

# Summary of Results from the Final Evaluation Study

## 1. Overview of the Project

Recipient country:	Republic of Chile
Name of the Project:	Project for Institutional Capacity Strengthening in the Environmental Management of Mining (FOCIGAM)
Sector:	Environment
Scheme of assistance:	Project-type technical cooperation
Section in charge at JICA:	Environmental Management Group, Global Environment Department
Total sum of assistance:	app. 685 million Japanese yen
Period of the Project (R/D):	July 1 <sup>st</sup> , 2002 – June 30 <sup>th</sup> , 2007
Target group:	National Service for Geology and Mining (SERNAGEOMIN)
Japanese ministry in charge:	Ministry of Economy, Trade and Industry
Other related cooperation:	Japan's assistance activities Japan International Cooperation Agency (JICA)'s technical cooperation project: Mine Safety and Environmental Training Center (1994.7.1 - 1999.6.30)

### 1-1 Background and Outline of the Project

The Republic of Chile (hereinafter referred to as “Chile”) is one of the world’s largest producers of minerals, especially copper. With a recognition that it is critical to appropriately address and settle environmental problems caused by mining, so as to further develop the mining industry, the Government of Chile has established and revised several government ordinances since 1990s. On the other hand, the National Service for Geology and Mining (hereinafter referred to as “SERNAGEOMIN”), a governmental body in charge of supervising the technical aspects of mining pollution control measures, is not sufficiently furnished with techniques to survey mining pollution, formulate and monitor environmental control measures, and develop a database on closed and abandoned mines. That being the case, the Government of Chile requested the Government of Japan for a technical cooperation project on “Institutional Capacity Strengthening in the Environmental Management of Mining” in October 2000. Accordingly, an Implementation Study Team was dispatched in January 2002, which decided to implement a five-year project starting in July that year.

### 1-2 Contents of the Project

#### (1) Overall Goals

Overall Goal 1: “The Chilean government prevents mining pollution caused by closed and abandoned mines.”

Overall Goal 2: “SERNAGEOMIN provides technical guidance concerning the mine closure measures.”

Overall Goal 3: “SERNAGEOMIN compiles a database on Chilean mines.”

#### (2) Project Purposes

Project Purpose 1: “SERNAGEOMIN grasps the situation surrounding operating, closed and abandoned mines. SERNAGEOMIN compiles a database for closed and abandoned mines, including information on potential environmental impact.”

Project Purpose 2: “SERNAGEOMIN has a capacity to evaluate the plan for minimizing and monitoring environmental damage caused by mining, including mine closure.”

#### (3) Outputs

Output 1: “The inputs initially planned are completed.”

Output 2: “Basic knowledge regarding prevention of mining pollution is disseminated among inspectors in SERNAGEOMIN.”

Output 3: “Necessary investigation skills for closed and abandoned mines are strengthened in SERNAGEOMIN.”

Output 4: “SERNAGEOMIN has an improved database system to store investigation results.”

Output 5: “SERNAGEOMIN develops the capacity to evaluate technical measures for closing mines.”

- Output 6: “SERNAGEOMIN strengthens its skills for examining pollution from model mines.”
- Output 7: “SERNAGEOMIN develops the capacity to evaluate pollution protection plans for model operating, closed and abandoned mines.”
- Output 8: “SERNAGEOMIN strengthens its capacity to assess environmental impact.”
- Output 9: “SERNAGEOMIN improves its chemical analysis ability and its skills in management of the equipment.”
- Output 10: “SERNAGEOMIN obtains data analysis and evaluation technologies for chemical analysis results.”

#### **(4) Input (at the time of evaluation)**

Japanese side:

- Dispatch of nine (9) long-term experts,
- Provision of machinery, equipment and materials worth app. 152,173,000 yen,
- Dispatch of eight (8) short-term experts,
- Local cost necessary for the project activities of app. 89,845,000 yen, and
- Acceptance of 17 trainees for training in Japan

Chilean side:

- Assignment of 36 Chilean counterparts (C/Ps),
- Provision of land, buildings and facilities for office space for the Japanese experts, etc., and
- Operation cost of 1,211,176,000 pesos.

## **2. Overview of the Evaluation Study Team**

Evaluators (Responsibility in the Evaluation Study, Name, Title)

Leader:	Mr. Eiji Iwasaki Team Leader, Environmental Management Team II, Group II (Environmental Management), Global Environment Department, JICA
Pollution Control Policy:	Mr. Takahiro Matsubuchi Deputy Director, Nuclear and Industrial Safety Agency, Mine Safety Division, Ministry of Economy, Trade and Industry
Pollution Control Technology:	Mr. Tadashi Ito Senior Councilor, Mine Pollution Control, Metals Finance & Technology Unit, Japan Oil, Gas and Metals National Cooperation
Project Planning:	Mr. Tadashi Suzuki Senior Program Officer, Environmental Management Team II, Group II (Environmental Management), Global Environment Department, JICA
Project Evaluation:	Mr. Atsu Kishinami Permanent Expert, International Development Associate Ltd.
Interpreter:	Ms. Atsuko Yoshikawa Japan International Cooperation Center

Period of the Evaluation Study: November 27 to December 16<sup>th</sup>, 2006

Type of evaluation: Final evaluation

## **3. Overview of the Evaluation Results**

### **3-1 Confirmation of the Performance**

#### 3-1-1 Project Purposes

The following summarizes the results of evaluation on the performance in comparison with the indicators.

- Indicators of the Project Purposes

1-1 Inspectors of SERNAGEOMIN ascertain the realities of operating, closed and abandoned mines in each region.

- Level of achievement

The technical transfer to the Chilean C/Ps has appropriately been carried out as follows:

- 1) 24 C/Ps and 21 C/Ps have acquired the investigation methods using the E-400 investigation form (to be used in investigating closed and abandoned mines) and the E-500 investigation form (to be used in investigation on operating mines).
- 2) The actual situations on model operating, closed and abandoned mines have been investigated using the E-400 and E-500 forms.
- 3) Each regional office continues to grasp more information on closed and abandoned mines using the E-400 form.

#### 1-2 Situation on the accumulated data

Information and data on 309 mines and mining offices were collected as of December 2006, out of which 219 have been entered into the database system (SIMIN-OL). Information on 19 model operating mines has also been collected.

- Indicators of the Project Purposes, Level of achievement

2 The C/P's technical level is enhanced to the level that they can monitor and evaluate by themselves.

- 1) C/Ps are now able to carry out environmental investigations on model operating mines and record the results based on the E-500 form. They have completed investigations on 19 model mines.
- 2) C/Ps have assessed approximately 50 mine closure plans and instructed in actual closures in accordance with the revised Mine Security Supreme Decree.
- 3) C/Ps have gained experience through basic and theoretical training as well as practical training on sites.

#### 3-1-2 Outputs

The indicators of Outputs 1-4 and 10 were almost fulfilled at the time of the final evaluation study conducted in December 2006. The rest, Outputs 5-9, were not completed at that time, but are expected to be fulfilled by the end of the implementation of the Project.

- Output 1: C/Ps and budgets are appropriately allocated. Machinery and equipment provided are appropriately operated and maintained.
- Output 2: C/Ps now have deeper knowledge on pollution control measures and technologies, which proves to be contributing to smooth implementation of investigations on closed and abandoned mines with the E-400 form (E-400 investigation) and operating mines with the E-500 form (E-500 investigation) that are primary activities of the Project.
- Output 3: Six regional offices have been carrying out E-400 investigations on their own, based on the knowledge and skills acquired through the Project. At the same time, C/Ps are capable enough of using necessary equipment for investigation, such as pH/electric conductivity meters and GPS, and have been using the apparatus in actual E-400 investigations.
- Output 4: The data can be entered and read on the intranet. Findings from the investigations on 213 closed and abandoned mines (219 facilities) (E-400 investigation) have been accumulated in the database system, which has been smoothly operated and begun to be utilized.
- Output 5: A total of 88 C/Ps have acquired the basics of mines, including tailing dump, mine dump, open-cut mining, waste dump and particle materials, which have been contributing to both E400 and E-500 investigations. The future plan (for FY2007) is to learn knowledge and skills in association with control of noise, vibration and mine entrance, thereby further improving the C/P's evaluation capability. (To be completed in June 2007)
- Output 6: A total of 88 C/Ps have acquired the basics of mines, including tailing dump, mine dump, open-cut mining, waste dump and particle materials, which have been contributing to E-500 investigations. The C/Ps prove to have an improved ability to supervise and inspect mining pollution. The future plan (for FY2007) is to learn knowledge and skills in association with control of noise, vibration and mine entrance, thereby further improving the C/P's technical level. (To be completed in June 2007)
- Output 7: A total of 88 C/Ps have acquired the basics of mines, including tailing dump, mine dump, open-cut mining, waste dump and particle materials, which have been contributing to both E400 and E-500 investigations. The future plan (for FY2007) is to learn knowledge and skills

in association with control of noise, vibration and mine entrance, thereby further improving the C/P's evaluation capability. (To be completed in June 2007)

- Output 8: C/Ps have renewed their recognition on the necessity and importance of environmental impact assessment (EIA) and have acquired relevant skills, which have been contributing to technical learning regarding E-500 investigations and provide the foundation for reviewing EIA reports. The future plan is to prepare EIA guidebooks. (To be completed by March 2007)
- Output 9: C/Ps have reached the level where they can release the results of environment-related chemical analysis and receive analysis requests from external sources. Two or more personnel are assigned to operation and management of each piece of the provided machinery and equipment and they are able to operate it without a problem. Furthermore, 10 analysis standard operating procedures, including ICP-MS, AAS, HG, TOC and IC, have been prepared. Of a particular note is Til-Til Laboratory, which has improved to the level that they can apply for a national licence concerning water analysis, which conforms to ISO17025. The future plan is to complete the remaining analysis standard operating procedures and provide technical guidance on solid sample analysis. (To be completed by March 2007)
- Output 10: C/Ps are now able to carry out environmental investigations on model operating mines and record the results using the E-500 form. They have completed investigations on 19 model mines. The C/Ps at the laboratory and regional offices have obtained a recognition on the necessity and importance of chemical analysis of samples and are proactively engaged in analysis, examination and evaluation of samples.

### **3-2 Summary of the Evaluation Results**

#### **3-2-1 Relevance**

In Chile, the existing thousands of closed and abandoned mines are adversely affecting the environment. Aiming to alleviate this environmental pollution while soundly developing the mining industry, the Government of Chile has been carrying forward the development of its legal systems by establishing the Basic Environmental Law in 1994 and the Environmental Impact Assessment System (SEIA) in 1997 and revising the Mine Security Supreme Decree 72 in 2002. Moreover, the current government has announced a strong political commitment to the environmental protection. More specifically, the President gives due thought to the establishment of the Ministry of Environment and strives to enact during her own administration the Mine Closure Law and the Environmental Remediation of Mining Liabilities (PAM) Law, which are currently under discussion at the President Office and the Chilean Ministry of Mining and Energy (MME), respectively. In the meantime, as international concerns for environmental protection have been growing, the Chilean government is expected to take initiative in addressing environmental issues in the effort to promote FTAs with other countries and accede to the OECD. The Project posts "SERNAGEOMIN has a capacity to evaluate the plan for minimizing and monitoring environmental damage caused by mining, including mine closure" as one of the purposes; thus the Project is in accordance with Chile's national environmental policies.

Moreover, SERNAGEOMIN, the target group of the Project, is expected to further build up its structure and capacity, not to mention human resources, for carrying out its tasks: i) information collection on operating, closed and abandoned mines, ii) construction of a database on operating, closed and abandoned mines, iii) evaluation and analysis of the actual conditions of operating, closed and abandoned mines, iv) maintenance of the machinery and equipment, and v) evaluation, analysis and supervision concerning mining pollution caused by mine closures from the mine security point of view. The Project directly satisfies the needs of SERNAGEOMIN, and thus the organization is deemed as appropriate as the target group.

In addition, JICA designates "environmental protection" as one of the priority areas in its assistance to Chile, while Japan has advanced technologies of pollution control and chemical analysis as well as rich experience in overcoming mining pollution. Thus, the Project is consistent with Japan's assistance policies.

#### **3-2-2 Effectiveness**

Project Purposes are deemed as almost completely attained based on the degree of achievement at the Project Purpose level. While Project Purpose 1 has already been fully accomplished, Project Purpose 2 was not completely achieved at the time of the final evaluation study given that Outputs 5, 6, 7, 8 and 9 are not 100% fulfilled. With the completion of these Outputs, expectedly at the end of the Project in July 2007, the Project Purpose 2 will be fully achieved. In addition, the assumption "Positive policies on mining problems will be carried out" has been fulfilled.

### 3-2-3 Efficiency

The Inputs from the Japanese side were efficiently converted into Outputs in terms of quality, quantity and timing. Although the arrival of the chief advisor and the long-term expert in mine safety and environment and the delivery of a few machines for solid sample analysis, including fluorescent X-ray analyzer, were delayed and caused a discrepancy with the original plan, the impact on the progress of the Project was successfully minimized by the efforts made by both the Japanese and Chilean sides. Furthermore, it should be noted that the capacity of the laboratory has been strengthened by the flexible introduction of technical assistance activities for solid sample analysis and acquisition of ISO17025 (for competence of testing and calibration laboratories), which were added into the Project after it started. It is also important to note that the local consultants have positively been utilized under supervision of Japanese long-term experts, which allowed preparation of materials and hosting of seminars adapted to the specific conditions in the country with less financial resources.

The Inputs from on the Chilean side, despite the several changes of C/Ps, were generally satisfactory, with personnel assignment and budget allocation made in compliance with the Record of Discussion (R/D).

### 3-2-4 Impact

The major Impacts of the Project are as follows:

- Overall Goal 2

As for the goal “SERNAGEOMIN provides technical guidance concerning the mine closure measures”, SERNAGEOMIN has already evaluated roughly 50 mine closure plans according to the Mine Security Supreme Decree, SEIA and the Clean Production Agreement (APL). This satisfies Indicator 2-1 “Status of the technical activities in connection with mine closures”. Also, since the C/Ps have mastered how to investigate model operating mines based on the E-500 form, Indicator 2-2 “Status of the capacity for monitoring and evaluation” can also be regarded as partially accomplished.

- Overall Goal 3

As for the goal “SERNAGEOMIN compiles a database on Chilean mines”, SERNAGEOMIN has already been carrying out investigations on closed and abandoned mines on their own and has shown a strong commitment to constructing a database for operating mines surveyed in accordance with the E-500 form, too. Furthermore, the organization has an intention to integrate the existing databases into SIMIN-OL in order to create a more user-friendly database system. Thus, Indicator 3 “Completeness of (environmental mapping) database” can be regarded as partially fulfilled.

➤ The Project includes a plan to host an international conference in March 2007, in order to present the outcomes of the Project and also share the information and knowledge regarding pollution control with neighboring countries. As SERNAGEOMIN has an intention to engage in South-South cooperation, based on the results of the Project, the seminar will most likely serve as a starting point of such cooperation. The seminar is also expected to reactivate the discussion over the Mine Closure Law.

### 3-2-5 Sustainability

#### (1) Institutional sustainability

The mining sector is one of the most critical industries in Chile and hence the Chilean government places high priority to the sound development of the sector as well as pollution control. Therefore, the government will likely continue to support the activities of SERNAGEOMIN which acts as the national authority of pollution control. In the meantime, SERNAGEOMIN has already started carrying out their activities from the perspectives of environmental protection and mine security according to the Basic Environmental Law, SEIA, the Mine Safety Supreme Decree and APL, and preparing for facilitating their expanding tasks by, for example, planning to hire 10 new staff members in 2007. Additionally, SERNAGEOMIN will revitalize the Mine Safety and Environmental Training Center in Copiapo, for which JICA carried out another project in the past, in order to fully utilize the training manuals and technical guides prepared in the Project and expand training programs to cover not only parties concerned in the mining sector but also the SERNAGEOMIN staff.

#### (2) Technical sustainability

The Chilean C/Ps have acquired knowledge and skills of using the E-400 and E-500 forms in investigations on operating, closed and abandoned mines. In addition to the 213 mines already registered into the SIMIN-OL database, SERNAGEOMIN, with its own initiative, is surveying 96 closed and abandoned mines and facilities, targeting the completion by December 2007. At the same time, the

machinery and equipment provided under the Project have been properly functioning and appropriately operated and maintained. The chemical laboratory is working hard to obtain ISO17025, concerning water analysis, and if successful, the knowledge, skills and technologies of the standard will systematically be transferred to the organization. It is noteworthy that the lab has been receiving an increasing number of requests for chemical analysis from external entities, which provides evidence for a heightened reputation of the lab.

### (3) Financial sustainability

Being a governmental body, SERNEGEOMIN has been funded sufficiently by the national budget as to their operating expenses and has no major financial concern. They also positively foresee that the budget will continue to be adequately assured in the future, in the light of the significance of the mining sector and the intention to sustain the effects of the Project even after its completion.

### **3-3 Factors promoting/hindering the Impacts**

Under the circumstances that the Chilean government attaches great importance to environmental issues arising out of the mining industry and the country draws international attention concerning its environmental policies, the contents of the Project are deemed as timely since they harmonize with the prioritized issues and concerns of the MME and SERNAGEOMIN. Of a number of factors that contributed to the success of the Project, the commitment of the highly-motivated Chilean C/Ps and the Japanese long- and short-term experts trying to respond to their positive attitude, which formed an implementation structure under the strong ownership of the Chilean side, are worth noting.

The original plan of the Project focused only on water quality analysis in the field of chemical analysis technical transfer. However, after the Project began, solid sample analysis was added when its necessity was recognized. This change required an extension of the dispatch period of the expert in this field and an input of additional equipment. Unfortunately, however, the additional apparatus for solid sample was not smoothly cleared at the customs, which forced the technical transfer to be carried out beyond the planned period and required a dispatch of a succeeding expert. Nevertheless, this flexible addition of technical assistance in the aspects of solid sample analysis and application for ISO17025 after the initiation of the Project, needless to say, contributed significantly to the strengthening of the functions of the laboratory.

### **3-4 Conclusions**

The evaluation study confirmed that the Project Purposes and 10 Outputs were all either fulfilled or expected to be fulfilled by the completion of the Project. Moreover, based on the five evaluation criteria, the Project is deemed as successful in terms of “efficiency” and “effectiveness” based on the fact that both Japan and Chile adequately poured necessary inputs and facilitated the project activities in an effective and efficient manner. The Government of Chile has been tackling with pollution control, as evidenced by the establishment of the Basic Environmental Law (1994) and SEIA (1997), the revision of the Mine Safety Supreme Decree (2004) and the signing of the APL (2003). Hence, the Project is deemed as “relevant” because it provided SERNAGEOMIN, which plays the key role in the pollution control issue under the aforementioned legal systems, with assistance in reinforcing the skills and knowledge needed for pollution control. Moreover, the current administration deals with the pending Mine Closure and the Environmental Remediation of Mining Liabilities bills with high priority, on the ground of its basic policy for strengthening the environmental administration. When these bills pass, the “Impacts” of the Project will further be enhanced. Sustainability-wise, the Project poses no major concern in the financial aspect so far since it targets SERNAGEOMIN under the MME as the C/P and aims at the strengthening of the capabilities of existing facilities and personnel. It is also deemed as highly sustainable in the technical aspect since it is planned to develop a plan for disseminating the skills and knowledge the C/Ps have acquired in the course of the Project throughout the mining industry by utilizing the manuals and technical guides created as part of the Project. In addition, the C/P plans to obtain ISO17025 (for analysis laboratories) by the completion of the Project, which will reassure the institutional sustainability. Furthermore, SERNAGEOMIN is deemed as at a high level of policy and regime sustainability, being in charge of pollution control of the country based on the aforementioned legal systems. With consideration given to all the above factors, it is deemed that the Project will be completed by June 2007 as planned.

### **3-5 Recommendations (specific measures, suggestions and advice in association with the Project)**

The Chilean and Japanese Joint Evaluation Team compiled and provided the following recommendations as a result of the evaluation study.

#### 3-5-1 Preparation of manuals and technical guides

SERNAGEOMIN is expected to prepare 11 manuals and technical guides based on the training and seminar materials used in the Project as their future training and reference documents on E-400/E-500 investigations, evaluation of mine closure plans, etc. These are important products of the Project particularly in terms of dissemination of the skills and knowledge obtained through the Project. As the Japan side has already provided all necessary information, the Chilean side is expected to complete the preparation by the scheduled deadline by its self-effort.

In addition, it is desirable to make them open to the public for the purposes of educating the related private companies with skills and knowledge on pollution control as well as raising the public awareness.

#### 3-5-2 Continuation of mine survey and preliminary risk evaluation

Chile is suspected as to have more than 4,000 mines either closed or abandoned, but does not have a clear grasp of the situation or assess the environment and security risks. The Project covered investigations on 219 closed and abandoned mines, which accounts for only a handful of the total. Therefore, it is recommended that SERNAGEOMIN will continue to investigate closed and abandoned mines and also operating mines even after the completion of the Project in order to ascertain the actual situation and compile the findings into a database for sustainable information management. The concentrated information should provide valuable data for rationalizing the necessity of the Mine Closure and the Environmental Remediation of Mining Liabilities bills to expectedly be brought up in the next parliament session.

#### 3-5-3 Construction of systems for personnel training

In accordance with the revised Mine Security Supreme Decree, many closure plans will foreseeably be submitted to SERNAGEOMIN, which should then examine and approve them and engage in the supervision and the provision of technical guidance in actual closure activities. In order to disseminate the skills and knowledge obtained through the Project across the organization and adequately apply them in carrying out those tasks, it is vital to establish an appropriate organizational structure and secure and nurture necessary human resources.

In this respect, it is highly valued that SERNAGEOMIN has detailed plans to increase the manpower in the environmental protection field (by 10 staff members in the FY2007 budget) and to strengthen the ISO9000 certified training center (Mine Safety and Environmental Training Center in Copiapo), which was covered by another JICA cooperation project, as the foundation for human resources development in Chile.

#### 3-5-4 Strengthening of Til-Til Laboratory

Til-Til Laboratory is managed by SERNAGEOMIN. It plans to obtain ISO17025 by the completion of the Project, and the procedural progress suggests that it will successfully obtain it by the completion of the Project.

The number of chemical analysis requests has drastically increased five-fold for the past one year, which proves that the laboratory has raised its technical level by appropriately and effectively utilizing the machinery and equipment provided by JICA and improved its liability as an analysis lab. On the other hand, the sudden increase in analysis requests was an unexpected phenomenon and the lab is not yet ready to handle all the requests under the current staffing structure. To resolve the overflow, the lab has put specific measures in place, such as hiring of additional analysis engineers; however, these actions are still not sufficient to keep pace with the incoming requests, and the lab sometimes fails in meeting the deadline for feeding the results back to the requesters. It is recommended therefore to review and revise accordingly the overall management plan of the lab, including further improvement of efficiency, reinforcement of workforce, and selection of requests to be accepted, both during the Project and continuously in the future as necessary.

### **3-6 Lessons Learned (Matters to be reflected in the finding/formation, implementation and operation/maintenance of similar projects)**

#### 3-6-1 Strengthening of the capabilities of existing personnel and institutional organizations and infrastructure

The Project has been carried out based on the approach to expand the capacity of the existing organization and personnel, instead of establishing a new facility and employing new personnel. In those developing countries with financial and organizational vulnerabilities, the conventional approach of constructing a new organization and procuring new human resources for an individual project encompassed uncertainty from the sustainability standpoint and in fact turned problematic in many cases. In this regard, the approach adopted in the Project is

deemed as a preferable model.

### 3-6-2 Effectiveness of technical guidance through on-site OJT

The Project has carried out a series of lectures in class together with practical training (OJT) in some of the mines. This combination of “lectures” and “training” is deemed as a desirable approach in terms of acquisition of skills and knowledge. Moreover, the OJT contributed to fostering mutual trust between the Japan side and the C/Ps and hence to facilitation of teamwork in the project activities.

### 3-6-3 Preparation of training and reference materials

As part of the Project, the C/P has been editing manuals and technical guides based on the materials and documents used in the lectures, seminars and training. It is highly valued from the sustainability viewpoint that these materials, reflecting the local conditions, provide an extremely effective tool to dissemination of the skills and knowledge to personnel concerned outside SERNAGEOMIN and developing the human resources in the sector.

### 3-6-4 How to procure and input equipment to be provided

It often takes more time than expected to clear the customs for machinery and equipment to be shipped from Japan. Thus, it is extremely important to pay sufficient attention to the procurement method by drawing a detailed plan from the initial stage of determining the contents and specifications of equipment. If the equipment delivery is delayed, the dispatched expert has no subject to instruct on and has to waste time. It is critical therefore to direct sufficient attention to the timings of procuring the equipment and dispatching experts together with how to procure the equipment. In other words, it is recommended to consider the possibility of local procurement as much as possible so long as sustainability is concerned.