th of December 2005;
- Methodology and tools validation: 20th of December 2005;
- Data collection: 29th of December 2005 to 20th of January 2006;
- Data analysis and interpretation: 9th to 24th of January 2006;
- Preliminary results presentation: 13th of January 2006;
- Preliminary report preparation: 11th to 30th of January 2006;
- Preliminary report presentation: 1st of February 2006.

III- PROJECT EVALUATION RESULTS

The main evaluation results are structured in four axes: general aspects, political/strategic context, impact dimension and sustainability dimension.

The *General Aspects* sum up the most important characteristics of the Project, particularly according to its conception and performance, and they are fundamental for understanding of the Project and for all kind of evaluation.

The *political and Strategic Context* is important to discuss since it permits to understand the general context of the Project carrying out.

The *Impact* and the *Sustainability* represent the concerned criteria by the Ex-post Evaluation.

The completed evaluation grid with major conclusions is given in Annex VII.

III-1 General Aspects

Even though the work of evaluation was oriented towards the evaluation of impact and sustainability of the Project effects, some aspects characterising the Project were made in evidence and are worthy to mention.

Thus, we can say that the Project is:

- ✓ **A Transversal Project**: This aspect is very important in the sense that it expresses a certain originality and particularity compared to other projects previously operated in the cooperation between JICA and BRPM. The previous projects were focused on the specific exploring surveys for mineral deposits in delimited area with research objectives and underground discoveries. This Project aims to organize and to transfer to the Moroccan side the exploration techniques and technologies.
- ✓ **A Pertinent and Coherent Project**: This aspect is related to the Moroccan mining policy and BRPM's strategy. In fact, the Project coincides with the elaboration in 1998 of a new strategy by the BRPM which focalize on Mining Exploration. This leads to conclude on a relevant demand of the BRPM and on a total coherence between the Project's philosophy and the BRPM's new strategy.
- ✓ **A Human Resources Centred Project**: The very important realisations of the Project (seminars, field works, training in Japan ...) had as a main objective to develop human resources competencies of the BRPM.
- ✓ **Of a Global Training Vision (Concepts versus Techniques)**: This aspect is essentially related to training seminars during which Japanese experts succeeded in finding equilibrium between concepts and techniques in mineral geology, metallogeny and exploration.
- ✓ **An Open and Flexible Project**: The collected data shows that the Project intended to answer BRPM's expected needs. Many activities and equipment, even thought not initially scheduled, were financed in accordance to the demands of the BRPM engineers and Managers.
- ✓ **Of Intelligent Equipment Realization**: the engaged investments were orientated to three aspects: [1] renewal of the main equipment (ICP for instance), [2] upgrading of existing but non functional equipment (complementary equipment for fluid inclusion technique) and [3] high technology acquisition (hyperspectral technique with the POSAM).

III-2 Political and Strategic Context

According to our evaluation approach, the political/strategic level is the first dimension to explore and to analyse. This aims to evaluate the coherence level between the Project and mining sector's policy and BRPM's strategy.

The Moroccan Government ranked the below policies as important in mining sector for developing the mining industry ("Les Grands Chantiers du Maroc", May 2005, Page 247~253) :

- consolidate further the current efforts for mining research and development of mining sector
- develop the existing legal system to encourage the investment into the mining industry
- encourage the international market entry of domestic mineral products

To operate this policy, many projects are implemented by the Energy and Mines Ministry: PDM (Development Mining Plan), PNCG (National Geological Mapping Program), GEOFORMA (GIS development and training)…

Since 2003, The Moroccan government integrated BRPM and ONAREP（Office National de Recherches et d'Exploitations Pétrolières）into a newly established organization ONHYM（Office National des Hydrocarbures et des Mines）for facilitating the sole organization charged with mining exploration. This integration is one important step for strengthening the system of BRPM. ONHYM is engaged with exploration of potential rare metal and basic metal, and is allocated with total 280 million dirham for its activities between 2005-2007.

ONHYM is now engaged to develop such potential areas as Ouarzazate, Tiznit, Tata, Figuig, Taroudant and Marrakech and also to prepare the verification survey of potential resources in the southern regions. This verification survey is realized upon the convention between the Moroccan Government and BRPM in March, 2003 which is to be financially assisted by the Canadian enterprise METALEX.

For commodity, we will continue in this report to use BRPM considering that all related documents (cooperation and evaluation reports) use this name.

Concerning the BRPM's strategy, since 1998, it is based on [1] re-focalizing on mining exploration and [2] development of partnerships (exploration and/or development).
All these aspects show, if needed, a particular dynamic of the mining sector since the mid of the nineties.

The Project which was orientated to the Exploration and Human Resources development is coherent with the Moroccan mining policy and the BRPM's strategy; it had efficiently accompanied the new policy and strategy implementations.

III-3 Impact

According to the evaluation grid, four main questions were examined: [1] super goal achievement level, [2] organizational impacts, [3] technical impacts and [4] environmental impacts.

III-3-1 Super goal achievement level

In the Project PDM, the Super goal turns around the hypothesis that "*The mining industry will be developed in Morocco*", and with two assumptions:

- Government policy on development of mining industry will not change;
- Overseas demand and international price of minerals resources will not decrease rapidly.

This Super goal will be reached by an Overall goal which declares that '*New mineral resources will be found in Morocco*".

In the Ex-post evaluation work, it is fundamental to investigate the Super goal and Overall goal by analyzing Moroccan mining industry and mining exploration evolutions to see to what extent we reached those goals.

Before analysing the Moroccan mining industry evolution, it is important to analyze the world minerals price movements. Figure 1 is the international price movements of lead, zinc and gold prices from 1998 to 2005 (source: BRPM). As from the figure 1, the zinc price decreased drastically from year 2000 till 2002, and for the lead price decrease slightly but continuously from year 1998 till 2002.

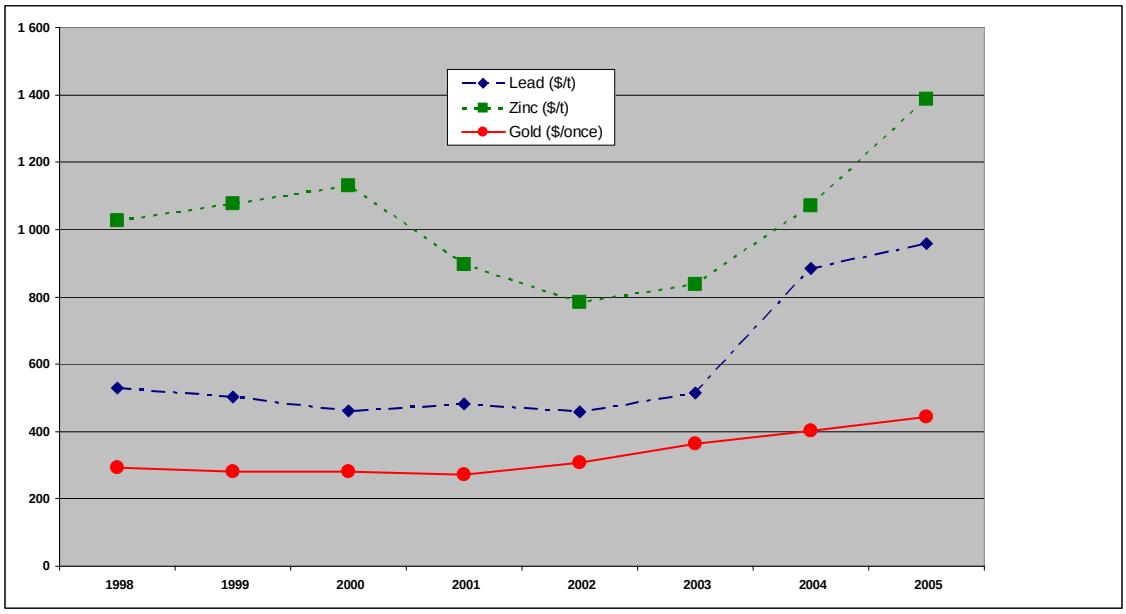


Fig. 1: Lead, zinc and gold prices evolution from 1998 to 2005 (source: BRPM)

From 2003, the evolution is inversed and the metals prices fly and reach historical levels; this has two major consequences:

- International mining investments resumption;
- mining projects re-evaluation

Globally, Moroccan mining production is stabilised in spite of drastic diminution of metals prices between 1998 and 2002-2003, which have direct consequences on the investments, particularly for exploration.

In spite of this unfavourable world mining context, the Moroccan mining production and exportations are globally stable (fig. 2). And, since 2003, a positive evolution is observed with +27 % and +21% respectively of production tonnage and exportations tonnage.

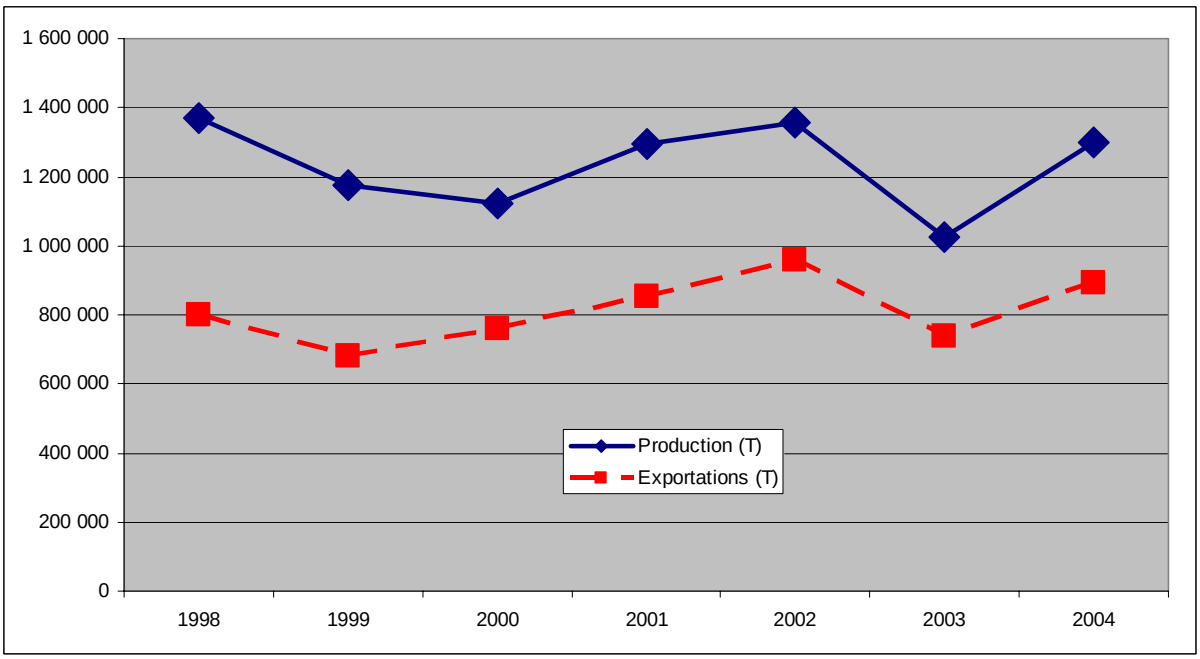


Fig.2: Moroccan mining production and exportation evolution (source: MEM).

Regarding the value, the mining exportation had known an important decrease of 28% directly attributed to the metals prices decrease. However, between 2003 and 2004, the increase is of 8%.

For investment, an important positive evolution is observed. Hence, from 1998 and 2004, the mining investments had passed (fig.3) from 474 millions MAD in 1998 to 635 millions MAD in 2004 with an important investment of 942 millions MAD in 2001 and 877 millions MAD in 2003.

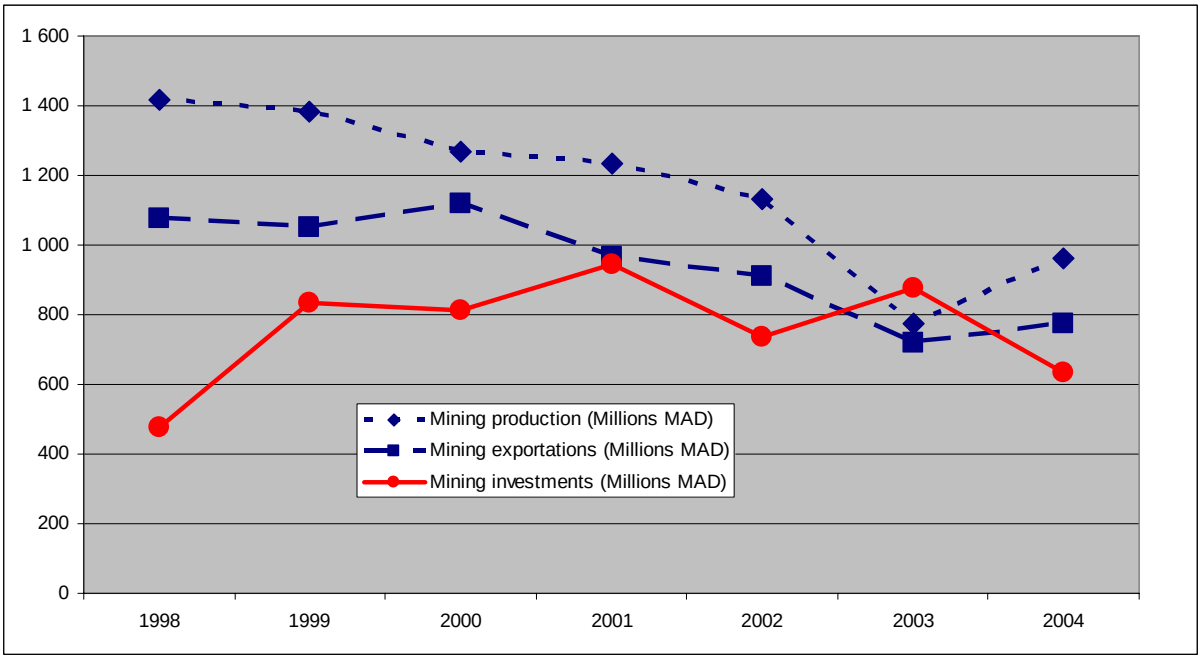


Fig. 3: Moroccan mining production, exportations and investments (source: MEM)

The Moroccan mining exploration budget in Morocco has been stabilized since 2002 around 220 - 230 millions MAD (Source: FDIM) in spite of mining market decrease. Since 2005, exploration budgets increase according to the rise of metals prices.

The BRPM strategy is coherent with the general governmental policy particularly on three objectives:

- Attract international investments;
- Develop exportations;
- Make less public spending.

Presently, BRPM operates in three major and strategic exploration targets: precious metals (Gold, Silver …), base metals (Copper, Zinc, lead …) and industrial minerals.

For the Project Overall goal reaching, it can be discussed among two strategic exploration targets:

- In base metals (Pb, Zn and Cu), two projects illustrate the Moroccan mining potential and the exploration dynamic: Khwadra deposit discovery (in 2000) and actual Draa Sfar mining resources increasing.
- In precious metals, many projects arrive today at an advanced stage and some of them will probably lead to industrial mining projects. Therefore, a large exploration target in South Provinces (Provinces Sahariennes) is recently opened to the exploration and its potential is evaluated as "Very high".

Hence, the achievement of the Project Overall goal is to be considered very interesting despite of that no major discoveries of new mineral deposit had been operated during 2002 – 2005 period. This consideration is based on the fact that many exploration projects are today in advanced phases and some of them will lead to new mineral discoveries during next years. Regarding the evolutions related to the mining exploration budget, productions and exportations, and investment, they show the dynamic of the Moroccan mining sector and its role in the Moroccan

economy. They attest, in spite of the difficult international context, that the Super goal achievement can be considered as globally accomplished because the BRPM plays an important role in the mining industry. It represents the first national exploration company which have important financial and human resources and a large range of exploration technologies.

Finally, we have to mention that the Moroccan exploration and mining know-how is presently "exported" to other countries, such as Managem operations in West Africa, Congo, Gabon, Saudi Arabia, etc.

III-3-2 Organizational Impacts

Two sub-questions are considered to evaluate the contribution of the Project to the actual BRPM exploration organization

[1]New Exploration Organization
With the launching of the Project, BRPM had created (in 1999) a new exploration unit "Methods and Programs" Division. Its mission is to conceive new programs of thematic exploration using techniques that have proven their efficacy in mineral exploration.

The implementation of this entity has taken benefit from the Project particularly at the level of methodologies' conception and techniques' use. Hence, the Project's activities -particularly seminars, training in Japan and newly introduced technologies- participate to the development of the unit know how with high qualified human resources and high exploration techniques.

Nowadays, the Methods and Programs Division teams are of high performance level and autonomy, and the Division have at one's disposal sophisticated and reliable equipment.

[2]Exploration Project Management
To manage the exploitation, the Project allowed the construction and consolidation of an exploration approach based on:

- High scientific level of engineers in the way of thinking thematic exploration;
- Well-defined and formalised exploration methodologies;
- A rigorous exploration undertaking with respect to the adopted methodology.

At the level of the exploration management, a new approach was performed with a main orientation on "Project Management" based on two important criteria:

- Lifetime of the exploration project and the necessity to optimise with a decisional analysis (each year) in order to make a decision to maintain or drop the project;
- Follow-up and budgetary consciousness of project managers.

For cultural aspects of management, the Project had permitted to develop and reinforce three fundamental aspects: [1] team working, [2] internal collaboration and exchange and [3] respect of mutual commitment.

At the present time, the management of exploration projects at BRPM is in conformity with international standards within an approach of efficiency, optimisation and professionalism.

III-3-3 Technical Impacts

This axis is explored with three sub-questions, [1] exploration technologies and tools, [2] exploration efficiency and [3] individual and collective competencies.

[1]Exploration Technologies and Tools
Concerning the techniques and the technologies of exploration, the Project impacts are performed by four major inputs shown underneath.

- **Hyperspectral Characterization (POSAM):** The introduction of this technique is globally due to the Project. In fact, the BRPM highly appreciated the Japanese's co-operation because the Project has proposed

the technique and performed the purchasing and the delivery of the equipment; moreover the Project trained BRPM's engineers to use the equipment, to exploit and to interpret results.
Nowadays, the technique is well mastered and systematically used. The BRPM has extended this method to other uses (drill holes) and proceeded to the acquisition of a new more sophisticated and reliable radiospectrometer with the necessary training (1 million MAD investments). Its connection to the POSAM was done by BRPM engineers.

- **Fluid Inclusions Technique:** The introduction of this new technique was tried before the Project by the acquisition (by the BRPM own means) of a part of the necessary equipment, the "Cooling freezing stage", but with the absence of the other necessary parts of the equipment and without the necessary training, the implementation of the technique was impossible to undertake.
  Following the BRPM's demand and in spite of the fact that this is not indicated in the PDM, the Project fitted completely for the technique implementation even though with:
  - Short term expert (one week), a well known expert of fluid inclusions who animated a seminar about the technique, its interest and its principles… (with a referential book on the technique), and had proceeded to a BRPM' needs analysis in terms of complementary equipment.
  - Purchasing of the necessary components missing at the BRPM (lens and standards).
  - A short term expert (one month) for equipment installation and machinery calibrating, the technique implementation and engineers' training.

  At the end of implementation process, the BRPM has become autonomous and operational in respect to this technique with functional equipment and its engineers mastered the technique uses in the exploration domain.
  Nowadays, the technique is mostly operational. Nevertheless, some problems on the "Cooling freezing stage" are affecting the obtained results, the BRPM is tackling this problem by planning -in 2006- the acquisition of new equipment allowing handling surveys with a good level of reliable results
- **Geophysical Software:** The Project gave two softwares for geophysical data interpretation and modelization.
  Beyond this direct benefit, the Project has brought a new vision related to the importance of software in facilitating data treatment and results' reliability. The Project and the Japanese experts have brought a cultural change with a new vision and consideration for high specialised software investment. This aspect was neglected in the past, but now it is completely understood by BRPM's Management.
  Presently, the Geophysical Department is well furnished in terms of computing solutions with the acquisition of high specialised and performing software at the international level (*Oasis Montage* of GEOSOFT in particular) and with software maintenance contract.
- **Geographic Information System (GIS) technical support:** Since 2000, GIS is a strategic orientation at BRPM. The latter asked the Project to assist it in the introduction of this technique and JICA approved the demand. Then, a short term expert was sent on June 2002 to train BRPM engineers in GIS conception and construction in exploration domain.
  The technical assistance allowed BRPM to realise independently the first GIS projects with an important competencies' development and practice; and to economise budget by cancelling an external assistance (of about 1 million MAD).
  Nowadays, the GIS is completely integrated in BRPM's exploration organisation and functioning. All the new projects are managed by the GIS; hence, all the cartographic data are integrated in it and a project of old data integration is planned during 2006 – 2009 period.

[2] Exploration Efficiency

With the BRPM's new strategy and the performance acquired with the Project, the mineral exploration is realised with efficiency and as a major indicator the twenty projects brought to their economic phase.

The developed methodologies and the techniques brought by the Project contributed to high professionalism in exploration undertaking. For this aspect, we shall remind that the Project's philosophy is built in a perspective to get the BRPM more professionalism to lead, in an efficient way and in an optimum time, exploration projects and programs.

Now and since 1998, some twenty projects were brought to their economic phase; these projects (see table below) are essentially related to the three strategic targets of BRPM's mining exploration, i.e gold, base metals mineralization and Industrial minerals.

① **N°**	② **Project**	③ **Region**	④ **Substance**
⑤ *1*	⑥ Had Imawn	⑦ Taroudant	⑧ Gold
⑨ *2*	⑩ Khwadra	⑪ Marrakech	⑫ Lead, copper, zinc
⑬ *3*	⑭ Boumaadine	⑮ Errachidia	⑯ Lead, copper, zinc
⑰ *4*	⑱ Zguounder	⑲ Taroudant	⑳ Silver
21 *5*	22 Oued Zemmour	23 Nador	24 Bentonite
25 *6*	26 Jbel Mahdi	27 Missour	28 Calcite
29 *7*	30 Dar Chaoui	31 Tanger	32 Siliceous sands
33 *8*	34 Achmmach	35 El Hajeb	36 Tin
37 *9*	38 Igoudrane	39 Ouarzazate	40 Silver
41 *10*	42 Draa Sfar	43 Marrakech	44 Lead, copper, zinc
45 *11*	46 Tafrent	47 Ouarzazate	48 Gold
49 *12*	50 Trebia	51 Nador	52 Bentonite
53 *13*	54 Alous	55 Taroudant	56 Copper
57 *14*	58 Jbel Tidiennit	59 Nador	60 Perlite
61 *15*	62 El Karit	63 Khemisset	64 Tin
65 *16*	66 Moumjoud	67 Tiznit	68 Gold
69 *17*	70 Tamlalt	71 Ouarzazate	72 Gold
73 *18*	74 Koudiat Aicha	75 Jebilets	76 Lead, copper, zinc
77 *19*	78 Akka Sud	79 Akka	80 Gold
81 *20*	82 Bouissafen	83 Guelmim	84 Zircon sands

One exploration project ("Provinces Sahariennes") has taken benefit from new technologies and techniques brought by the Project. This project launched in 2003 by and in a partnership with Moroccan Energy and Mining Ministry with a global budget of about 140 millions MAD. It aims the research of precious metal mineralization in the south of Morocco.

Taking into account the lack of a good geological infrastructure (geological maps, geochemical and geophysical, scientific surveys…) and the necessity to quickly identify the potential areas for tactic programs, Project's inputs were utilized such exploration methodologies and techniques (remote sensing and hyperspectral, alteration approach, geophysical data treatment and interpretation, GIS's building …)

[3]Individual and Collective Competencies

The Project's impact on BRPM individual and collective competencies is judged by Mr Mouttaqui, Director of BRPM's Exploration, as undeniable for upgrading and development of the institutional capability of BRPM and even introduction of many essential competencies for exploration undertaking.

The Project had developed a team working spirit between BRPM's engineers according to the Japanese expert's methodology based on systematic implication of all actors in discussion and analysis of exploration data and orientation. Fifteen engineers were recruited between 1998 and 2004 (4 in 1998, 1 in 1999, 7 in 2001, 1 in 2003 and 2 in 2004)

The impact on individual and collective exploration competencies is well marked mainly for the new recruited BRPM's engineers within and during the Project. These engineers were assigned to pilot projects. Hence, they were in a permanent contact with the Project and with the Japanese experts. Those Moroccan engineers have acquired, in an optimum time, an approach (described by their colleagues to be typically "Japanese" in the way of thinking and acting) and operational competencies allowing the BRPM's engineers nowadays to manage in an efficient way

exploration projects all over the Moroccan territory. Five individual and collective competencies illustrate the Project's impact.

- **Strategic Exploration Methodology:** At this level, thematic seminars, discussions and field work with Japanese experts (mainly short term experts) and training in Japan allowed BRPM's Engineers to reinforce their competencies to elaborate exploration methodologies, to choose the specific techniques, to interpret results, to evaluate and ameliorate the elaborated methodologies.
  In this methodology, a particular attention was drawn to the "multidisciplinary" approach used and promoted by the Japanese experts. It consists of giving importance to all exploration technologies (geological, geochemical, geophysical …) in a project carrying out or evaluation; this permit to have all pertinent and necessary data to guide exploration and makes decision for following exploration stage.
- **International Exploration Standards Orientation:** In a process to level out the exploration approach, it is essential to orientate towards a reasoning using international standards and last discoveries and mineralization modelisation. The seminars orientated underground deposit typology (seminars on MVT - Mississipi Valey Type-VMS- Volcanogenic Massive Sulfide) have given BRPM's engineers a scientific referential and knowledge allowing them to switch from a "local model" approach (Moroccan deposit) to an approach based on international standards' models.
  Nowadays, the BRPM's engineers adhere completely to the standardisation of underground deposit prospecting. They are following up new discoveries concerning characteristics, modelization and exploration techniques of these types of underground deposit in order to use them in the BRPM's exploration projects.
- **Hyperspectral and the Introduction of the "POSAM", Technical Equipment used in Alteration Studies:** With the hyperspectral analysis and the *"POSAM"* introduction, the BRPM exploration capacities got the necessary means to lead sophisticated surveys on hydrothermal alteration phenomena accompanying the underground deposit formation.
  The direct characterisation of these alterations using the POSAM allows defining and delimiting the areas to explore while searching for underground deposit.
  This characterisation is decisive in hidden underground deposit searching, an axis more developed by BRPM. The BRPM engineers in charge of this technique (Remote sensing Department) are operational and autonomous for field working, data treatment and interpretation.
- **Fluid Inclusions Studies:** The complementary equipment furnished by the Project for this technique and Japanese expert's intervention allowed the BRPM to acquire a new advanced technique which was previously missing.
  Presently, BRPM's engineers are mastering all the basic aspects of the technique's implementation with the aim to ameliorate it by the planned acquisition of new equipment and new training.
- **GIS Project Implementation:** The training method adopted by the GIS short term expert, based on the concept of "On the job training", permit to BRPM's engineer to acquire the essential basis for conception, organisation and exploitation of GIS in mining exploration.
  Since 2002, BRPM has continued to invest in GIS equipment, software and training, and to develop its autonomy in undertaking the first projects.
  At the present time, the developed competencies allowed BRPM to secure GIS's knowledge and to consider with autonomy the starting up of the next phases in GIS's implementation related to generalisation and integration of old data.

III-3-4 Environmental Impacts

To evaluate these impacts related to the mining sector, four sub-questions are considered, [1] institutional partnerships, [2] external services (to mining operators), [3] projects' promotion and transfer, and [4] training and technical support.

[1] Institutional Partnerships

In the new strategy, the BRPM develop partnerships with other institutions or private companies; these partnerships concern exploration and discovered mines development.

In this aspect, it is important to draw attention to the main difficulty for operating this strategy: the Moroccan (old) mining legislation which is not conformable to the international best practice and does not encourage international mining investors. Presently, a new mining legislation, "Mining Code", is prepared and will be submitted to the Parliament in the near future for ratification.

The BRPM's partnerships strategy aims to :

- Attract world investments for the mining sector, particularly for exploration;
- Operate a risk management orientation based on risk sharing with other mining operators;
- Bring an international know-how for the Moroccan mining exploration;

Hence, since 1998, BRPM is more opened to all form of partnerships; this allows it to give shape to more than 26 majors contracts (see table below) either with Moroccan institutions and mining operators (Energy and Mines Ministry, AGM, CMG, Reminex, Managem,...) or international (Odyssey-Canada, Metalex-Canada, Naimex-Greece, Aminsa-Spain, Tolsa-Spain, Caolino-Panciera-Italy, Okosys-Germany...). These partnerships inject today more than 10 millions MAD to exploration.

85 **N°**	86 **Institution**	87 **Country**	88 **Concerned domain**	89 **Concerned substance**
90 *1*	91 AMINSA	92 Spain	93 Ras El Ma and Ksima	94 Zircon
95 *2*	96 TOLSA	97 Spain	98 Northern Morocco	99 Clays
100 *3*	101 MANAGEM	102 Morocco	103 Akka south	104 Gold
105 *4*	106 CMG	107 Morocco	108 Jebilets	109 Lead, copper, zinc
110 *5*	111 IGC	112 Canada	113 Ouarzazate	114 Gold
115 *6*	116 ODYSSEY	117 Canada	118 Taroudant	119 Copper
120 *7*	121 ENNEX	122 Ireland	123 Middle Anti Atlas	124 Zinc oxides
125 *8*	126 OUTOKUMPU	127 Finland	128 Haouz	129 Lead, copper, zinc
130 *9*	131 CUPRUM	132 Poland	133 Ouarzazate	134 Copper, gold
135 *10*	136 NAVAN RESSOURCES	137 Canada	138 Kerdous et Siroua	139 Gold
140 *11*	141 METALES HISPANIA	142 Spain	143 Tamsloht	144 Lead, copper, zinc
145 *12*	146 CAOLINO PANCIERA	147 Italy	148 Rhamna	149 Clays
150 *13*	151 OKOSYS	152 Germany	153 Nador	154 Bentonite
155 *14*	156 AGM	157 Morocco	158 Akka East	159 Gold
160 *15*	161 NAIMEX	162 Greece	163 Nador	164 Bentonite
165 *16*	166 METALEX	167 Canada	168 Saharian provinces	169 Diamond
170 *17*	171 ROCHE INVEST	172 Morocco	173 Nador	174 Perlite
175 *18*	176 CMT	177 Morocco	178 Taroudant	179 Silver
180 *19*	181 JOGMEC/JICA	182 Japan	183 Tekna	184 Lead, copper, zinc
185 *20*	186 MINING MINISTRY	187 Morocco	188 Saharian provinces	189 Gold, diamond, copper, zinc …
190 *21*	191 CMG	192 Morocco	193 Guemassa	194 Lead, copper, zinc
195 *22*	196 IGP	197 Poland	198 Thematic/scientific cooperation	199 -
200 *23*	201 UPM	202 Spain	203 Thematic/scientific	204 -

205 *24*	206 IRAN ITOK	207 Iran	cooperation 208 Thematic/scientific cooperation	209 -
210 *25* 211	212 ENG Nancy	213 France	214 Thematic/scientific cooperation	215 -
216 *26*	217 CGS	218 South Africa	219 Geological/geochemical mapping	220 -

In these partnerships, BRPM plays an important role either as an operator or as a technical support in accordance with the organisation and human resources professionalism for which the Project had effectively and intensely participated.

[2]External Services to Mining Operators
Historically, the BRPM had always assured exploration services (chemical analysis, drill holes, potential evaluation, etc.) to small and middle mining companies.

With the Project, the BRPM extend its external services to major Moroccan mining operators; two examples illustrate this extension:

- Hyperspectral studies (with the POSAM) for the Compagnie Minière des Guemassa (spectral characterization of the Guemassa domain), Reminex (Jebilets hyperspectral study) and Akka Gold Mining (hyperspectral study of the Tagragra inlier);
- ICP chemical analysis for BRPM's partners and mining operators.

This external service brings to BRPM an interesting annual turnover of thirty two millions MAD.

[3] Projects Promotion and Transfer
In the BRPM's new strategy, discovered ore deposits are automatically promoted with international invitation to tender and transferred to national or international companies. These promotion and transfer represent a major performance criterion and important BRPM's annual output which gives added value.
Since 1998, twelve major projects had been promoted; this gives an average of one to two promoted projects per year. The table below gives the list of those promoted projects.

221 **N°**	222 **Name**	223 **Region**	224 **Mineral substance**
225 *1*	226 Boumaadine	227 Errachidia	228 Lead, copper, zinc
229 *2*	230 Zguounder	231 Taroudant	232 Silver
233 *3*	234 Oued Zemmour	235 Nador	236 Bentonite
237 *4*	238 Jbel Mahdi	239	240 Calcite
241 *5*	242 Dar Chaoui	243	244 Siliceous sands
245 *6*	246 Achmmach	247 El Hajeb	248 Tin
249 *7*	250 Igoudrane	251 Ouarzazate	252 Silver
253 *8*	254 Draa Sfar	255 Marrakech	256 Lead, copper, zinc
257 *9*	258 Tafrent	259 Ouarzazate	260 Gold
261 *10*	262 Trebia	263 Nador	264 Bentonite
265 *11*	266 Alous	267 Taroudant	268 Copper
269 *12*	270 Jbel Tidiennit	271 Nador	272 Perlite

[4]Training and technical support
The know-how developed with the Project allows to BRPM to assure training and technical support for mining exploration technology. Hence, BRPM's engineers had managed trainings on hyperspectral technique for Mauritanian engineers and for OADIM members, and ensure technical supports for all projects in partnerships.

III-4 Sustainability

For this dimension, the evaluation grid was organized around three main questions: [1] organizational sustainability, [2] financial sustainability and [3] technical sustainability.

[1]Organizational sustainability:

The BRPM represents one of the Moroccan major and historical public offices. Created in 1928, BRPM plays an important role in the development of the Moroccan mining sector by participating actively in the most important mine's discoveries and development. These mining discoveries and development allows the development of distant region (such as Ouarzazate, Taroudant …) with consequent basic infrastructures (roads, electricity …).
This important history permit the development of a Moroccan mining know-how regionally and internationally recognized.

Since 2003, The BRPM is integrated, with the ONAREP （Office National de Recherches et d'Exploitations Pétrolières） into a newly established organization ONHYM （Office National des Hydrocarbures et des Mines). This new organization is in charge of mineral, oil and gas exploration on the whole Moroccan territory.

On this merging operation, the ONHYM General Manager affirm that "*by creating a single entity for mineral exploration (except phosphates), oil and gas exploration, the aimed objective is to maximize all the human, technical and financial synergies between the different fields and to capitalize all the gains thus obtained in order to accompany the already launched dynamics in both present organizations*" (2002 BRPM's annual report).

The ONHYM will play a major role in the exploration of mineral resources and the Moroccan government hopes developing the mining sector with new mineral deposits discoveries. For this, an important financial budget is allocated with total 280 million dirham for its activities between 2005-2007.

Hence, the present public policy and strategy demonstrate the sustainability of the Moroccan mineral exploration activity and the economic importance of this activity.

[2]Financial sustainability:

Financial support for BRPM's activity is principally of government origin; to witch is added turnover of external services (32 millions MAD per year) and the royalties for BRPM's participations in active mines (37 millions MAD in 2004). In addition to this budget and royalties, BRPM partnerships in Moroccan exploration are more than 10 millions MAD per year of investment and this contribution will increase during the next years.

For the period 1998 – 2004, BRPM's budget had increased by 14%, from 75 millions MAD in 1998 to 86 millions MAD in 2004. The table below shows BRPM's budget during 2002, 2003 and 2004.

273 **Year**	274 **Budget**
275 2002	276 94,6 millions MAD
277 2003	278 70,9 millions MAD
279 2004	280 85,7 millions MAD

For 2005, the budget accorded by the government to the newly ONHYM is of 110 millions MAD. For 2006 prevision, a budget of 185 millions MAD is to be considered (source: MEM (Ministry of Energy and Mining)) and this represent an important budget increasing (68%).

All these financial support show a stabilized public support for the BRPM's finance and attest of the sustainability of the Moroccan mineral exploration.

[3]Technical sustainability:

For this main question, three aspects are to be considered: (1) planned improvements, (2) technical and technological appropriation and (3) inputs maintenance and development.

[3-1]Planned Improvements

- **Upgrading Strategy:** At present, BRPM has an important and ambitious strategy which will permit it to validate and develop its management and technologies in exploration.
  This orientation is directly supported and supervised by the General Manager with the necessary resources (financial, human …). Concerning human resources, the BRPM's staff evolved from 1014 in 2003 to 953 in 2004. This reduction is operated in accordance with the government policy oriented on public charges reduction. However, BRPM operate a recruitment strategy oriented on specific needs in terms of competencies; hence, fifteen engineers (in exploration methodology, GIS …) had been recruited between 1998 and 2004.
  It ensures BRPM to be in an upgrading way with international standards orientation and continuous human resources development.
  To carry out this upgrading strategy, three short term major projects are committed:
  - ISO 9001 - V2000 Certification of the BRPM's Laboratory;
  - 17025 Accreditation for the Gold analysis method;
  - GIS's data base development.
- **Planned Equipment(s):** BRPM equipment strategy and budget are considered to continue during next year; this shows a real willingness to maintain a technological watch for the equipment.
  Hence, two important investments are planned for 2006:
  - ICP analyser to support the existent one (a Project input); the investment is of approximately 2 millions MAD.
  - Fluid inclusion "Cooling Freezing Stage" (0.15 million MAD of investment) which will permit the technology's upgrading and functioning.
- **Planned Training(s):** For this aspect, the BRPM develops a professional training approach with an annual training plan built on specific needs' evaluation; the reserved budget is 2 to 2.5 millions MAD per year.

[3-2]Technical and Technological Appropriation:

- **Technical Integration Level:** This level is to be considered sufficiently high because the acquired techniques are of systematically utilised: ICP analysis, hyperspectral characterisation, alteration approach and GIS's technology.
- **Equipments Integration Level:** This level is to be considered also sufficiently high because the ICP and POSAM equipments are completely utilised. For the fluid inclusions, the use is occasional since it depends on geologists' demands.
- **Technical and/or Technological Improvement(s):** For the technologies introduced by the Project, some improvements had been made by the BRPM's engineers :
  - **Improvement of the POSAM Results' Processing:** In this way, a connection between the two radiospectrometers is established and the analyses made by the POSAM are transferred to the newly acquired radiospectrometer for (easy) reliable interpretations.
  - **Extension of the Hyperspectral Characterization:** This extension is made to drill holes and gives to geologists a radiometric characterisation and ideas on the vertical evolution of alteration phenomena ; this permits to optimize the emplacement of next drill holes and to improve the geological interpretation.
  - **Conception and Realization of the BRPM's Exploration GIS:** For this strategic orientation, BRPM is autonomous and the technique is definitively secured since all the exploration managers and engineers are committed in this way the Management of BRPM talks about "definitive GIS's dependence"

[3-3]Inputs Maintenance and Development
This axis aims to evaluate the post-project inputs made by BRPM in relation to Project's inputs maintenance, improvements and new acquisitions.

- **Equipments Maintenance:** With the Project, the BRPM had developed and consolidated a maintenance culture for its equipment; this permits to BRPM to dispose for long time of performing equipments. For the ICP analyser donated by the Project, the BRPM has a maintenance contract with the manufacturer. Also, the maintenance approach is applied to professional software acquired by BRPM, especially for Geophysical and GIS's techniques.
- **New Equipments Acquisition:** Since 2002, BRPM increased its equipment investment and reserve 2.5 to 3 millions MAD per year for equipment's. Hence, important investments had been realised, they concern the acquisition of:

- New radiospectrmeter for hyperspectral analysis (1 million MAD);
- Gravimeter analyser (1.15 millions MAD);
- Geophysical equipment (2 millions MAD);
- Microscopes (0.75 millions MAD);
- Geophysical software (0.45 millions MAD);
- Tin section confection unit (0.15 million MAD).

These investments prove that the BRPM has an upgrading strategy for its equipment, and secure the sustainability of the introduced technologies (by JICA or directly by BRPM).

- **Competencies Maintenance/Development:** With the Project, the level of exploration at BRPM is definitely of international standards. To ensure this result, the BRPM undertakes the following actions:
  - BRPM engineers' participation to international exploration meetings: this aims to make BRPM in continuous contact with the newest Exploration World and to ensure continuous personnel and collective competencies maintenance, acquisition and development;
  - Training on newly acquired equipment and software: this aspect is henceforth systematically registered in equipment acquisition contracts;
  - Internal seminars and talks: since the Project, this activity is integrated in the exploration management and aims to develop mutual competencies and experiences exchange. However, with the restructuration of BRPM into ONHYM, a Training Department was created related to the Human Resources Direction, and whose mission is to plan and execute continuous and periodical training programme. For BRPM's staff, this department, which had been a service in charge of related activities at the training, at the beginning of the project, was not clearly implicated during the implementation of the Project.
- **Manual Revision(s) and New Production(s):** For the Exploration Manual, it is still considered as pertinent, and no significant revision is identified or operated. However, the manual production experience had developed a formalizing culture in BRPM with systematic document production for promoted projects and production of scientific and/or commercial document for national and international meetings.

IV- CONCLUSION, RECOMMENDATIONS AND LESSONS LEARNED

IV-1 CONCLUSION

After the termination of cooperation period, the Project has steadily been producing a satisfying outcome. BRPM developed its exploration technology which covers high-precision charts of potential mineral resources. BRPM takes an important role in the technical transfer through the partnership with domestic enterprises. BRPM is entrusted to implement exploration activities and chemical analysis and also to implement technical cooperation upon the request of Arabian and African countries. It is highly appreciated that BRPM achieved high reputation in domestic and international mining world.
BRPM was integrated into ONHYM in 2004. ONHYM is expected to meet the high needs of mining sector. The Moroccan national policies of mining sector such as attainment of high productivity and high competence for international market as well as diversified needs of mining sector and BRPM's partnership assured the sustainability of BRPM as an important actor in the Moroccan mining sector.

IV-2 RECOMMANDATIONS

The exploration manual is an important tool. Therefore its regular revision should be continued to maintain BRPM's high standard of technology. Moreover the advanced technology should be shared among BRPM's engineers for avoiding the risk of appropriation and conserving institutional memory to be succeeded to younger generations.
To take into consideration the role of the BRPM's Training Department related to the Human Resources Direction, its role is to be reinforced in view of the BRPM's significance in human resource development of domestic and international mining sector.

IV-3 LESSONS LEARNED

For preparing the technical cooperation in the advanced technology such as exploration of mining resources, the current and future national priority of policies and the grasp of needs of private enterprises are to be considered sufficiently. In Morocco, the government intervention is still important but the government highly respects the contribution of private enterprises in mining sector. Therefore, the future diffusion of transferred technology to the private sector is contrived beforehand even though the cooperation is implemented in the scheme of bilateral

cooperation. For example, inviting the private enterprises to the seminars organized by the Project is an ambitious attempt for increasing their understanding on the Project purpose.

Mohammed BENHARREF
Consultant

Rabat on the 6th February 2006

Annex 3

Project Summary

Evaluation conducted by: JICA Morocco Office

I. Outline of the Project		
Country: Morocco		**Project title:** **Ex-post Evaluation Study on "The Project on Upgrading Exploration Technology of Mineral Resources"**
Issue/Sector: Technical Cooperation in Mining		**Cooperation scheme:** **Project-type technical cooperation**
Section in charge:		**Total cost: 500,000,000yen**
Period of Cooperation	**(R/D):** April 1998 to March 2002 **(Extension):** **(F/U):**	**Partner Country's Related Organization(s):** **BRPM(Bureau de recherche et de participations minieres)** **Supporting Organization in Japan:** **Ministry of Economy, Trade and Industry** **Metal Mining Agency of Japan** **Japan Mining Engineering Center for International Cooperation**
Related Cooperation		

1 Background of the Project

The agriculture, fishery and tourism occupy an important portion in the economic structure in Morocco.The Moroccan economic situation largely depends upon the above three sectors.

Upon the Fifth Five-Year National Programme (1988-1992),the Kingdom of Morocco aimed at further stable economic growth with strengthening the mining sector and also promoting export of mineral products through searching for the future possibility of development in mining sector.

Since 1970s, the Government of Japan implemented the dispatch of experts, the feasibility study and the mini-project to BRPM upon the official request from the Government of the Kingdom of Morocco.

The Government of the Kingdom of Morocco submitted an new official application form for the Japanese technical cooperation to acquire advanced technology of mineral exploration, ore dressing and industrial materials which enables the BRPM engineers to find out the mineral resources hidden in the ground rather than the resources exposed on the surface of the earth.

The Record of Discussion signed in January 26,1998. The cooperation commenced on April 1,1998

As 3 years passed since the end of the Project, JICA Morocco Office implemented an Ex-post evaluation of the above Project.

2 Project Overview

With the advanced Japanese exploration technology, this project was implemented to strengthen BRPM'capacity to conduct systematical and practical exploration by a transfer of the technology and the enhancement of BRPM's mining skills with the special emphasis to:

- Allocate appropriate personnel and facilities to the Staff Section
- Procure and install advanced exploration equipments (ICP, POSAM)
- Collect and interpret existing data to select prospective areas (model areas)
- Elaborate a geological and geochemical survey plan
- Transfer comprehensive exploration technology on the basis of the results of geological, geochemical and geophysical exploration activities
- Organize internal seminars in BRPM with assistance of Japanese experts for share the technological information

(1) Overall Goal New mineral resources will be found in Morocco.

(2) Project Purpose

BRPM will be able to continuously carry out the systematical and practical exploration.

(3) Outputs

- The Organization of Exploration Department of BRPM will be improved and it will be operated efficiently.
- Equipment will be efficiently operated and properly maintained.
- Planning method on efficient exploration will be acquired.
- Practical technology on exploration will be acquired.
- Comprehensive exploration technology will be acquired
- Manual on exploration technology will be ready for use.
- A system of transferring exploration technology will be established in BRPM

(4) Inputs

Japanese side:

Long-term Expert	**7**	**Equipment**	**60,090,000 Yen**
Short-term Expert	**20**	**Local cost**	**15,140,000 Yen**
Trainees received	**7**	**Others**	**Yen**

Moroccan Side:

Counterpart 32 Equipment ___local currency (_____Yen) **Land and Facilities___local currency (___Yen) Local Cost___local currency (170,600,000Yen)** **Others ___local currency (___Yen)**		
II. Evaluation Team		
Members of Evaluation Team	Mohammed Benharref/Moroccan Consultant	
Period of evaluation	**20/ December/ 2005 - 24/ February/ 2006**	**Type of Evaluation: Ex-post Evaluation**
III. Results of Evaluation		

EX-POST EVALUATION OF THE PROJECT ON "UPGRADING EXPLORATION TECHNOLOGY OF MINERAL RESOURCES IN THE KINGDOM OF MOROCCO"

３－１ Summary of Evaluation Results

（１）Impact

In the field of underground mining resource exploration technology, this project successfully produced meaningful outcomes to advance BRPM exploration engineers' capacities and to enhance the capacity of BRPM's overall technology to the level of international standard. Utilizing the donated equipments such as POSAM, the Project successfully transferred the technology of geothermal exploration to BRPM. As a result, this advanced technology minimized the exploration survey areas and facilitated highly precise exploration activities.

The achievement of the Project Overall goal is to be considered very interesting despite of the fact that no major discoveries of new mineral deposit had been operated during 2002 – 2005 period. Because the discovery of new mineral deposit is considerably attributed to chance. BRPM is now engaged in exploring new mineral deposit considered to be with bright prospects in the southern region of Morocco.This consideration is based on the fact that many exploration projects have today reached in advanced phases and some of them will lead to new mineral discoveries during next years.

With development of technology in the mining exploration, BRPM developed, since 1998 until now, around 20 projects in gold, base metals mineralization and industrial minerals, of which the project launched in 2003, with the partnership of Energy and Mining Ministry, to explore precious metals in the south of Morocco with an investment of about 140 million dirham. BRPM operated also the session of 12 major projects to national and international companies, since 1998.

BRPM hereby acquired high international reputation, and it established as many as 25 partnerships of development of mineral resources with domestic and international institutions and enterprises. Before the project, BRPM were directly engaged with small- and medium-sized exploration activities. Nowadays BRPM is entrusted to implement exploration of mineral resources and chemical analysis, and moreover to implement technical transfer for engineers of domestic and foreign enterprises such as the Arabian and African countries.

To grab the correct mineral reserve, the Moroccan government ranked geological, geophysical and geochemical distribution charts of mineral resources in the whole country as one of the high-priority projects. The technology of Geographic Information System (GIS) introduced by the Project enabled BRPM to implement data processing for drawing up a high-precision chart of mineral resources throughout territory. According to the high level of acquired technology by the project, BRPM awaits an ISO 9001/V2000 Certification of its laboratories and also a 17025 Accreditation for the Gold analysis method.

（２）Sustainability

The Moroccan Government ranked the below policies as important in mining sector for developing the mining industry:

- consolidate further the current efforts for mining research and development of mining sector
- develop the existing legal system to encourage the investment into the mining industry
- encourage the international market entry of domestic mineral products

With the result of cooperation, BRPM is now implementing the below activities to maintain sustainability of cooperation.

- BRPM introduced an efficient maintenance system for advanced equipment of ICP
- BRPM purchases advanced equipments with its own annual expenses of 2.5 to 3 million dirham and secure systematical training on the newly acquired equipments and software
- BRPM continuously dispatches its engineers to the international seminars and conferences to brush up their skills and experiences and integrates internal seminars in exploration management to develop engineers' competencies by information and knowledge exchange.

The Moroccan government integrated BRPM and ONAREP（Office National de Recherches et d'Exploitations Pétrolières）into a newly established organization ONHYM（Office National des Hydrocarbures et des Mines）for facilitating the sole organization charged with mining exploration. This integration is one important step for strengthening the system of BRPM. ONHYM is engaged with exploration of potential rare metal and basic metal, and is allocated with total 280 million dirham for its activities between 2005-2007.

ONHYM is now engaged to develop such potential areas as Ouarzazate, Tiznit, Tata, Figuig, Taroudant and Marrakech and also to prepare the verification survey of potential resources in the southern regions. This verification survey is realized upon the convention between the Moroccan Government and BRPM in March, 2003 which is to be financially assisted by the Canadian enterprise METALEX.

The ONHYM will play a major role in the exploration of mineral resources because the Moroccan government entrusts ONHYM with a mission to develop the mining sector with new mineral deposits discoveries. For this, an important financial budget is allocated with total 280 million dirham for its activities between 2005-2007.

The present public policy and strategy demonstrate the sustainability of the Moroccan mineral exploration activity and the economic importance of this activity.

For financial sustainability, BRPM's financial support is principally derived from government origin; to which is added the turnover of external services (32 millions MAS per year) and the royalties for BRPM's participations in active mines (37 millions MAD in 2004). In addition to this budget and royalties, BRPM partnerships in Moroccan exploration are more than 10 millions MAD per year of investment and this contribution will increase during the next years.

For the period 1998 – 2004, BRPM's budget had increased by 14%, from 75 millions MAD in 1998 to 86 millions MAD in 2004. For 2005, the budget accorded by the government to the newly ONHYM is of 110 millions MAD. For 2006 projection, a budget of 185 millions MAD is to be considered (source: MEM) and this represents an important budget increasing (68%).

These financial support show a stabilized public support for the BRPM's finance and attest of the sustainability of the Moroccan mineral exploration.

Concerning human resources sustainability, the BRPM's staff evolved from 1014 in 2003 to 953 in 2004. This reduction is operated in accordance with the government policy oriented on public charges reduction. However, BRPM operate a recruitment strategy oriented on specific needs in terms of competencies; hence, fifteen engineers (in exploration methodology, GIS …) had been recruited between 1998 and 2004.

3－2 Factors that have promoted project

（1）Impact

- The Moroccan government implemented such policies as the development of exploration technology and the promotion of competence toward international market. These policies accelerated the progress of the Moroccan exploration technology.
- The Moroccan government entrusted BRPM with the grand and ambitious verification survey of potential mineral resources in the southern region.
- The government integrated BRPM and ONAREP into the sole organization for strengthen the implementing structure of exploration activities.
- The government continuously allocated a sufficient budget for exploration activities of BRPM: 75million dirham in 1998, 95million dirham in 2002, 71million dirham in 2003 and 86million dirham in 2004.
- Since 1970, the Japanese government had commenced to collaborate with BRPM in bilateral cooperation. The precedent cooperation of the Project cultivated the good human relationship between Japanese and Moroccan engineers. This familiar relationship encouraged efficient technical transfer during the Project period.

（2）Sustainability

- Government's mining policies and stability of BRPM's organisational ability
- The increase of BRPM's budget
- Taking the opportunity of the bilateral cooperation with the Japanese government, BRPM opened up domestic and international partnerships. BRPM achieved high international reputation with partnerships.

3－3 Factors that have inhibited project

（1）Impact None

（2）Sustainability

- The exploration manual which was introduced during the Project is not reviewed.

3－4 Conclusions

After the termination of cooperation period, the Project has steadily been producing a satisfying outcome. BRPM developed its exploration technology which covers high-precision charts of potential mineral resources. BRPM takes an important role in the technical transfer through the partnership with domestic enterprises. BRPM is entrusted to implement exploration activities and chemical analysis and also to implement technical cooperation upon the request of Arabian and African countries. It is highly appreciated that BRPM achieved high reputation in domestic and international mining world.

BRPM was integrated into ONHYM in 2004. ONHYM is expected to meet the high needs of mining sector. The Moroccan national policies of mining sector such as attainment of high productivity and high competence for international market as well as diversified needs of mining sector and BRPM's partnership assured the sustainability of BRPM as an important actor in the mining sector.

3－5 Recommendations

The exploration manual is an important tool. Therefore its regular revision should be continued to maintain BRPM's high standard of technology. Moreover the advanced technology should be shared among BRPM's engineers for avoiding the risk of appropriation and conserving institutional memory to be succeeded to younger generations.

To take into consideration the role of the BRPM's Training Department related to the Human Resources Direction whose mission is to plan and execute continuous and periodical training programme for BRPM's staff, this department was not clearly implicated during the implementation of the Project. Hence, its role is to be reinforced in view of the BRPM's significance in human resource development of domestic and international mining sector.

3－6 Lessons Learned

For preparing the technical cooperation in the advanced technology such as exploration of mining resources, the current and future national priority of policies and the grasp of needs of private enterprises are to be considered sufficiently. In Morocco, the government intervention is still important but the government highly respects the contribution of private enterprises in mining sector. Therefore the future diffusion of transferred technology to the private sector is contrived beforehand even though the cooperation is implemented in the scheme of bilateral cooperation. For example, inviting the private enterprises to the seminars organized by the Project is an ambitious attempt for increasing their understanding on the project purpose.

EX-POST EVALUATION OF THE PROJECT ON "UPGRADING EXPLORATION TECHNOLOGY OF MINERAL RESOURCES IN THE KINGDOM OF MOROCCO"

事後評価調査結果要約表

評価実施部署：モロッコ事務所

１．　案件の概要		
国名：モロッコ		案件名：鉱物資源探査技術向上プロジェクト
分野：鉱業分野技術協力		協力形態：プロジェクト方式技術協力（現：技術協力プロジェクト）
所轄部署：経済開発部資源・エネルギーＧ・資源・省エネルギーＴ		協力金額：下記案件概要を参照。
協力期間	(R/D) 1998 年 4 月～2002 年 3 月	先方関係機関： モロッコ鉱山探査投資公社（BRPM）
		日本側協力機関：R/D 締結時の名称（現名称） 経済産業省資源エネルギー庁鉱物資源課 金属鉱業事業団（MMAJ） 財団法人国際鉱物資源開発協力協会
他の関連協力：		

１-１　協力の背景と概要

モロッコでは、農業、水産業、観光などの一部産業に大きく依存した経済構造を有し、経済状況が同産業の盛衰に大きく影響されるという不安定な経済体質を有している。第 5 次国家開発 5 ヵ年計画（1988－1992 年）に基づき、同国政府は鉱業分野を強化すること及び同分野での技術開発・向上の可能性を探りつつ、鉱業製品の輸出振興を図ることを通じ安定的な経済成長を目指すこととなった。

わが国は、エネルギー鉱山省（現商業鉱業エネルギー鉱山省）所管の鉱山探査投資公社（BRPM）に対して、個別専門家派遣、資源開発協力基礎調査、ミニ・プロジェクトなどの協力を 1970 年代から実施してきた。

モロッコ政府は、上記のミニ・プロジェクト終了後、同国の鉱物探査が従来の地表で目に見えるものを対象とした探査から、今後は目に見えない「潜頭鉱床」の探査にシフトするものとして、より広い分野での高度技術レベルを求め、わが国に対して新たに BRPM の探査、選鉱及び工業原料の各部門における組織的な技術向上をめざすプロジェクトの実施を要請してきた。本プロジェクトは、1998 年 1 月 26 日付 R/D に基づき同年 4 月 1 日に協力が開始された。

同協力の終了後 3 年を経過し、モロッコ事務所では本プロジェクトの事後評価調査を実施した。

１－２　協力内容

本プロジェクトでは、下記の事項に重点をおきつつ、わが国の先端的な鉱物資源探査技術をもって BRPM の探査技術を組織面及び実践面の両面から強化することにより、BRPM の探査能力を向上させる目的で協力が実施された。

（1）スタッフセクションに適切な人員・資源を配置する。
（2）高度な探査用機材（ICP、POSAM 等）を調達し、配備する。
（3）鉱物資源で有望なエリア（モデルエリア）を選定するためのデータ収集・解析を行う。
（4）地質学、地化学による調査計画を策定する。
（5）地質学、地化学及び地球物理学的探査活動の成果に基礎をおいて包括的な鉱物探査技術を移転する。
（6）日本人専門家の協力により BRPM 内でセミナーを開催して技術情報の共有化を図る。

［1］上位目標　モロッコにおいて新たな鉱物資源が発見される。
［2］プロジェクト目標　BRPM が継続的に組織的・実践的な鉱物探査を実施できるようになる。
［3］アウトプット（成果）
①BRPM の探査部門の機構が改善され、効率的に運営されるようになる。
②機材が効率的に操作され、適切に維持管理されるようになる。
③効率的な探査のための計画手法が習得される。
④実践的な探査技術が習得される。
⑤包括的な探査技術が習得される。
⑥探査技術マニュアルが使用可能なものとして維持される。
⑦BRPM 内で探査技術移転システムが確立される。
［4］投入（プロジェクト終了時）

日本側：

長期専門家派遣	7 名	機材供与	6,009 万円
短期専門家派遣	20 名	ローカルコスト負担	1,514 万円
研修員受入	7 名	その他	億円

総額　5 億円

相手国側：

カウンターパート配置	32 名	機材購入	現地通貨　億円
土地・施設提供		ローカルコスト負担	現地通貨 1 億 7,060 万円
その他			

EX-POST EVALUATION OF THE PROJECT ON "UPGRADING EXPLORATION TECHNOLOGY OF MINERAL RESOURCES IN THE KINGDOM OF MOROCCO"

２． 評価調査団の概要		
調査者	（担当分野：氏名、所属先、職位） Mohammed BENHARREF、Moroccan Consultant	
調査期間	2005 年 12 月 20 日ー2006 年 2 月 24 日	評価種類：在外事後評価

３．評価結果の概要

３－１　評価結果の要約

（１）インパクト

本協力の結果、「潜頭選鉱」分野での BRPM の探査技術者の能力向上が図られると共に、BRPM の技術レベル全般が国際的水準にまで引き上げられた。本協力で供与された携帯型変質鉱物簡易同定装置（POSAM）等の先端技術の活用によって、地熱変化現象を応用した地熱資源探査等の高度な探査技術が BRPM に移転された結果、鉱物探査の実施範囲を縮小でき、高精度の探査が可能となった。

本プロジェクトの上位目標達成に対しては大いに期待がもたれているものの、新規の主要な鉱物資源は 2002-2005 年の間には発見されていないのが現状である。この理由には、新規の鉱物資源の発見はかなり幸運に左右されるものであることが挙げられる。BRPM は現在、有望視されている南部地域で新規の鉱物資源探査に従事している。本プロジェクトの成果により、多くの探査プロジェクトの進展は目覚しく、今後数年以内には新規の鉱物資源が発見されるものと期待されている。

鉱物探査分野での技術が向上した結果、BRPM は 1998 年から現在に至るまで金、基礎金属及び産業金属分野で 20 件のプロジェクトを立ち上げた。この中には、エネルギー鉱山省とのパートナーシップに基づき、南部で実施された希少金属の探査プロジェクトも含まれている（2003 年開始、総経費 1 億 4 千万ディルハム）。また、BRPM は 1998 年以降、国内・外の企業と連携して 12 件の主要プロジェクトも実施してきた。

上記の調査活動を通じて、BRPM の国際的知名度が高まり、BRPM は現在、国内・外の機関または企業と 25 件に上るパートナーシップを結び探査技術及び鉱床の開発を行っている。BRPM は、本協力以前は中小規模の探査活動に直接従事してきたが、本協力以後は高度技術を活用して、鉱物探査及び化学分析に関する委託調査を実施している他、国内及びアラブ・アフリカ地域の企業に対する技術移転も実施している。

他方、モロッコ政府は同国の鉱物資源の正確な埋蔵量を把握するために、全土レベルの地質学、地球物理学及び地化学面の鉱床分布地図作成を重要プロジェクトとして位置づけているが、本協力を通じ移転された地理情報システム（GIS）によって BRPM は全国レベルの鉱床に関する高精度地図作製のためのデータ処理の実施が可能となった。

本プロジェクトで習得した高度技術をもって、BRPM はラボラトリーに対しては ISO9001/V2000 認定を、金分析手法に対しては同 17025Accreditation を申請中である。

（２）自立発展性

モロッコ政府は今後の鉱業分野の主要政策として鉱物探査及び開発における既存技術の集約と更なる向上、同国鉱業界への投資誘致を促進するための国内法制度の整備（外国投資環境の整備）及びモロッコ産鉱物製品の国際市場への参入促進等を掲げ、鉱業分野の一層の振興を図る方針を打ち出している。

本協力の成果を踏まえ、組織内での自立発展を促進するために下記の施策を実施している。

①BRPM は、プラズマ発光分光分析装置（ICP）等の高度機材の効率的な維持管理システムを導入した。

②BRPM は年額 2.5ー3 百万ディルハムの独自予算で高度機材を新規に調達している。また、BRPM は新規調達機材及びソフトウェアに習熟するためシステム化された訓練を実施している。

③BRPM では技術者を国際セミナー及び会議に派遣するなど技術者の探査技術を常に国際的な水準に維持するために自助努力している。また、組織内での情報・知識交換を行うために探査手法に関する内部セミナーを実施している。

同政府は 2004 年に BRPM 及び ONAREP（モロッコ石油公社）を統合して ONHYM（国立炭化水素・鉱物公社）として新組織を発足させ鉱物探査活動に従事する機関を一元化した。本統合は、BRPM の組織を強化するために重要な一歩であった。因みに、ONHYM は有望な希少金属及び基礎金属の探査、開発事業に従事しており、2005－2007 年の事業予算額として 2 億 8 千万ディルハムが配賦されている。

また、ONHYM は、Ouarzazate,Tiznit,Tata,Figuig,Taroudant 及び Marrakech 等の有望な主要鉱物埋蔵地域の開発に従事している他、南部地域の有望鉱床の実証調査に着手予定である。本実証調査は、2003 年 3 月付の政府及び BRPM 間の協定に基づき実施されるもので、カナダの METALEX 社が資金援助を行う予定である。

モロッコ政府は、新規の鉱物資源発見を伴う鉱業分野の振興に向けた使命を ONHYM に託しており、今後とも ONHYM は重要な役割を演じていくこととみられている。政府が 2005-2007 年に ONHYM に対して上述の予算を配賦したことは、政府の期待感の証左でもある。

当国政府の現行政策はモロッコの鉱業探査活動の自立発展性と経済面での重要性を裏書している。BRPM の運営予算は主として政府予算で賄われているが、対外的サービスからの見返り資金（毎年 32 百万ディルハム）、BRPM の探査活動への参入に伴う鉱山使用料（2004 年には 37 百万ディルハム）に加え、BRPM のパートナーシップがもたらす資金が年額千万ディルハムに上る。これらの活動原資は今後とも増加することが見込まれている。

BRPM の予算は 1998－2004 年において 14%増加した（98 年が 75 百万ディルハム、2004 年には 86 百万ディルハム）。2005 年に ONHYM に配賦された予算は 1 億 1 千万ディルハムに上る。また、2006 年には 1 億 85 百万ディルハムが配賦される見通しであり（出典：MEM）、堅調な予算の伸び（対前年比 68%増）である。

これらの政府予算等の配賦状況をみても、BRPM は安定した公的支援を受け、モロッコの資源探査活動の自立発展性は保障されている。

他方、人的資源開発の分野では、BRPM スタッフは 2003 年の 1014 名から 2004 年の 953 名へと削減された。この削減は、政府の推進する公共支出削減政策に準じたものであるが、BRPM は特定分野については有能な人材の登用を継続している。1998-2004 年においては、探査手法及び GIS 分野で 15 名のエンジニアが新規に採用されている。

3-2　プロジェクトの促進要因

（1）インパクト発現を促進した要因

①政府が鉱物資源探査技術の向上及び自国産鉱物資源の国際市場参入促進といった振興政策をとった結果、鉱業探査技術の向上を促進した。

②BRPM は南部の有望鉱床の探査に係る大規模実証調査を受託するなど政府からも高い信任を獲得しつつある。

③政府は BRPM 及び ONAREP を ONHYM として統合し、鉱物資源探査の実施体制強化を図った。

④BRPM の鉱物探査活動に対する予算は多少の増減はあるものの、98 年 75 百万ディルハム、2002 年 95 百万ディルハム、2003 年 71 百万ディルハム及び 2004 年 86 百万ディルハムと概ね堅調に推移している。

④本プロジェクトの開始前の 1970 年代からわが国は BRPM に対する協力を開始した。先行する協力期間に形成された日・モ間での良好な人間関係によって本プロジェクトによる円滑な技術移転が可能となった。

（2）自立発展性強化を促進した要因

①政府の鉱業振興政策及び BRPM の組織面での安定性

②BRPM の予算の伸び

③わが国との協力を契機に、BRPM は国内・外のパートナーシップを開拓した結果、鉱業分野での高い国際的知名度と評価を獲得した。

3-3　プロジェクトの阻害要因

（1）インパクト発現を阻害した要因　なし

（2）自立発展性強化を阻害した要因

①本プロジェクト協力期間中に移転された探査マニュアルの更新が行われていない。

3-4　結論

本プロジェクトは、2002 年の協力終了後も着実に満足すべき成果を生み出した。BRPM は高精度の鉱床分布地図情報の整備を含む探査技術を向上させた。BRPM は国内の民間企業とのパートナーシップを通じて技術移転でも重要な役割を果たしている。また、BRPM は独自の探査活動に加え、民間企業からの委託で鉱物探査及び化学分析等を実施すると共に、アラブ・アフリカ地域への技術移転にも貢献するなど 2 次的技術移転でも成果を発揮している。BRPM が国内外から鉱業分野で高い信頼と知名度を獲得したことも高く評価される。

BRPM は 2004 年に ONHYM と組織統合した。鉱業分野での ONHYM に対するニーズは引き続き高いと思われる。発足して間もない新組織 ONHYM の将来の貢献度には未知数の部分もあるが、政府の鉱業分野での生産性向上及び国際市場参入を視野にいれた競争力向上及び鉱業界の ONHYM に対する多岐にわたる高いニーズ及びパートナーシップにより、BRPM は当該分野で重要な役割を果たすものと期待され自立発展性においても問題はない。

3-5　提言（当該プロジェクトに関する具体的な措置、提案、助言）

高度の鉱物探査分野においては、探査マニュアルの更新は重要である。また、技術の私物化を避け、組織内に確実に蓄積するためにもマニュアルの定期的な更新は継続されるべきである。

BRPM 訓練局（BRPM 技術者に対する継続的・定期的な訓練を実施する部署）は、本プロジェクト期間中に位置づけが明確でなかった。BRPM の人材育成面での重要性に鑑みて、組織内のステータス・機能を明確化することが必要である。

3-6　教訓

鉱業資源探査のように先端的な技術分野で協力を実施する場合は、相手国政府の政策上の優先度及び民間企業のニーズ把握が重要となる。モロッコの場合は、現在も政府による鉱業分野への関与は高いものの、政府方針として現在、鉱業分野の開発における民間セクターの貢献を重視している。従って、二国間協力においても政府機関への技術移転に留まらず、将来的に民間レベルへの技術伝播も確実に行われるような方策の検討が必要である。例えば、協力期間中の技術移転セミナーなどの場に民間企業関係者を招聘して理解共有を図るなどの方策が一案として考えられよう。

3－7　フォローアップ状況　なし