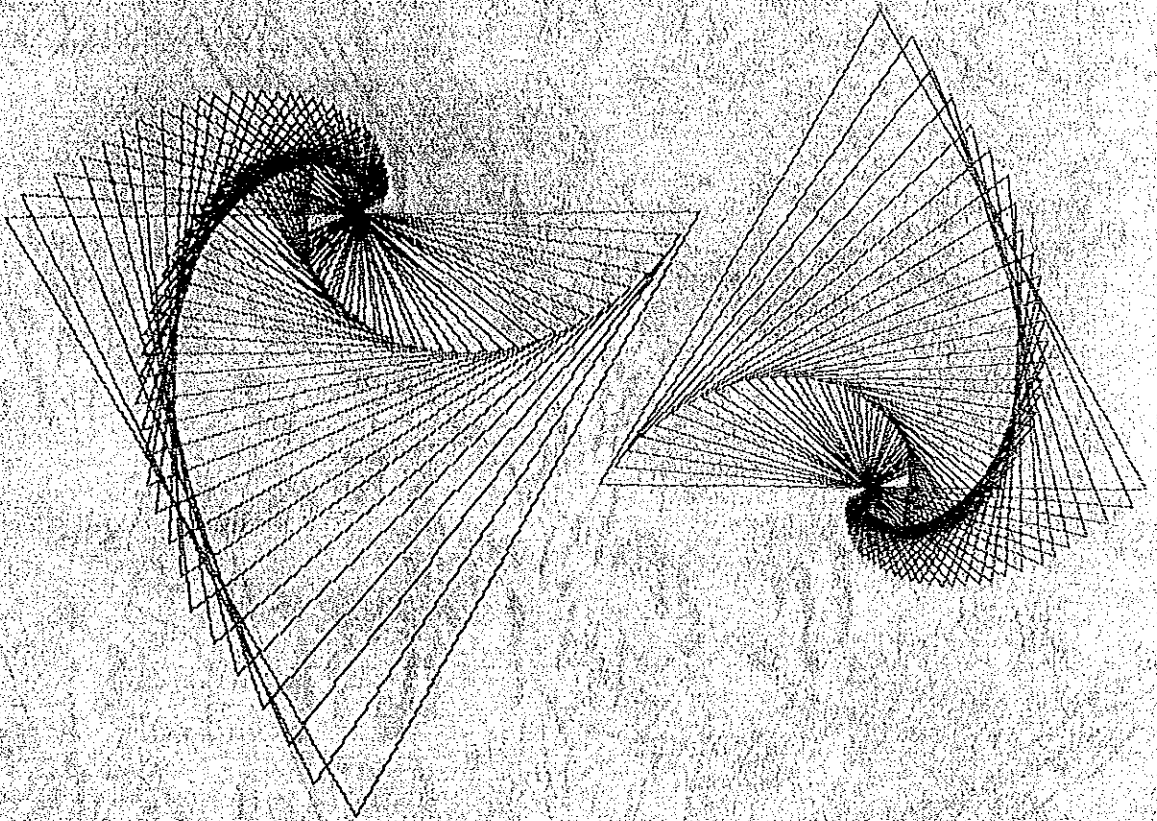


**THE INSTITUTE OF ECONOMIC GEOLOGY  
SAN ANDRES UNIVERSITY**

**(REPUBLIC OF BOLIVIA)**



**March 1989**

**Institute for International Cooperation  
Japan International Cooperation Agency (JICA)**

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PROJECT  
ON  
THE INSTITUTE OF ECONOMIC GEOLOGY  
SAN ANDRES UNIVERSITY  
(Republic of Bolivia)

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March 1989

Institute for International Cooperation  
Japan International Cooperation Agency (JICA)

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## PREFACE

The Project-type Technical Cooperation is an integrated form of cooperation whose aim is to realize technology transfer to relevant personnel of the project in the recipient country, by effectively combining such assistances as dispatch of experts, training of counterparts in Japan, and supply of equipment as required. It is intended to assure smooth and systematic implementation of technical cooperation program through planning, implementation and evaluation.

The duration of cooperation is usually about five years. When the project is actually commenced, a variety of survey teams and experts are dispatched to the recipient country, preparing work reports.

This case study of Project-type Technical Cooperation has been compiled originally in Japanese, then translated into English, based upon a number of these reports prepared at each stage of planning, implementation and evaluation of the project.

We would be pleased if it would be of some usefulness as reference material for those who are interested in our technical cooperation.

March 1989

Director  
Institute for International Cooperation  
Japan International Cooperation Agency (JICA)



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## Outline of the Project

The Republic of Bolivia, a country with an extensive mining industry, is now confronted with the gradual exhaustion of known reserves year by year. It is urgent that the promotion of exploitation of new mines be carried out.

Adopting a policy for the establishment of new mines as one of its important policies, the Government of the Republic of Bolivia created the Institute of Economic Geology at the National San Andres University in February 1979 as a working base for prospecting activities. The Government requested cooperation from the Japanese Government in the form of a technical cooperation center so that the Institute might expand and reinforce its functions and might develop advanced research activities.

In response to this request, the Japan International Cooperation Agency (JICA) sent a preliminary survey team in September 1981 to study the viability of technical cooperation with the Institute of Economic Geology in question, and in order to better understand details of the request and the background.

In May 1982, JICA sent an implementation survey team. Based on the survey results obtained by the preliminary survey team, the implementation survey team discussed concrete items concerning the implementation of the requested technical cooperation with the competent authorities of the Bolivian Government. As a result, the team signed "the Record of Discussions on the Japanese Technical Cooperation for the Project on the Institute of Economic Geology, San Andres University," (R/D) and "the Tentative Schedule of Implementation for the Project" (T/S).

It was agreed that the cooperation period for this project would be five years starting from May 20, 1982 and ending on May 19, 1987. The Project for practical purposes was started on October 31, 1982 when the Japanese Government dispatched four experts as the first mission. During the projected five years, the total number of experts dispatched was 33, for both long and short stays. Twelve trainees visited Japan, and seven survey teams were dispatched. The total value of machinery and equipment granted reached ¥284,549,000.

These figures fully met the details agreed upon in the said R/D.

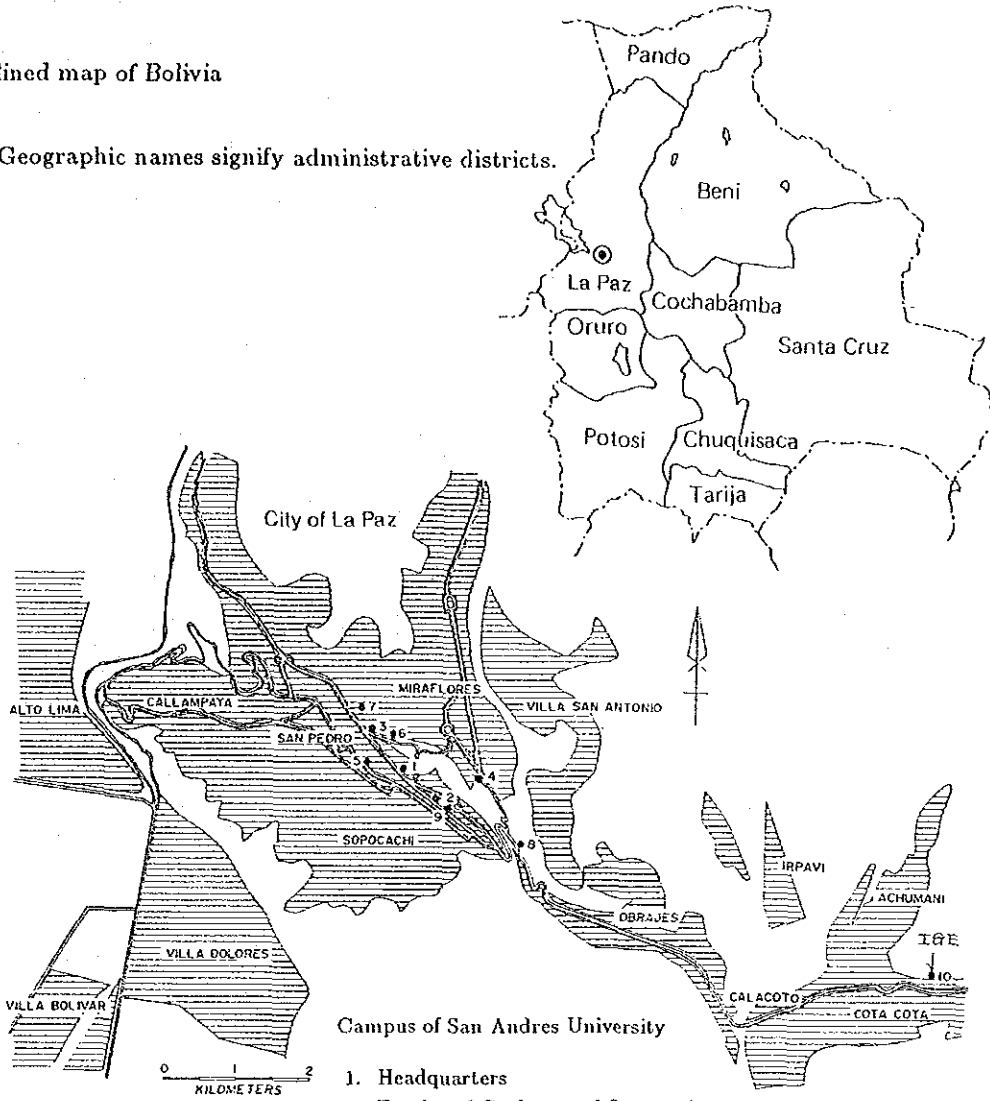
The technical transfer began with instructions given to all the counterparts through lectures, experiments, and practical exercises upgraded gradually to instructions of important items and instructions on research by theme in a man-to-man manner. The curriculum which had been initially intended to correspond to the level of studies for master's courses in Japanese graduate schools was carried out with sufficient effect, and the cooperation under the Project was completed on schedule.



# Map of the Project Site

Outlined map of Bolivia

- Geographic names signify administrative districts.



Campus of San Andres University

1. Headquarters
2. Faculty of Geology and Secretariat
3. Faculty of Technology
4. Faculty of Medicine, Pharmacy, and Dentistry
5. Faculty of Architecture
6. Faculty of Jurisprudence
7. Faculty of Engineering
8. Department of Industrial Administration
9. Faculty of Sociology
10. Campus at Cota Cota  
(the Institute of Economic Geology = I.G.E.)

## Outlined Schedule of the Project

Name of Country : The Republic of Bolivia  
 Name of the Project : The Institute of Economic Geology, San Andres University  
 Date requested : June, 1978 Date of R/D signed : May 20, 1982  
 Period of cooperation in R/D : From May 20, 1982 to May 19, 1987

Project Year	1981	1982	1983	1984	1985	1986	1987
Survey teams sent	Preliminary Survey Team September 15 to October 14 No. of members : Five.	Implementation Survey Team, May 9 to May 24 No. of members : Five.	Mutual Consultation Team, October 2 to October 16 No. of members : Four.	Technical Guidance Team, July 1 to July 15 No. of members : Three.	Mutual Consultation Team, August 16 to August 25 No. of members : Three.	Evaluation Team, October 21 to November 3 No. of members : Four.	Short-term Expert Team, April 6 to May 22 No. of members : Four.
Dispatching of Experts							
1) Long-term Japanese Experts							
Team Leader (Economic geology)		10/31	3/30	7/30	3/30	3/15	
Economic geology		3/20	3/14	8/20	2/18	5/18	4/18
Petrology			10/30	10/30	9/20	10/30	4/30
Mineralogy			10/30		10/13	10/30	
						10/12	3/15
						10/1	
2) Short-term Japanese Experts							
Economic geology		11/14 11/24	11/12 2/26 3/10	7/1 7/29 11/2 11/30	11/23 12/22	8/6 9/5	
Installation and repairing of machinery and equipment			11/12 12/8	10/18 10/29	7/15 7/24		
Counterparts' Training in Japan							
Short-term training (Study tour)		10/13 10/28		8/26 9/8	3/6 3/23		
Long-term training (Economic Geology)			11/18	9/30 10/31	10/24 11/16	10/1 11/11	9/26
Long-term training (Economic Geology)			11/15	9/9 10/31	10/24 11/16	10/1 11/11	1/27 5/3 9/26



## Brief History of the Project

August 1977	When Prof. Asahiko Sugaki of Tohoku University and Prof. Hiroshi Ueno of Yamaguchi University were dispatched to the San Andres University as experts in applied geology, Ing. Gaston Mejia, Chief of the Allied Research Institute of the University and Ing. Antonio Saavedra, Chief of the Faculty of Science requested that the professors would notify the Japanese Government of their request for establishing an institute of economic geology as part of a project-type cooperation.
June 1978	The Government of the Republic of Bolivia submitted to the Japanese Embassy in Bolivia an official request for the project.
February 1979	The San Andres University separated the Institute of Economic Geology from the Earth Science Section of the Faculty of Science to create an organization in charge of the project for receiving assistance from the Japanese Government. It started construction of buildings to be used for the Institute on its own account.
September 1981	Preliminary Survey Team for the Project (Prof. Asahiko Sugaki as Leader, and three other members) was dispatched.
May 1982	Implementation Survey Team (Prof. Sugaki and other four members) was dispatched. It signed and exchanged the Record of Discussion (R/D) and the Tentative Schedule (T/S).
October 1982	Kano (Chief adviser), Nanbu (expert in economic geology), Nakada (expert in petrology), and Mizota (expert in mineralogy) arrived at their respective posts in Bolivia. Japan accepted Mr. L. Rodrigo, Director of the Department of Education for observation and training.
November 1982	Prof. Sugaki was dispatched as a short-term expert in economic geology.
March 1983	Hayashi, expert in economic geology, arrived at his post in Bolivia.
July 1983	A ceremony to grant machinery and equipment was held.
October 1983	Mutual Consultation Team (three members including Prof. Sugaki as Leader) was dispatched. Yamamoto (expert in petrology) and Azuma (expert in mineralogy) arrived at their posts in Bolivia.
November 1983	P. White and Takano (as experts in installing machinery and equipment) were dispatched.
November 1983	Prof. Hirowatari, Kyushu University was dispatched as short-term expert in economic geology.
November 1983	A. C. Sanchez and O. V. Vargas were accepted for training in Japan.

February 1984	Yazawa, Chief of Mineral Processing and Smelting Institute, Tohoku University was dispatched as short-term expert in economic geology.
March 1984	Aoki arrived at his post as chief adviser. Naya, expert in installation of machinery and equipment, was dispatched.
May 1984	The Department of Geology, Faculty of Science, the San Andres University was promoted to the Faculty of Geology.
July 1984	Technical Guidance Team (composed of two members, including Kano as Leader) was dispatched. Prof. Sugaki was dispatched as short-term expert in economic geology.
August 1984	A ceremony to grant machinery and equipment was held. Ueno, expert in economic geology, arrived at his post in Bolivia. Japan accepted observation and training of Mr. P. R. Sanchez, Rector of San Andres University.
October 1984	Minoura and Yoshikawa, experts in petrology and mineralogy respectively, arrived at their posts in Bolivia. R. Santivanes and M. Blanco were accepted as counterparts to be trained in Japan.
November 1984	Prof. Sugiura, Kanazawa University was dispatched as short-term expert in economic geology.
March 1985	Konno, expert in economic geology, arrived at his post. Shimada, chief adviser, arrived at his post.
May 1985	Ono, expert in economic geology, arrived at his post.
June 1985	A ceremony to grant machinery and equipment was held.
August 1985	Mutual Consultation Team (composed of two members, including Prof. Sugaki as Leader) was dispatched.
September 1985	Nakamuta, expert in petrology, arrived at his post.
October 1985	Ikeda, expert in mineralogy, arrived at his post. Kitakaze and Yamaguchi were dispatched as experts in installing and repairing machinery and equipment.
November 1985	H. Alarcon B. and S. Orlando Sanjines were accepted as counterparts to be trained in Japan (long term). Prof. Yamamoto, Fukuoka Educational University was dispatched as short-term expert in economic geology.
March 1986	Director J. L. Telleria, Faculty of Geology was accepted as a counterpart for observation and study. Watanabe, Chief adviser, arrived at his post.
April 1986	Kimura, expert in economic geology, arrived at his post.
May 1986	Wada, expert in petrology, arrived at his post.
July 1986	Ito, expert in repairing machinery and equipment, was dispatched.

August 1986	A ceremony to grant machinery and equipment was held. Prof. Shima, Yamaguchi University, was dispatched as short-term expert in economic geology.
October 1986	Nakajima, expert in mineralogy, arrived at his post. Evaluation Team (composed of three members including Prof. Sugaki as Leader) was dispatched.
November 1986	A. Vilalpando and A. J. Arellano were accepted as counterparts to be trained in Japan (long term).
January 1987	F. Blanco Vasquez was accepted as a counterpart to be trained in Japan (long term).
April 1987	Short-term Expert Team (composed of three members, including Prof. Sugaki as Leader) was dispatched.
May 12, 1987	An open seminar of the Institute of Economic Geology and a project completion commemorating reception were held.
May 13, 1987	A joint final assembly was held including counterparts of the Institute of Economic Geology, experts, and JICA. A ceremony to exchange documents was also held.
May 18, 1987	All the procedures for the takeover of the project by the counterparts were completed. The Short-term Expert Team settled the remaining business, handed over the key and the number of the safe to the Chief in the Bolivian side, and handed over the keys for the experiment rooms.





# 1. REQUEST FOR COOPERATION

## 1-1 Intention of the Request

In August 1977, two experts in applied geology, namely, Hiroto Ueno (assistant professor, Yamaguchi University, one year term of office) and Asahiko Sugaki (professor, Tohoku University, one-and half month term of office) were dispatched to the San Andres University. Ing. Gaston Mejia, Chief of the San Andres University CEPIC and Ing. Antonio Saavedra, Director of the Faculty of Science of the same consulted both experts about a request for a project-type technical cooperation with the Institute of Economic Geology. At that moment, there were two foreign assistance programs involved with the geological studies department of San Andres University; one was assistance to the Institute of Applied Geology from West Germany and the other was assistance to the Institute of Limnology.

After repeated revisions of its contents, the Bolivian request for the Project was formally submitted by the Government of the Republic of Bolivia to the Japanese Embassy in Bolivia.

The Bolivian request took shape to eventually include grant aid cooperation.

Far before this project began to take real shape, however, the Bolivian authorities concerned with mining, such as the Ministry of Mining and Metallurgy, Mining Public Corporation, and the Institute of Geology had made similar requests. It was necessary, therefore, that the Project should involve the establishment of an Institute of Economic Geology which could address all of these requests.

In February 1979, San Andres University separated its Institute of Economic Geology from the Earth Science Section of the Faculty of Science, thus creating an as organization in charge of the Project for the purpose of receiving assistance from the Japanese Government. Under these circumstances, the Bolivian side, which required earlier implementation of and placed a top priority on the Project, started construction of the Institute buildings on its own account. The Bolivian Government also started reviewing a policy to separate its request for grant aid cooperation and to request a technical cooperation/center-type project.

Ing. Orland Sanjines, who was the counterpart to Expert Shimada, took office as the Chief of the Institute of Economic Geology, and then endeavored to establish domestic systems to take charge of the Project. He set up the Bolivian Domestic Committee covering the Ministry of Mining and Metallurgy, the Mining Public Corporation, and the Institute of Geology for implementing the Project and surveyed domestic requirements in the Bolivia towards this end. During the 15-month term of office of an expert (assistant professor, Kagoshima University) who succeeded Expert Shimada in December 1979, the opinion that the scope of the Project should be narrowed was aired, because the contents of the project cooperation had become too widely dispersed. The project plan, which was attached to the request for the project submitted again by the Bolivian Government in January 1981, restricted the counterpart to San Andres University as had also been the case with the initial version, partly because the domestic opinions had not been fully consolidated in Bolivia. Since the project plan limited the cooperation to the field of economic geology, it was to take on the form of cooperation for research.

Based on the procedures taken in respective phases, the Preliminary Survey Team was dispatched for the purpose of reviewing possibilities of technical cooperation with the Institute of Economic Geology, gaining an understanding of the contents of the request, and surveying its background.

## 1-2 Contents of the Request

The request for technical cooperation for the Institute of Economic Geology was submitted with the objectives that rapid development might be assured in the field of economic geology in Bolivia, and that substantial contribution would be made to the exploitation of mineral resources in the whole of Bolivia by applying economic geology in order to clarify how Bolivian mineral resources had been formed, and in order to obtain the knowledge which might be required for prospecting unknown mines and/or exploiting existing ones.

To attain this goal, Japan should implement technical cooperation for the Institute of Economic Geology of San Andres University in a manner that the research staff and facilities of the Institute would be reinforced by them. Furthermore, the Institute was to become an organization which could play a leading role in Bolivia in the future. It is highly expected that the technical level of the Institute, having been enhanced by Japanese cooperation, would make substantial contributions to the exploitation and utilization of mineral resources in Bolivia.

The objectives which were selected initially were as follows:

- 1) Instruction on techniques and research should be presented in a manner equal to the level graduates at Japanese universities would reach at the end of their three-year period of basic study. A level equal to that of students who completed a masters' course in Japan would be reached at the end of the subsequent two-year period of the applied study course.
- 2) The contents of the above-mentioned instructions were set up in a manner such that students in the technique instruction course were to aim at mastering research and survey methods in the general field of economic geology, while those in the research instruction course were to engage in basic research of mineral deposits in Bolivia.

## 2. IMPLEMENTATION SURVEY OF THE PROJECT

### 2-1 Dispatching a Preliminary Survey Team

The Republic of Bolivia, a mining country which has now been confronted with gradual exhaustion of known reserves of resources year after year, is adopting a policy to prospect new mines. As one of the important parts of this policy, the Government of the Republic of Bolivia established, in February 1979, the Institute of Economic Geology at National San Andres University. The Institute is an organization to promote education as well as research and survey activities aiming at the exploitation of mines. The Government requested cooperation for the Japanese Government in the form of a technical cooperation center so that the Institute might expand and reinforce its functions and also so that it might develop advanced research activities.

In response to this request, JICA sent a preliminary survey team to the Institute. Headed by Professor Asahiko Sugaki, Faculty of Science, Tohoku University, the team stayed in Bolivia from September 15 to October 4, 1981 for the purpose of studying the viability of technical cooperation with the Institute of Economic Geology in question and in order to better understand the details of the request and its background.

### 2-2 Objectives of Cooperation

The Project of the Institute of Economic Geology of San Andres University was expected to meet certain objectives so that rapid development would be assured in the field of economic geology in Bolivia. It was also expected that the Project would substantially contribute to the exploitation of mineral resources in the whole of Bolivia by clarifying how the Bolivian mineral resources had been formed. These data should supply the knowledge required for prospecting unknown mines and for exploiting existing ones.

To attain this goal, Japan was to implement the technical cooperation program for the Institute of Economic Geology at San Andres University such that the research staff and facilities of the Institute might be reinforced, so that it could play a leading role in Bolivia in the future. It was expected that the technical level in economic geology and related fields at the Institute would be enhanced by Japanese cooperation, so that they would be able to make substantial contribution to the improvement of the Bolivian mining industries and to the exploitation of the mineral resources in Bolivia.

Immediately after its establishment, however, the Institute of Economic Geology of San Andres University had only four research scientists, including the chief, and was insufficiently equipped. Moreover, most of the research scientists lacked knowledge in related fields such as economic geology, petrology, and mineralogy. Even if Japan were to dispatch one or two experts to the Institute, which was still in this state of poor preparedness, it was not expected that rapid progress could be made in the field of economic geology at the Institute of Economic Geology. It was planned, therefore, that the below-mentioned technical cooperation project should be carried out for the purpose of realizing the quick upgrading of the Institute which could then in turn

play a leading role in the field of economic geology in Bolivia.

### 2-3 Details of Discussions made for Concluding the R/D

In January 1981, the Bolivian Government submitted a request for cooperation, in the form of a technical cooperation center for the Institute of Economic Geology of San Andres University, to the Japanese Government. In response to this request, JICA dispatched the Preliminary Survey Team in September 1981.

Based on the survey results from this Team, JICA dispatched the Implementation Survey Team, which was composed of five members including Prof. Asahiko Sugaki, Tohoku University, from May 9 to 24, 1982. The Team discussed concrete items concerning the implementation of the requested technical cooperation with the relevant authorities of the Bolivian Government. As a result, the Team signed "the Record of Discussions (R/D) on the Japanese Technical Cooperation for the Project on the Institute of Economic Geology, San Andres University," and "the Tentative Schedule of Implementation for the Project" (T/S).

### 3. IMPLEMENTATION OF THE PROJECT

It was provided for in the R/D that the technical cooperation for the Project should be effected for five (5) years from May 20, 1982 to May 19, 1987, but that there would be a general review by the Steering Committee on the progress of the implementation of the Project after three (3) years from the commencement of the cooperation, to decide if the cooperation should be continued for two (2) more years.

Since the Project commenced, Japan dispatched the Mutual Consultation Team in October 1983, the Technical Guidance Team in July 1984, and the Mutual Consultation Team in August 1985 to study the progress and problematic points of the Project in order that subsequent implementation programs could be modified as required.

The Mutual Consultation Team was dispatched in August 1985 at the time of completion of the first three years of cooperation. It summarized the states of progress in the cooperation at this interim point, and drew up the cooperation program for the next two (2) years, as described below:

#### 3-1 Status of Technical Transfer

The period of about a year after the conclusion of the R/D was applied to those activities which placed top priority to improvement of the bases for the Project. As main machinery and equipment were installed one after another, technical transfer of diversified research methods was steadily carried out by means of effective utilization of these machines and equipment. The machinery and equipment granted in fiscal 82 and 83 amounted to approximately ¥230 million (in CIF), being one of the forms of cooperation most ideal for the Latin America. It was expected that, when the counterpart personnel fully mastered the methods of utilizing such machinery and equipment, the research and development capability in this field would be enhanced to an extreme extent and the significance and the effect of the technical cooperation would be maximized.

Technical transfer in the field of economic geology was characterized by the fact that techniques would be transferred in a limited manner if their theoretical phases alone were treated. Extreme importance was attached in this field to O.J.T. which should be combined with practical exercises at sites such as field surveys. With this in mind, technical transfer was carried out by selecting themes for respective research fields and by adopting basic research methods such as data-analyzing methods which utilized data obtained through field surveys.

##### 3-1-1 Concentrated lectures and practical training

Lectures which applied to all of the counterpart personnel included methods for identifying minerals, for observing and interpreting structures of ores and stones, and for analyzing them using principal measuring instruments, as well as introduction to theories of mineral balance, isotopic geochemistry, petrology, and clay mineralogy as required for implementation of economic geology.

Concentrated laboratory instruction was also given, in principle, to all of

the counterpart personnel, covering wet chemical analyses, methods for utilizing a simple balance and a water distiller, and practical exercises related to developing photographs. Concentrated practical exercises were also given in microscopic observation, atomic absorption analyses, fluorescence x-ray analyses, x-ray diffraction, and thermal analyses.

### 3-1-2 Instructions on field surveys

Field surveys which included mine surveys were frequently made. Since Japanese experts had never experienced the Bolivian type of ore deposits, they surveyed the deposits only in a rough manner.

In 1984 when the research in cooperation was started, technical transfer was begun covering such basic techniques as route-mapping, sampling, and simplified surveying methods in field surveys.

### 3-1-3 Research in cooperation

In 1983, the Institute of Economic Geology selected San Jose Mine as an objective of its own research project. On the other hand, Japanese Expert Team had forecasted that much time would be consumed that year in moving to and arrangement of the new buildings of the Institute, in delivery, installation, and adjustment of granted machinery and equipment, and in lectures and practical exercises. It decided not to take charge of any part of the project, but rather to give as much assistance to the counterparts as possible. When the Team decided to take positive part in the research project from January 1984 on, and presented the counterparts such research themes as alteration of country rocks, accessory minerals in injected igneous rocks, and sulfur isotopes, the counterparts accepted the themes presented and selected concrete fields for respective themes. Therefore, a group composed of a Japanese expert and a Bolivian counterpart was designated for each of the themes and began its research activities appropriately. Such activities were effected under the name of research in cooperation, but in practice, they took the form of research instruction given by the experts. It was expected, however, that economic geologists would be established in Bolivia through this type of research and that granted machinery and equipment would be utilized more effectively in accordance with their acquisition of the proper research techniques.

## 3-2 Bolivian System for Implementing the Project

### 3-2-1 Organization

On May 26, 1984, the Geology Section of the Faculty of Science at San Andres University was renamed to the Faculty of Geology, and the Project was implemented under this new organization. The Faculty of Geology was composed of two courses of study, namely, academic and research courses. The research course was consolidated into the Geological Research Center (CIG). Teaching staff in the academic course engaged primarily in the education of students, but although in the research course the staff also took charge of educating students (such as giving lectures) in addition to their own research activities. The Institute of Economic Geology belonged to the

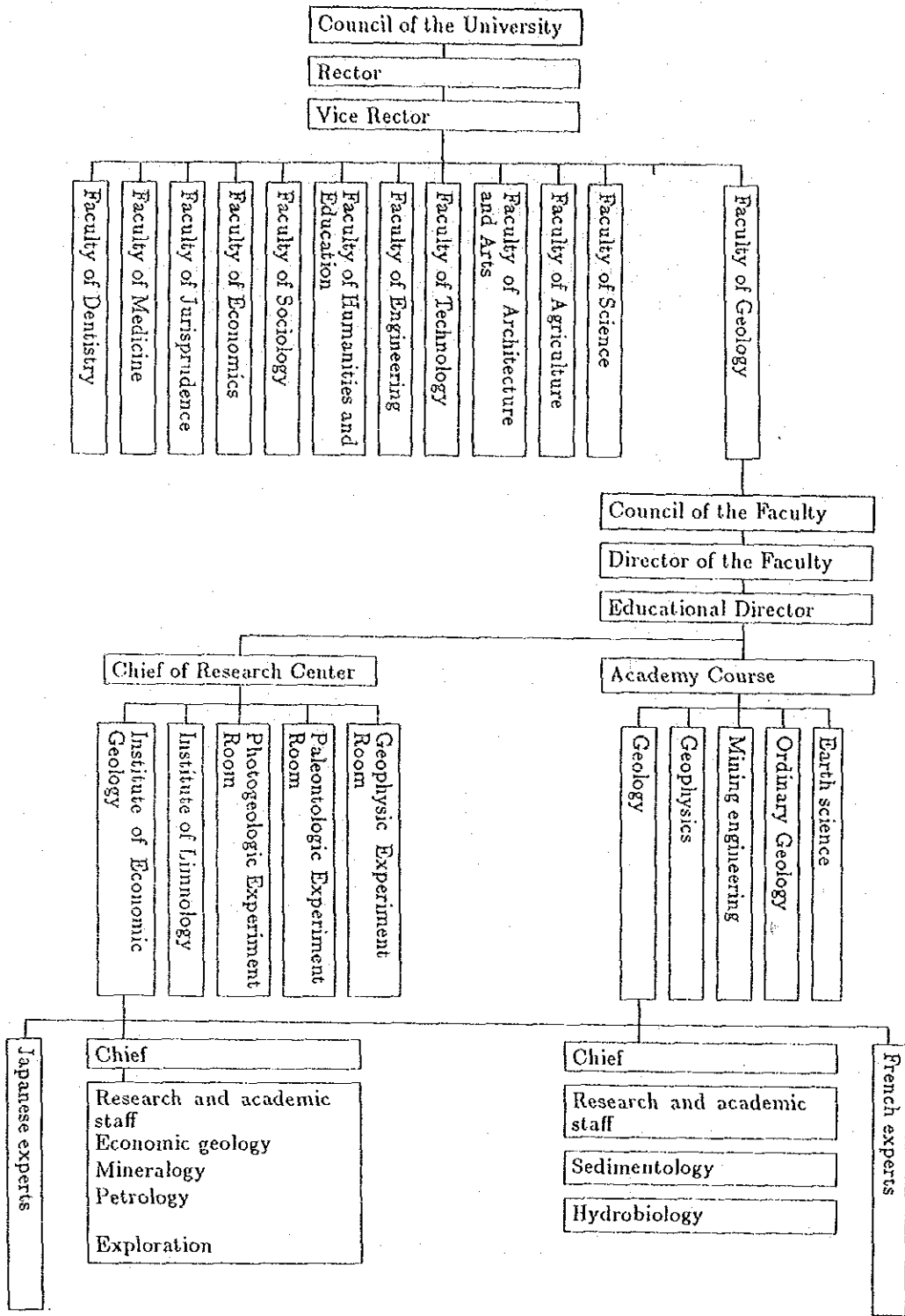
CIG. (See Fig. 1.)

The main staff of San Andres University (UMSA) as of August 1985 are shown below:

Rector of the UMSA:	Lic. Pablo Ramos Sanchez
Vice Rector of the UMSA:	Dr. Rolando Costa Arduz
Director of Faculty of Geology:	Ing. Fernando Blanco V.
Educational Director:	Ing. Antonio Saavedra M.
Chief of the Institute of Economic Geology:	Ing. Hugo Alarcon B.
No. of research staff:	10 (five professors and five assistants)
No. of clerk staff:	5 (one each of secretary, draftsman, artisan, chauffeur, and servant)



Fig.1 Organizational Chart of San Andres University



### 3-3 Interim Evaluation

It was agreed in the R/D, as signed in May 1982, that there would be a general review by the Steering Committee on the progress of the implementation of the Project after three (3) years from the commencement of the cooperation so that the Committee might decide whether or not the cooperation should be continued for two (2) more years.

In August 1985, JICA dispatched the Mutual Consultation Team headed by Prof. Sugaki of Tohoku University in accordance with the agreement cited above. The interim evaluation of the Project and the results of the Project expedition effected by the Team are summarized as follows:

The technical transfer was being effected in the following three styles, and it seemed that the Project had been producing excellent results which would lead to meeting of the initial objectives of the Project.

- 1) Concentrated lectures and practical exercises applied to all the counterparts
- 2) Instruction on field surveys including mine surveys
- 3) Research instruction in a man-to-man system

Although there were many guidelines with which degrees of progress in technical transfer could be measured, this report adopted the following four items:

- 1) Counterpart personnel have acquired the capabilities to discover research themes for themselves and to solve the problems concerned thereto.
- 2) They could complete scientific papers.
- 3) They could fully utilize and maintain machinery and equipment which had been granted.
- 4) Educational materials have been fully arranged in order.

Among these four factors, the items 3) and 4) had made sufficient progress, and it was expected that these two items would be satisfied in the subsequent cooperation period of about two years. Item 1) depended largely upon abilities inherent to researchers. The present researchers possessed sufficient abilities and strong enthusiasm, and therefore the goal of item 1) was expected to be reached. When referring to item 2) above, it was most preferable that the counterparts would acquire the ability to complete papers as a result of item 1), and it was expected that they would fulfill this expectation.

The Bolivian side had reinforced the counterpart personnel in spite of stringent financial status, and it had decided to give top priority to the budget for constructing a garage. It appeared, therefore, that the importance of the Project had been rapidly understood among the parties concerned in the country.

It was estimated that, among others, the promotion of the conventional Section of Geology, in the Faculty of Science, to the Faculty of Geology in May 1984 represented one of the evidences of the University's understanding of the Project.

It had been judged, based on the state of activities to date, that a maximum degree of technical transfer would be carried out, if the Project made progress as programmed in the remaining cooperation period (about two years). As a result of the discussion in the Steering Committee, both parties confirmed that the Project period should be continued for two more years.

The following three plans were expected to be implemented after the Project was completed:

- 1) To dispatch an expert as necessity arises
- 2) To extend the period of cooperation
- 3) To effect third-party training.

The Project had no objectives in terms of time or volume, for example, how many technicians should be trained in what fields during how many years. Since the aim was to bring up researchers rather than to train technicians, it would be necessary for the counterpart personnel to continue their efforts.

At the same time, one of the basic characteristics of the Project was "joint research activities in which practical instructions and recommendations are incorporated."

It was preferable, therefore, that joint research themes should be established in a more concrete manner based on the results of the cooperation to date, if the cooperation period be extended as seen in the items 1) and 2) above. When taking the functions in the Latin America, international relationship, and economic status of Bolivia into consideration, it appeared rather difficult to realize item 3) as far as the present status was concerned.

## 4. EVALUATION OF THE PROJECT

### 4-1 Evaluation Methods

The ultimate object of the Project lay in improvement of the basic research levels of economic geology in Bolivia, and it was expected, therefore, that such improvement would build up a sound foundation for developing the ability to exploit and utilize the mineral resources of Bolivia, one of the world's richest countries in terms of resources. This means that the Project was rather different qualitatively from other ordinary overseas center projects and that it could be hardly evaluated quantitatively in a short period.

In order to make such a qualitative evaluation in as objective a way as possible, the evaluation items as shown below should be reviewed so that the Project might be fully summarized by evaluating the contribution of the whole Project to the Republic of Bolivia:

- 1) Comparison between initial plan and actual implementation
  - a. Evaluation of the actual investments in the Project
  - b. Evaluation of the practical activities in the Project
  - c. Evaluation of the degree of goals attained in the instruction items and of utilization of machinery and equipment
- 2) Evaluation of the implementing and administering systems

### 4-2 Comparison between Initial Plan and Actual Implementation

#### 4-2-1 Evaluation of the actual implementation in the Project

Dispatching of experts, acceptance of counterparts' training, grant of machinery and equipment, and dispatching of the survey teams for the Project were implemented as agreed in the R/D.

The Steering Committee, which was held while the Survey Team for evaluating the Project was staying in Bolivia, confirmed that the duties of the Japanese for cooperation in the Project had been fully carried out, and the minutes of the Committee expressly indicate this fact.

#### 4-2-2 Evaluation of the practical activities in the Project

The practical activities of the Project were divided into the following six categories: 1) lectures, 2) instructions on experiments, 3) practical survey, 4) announcement at academic conferences, 5) open announcement of researches, and 6) publication of printed matter including pamphlets and research results.

The basic program which was set up at the initial stage of the Project aimed at raising the level of Bolivian economic geology to one equivalent to that of students completing masters' courses in postgraduate school in Japan, by repeating attempts for improving techniques and giving instructions on researches under the main framework of items 1), 2), and 3) within the cooperation period.

When reviewing the results of the Project, however, it might be said without exaggeration that items 1), 2), and 3) had progressed as programmed and that the Project had already grown into advanced stages of research activities as described in

items 4), 5), and 6). In other words, the Institute had grown to an ideal stage of development for an institute of this kind. Although this might be said to be a natural result of the development of research instructions, this has surpassed the objectives of the initial program. So, the present status should be largely evaluated as a result of the combined efforts of the counterpart personnel as well as the experts.

When referring to item 6) above, attention should be paid to the following fact. Namely, a few research results attained by Bolivian people in the field of geology as a whole, including economic geology, had been printed and published by 1976, but the publication was brought to a standstill as a result of subsequent political changes and abnormal economic recession. At the same time, government organizations such as the Institute of Geology as well as universities had suspended purchases of foreign documents since then. Under these circumstances, the fact that research results acquired by Bolivian researches were printed and published through the Bolivian research organization under the cooperation of the Project is now received among the Bolivian people with an expression of "a satisfactory event during these ten years."

It is clear, on the other hand, that objectives of research activities should be endless in theory and that the operations of an institute could make more contribution to the society when they are continued. It is expected in this sense that the Institute of Economic Geology will operate actively enough to be highly valued on the international level. To attain this goal, the organization of the Institute should be maintained through its own efforts, and there should be created an environment in which the counterpart personnel will obtain doctorates one after another. It should be added that, as far as the present counterparts are evaluated, at least two counterparts have grown up to a level in which they may complete papers for their doctorate in the near future.

#### 4-2-3 Evaluation of degrees of goals attained in the instruction items and of utilization of machinery and equipment

The degrees of goals arrived at in the instruction items and the counterparts' capabilities were evaluated in a manner which was first attempted by the Technical Guidance Team (in July 1984) then followed by the Mutual Consultation Team (in August 1985).

This report effected comparison and review based on these three past evaluation results. It was found from these results that both degrees of goals attained and of machinery utilized had been improved, though little by little. Since the experts were dispatched one after another, the degrees were evaluated at different times by different experts. However, the fact that the technical transfer as a whole had been relatively improved will indicate that the degrees had been evaluated with a certain degree of objectivity, though it was rather natural.

The contents of the degrees of goals thus attained were commented upon as follows:

- 1) At least one counterpart who received a higher rank, namely, A or B was found in most of the instruction items. This indicated a possibility that, if the counterparts cooperated with each other while the Japanese experts were absent, the main tenor of the Project would continue to develop.
- 2) Some instruction items reached approximately the middle point of development. An example of this was experimental research using a (scanning) electron microscope which arrived at Bolivia in July 1986. The problem was due to the fact that it had taken a much longer time than expected in adjustment for observation at high magnification as a result of trouble encountered at the time of delivering the same. Since the microscope then operated in a normal manner, it was expected that a lecture for all the counterparts would be held soon. Moreover, some counterparts who had been trained in Japan had acquired techniques with this kind of devices in Japanese universities, and if they understood some differences in models of the devices, they would certainly improve the technical level. Thus, there were really no special problems at all.
- 3) The level was still low regarding the instruction item on mass analysis. This was caused mainly by the fact a) that the instrument was partially damaged in a power failure and b) that continuous experiments were prevented over a long period by great difficulty with the local procurement of liquefied nitrogen, a requisite for operation of the instrument because of production plant slowdowns due to abrupt aggravation of the economic situations. Concerning the cause (a) above, the Machinery Repair Team was dispatched in October 1985 to make temporary repairs and this problem had been basically solved by incorporating a safety circuit in the instrument and by supplying spare parts. Concerning the cause (b), a sign of improvement in production had appeared at the manufacturers, and it was then probable that liquefied nitrogen might be procured in one or two months after placing an order, by paying about ten times higher values than in Japan. This means that certain budget allocations were required. Outlined instructions on operation of the instrument had been given for about one year from January 1984. Since it was certain that the instrument for mass analysis would require more advanced techniques than any of the machines and equipment granted, in terms of the principles, operations, and interpretation of the measurement results, it was desirable that the problem of procurement of liquefied nitrogen as consumable goods should be favorably solved so that re-education might be repeated during the remaining period of the cooperation.

### 4-3 Evaluation of the Implementing and Administering Systems

#### 4-3-1 Positioning of the Project in the organization of the Institute of Economic Geology

When the R/D was concluded, the project site was positioned at the Institute attached to the Section of Geology, in the Faculty of Science at San Andres University. The R/D contemplated a system in which counterparts would not only teach students in the Section but also would engage in research activities as members of the Institute.

As the cooperation became more and more active, and as the machines and equipment, as granted, arrived one after another at the Institute, however, the concept of the Japanese cooperation prevailing among the leaders of the University underwent an abrupt change. The scale of the machinery and equipment granted under the Japanese cooperation was far larger than that in the Sections of Physics or Chemistry which belonged to the same Faculty of Science. So, it was no longer possible to leave the Institute attached to the Section of Geology, and in May 1984, the Council of the University separated the Section of Geology from the Faculty of Science and promoted it to an organization of the Faculty of Geology. An example in which geology composes a faculty of a university rather than a section is found in the U.S.S.R. which is one of the largest countries with rich mineral resources. But it is certainly a rare example.

This fact demonstrated the evaluation of the Project by the Bolivian side, based on their sincere gratitude to Japan. Similar reactions of the Bolivian side were found in other examples. One of them was seen in the fact that in July 1984 the San Andres University conferred a title of emeritus professor to then Prof. Asahiko Sugaki, Tohoku University who was one of the organizers of the Project and who had often visited the project site as short-term expert and leader of the survey teams.

#### 4-3-2 Bolivian cooperation as to facilities

One of the measures to be taken by the Bolivian side in implementing the Project was to assure a lot of land for the Institute of Economic Geology and to construct its buildings and ancillary facilities.

Although there were no special problems in assuring the land, a variety of problems arose as to the buildings and the ancillary facilities.

The buildings were initially planned to be used as an institute covering all the fields related to earth science, but the construction work did not make progress as programmed. In response to Japan's repeated requests, only the exterior work was completed in March 1984. However, both power and water supply work started after the completion of the exterior work. In spite of Japan's repeated requests, the work was delayed so much that the construction work was only completed through running it up under the assistance of the Japanese experts by the time the granted machinery and equipment arrived at the site.

The construction work of the ancillary facilities was confronted with more severe difficulties. For instance, telephone facilities to the Institute of Economic Geology had not been installed at all, because of expensive costs. Regarding the construction of a garage for survey jeeps, the Bolivian side had often promised to construct it at an early date in response to the earnest request by the Survey Team. The actuality was that it was postponed month after month and a garage with a simplified structure was only completed at the end of April 1985, leaving just a year before the project term came to an end. Corrugated slate was used for roofing. Many of the experiment rooms had no ceilings under the slate roof. Since the precision instruments were subjected to rainwater leaking through the roof and to dust and dirt, it was important that the experiment rooms be improved. Although the Bolivian side admitted this fact and promised to start improvement work, it had not yet started.

The above-mentioned problems are all economic matters, and it was apparent that they had been caused by the economic rupture in Bolivia which proceeded at a high pace after the conclusion of the R/D, and to the ultra inflation following it. The University demonstrated its intention to cooperate with us by making maximum efforts to construct the buildings and the garage while it was in arrear with monthly payments to its staff. We should appreciate this fact.

#### 4-3-3 Stationing the counterpart personnel

It was agreed in the R/D that at least three counterparts should be stationed as full-time researchers in each field of experts (economic geology, mineralogy, and petrology).

The number of the counterpart personnel was five at the time when the Project started functioning. It was increased to six in February 1983, to seven and eight thereafter, and finally to ten in May 1985. In April 1986, a counterpart was transferred to another organization, so the number is nine since then. This indicates that the minimum requirements of nine counterparts have been respected and observed.

When reviewing the whole cooperation period, a total of 14 counterparts were stationed in the Institute, and five out of these had been transferred on the way. Most of them were academically enthusiastic and were interested in the research activities of the Institute. Since most of the transferred counterparts could not make a living under the excessively inflationary economy, they were compelled to find posts in foreign enterprises or overseas countries at which higher incomes were assured.

Apart from economic reasons, political changes (such as a power change or coup d'etat) happened frequently in Bolivia. It was customary that, when a political change happened, senior staff was changed and their inferiors lost their posts. Judging from the labor situations in Bolivia, the ratio of the counterparts fixed to the Institute will be highly valued.

It was rather regrettable that the ratio of young counterparts was low, as they were the direct object of the technical transfer. The age of the present nine counterparts ranged from 32 to 51, with the average being 43.6. (The composition was one in his fifties, six in their forties, and two in their thirties.) The following two factors may be pointed out as background for this fact:

- 1) The counterparts were not only research workers of the Institute but also teachers in the Faculty of Geology, engaging in education. This means that the counterparts were selected as a personnel matter regarding teachers in the Faculty and were determined through discussions in the complicated organizational systems of the University. With this in mind, the Japanese side did nothing more than express its desires and refrained from interfering with their decisions.



- 2) When the posts of counterparts were increased or refilled, they were offered for public application. Many applied for the posts, since the Institute of Economic Geology had gradually gained fame. As a result, the University was compelled to adopt aged applicants with excellent experience and high-sounding titles, not being able to give priority to younger persons. Applicants with high-sounding titles means a former president of a mining public corporation or a former president of a mineral exploration fund.

The fact that the counterparts were both research workers and teachers is similar to the teachers in Japanese universities, and this was well known when the Project started. This means that, as the Japanese experts give technical instructions directly to the counterparts, the education of the counterparts to their students is expected to change qualitatively, while the essence of the cooperation will be indirectly transferred to fresh students year after year. In actuality, some counterparts have started their new lectures making full use of the machinery and equipment granted. It is indeed certain that the effect of the Project is far-reaching, but it will take much time until such an effect becomes visible.

#### 4-3-4 Acceptance of counterparts for training

Counterparts were accepted for training as programmed, and some of them are still under way.

When returning to Bolivia after receiving long-term training in Japan, some of the counterparts reported the results of their training courses in their seminars or open research meetings. This is said to strengthen academic competition among the counterparts and to promote mutual enlightenment. More effects will be found in the fact that the below-mentioned actualities have been comprehended through the training courses.

- 1) The scale of those machinery, equipment, and other facilities which had been installed in the Project site was superior to that of the average of faculties of geology in Japanese universities, and that they were modern and sophisticated.
- 2) The research systems prevailing in Japan were not so particular. The Bolivian system in which research workers were allowed to freely entrust jobs to secretaries, typists, drawers, and other workers is far more favorable than the Japanese one.
- 3) Teachers in Japanese universities devote themselves to research work in a slow but steady manner while engaging in education and in experiments by themselves and being busy at meetings and miscellaneous affairs.
- 4) The Bolivian counterparts were deeply oriented when they were in direct contact with Japanese postgraduate students who work hard late at night.
- 5) The counterparts could apply advice and ideas, which they gained in their research work during their stay in Japan, to their own work in the Institute which was equipped with sufficient machines and facilities.

On the other hand, a Rector and two Directors of Faculty were accepted for short-term training. Among others, the fact that the Rector was treated as a high-grade counterpart produced more excellent effects than had been expected.

The Rector, who had been said to be a pure supporter of communism and not to have any favorable thoughts to capitalistic countries, became an enthusiastic sympathizer for Japan when he returned home. At the same time, he came to show deep understanding of the Project, and he gave top priority when solving a variety of troubles which occurred as to the Project. Similar effects were found in the case with the Director of Faculty of Geology who was accepted as semi-high-grade trainee in March 1986. Later he earnestly requested Japan to extend the cooperation period for the Project, and then he came to formulate a plan to develop the Institute into a training center for Latin America. The other semi-high-grade trainee (who was then the Director of the Education Dept. and was accepted as trainee in October 1982) was transferred, after he returned home, to an overseas post as a result of personnel contention among the leaders of the University. Unfortunately, he failed to bring about any direct effects in the Project.

#### 4-4 Measures to Be Taken

When considering the present state of the Project, it was preferable that Japan should dispatch: four short-term experts for a term of about two months towards the end of the cooperation period of which about a half year was then left, and an equipment maintenance team which should be composed of one or two engineers at the same time. To realize their dispatch, it was necessary that budget allocations be made to cover emergency replacement and consumption materials and printing expenses.

The reasons are described as follows:

- 1) Three out of the present four experts would complete their term of office by March to April 1987, and it appeared to be impossible to extend their terms. This means that only one expert would stay in Bolivia toward the end of the cooperation period (which ends on May 19, 1987).
- 2) The Bolivian side as well as the JICA local office and the Embassy had earnestly requested a closing ceremony to be held together with the final seminar to commemorate the end of the Project. It was understood that this was an effective means to assure public relations of the Project and to promote self-assisting efforts in the Bolivian side in the future.
- 3) When referring to the technical transfer, there were a few items for which the objectives had not yet been fully satisfied. They were, however, expected to be satisfied if short-term experts are dispatched to give cooperation till the end of the period.

- 4) Some of the granted machinery and equipment had displayed new trouble. This seemed to have been caused by age deterioration and to the special working conditions involving high altitudes. An example of this was the degree of vacuum in the Guinier-Johansson camera. All the machines and equipment as well as the stock of spare parts were presently being rechecked at the project site. It was advisable that all machines and equipment be adjusted at least by the time when the Project was completed so that they might be handed over to the recipient country in an ideal state.
- 5) Favorable effects had been found increasingly in the research activities of the counterparts. If all the results of their research continued to date were consolidated in printed form, such printed matter would demonstrate the actual efforts of the Institute and would act as spiritual support for the future activities of the Institute.

#### 4-5 Problems Left Unsolved at the Time of Completion of the Project

The Project was to end on May 19, 1987 as planned. Any problems which might be left unsolved after the completion of the Project were suggested in the section that follows:

Dr. Alcazav, Vice Rector of San Andres University extended his whole-hearted gratitude to the JICA Evaluation Team for the substantial assistance of the Japanese Government over a long period. He described the relationship between Japan and Bolivia as similar to that of a mother and her child. He spoke sincerely to the Team of his desire that the child would follow a way of independence in accordance with its parent's suggestions and that if the child were to be confronted with problems, he hoped for parent would help, protect at any time, and never sever the close relationship.

As clearly shown in the minutes of the Evaluation Team, the managing authorities of San Andres University promised that the techniques and knowledge transferred from Japan, and the machines and equipment granted, would be fully utilized in the Institute of Economic Geology and further that they would develop research activities so that the Institute might be an academic center for economic geology in Latin America in the future.

Maintaining and developing the Institute of Economic Geology by means of their own self-assisting efforts, however, would never be simple or easy. The following two themes were then regarded as problematic points:

The first is the matter of dispersion of the machines and equipment. While every other field of the University suffered from extreme shortage of machines and instruments, the Institute was equipped with extraordinary amounts of them. There had, therefore, been strong insistence on a so-called "equal distribution of profits" i.e. that they should be dispersed equally throughout the University. The other point was the burden of local costs. This was a matter of how to assure the availability of funds for expenses which would be required for continuing research activities.

The following suggestions would be given to address these problems, and the Rector, counterparts, and other parties concerned had been given explanations on the same. Namely, regarding the first point, the implementation of the Project was first programmed in accordance with the earnest requests of San Andres University and was realized because the Bolivian Government formally requested it from the Japanese Government. Should the machines and equipment be dispersed as soon as the Japanese cooperation for the Project comes to an end, it would clearly run counter to the spirit of the request and would exercise significant influence upon the whole of Japanese cooperation in projects with Bolivia in the future. It was desirable that the tenor and the process regarding the construction of the Institute of Economic Geology never be forgotten and that the leaders of the University would never spare effort to make their promises clear. Furthermore, it was important that these be treated as consensus within and outside of the University both. When referring to the second point, Japan had granted spare parts and consumable parts related to the machines and equipment directly so that they might be operated for a few years, and so the research activities would not be hindered as soon as the cooperation period is completed. However, the matter of local cost was basically a problem related to the counterparts themselves, and it was important that all the counterparts should discuss the matter at any relevant time to devise an appropriate policy. For example, a policy to accept entrusted, joint, or requested research and tests from governmental authorities and to receive their expenses as income of the University would deserve discussion, and this was suggested to the counterparts. This did not only produce funds for research by itself but also helped spread the techniques and knowledge of the Institute to the society.

It was earnestly desired by all the parties concerned that the Institute of Economic Geology would be maintained and developed after the Project was completed. In two or three years new problems with different styles would arise in the interior of the Institute. They might include the introduction of newer technology and repair of the present machines and equipment, and replenishment of parts and consumable items. It was expected, therefore, that JICA would dispatch a post-project survey team so that aid for aftercare might be given to them.



## **APPENDICES**

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- 2. List of Main Machinery and Equipment Granted ..... 35**



## 1. The Record of Discussions (R/D)

The Record of Discussions between the Japanese  
Implementation Survey Team and the Authorities Concerned  
of the Government of the Republic of Bolivia  
on the Japanese Technical Cooperation for the Project  
on the Institute of Economic Geology, San Andres University

The Japanese Implementation Survey Team (hereinafter referred to as "the Team") organized by the Japan International Cooperation Agency (hereinafter referred to as JICA) and headed by Dr. Asahiko SUGAKI, Professor, Faculty of Science, Tohoku University, visited the Republic of Bolivia from May 11th, 1982 to May 21st, 1982 for the purpose of working out the details of the technical cooperation program concerning the Institute of Economic Geology, San Andres University Project in the Republic of Bolivia.

During its stay in the Republic of Bolivia, the Team exchanged views and had a series of discussions with the Bolivian Authorities concerned in respect of the desirable measures to be taken by both Governments for the successful implementation of the above-mentioned Project.

As a result of the discussions, the Team and the Bolivian authorities concerned agreed to recommend to their respective Governments the matters referred to in the document attached hereto, taking account of the provisions of the "ACUERDO SOBRE COOPERACION TECNICA ENTRE EL GOBIERNO DEL JAPON Y EL GOBIERNO DE LA REPUBLICA DE BOLIVIA".

La Paz, May 20, 1982

Dr. Asahiko SUGAKI  
Head of the Japanese Implementation  
Survey Team

Dr. Gastón Ponce Caballero  
Director of the Investigation and Extension  
División of UMSA (for Rector of UMSA)

Ing. Orlando Sanjines V.  
Director of the Institute  
of the Economic Geology of UMSA

Ing. Raúl Bascón  
Director of Investigation División  
of UMSA



## THE ATTACHED DOCUMENT

### I. COOPERATION BETWEEN BOTH GOVERNMENTS

1. The Government of Japan and the Government of the Republic of Bolivia will cooperate with each other in implementing the Project on the Institute of Economic Geology, San Andres University (hereinafter referred to as "the Project") for the purpose of training Bolivian investigators and other researchers who will be able to carry out theoretical and practical research activities in the field of Economic Geology thereby contributing to the development of the said field in the Republic of Bolivia.
2. The Project will be implemented in accordance with the Master Plan which is given in Annex I.

### II. DISPATCH OF JAPANESE EXPERTS

1. In accordance with the laws and regulations in force in Japan, the government of Japan will take necessary measures through JICA to provide at its own expense services of the Japanese experts as listed in Annex II through the normal procedures under the Technical Cooperation Scheme of the Government of Japan.
2. The Japanese experts referred to in 1 above and their families will be granted in the Republic of Bolivia the privileges, exemptions and benefits as listed in Annex III, which are no less favourable than those granted to experts to third countries or international organizations performing similar missions.

### III. PROVISION OF MACHINERY AND EQUIPMENT

1. In accordance with the laws and regulations in force in Japan, the Government of Japan will take necessary measures through JICA to provide at its own expense such machinery, equipment and other materials necessary for the implementation of the Project as listed in Annex IV, through the normal procedures under the Technical Cooperation Scheme of the Government of Japan.
2. The articles referred to in 1 above will become the property of the Government of the Republic of Bolivia upon being delivered c.i.f. to the Bolivian authorities concerned at the ports and/or airports of disembarkation, and will be utilized exclusively for the implementation of the Project in consultation with the Japanese experts referred to in Annex II.

#### **IV. TRAINING OF BOLIVIAN PERSONNEL IN JAPAN**

1. In accordance with the laws and regulations in force in Japan, the Government of Japan will take necessary measures through JICA to receive at its own expense the Bolivian personnel connected with the Project for technical training in Japan through the normal procedures under the Technical Cooperation Scheme of the Government of Japan.
2. The Government of the Republic of Bolivia will take necessary measures to ensure that the knowledge and experience acquired by the Bolivian personnel from technical training in Japan will be utilized effectively for the implementation of the Project.

#### **V. SERVICES OF BOLIVIAN COUNTERPART PERSONNEL AND ADMINISTRATIVE PERSONNEL**

1. In accordance with the laws and regulations in force in the Republic of Bolivia, the Government of the Republic of Bolivia will take necessary measures to secure at its own expense necessary services of Bolivian counterpart personnel and administrative personnel as listed in Annex V.
2. As to the Bolivian counterpart personnel, the Government of the Republic of Bolivia will endeavor to allocate the necessary number of suitably qualified personnel corresponding to each Japanese expert to be dispatched by the Government of Japan as specified in Annex II, to fulfill the effective and successful transfer of technology under the Project.

#### **VI. MEASURES TO BE TAKEN BY THE GOVERNMENT OF THE REPUBLIC OF BOLIVIA**

1. In accordance with the laws and regulations in force in the Republic of Bolivia, the Government of the Republic of Bolivia will take necessary measures to provide at its own expense:
  - (1) Land, buildings and facilities as listed in Annex VI.
  - (2) Supply or replacement of machinery, equipment, instrument, vehicles, tolls, spare parts and any such materials necessary for the implementation of the Project as are not than those provided through JICA under III above;
  - (3) Transportation facilities and travel allowance for the Japanese experts for the official travel within the Republic of Bolivia;
  - (4) Suitable furnished accomodation for the Japanese experts and their families.
2. In accordance with the laws and regulations in force in the Republic of Bolivia, the Government of the Republic of Bolivia will take necessary measures to meet:
  - (1) Expenses necessary for the transportation within the Republic of Bolivia of the articles referred to in III above as well as for the installation, operation and maintenance thereof;

- (2) Customs duties, internal taxes and any other charges, imposed in the Republic of Bolivia on the articles referred to in III above;
- (3) All running expenses necessary for the implementation of the Project.

## VII. ADMINISTRATION OF THE PROJECT

1. The Rector of San Andres University (hereinafter referred to as "UMSA") will bear the overall responsibility for the implementation of the Project and the Director of the Institute of Economic Geology will be responsible for the administrative and managerial matters concerning the implementation of the Project.
2. The Japanese Chief Advisor will provide necessary technical and managerial advice on the Project to the Director of the Institute of Economic Geology and in consultation with the Director to the Rector of UMSA or any other persons as deemed necessary.  
The Japanese experts will give necessary technical guidance and advice to the Bolivian counterpart personnel.
3. For the effective and successful implementation of the Project the Steering Committee (hereinafter referred to as "the Committee") will be established as listed in Annex VII, and will be held when necessity arises. The functions of the Committee are as follows:
  - (1) To evaluate and formulate various plans concerning staff training and research activities of the Project,
  - (2) To review the implementation of the Project with particular reference to its budget and requests for technical experts, fellowships and equipments,
  - (3) To report to relevant authorities of the two countries progress on the implementation of the Project at all stages and at all levels, (4) To consult and treat with any other matters pertaining to the implementation of the Project.

## VIII. CLAIMS AGAINST JAPANESE EXPERTS

The Government of the Republic of Bolivia undertakes to bear claims, if any arises, against the Japanese experts engaged in the Project resulting from, occurring in the course of, or otherwise connected with the discharge of their official functions in the Republic of Bolivia except for those arising from the willful misconduct or gross negligence of the Japanese experts.

## **IX. MUTUAL CONSULTATION**

There will be mutual consultation between the two Governments on any major issues arising from or in connection with this Attached Document.

## **X. TERM OF COOPERATION**

The duration of the technical cooperation for the Project under this Attached document will be basically five (5) years from the date of signing of this Record of Discussions.

However, there will be a general review by the Committee on the progress of the implementation of the Project after three (3) years from the commencement of the cooperation taking account of measures to be taken by both governments in order to decide if the cooperation should be continued for two (2) more years.

- Annex I MASTER PLAN
- Annex II JAPANESE EXPERTS
- Annex III PRIVILEGES, EXEMPTIONS AND BENEFITS
- Annex IV LIST OF THE ARTICLES
- Annex V LIST OF BOLIVIAN STAFF
- Annex VI LIST OF LAND, BUILDINGS AND FACILITIES
- Annex VII MEMBERS OF THE STEERING COMMITTEE

## Annex 1 MASTER PLAN

1. The main purpose and function of the Project are to provide theoretical and practical training and research activities for the Bolivian Investigators in the Institute of Economic Geology who will take the initiative in the development of the Economic Geology field, especially the mechanism of ore formation, the forming conditions of mineral deposits and the geochemistry of ore solution etc., in the Republic of Bolivia.
2. Training and research fields are as follows:
  - (1) training for fundamental research methods of Economic Geology,
    - (a) Optical mineralogy (economic Geology, Mineralogy and Petrology),
      - to determine minerals and rocks by using a polarized microscope,
      - to identify ore minerals, observe ore textures and measure reflectivity and hardness by using an ore microscope with photometer and microhardness tester,
      - to determine the microstructure of minerals by using a scanning microscope,
      - to determine the physical property by using other optical apparatuses,
    - (b) X-ray and fluorescence analysis (Mineralogy and Economic Geology),
      - to identify minerals and determine crystal structures by using X-ray diffraction apparatuses,
      - to determine minor elements of minerals by using a X-ray fluorescence apparatus,
    - (c) wet chemical analysis (Petrology),
      - to analyze rocks about their chemical composition exactly,
      - to determine the chemical composition of rock forming minerals and ore minerals,
    - (d) Thermal and electro-magnetic analysis (economic Geology and Mineralogy),
      - to identify clay minerals by using an apparatus of thermal analysis,
      - to measure the sulfur isotope ratio of minerals and rocks by using a mass spectrometer,
    - (e) Liquid inclusion study (Economic Geology),
      - to estimate the forming temperature of minerals by using a heating stage,
      - to determine the composition of ore fluid by using a cooling stage,
  - (2) Basic researches on the Bolivian mineral deposits,
    - (a) Field surveys in the mining area (economic Geology, Mineralogy and Petrology),
      - surveying the regional surface geology and making the geological map,
      - surveying underground geology and making the underground geological map,
      - sampling rock and mineral specimens for researches,

- (b) Studies on the relation between mineralizations formed ore deposits and igneous activities (Petrology and Economic Geology),
  - studies of igneous activities in the regional area,
  - investigations on the igneous rock bodies related to the mineral deposits,
  - investigations of mineralization stages in geological age,
  - studies on sequence of mineralization and mineral zoning in the deposits,
  - studies on hydrothermal alteration of country rocks by mineralization,
- (c) Mineral paragenesis of ore minerals (Mineralogy and Economic Geology),
  - investigations of the mineral assemblage in the ores,
  - studies on ore textures and their intergrowths,
  - estimating the forming conditions of minerals,
- (d) The genesis of mineral deposits (Economic Geology and Mineralogy),
  - estimating the forming temperature of mineral deposits,
  - estimating the forming total pressure, and sulfur and oxygen fugacities of mineral deposits,
  - estimating the composition of ore fluid,
  - investigations of the mechanism of ore formation,
  - investigations of the origin of mineral deposits,
- (e) Prospecting methods by the standpoint of the genesis of mineral deposits (Economic Geology and Petrology).

Notes:

- 1) The fields of Japanese Experts are indicated in the brackets after each subject.
- 2) Activities of training and research as mentioned above will be carried out, in principle, starting from basic training stage and then converting to their application stage. It is anticipated that the basic training stage will take about two and a half years, i.e. the first half of this technical cooperation.

## Annex II JAPANESE EXPERTS

1. Chief Advisor
2. Experts on:
  - (1) Economic Geology
  - (2) Mineralogy
  - (3) Petrology
3. Short-term experts may be dispatched, as and when necessary, for the installation of equipment and machinery provided by the Government of Japan and for other purpose.
4. The Chief Advisor will be concurrently an expert in one of the fields mentioned above.

## Annex III PRIVILEGES, EXEMPTIONS AND BENEFITS

1. Exemptions from income tax and charges of any kind imposed on or in connection with the living allowance remitted from abroad.
2. Exemption from import and export duties and any other charges in respect of personel and household effects, including one motor vehicle per family, which may brought into the Republic of Bolivia from abroad.
3. Free medical services and facilities to the Japanese experts and their families.

#### Annex IV LIST OF THE ARTICLES

1. Machinery and equipment for optical mineralogy
2. Machinery and equipment for X-ray and fluorescence analysis
3. Machinery and equipment for wet chemical analysis
4. Machinery and equipment for thermal and electro-magnetical analysis
5. Machinery and equipment for liquid inclusion study
6. Machinery and equipment for field survey
7. Machinery and equipment for preparation of rock and mineral samples
8. Some other machinery and equipment to implementation of the Project.

#### Annex V LIST OF BOLIVIAN STAFF

1. Director
2. Permanent investigators on,
  - (1) Economic Geology
  - (2) Mineralogy
  - (3) Petrology
3. Technical staff
  - (1) Draftmen
  - (2) Sample preparators
4. Administrative staff
  - (1) Administrative officers
  - (2) Secretaries/typists
  - (3) Drivers
  - (4) Messengers
5. Other personnel mutually agreed upon as necessary

Note:

At least three (3) permanent investigators will be assigned for each field as listed in 2. above.



## **Annex VI LIST OF LAND, BUILDINGS AND FACILITIES**

1. Space of land and building necessary for the Project
2. Administration office
3. Director room
4. Chief advisor room
5. Rooms for Investigators and Experts
6. Laboratories
7. Lecture rooms
8. Others

## **Annex VII MEMBERS OF THE STEERING COMMITTEE**

1. Chairman:  
Rector of UMSA
2. Bolivian side:
  - (1) Vice-Rector of UMSA
  - (2) Director of the Investigation and Extension Division of UMSA
  - (3) Director of the Investigation Division of UMSA
  - (4) director of the Center of Geological Investigation
  - (5) Director of the Institute of economic Geology
3. Japanese side:
  - (1) Chief Advisor
  - (2) Experts designated by the Chief Advisor
  - (3) Representative of JICA

### **Note:**

Officials of the Embassy of Japan may attend the Steering Committee as observers.

TENTATIVE SCHEDULE OF IMPLEMENTATION FOR THE PROJECT  
ON THE INSTITUTE OF ECONOMIC GEOLOGY, SAN ANDRES UNIVERSITY

The Head of the Japanese Implementation survey Team and the Rector of the san andres University have jointly formulated the tentative schedule of implementation for the Project as annexed hereto.

This has been formulated in connection with the Attached Document of the Record of discussions signed between the Head of the Japanese Implementation survey Team and the Rector of the san Andres University concerned for the Project on the Institute of Economic Geology, San Andres University on conditions that necessary budget will be allocated for the implementation of the Project by both sides and that the schedule is subject to change within the framework of the Record of Discussions when necessity arises in the course of implementation of the Project.

La Paz, May 20, 1982

Dr. Asahiko SUGAKI  
Head of the Japanese Implementation  
Survey Team

Dr. Gastón Ponce Caballero  
Director of the Investigation and Extension  
División of UMSA (for Rector of UMSA)

Ing. Orlando Sanjines V.  
Director of the Institute  
of the Economic Geology of UMSA

Ing. Raúl Bascón  
Director of Investigation División  
of UMSA

### Tentative Schedule of Implementation

	1982 (fiscal year of Japan)	1983	1984	1985	1986	1987
Term of Cooperation	May					May
Long term						
Japanese experts						
Chief Advisor	Nov.					
Economic Geology						
Mineralogy						
Petrology						
Short term						
Japanese experts						
Machinery and equipment						
Counterparts' training in Japan				Several persons each year		
Services of Bolivian staff						
Director						
Investigators						
Draftman						
Sample preparator						

Note: This schedule is formulated tentatively on the assumption that necessary budget will be acquired. This schedule is subject to change within the scope of the "Record of discussions" in the future if necessity arises.

## 2. List of Main Machinery and Equipment Granted

The machinery and equipment under the Project amounted to ¥284,500 thousand and was granted over five years.

The List of machinery and equipment granted is shown below:

Name of machinery and equipment	Year granted	Amount
A. Microscopes and optical instruments		(thousand yen)
Polarized microscope	82	6,000
Microscope photographing unit, automatic, Nikon	82	1,000
Microscopic spectrophotometer, Life M PV-3	83	20,000
Microhardness meter, Akashi MVK-E	82	1,300
Universal stage, Life UT-4	82	1,700
Cooling/heating stage, Lincam TH-600, with a microscope	85	4,400
Scanning electron microscope, Nippon Denshi JSM-35CF	85	22,000
Polarized projector, Maruto CPV-300	82	3,000
Photo map reader, Nikon	82	3,000
B. X-ray diffraction and fluorescence X-ray analyzers		
X-ray generator, Rigaku 3 kW, 4056A3 (fluorescence)	82	8,700
X-ray generator, for camera, Rigaku 4012K x 2	82	17,800
X-ray spectroscope, Nippon Denshi, DDS	82	19,000
(Guinier-Johansson camera, Philips XDC-700)	82	3,000
(Weissenberg camera, Rigaku)	83	2,000
Precession camera, Rigaku	83	2,000
Comparator for monocrystal	83	1,000
Equipment for maintenance and inspection	83	2,000
C. Equipment for preparing samples		
Large rock cutter, HP16SS-P	82	1,200
Manual rock cutter, Maruto MC-305, x 2	82	2,380
Ore cutting/grinding unit	82	3,730
Rock surface grinder, Maruto ML-304 x 3	82	4,170

Name of machinery and equipment	Year granted	Amount
Preparatory grinder	82	1,970
Automatic grinder x 3	82	4,860
Iso-dynamic separator, Frantz	82	2,200
Vacuum depositor, Nippon Denshi JEE-4X	85	5,200
Vibro-polisher, Maruto ML-251	85	1,300
D. Survey equipment		
Small and medium-sized jeep	82, 83	3,800
E. Thermal analysis and electromagnetic analysis		
Thermobalance, Rigaku TG	82	4,500
Mass analyzer, VG-602E	82	23,680
SO <sub>2</sub> gas separator, VG-5050	82	11,000
SO <sub>2</sub> gas modification unit	82	9,000
F. Chemical analysis units		
Atomic absorption. flame spectrophotometer, Hitachi 180-30	82	6,500
Spectrophotometer, Hitachi 200-20	82	2,300
Emission spectrometer, Shimadzu GEW-170	82	23,000
Microphotometer, Sakura PDS-15	82	8,000
Diffraction grating photographer, Shimadzu GE-100	82	6,000
G. Educational and office equipment		
Electronic copying machine	82	2,000
Electric typewriter, IBM x 4	82,83,84	2,000
Microcomputer for scientific calculation, Apple II	82	2,000
H. Air-conditioning and power facilities		
Closed-type air conditioner	82	2,500
Stabilizer and transformer, x 6	82	7,200









JICA