

サウジアラビア王国  
非金属鉱物資源開発利用プロジェクト  
予備調査報告(案)

資 料

昭和51年5月14日

国際協力事業団

サウジ非金属プロジェクト予備調査団

国際協力事業団

受入 月日	'84. 4. 21	312
登録No.	03776	66.9
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### 非金属プロジェクト予備調査団行動経過

(3月27日～30日迄 地形図ミッション桑形久夫氏合流)

- |               |  |       |
|---------------|--|-------|
| 昭和57年3月24日(水) | 東京発  | カラチ着  |
| 26日(金)        | カラチ発   | ジエツダ着 |
| 27日(土)        | 日本大使館表敬、DGMR表敬および予備会談<br>(多田公使、徳永書記官同席)<br>サ側 アサド次官補、コロネット顧問 |       |
| 28日(日)        | USGS/DGMR 化学実験室、出版室、写真室、<br>コンピュータ室見学                        |       |
| 29日(月)        | 野外調査用車輛等借出手續 BRGM訪問  |       |
| 30日(火)        | 野外調査用キャンプ用品借出手續 USGS訪問                                       |       |
| 31日(水)        | DGMR地質部地質家達と懇談   |       |
| 4月3日(土)       | 出張準備   |       |
| 4日(日)         | サルタン次官を表敬、午後ジエツダ発 ラホ着  |       |
| 5～8日          | ラボ・ウスファン付近調査   |       |
| 9日(金)         | ジエツダ帰着   |       |
| 10日(土)        | 車輛・キャンプ用品等返納   |       |
| 11、12日        | 公式会談準備   |       |
| 13日(火)        | DGMR首脳と公式会談(多田公使同席)<br>サ側 サルタン次官、アフアナジマ局長、<br>コロネット顧問        |       |
| 14日(水)        | Minutes 製作、DGMRと協議   |       |
| 17日(土)        | Minutes 署名・交換  |       |

- 4月18日(日) 藤井・安藤 ジエツダ発リヤードへ
- 19日(月) 藤井・安藤 中央計画省アナニー官房長を訪問・  
概要を報告、  
同日夕方リヤード発カラチへ  
蓮田・橋本・渡辺はフライトの遅れで深夜ジエツダ  
発カラチへ、
- 20日(火) 藤井・安藤 バンコック着、他3人はカラチ着
- 21日(水) 藤井・安藤 バンコック発東京着  
他3人はカラチ発、22日早朝東京着

## 私契約による地質調査所専門家の派遣状況

年 月	派遣次	団長名	専門家内訳	備 考
1963年 9月 64年 65年 3月	第1次	奥海 靖	地質 ---- 3	地質 / は日産鉱業より出向
測量 ---- 2				
試錐 ---- 1				
65年 11月 66年 67年 5月	第2次	故 中沢次郎 平山 健	地質 ---- 3	
測量 ---- 2				
物探 ---- 1				
67年 11月 68年 5月 69年 5月	第3次	広川 治	地質 ---- 3	
地化学 ---- 1				
物探 ---- 1 測量 ---- 2				
70年 11月	第4次	広川 治	地質 ---- 3	
			地化学 ---- 2	
			測量 ---- 2	
71年 4月	代行 大沢 穰	代行 大沢 穰	地質 ---- 1	リ側 手続遅延のため、第5次 の派遣が遅れた。
			地化学 ---- 1	
			測量 ---- 1	
72年 73年 10月	第5次	奥海 靖	地質 ---- 3	
地化学 ---- 1 測量 ---- 1				
74年 75年 5月	第6次	藤井 紀之	地質 ---- 2	
地化学 ---- 1 測量 ---- 1				
75年 5月 77年 3月	第7次	平山次郎	地質 ---- 3	地質 / は日産探開より出向
地化学 ---- 1				

註 ----- 専門家内訳には団長を含む。

## Project Proposal of Technical Cooperation by Japan

## Name of Project

Technical Cooperation for exploitation and Utilization of Nonmetallic Minerals (Dispatch of Experts' Group)

## Outline of the Project

In order to render cooperation in the exploitation of nonmetallic minerals incorporated in the new five-year programme for the exploitation of mineral resources in Saudi Arabia in place of the cooperation which has heretofore been extended in the exploitation of mineral deposits, an experts' group (about 15 persons) consisting mainly of research officials of the Geological Survey of Japan (GS Japan), Agency of Industrial Science and Technology, Ministry of International Trade and Industry, will be dispatched to the Ministry of Petroleum and Mineral Resources in Saudi Arabia for a period of about three years.

This experts' group, taking comprehensive charge of about two of the areas of exploitation envisaged in the new five-year programme, will formulate programmes and carry out surveys on mineral deposit areas as well as the quality, and exploiting conditions of minerals usable as industrial resources. With a laboratory set up at an

appropriate place to study minerals usable as industrial resources, the experts' group will also examine possibilities of industrial utilization with mineral dressing and testing and file a report on their studies.

At the same time, Saudi Arabian experts will be accepted into Japan to contribute to an upgrading of the technical level of experts in Saudi Arabia in addition to the surveying of mineral deposit and also to testing and research work at the laboratory.

Incidentally, the experts will cover the sectors of geology, ceramic industry, chemistry, industrial chemistry, dressing, photogeometry and cartography, thin plate making, etc.

INVESTIGATION OF NONMETALLIC MINERAL RESOURCES  
(INDUSTRIAL RAW MATERIALS)

1. Background of this project

(1) The country of Saudi Arabia can be divided geologically into the shield-region of pre-Cambria system in the coast of the Red Sea and the surrounding sedimentary rock zone. Nonmetallic minerals are produced in both of these regions. In particular, a huge scale of deposits both in quantity and in quality is expected in the sedimentary rock zone.

Saudi Arabia has concentrated its effort on the investigation of metallic mineral resources among the mineral resources in addition to petroleum.

However, the Saudi Arabian government has decided to include the nonmetallic mineral deposits as one of the important objectives in the new five year plan prepared for resource investigation.

It can be considered that the Saudi Arabian government intends to apply the metallic mineral investigating engineers to the investigation of nonmetallic mineral resources.

(2) On the base of personal contract concluded between the Japanese specialists recommended by the Japanese government and the Saudi Arabian government, Japan has



cooperated in the investigation of the mineral resources in Saudi Arabia. It is said that this cooperation of Japan with Saudi Arabia in the investigation of mineral resources on the private contract base will be terminated on March of 1976.

Japanese government, however, considers that the mineral resources investigating technique of Japan and the quality and quantity of the Japanese specialists are ranked at the highest level even in the world.

It can be said, therefore, that if Japan continues its cooperation with Saudi Arabia in the investigation of mineral resources, it will certainly a large contribution to the exploitation program of the mineral resources of Saudi Arabia.

- (3) Judging from the above mentioned conditions, Japan has an intension to continue cooperation in the investigation of the nonmetallic mineral resources. We propose therefore that, this cooperation should be base on the governmental contract between the Japan and Saudi Arabia, not on the private contract between the Japanese specialists and Saudi Arabian government.

## 2. Objectives of this investigation

This investigation shall be promoted for realization of the objectives listed below.

- (1) To understand the quantity and quality of the nonmetallic

deposits in Saudi Arabia

- (2) To examine possibilities of the exploitation and utilization of nonmetallic minerals (including development of industries using nonmetallic minerals as raw material)
- (3) To improve the mineral resources investigation technique of Saudi Arabia

### 3. Contents of this investigation

The contents of the service of this investigation include the following three items.

- 1) Preliminary field investigation
- 2) Main field investigation
- 3) Training for Saudi Arabian engineers

Details of each item are as follows:

#### (1) Preliminary field investigation:

In the preliminary field investigation, arrangements will be made with the Saudi Arabian government relating to the scope of the main field investigation, and the range of cooperation of both Japan and Saudi Arabia, and on the actual method of the field investigation.

#### (2) Main field investigation

In the main field investigation, the following items will be examined and studied.

- 1) Selection of objective area and objective minerals;

Japanese government considers at present to take the civil engineering-use material, sub-objective material, and chemical industries material (including limestone, dolomite, magnesite, feldspar, fluorite ore, fire clay, silica sand, serpentite, halogen ore, boron ore, etc.) as the objectives of this investigation.

2) Geological survey on the objective area

3) Detailed survey of the objective area

- Investigation of quantity of ore
- Investigation of quality of ore

4) Survey on exploitation of objective area

- Investigation of mining conditions
- Ore dressing in laboratory
- Examination of possibility of utilization as industrial material through utilization test

(3) Training of Saudi Arabian engineers

In the item (2) above, the Japanese specialists will also perform technical training on the engineers nominated by the Saudi Arabian government. The engineers of Saudi Arabia may be trained in a proper facilities in Japan for training of mineral resources investigation technique.

4. Execution method of this investigation and its schedule

(1) Japanese government will dispatch preliminary investigation team to Saudi Arabia on June 1976 for about

two months for the purpose of performing negotiation with the Saudi Arabia side on this investigation project. The preliminary investigation team will talk with the Saudi Arabian government over the scope of the main field investigation, actual method of execution and the range of cooperation between Japan and Saudi Arabia.

- (2) Japanese government and Saudi Arabian government will examine the results of the preliminary investigation, and conclude a contract that specifies the outline of the main investigation, the measures to be taken by Japanese government and shares of the Saudi Arabian government before execution of the main field investigation.
- (3) The main field investigation will be performed in accordance with the contract of item (2) above. Japanese government considers that the field investigation may be started on April of 1977 for three years, and the term of the contract may be extended as necessary. Japanese government proposes that the Saudi Arabian government will establish an organization temporarily for investigation of the nonmetallic mineral resources for convenience of execution of the main field investigation. Such organization will fulfill the project plan, receive budgetary measures and execute the project, under the supervision of the director of the

mineral resources bureau of the Saudi Arabian government. This organization will possess specially attached research workers and personnels, research facilities, apparatus and all other equipment required for execution of the research. All the expense required will be beared by the Saudi Arabian government. Japanese government will dispatch a group of about 15 specialists, charged to Japanese government, for such organization. These specialists will cooperate with the Saudi Arabian engineers for execution of the main field investigation.

- (4) Simultaneously with the execution of the main investigation, Japanese government will receive the Saudi Arabian engineers and conduct training on mineral resources investigation technique in a proper organization in Japan, and the expense for this training will be payed by the Japanese government.

**THE MINUTES OF DISCUSSION  
BETWEEN THE JAPANESE PRELIMINARY STUDY TEAM  
FOR NONMENTAL PROJECT IN SAUDI ARABIA AND THE  
AUTHORITIES OF THE DIRECTORATE GENERAL OF  
MINERAL RESOURCES, MINISTRY OF PETROLEUM AND  
MINERAL RESOURCES, KINGDOM OF SAUDI ARABIA**

**April 13, 1976**

## MINUTES

In accordance with the Agreement on Economic and Technical Cooperation signed between the Kingdom of Saudi Arabia and Japan, the First Meeting of the Saudi Arabian-Japanese Joint Committee was held at Riyadh on January 13 and 14, 1976.

In the Meeting, several projects, including non-metallic mineral investigation, were proposed by the Government of Japan with the aim of developing cooperation between the two governments concerned, based on the above Agreement.

The Government of Japan dispatched a Preliminary Study Team for Non-Metallic Mineral Investigation to Saudi Arabia, headed by Dr. Noriyuki Fujii of the Geological Survey of Japan, Ministry of International Trade and Industry, to contact the authorities of the Government of Saudi Arabia. The Preliminary Study Team got in touch with His Excellency Sheikh Ghazi Sultan, Deputy Minister for Mineral Resources, Ministry of Petroleum and Mineral Resources, and discussed with him the question of promoting cooperation between Saudi Arabia and Japan in the field of non-metallic mineral investigation. The present paper consists of the Minutes of Discussion held between the Japanese Team and the authorities of the Directorate General of Mineral Resources (DGMR). Three Annexes are attached herewith. Annex (1) includes a list of the members of the Japanese Contact Team, Annex (2) the schedule of the said Team, and Annex (3) the talking papers brought by the Team.

### Record of Discussions

(1) Both the Japanese Contact Team and the DGMR expressed their willingness to develop and promote technical cooperation in the mineral exploration projects of DGMR

(2) The Japanese Contact Team explained the scope of cooperation on a mission-style basis resting on papers and annexes.

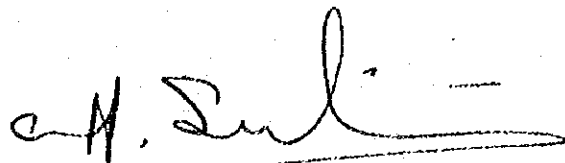
(3) Mr Sultan explained that the DGMR Second 5-Year Plan provided for assistance by the Japanese Geological Survey on the same basis as in the first Plan, and that it was not possible at this stage to introduce the concept of a separate mission for non-metallic mineral exploration. However Japanese geologists could be incorporated into the DGMR organisation and program on the former basis, possibly with some minor changes to meet the present difficult housing situation.

The possibility of a separate mission for the Third Plan can be reviewed at a later date when that Plan is formulated.

(4) The Japanese Contact Team stated that the Government of Japan thought of mission-style cooperation only at the present time. Therefore, the current Team could not give any answer concerning the proposal of DGMR. After concluding its visit, the current Team will consult with the Government of Japan. In addition, Mr. Tada, Minister of the Japanese Embassy in Jeddah, said that the Government of Japan would submit new proposals on the basis of the present talks with a view of its situation and conditions.

(5) H.E. the Deputy Minister replied by favourably accepting Mr. Tada's view and said DGMR would study any new proposals of the Government of Japan.

The Japanese Team expressed its appreciation of the good reception and cooperation which it had from H.E. the Deputy Minister for Mineral Resources and the officials of DGMR hoping that its current visit would end in the enhancement of cooperation between the two friendly countries of Saudi Arabia and Japan.



H.E. ~~Sheikh~~ Ghazi H. Sultan  
Deputy Minister For Mineral  
Resources  
Ministry of Petroleum and Mineral  
Resources



Dr. Noriyuki Fujii  
Leader  
Japanese Preliminary Study  
Team For Non-Metal Project  
In Saudi Arabia



ANNEX I

LIST OF MEMBERS OF THE JAPANESE PRELIMINARY  
STUDY TEAM FOR NONMETAL PROJECT IN THE  
KINGDOM OF SAUDI ARABIA

Dr. Noriyuki FUJII	Leader	Head, Nonmetal Research Group, Geological Survey of Japan, Ministry of International Trade and Industry (MITI)
Dr. Atsushi ANDO		Chief, Geochemical Research Section, Geological Survey of Japan, Ministry of International Trade and Industry (MITI)
Mr. Tetsuhiko HASUDA		Senior Researcher, Resources Research Division, National Research Institute for Pollution and Resources, Ministry of International Trade and Industry (MITI)
Mr. Hisayoshi HASHIMOTO		Chief, Planning and Promotion Section, Office of International Research and Development Cooperation, Ministry of International Trade and Industry (MITI)
Mr. Tosei WATANABE	Coordinator	Deputy Senior Coordinator, Mining and Industrial Development Cooperation Department, Japan International Cooperation Agency (JICA)

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ANNEX 2

SCHEDULE OF THE JAPANESE PRELIMINARY STUDY TEAM

24th, Mar. 1976	(Wed.)	Departure from Tokyo
26th, Mar.	" (Fri.)	Arrived at Jeddah
27th, Mar.	" (Sat.)	Courtesy visit to DGMR and preliminary discussion with H. E. Mr. Qusai Asa'd, Assistant Deputy Minister for Mineral Resources, and Mr. P. Collenette, Technical Advisor
28th, Mar.	" (Sun.)	Visit to USGS/DGMR Laboratory and Publication Office
29th, Mar.	" (Mon.)	Visit to BRGM Mission
30th, Mar.	" (Tue.)	Courtesy visit to DGMR geologists
31th, Mar.	" (Wed.)	Preparation for the field trip
3rd, Apri.	" (Sat.)	Preparation for the field trip
4th, Apr.	" (Sun.)	Courtesy visit to H. E. Shelkh Ghazi H. Sultan, Deputy Minister for Mineral Resources. Departure from Jeddah for Rabigh
5th to 8th, Apr.		Field Investigation in the vicinity of Rabigh and Usfan
9th, Apr.	" (Fri.)	Arrived at Jeddah
10th, Apr.	" (Sat.)	Return back of camping equipment and vehicles to DGMR
13th, Apr.	" (Tue.)	Formal meeting with DGMR authorities, H. E. Sheikh Ghazi H. Sultan, Mr. Abdullah Abuanaja, Director General of Technical Affairs, and Mr. P. Collenette
14th, Apr.	" (Wed.)	Drafting of the Minutes of discussion
18th, Apr.	" (Sun.)	Departure from Jeddah for Riyadh
19th, Apr.	" (Mon.)	Courtesy visit to the Ministry of Planning. Departure from Riyadh for Japan.

ANNEX 3

TALKING PAPERS SUBMITTED TO THE DGMR AUTHORITIES

CONTENTS

- Paper 1 Terms of reference of the Japanese Preliminary Study Team
- Paper 2 Outline of the work of the Japanese Industrial Mineral Investigation Mission (JIMI), named tentatively
- Paper 3 Areas proposed for JIMI
- Paper 4 Draft plan on technical matters
- Paper 5 Room plan for office and laboratory
- Paper 6 Members of JIMI
- Paper 7 Position of JIMI Mission
- Paper 8 List of facilities for field and laboratory work

To : Deputy Minister for Mineral Resources  
From : Japanese Preliminary Study Team

THE JAPANESE PRELIMINARY STUDY TEAM FOR NONMETAL

PROJECT IN SAUDI ARABIA

PAPER 1

TERMS OF REFERENCE

1. TERMS OF REFERENCE

- (1) To discuss with the DGMR authorities concerning technical and other related matters of the Japanese Industrial Mineral Investigation Mission (JIMI), a tentative name, and to exchange the minutes of discussions.
- (2) To draft a plan of operation of JIMI

Note : The minutes will be signed by both DGMR and the current team, and in near futures, the final proposal prepared by the Government of Japan or the organization authorized by the Japanese Government will be offered to the Government of Saudi Arabia on the basis of the minutes.

2. PROPOSED SCHEDULE

- |                           |  |
|---------------------------|--|
| 24th, March               | : Departure from Tokyo   |
| 27th and/or 28th, March   | : Preliminary discussion with the DGMR authorities.  |
| 29th, March to 3rd, April | : Feasibility study on the proposed areas and observation of the DGMR laboratory and the two foreign missions. |
| 4th to 8th, April         | : Field trip to one of the proposed areas at the north of Jeddah.  |
| 10th to 11th, April       | : Preparation for meeting with the DGMR authorities.   |
| 12th to 14th, April       | : Discussion with the DGMR authorities on technical and other related matters.                                 |
| 15th and 16th, April      | : Drafting the minutes of discussion.  |

17th and/or 18th, April : Signature of the minutes of discussion

19th, April : Departure from Jeddah

To : Deputy Minister for Mineral Resources  
From : Japanese Preliminary Study Team

## PAPER 2

### OUTLINE OF THE WORK OF JIMI

#### 1. Objectives

- (1) To build up regional inventories of nonmetallic minerals in the areas approved by DGMR in accordance with the New Five Year Programme, and to investigate useful nonmetallic mineral deposits in areas excluding the above under the request and approval of DGMR.
- (2) To establish the industrial mineral laboratory for evaluation of the nonmetallic resources. Mineralogical, chemical and some engineering studies are indispensable for the above purpose.
- (3) Arrangement for the training of Saudi Arabian scientists and engineers in Japan.

#### 2. Justification

As shown in the New Five Year Programme of DGMR, much greater attention is given to nonmetallic mineral resources for uses within Saudi Arabia. It is especially emphasized that the proposed plan accords with the national policy of industrialization.

In addition, it is considered that the laboratory for industrial mineral investigation is very useful to improve the scientific and technical capability of DGMR.

#### 3. Scope of work

### 3.1 Field investigation

- (1) Geological and geophysical field investigations for nonmetallic mineral inventories in the areas approved by DGMR. It is expected that the resources for the construction and ceramic industry materials are mainly investigated in the areas.
- (2) In areas excluding the above, temporary field investigation is to be done based on the request and approval of DGMR. It will be done focusing on the industrial mineral resources, information of which is almost lacking in Saudi Arabia. They are feldspar, heavy sand and others.

### 3.2 Laboratory work

- (1) Mineralogical and petrographical studies are to be done to mainly determine the mineral composition of nonmetal ores.
- (2) Chemical analysis of ores including the total analysis is to be carried out with the instrumental and wet method.
- (3) Engineering studies to estimate the mineral processing and firing effects of nonmetal ores.

### 3.3 Summarizing work

Evaluation of each nonmetallic mineral deposit investigated by JIMI.

## 4. Phase and step of the work

### 4.1 Phase of work

Phase 1	1977-78 (six months or more)	Arrangement of office and others
Phase 2	1978-80	Field and laboratory investigations

#### 4.2 Step of work

Classification	Resources which predominate in the sedimentary rocks.	Resources which occur in the specific rock units.
Examples	Limestone, silica sand, etc.	Clays, feldspar, heavy sand, etc.
Step 1	Feasibility study to select a few target areas in the approved districts.	Feasibility study to identify the rock units probably producing nonmetallic minerals.
Step 2	Regional reconnaissance and geological mapping. Preliminary laboratory study.	Regional reconnaissance. Preliminary laboratory study.
Step 3	Detailed investigation at places suitable for mining. Systematic laboratory studies of ores.	Detailed investigation at sites capable of mining. Systematic laboratory studies of ores.
Step 4	Evaluation of the investigated deposits.	Evaluation of the investigated deposits.



To : Deputy Minister for Mineral Resources  
From : Japanese Preliminary Study Team

PAPER 3

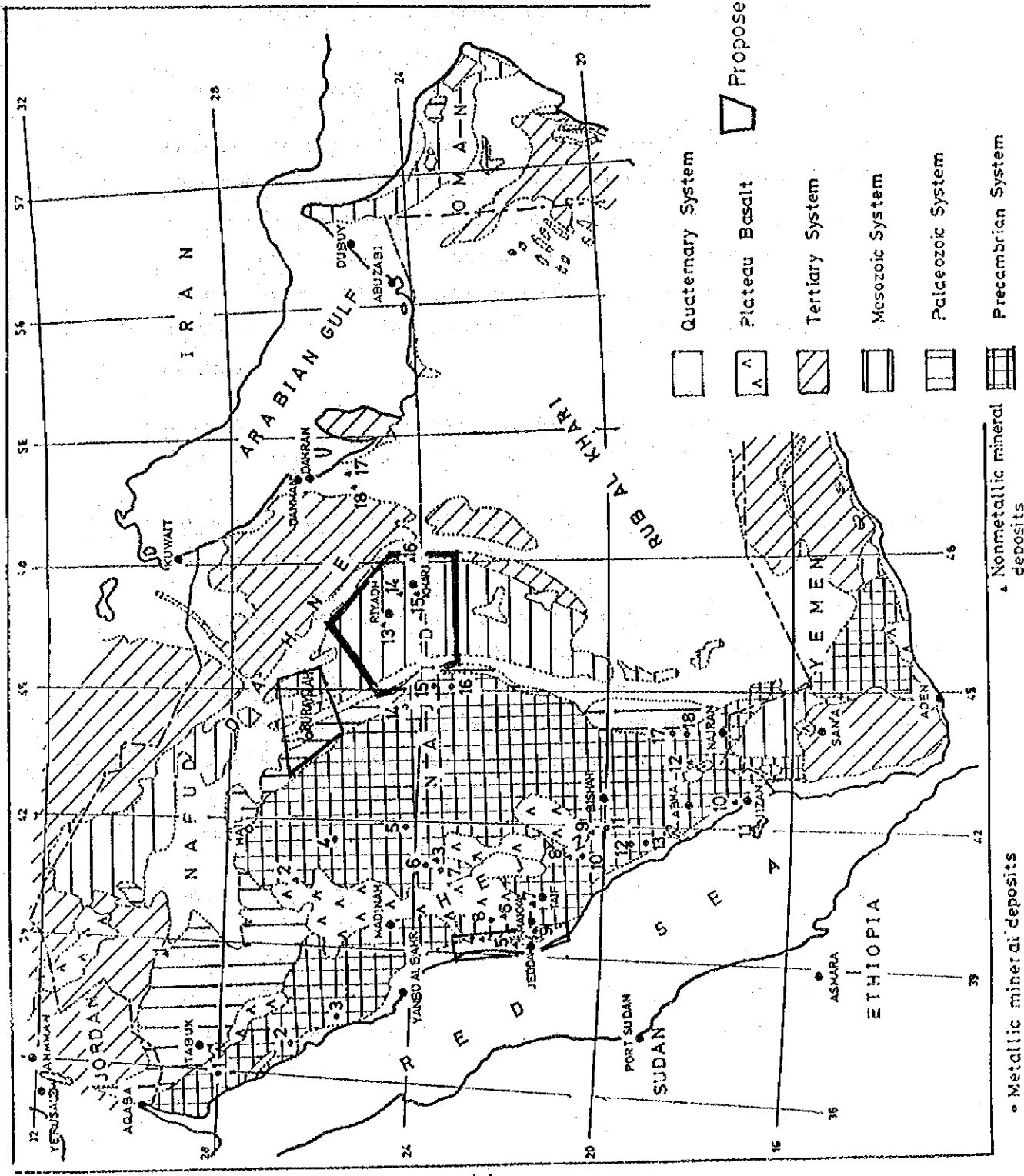
AREAS PROPOSED FOR JIMI MISSION

1. Riyadh to Kharj district
2. Buraydah district
3. Jeddah district

Note : Limestone, dolomite, silica sand, gypsum and clay are to be mainly investigated in these districts.

4. Other field work

Temporary field investigations focusing on feldspar, heavy sand, fluorite, high-alumina minerals, brine materials and others, informations of which is almost lacking in Saudi Arabia, are to be carried out under the approval of DGMR in areas except for the above three districts.



To : Deputy Minister for Mineral Resources  
From : Japanese Preliminary Study Team

PAPER 4

DRAFT PLAN ON TECHNICAL MATTERS

1. Technical setting

As shown in Paper 3, three districts, namely, Riyadh to Kharj, Buraydah and Jeddah districts, are proposed for work of JIMI. In addition, temporary field investigations focusing on industrial mineral resources such as feldspar and heavy sand are to be done under the approval of DGMR with the exception of the above districts. The present paper describes the scope of work of JIMI.

According to the past investigations, nonmetallic mineral resources in Saudi Arabia can be divided into the following three groups.

(1) Resources which predominate in the sedimentary rocks surrounding the precambrian shield

Limestone, dolomite, silica sand and gypsum belong to this group. And it is required that these resources are homogeneous in quality and are minable in quantities at a low cost. Certainly, these resources occur in the proposed districts except for the Jeddah district. Scarce information concerning the chemical and mineralogical properties of these resources are, however, available at the present time.

(2) Resources which commonly occur in the specified sedimentary beds

This group comprises phosphorite, kaolin and bentonite clays. They are very useful for various kinds of industry and their prices are high comparing with those of the first group resources.

Among them, phosphorite deposits have been investigated in detail by the USGS Mission. For the other two, further investigations are warranted.

(3) Resources, information of which is almost lacking at the present time

Feldspar, fluorite, high-alumina minerals, heavy sand, brine materials and others belong to the group.

This group resources are indispensable for some industries and very valuable. They are worthwhile to be explored preferentially.

Systematic and efficient investigations concerning geologic occurrence and assessment of qualities and reserves are to be carried out.

For the first group resources, a few target areas should be selected in the proposed districts depending on geologic condition and social factors such as population and transportation. And areal field investigation including geological mapping and geophysical reconnaissance is to be done in these areas. Based on the results of the above investigations, detailed survey including trenching and short hole drilling is to be carried out at places suitable for mining.

The second and third groups of nonmetallic resources occur restrictedly in some specific rock units. Regional geological reconnaissance focusing on these units is to be done at first. And it is to be followed by detailed investigation at the sites suitable for mining.

It is very possible that several promising deposits of the first and second group resources will be discovered in both the Riyadh to Kharj and the Buraydah districts. Feasibility of the Jeddah district will be studied by the current team.

It should be emphasized that these investigations are proposed in accordance with the regional inventories of nonmetallic minerals in the new five years programme of DGMR. Nevertheless, the investigation of a number of minerals are added as they are also important for benefit of Saudi Arabia.

However, it is impossible to evaluate these nonmetallic mineral deposits without laboratory studys. Even for limestone deposits, a large number of chemical data on  $\text{CaO}$ ,  $\text{MgO}$ ,  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$  and  $\text{P}_2\text{O}_5$  is indispensable to evaluate them. And much more systematic laboratory studys, mineralogical, chemical, firing and mineral processing tests, are necessary to evaluate the second and third groups.

This laboratory is surely useful for the other basic geology and mineral exploration projects as well as the work of JIMI.

DGMR scientists also can use various kind of facilities in the laboratory for their work.

## 2. System of field investigation

JIMI proposes the following systems for field investigation.

### (1) Investigation for the first group resources

Feasibility study for selection of target areas.

Areal geological reconnaissance using helicopter.

Geological mapping using colour airphotoes and preliminary sampling.

Geophysical reconnaissance by ARGAS.

Topographic survey and detailed geological investigation including trenching.

Detailed geophysical survey by ARGAS.

Short hole drilling by ADC.

Note : Most effective method of geophysical survey is to be recommended to DGMR. The subject is to be discussed between DGMR and the current mission.

(2) Investigation for both the second and the third groups resources

Regional geological reconnaissance and preliminary sampling using helicopter.

Topographical survey and detailed geological investigation including trenching.

Short hole drilling by ADC.

3. Contents of laboratory work

Main function of JIMI laboratory is as follows.

(1) Mineralogical and petrographical study

Microscope is used for study of petrography and main mineral composition of rocks and sands. Detailed mineralogy is investigated using X-ray diffractometer.

(2) Chemical analysis

Analysis of major and minor elements in some industrial mineral materials are performed by the instrumental and wet chemical method.

Major components,  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{MnO}$ ,  $\text{CaO}$ ,  $\text{MgO}$  and  $\text{K}_2\text{O}$ , in rocks and clays are analysed by X-ray fluorescence spectrometry. Most of constituents of mineral materials are easily determined by atomic absorption spectrophotometry and wet chemical method.

(3) Mineral processing test

Mineral particles pulverized by grinding machines are concentrated by the separation instruments, floatator, shaking table, magnetic separator and electrostatic separator. Elutriator also is used for separation of clay materials.

(4) Firing test

Various kind of firing tests including the measurement of refractoriness, compression and bending effects are carried out in order to determine the feasibility for ceramic wares.

4. Other technical work

(1) Photogeological study and photogrammetry

(2) Making thin section

(3) Drafting

(4) Printing of reports

To : Deputy Minister for Mineral Resources  
From : Japanese Preliminary Study Team

PAPER 5

Room plan for office and laboratory

	<u>Utility</u>	<u>Span</u>
1. Office		
	Head	1
	Chief geologist	1
	Chief administrator	1
	Senior researchers	2
	Meeting room	1
	Accounting office	1
	General affairs	1
	Library	1
	Printing	1
	Topography and drafting	1
	Knitchen	1
	Servant room	1
2. Laboratory		
	X-ray diffraction and fluorescence instruments	1
	Sample preparation for the above instruments	1
	Wet chemical analysis	1
	Balances and other instruments for chem. anal.	1
	Atomic absorption	1/2
	Pulverizing of mineral samples for chem. anal.	1
	Heating investigation of minerals	1
	Pulverizing for mineral processing	1*
	Firing and other tests	1*
	Stereo-plotter work	1
	Dark room	1/2



<u>Utility</u>	<u>Span</u>
Making thin section	1
Senior researcher office	2
Store for chemicals and others	1
Store for samples	1
Special store for dangerous chemicals	1

**Total:**

Office 13 spans in regular size (40m<sup>2</sup>)

**Laboratory**

14 spans in regular size (40m<sup>2</sup>)

2\*spans in larger size (100m<sup>2</sup>)  
with concrete floor

To : Deputy Minister for Mineral Resources  
From : Japanese Preliminary Study Team

PAPER 6

MEMBERS OF JIMI

JIMI is to consist of experts and administrative officers as shown below.

Head

Technical Manager / Chief Geologist

Geologist

Geophysicist

Photogrammetrist

Chemist

Ceramic Engineer

Mineral Processing Engineer

Manager / Chief Administrative Office

Accounting officer

General Affairs Officer

Temporary experts

Palaeontologist

Industrial Chemist

Technician for making thin section

Technician for maintenance of instruments

Others

An Advisory Board is to be proposed. It consists of the following members.

Technical Advisers

Auditor

Note : The above staff are to be permanently nominated and to visit to Saudi Arabia temporarily.

To : Deputy Minister for Mineral Resources  
From : Japanese Preliminary Study Team

PAPER 7

POSITION OF JIMI MISSION

1. The required amount for the work of JIMI, including wages, travel expense and others for JIMI members is to be in charge of the Government of Saudi Arabia. And the work of JIMI is to be identified by the contract between the Government of Kingdom of Saudi Arabia and the Government of Japan or the organization authorized by the Government of Japan.
2. The Government of Saudi Arabia is to provide office, laboratories and a garage necessary for the activities of JIMI and residences for JIMI members.
3. The Government of Saudi Arabia is to provide JIMI with personnels who will be engaged in office, laboratory and field work.
4. Equipments, expendable supply and any other materials to be used for the work of JIMI are to be exempted from custom duties. The Japanese experts and their families are to be granted privileges, exemption and benefits not less favourable than those granted to the experts and their families of a third country performing similar duties in Saudi Arabia.
5. Internal travel expense, vacation and transit expense to and from office are also to be provided to the Japanese experts and free medical treatment, to the Japanese experts and their families as well.

To : Deputy Minister for Mineral Resources  
From : Japanese Preliminary Study Team

PAPER 8

List of facilities for field and laboratory work

1. Field Investigation

Item	Number needed
Camping car with two beds and airconditioner	6
Truck with water tank	4
Power wagen	6
Land cruiser	6
Land cruiser with airconditioner salon type	2
Generator	3
Refrigerator	4
Angledozer, Komatsu D-60	1
Power shovel, Komatsu 15-H	1
Truck for transportation of bulldozer and power shovel	2
Radio, transmitter and receiver	4 set
Tents, water proof	15
Others	

2. Laboratory work

2.1 Mineralogical study

X-ray diffractometer with attachment for heating	1
Differential thermal balance	1

Item	Number needed
Polarizing microscope with camera and others	1
Poralized microscope with attachment for reflection	1
Isodynamic separator	1
Biocular microscope	1
Others	
2.2 Chemical analysis	
X-ray fluorescence spectrometer with accessory	1
Atomic absorption spectrometer with accessory	1
Spectrophotometer with accessory	1
Auto-still, pure water supply	1
Muffle furnace	2
Drying ovens	2
Hot plates	5
Ionmeter	1
Ph meter	1
Balances	4
Plutinium crucible	6
Plutinium basin	6
Tongs with plutinium end	5
Refrigerator	2
Water bath	2
Security box	1
Jaw crusher	1
Disk grinder	1

Item	Number needed
Electric motor	1
Steel motor	1
Pulverizer	1
Agate motor	3
Sampler	2
Sieve	2 set
Tools	1 set
Working bench	2
Press crusher	1
Centrifugator	1
Labo stirrer	2
Mag mixer	4
Chemical bench, central	1
" " , sub	10
" " , small	5
Labo cart	5
Draft	3
Others	

### 2.3 Dressing test

Jaw crusher	1
Sample grinder	1
Ball mill	1
Sieve	2 set
Shieve shaker	2
Sampler, Johnes riffle type	1
Shaking table, Wilfey type	1
Flotator	2

Item	Number needed
Conditioner for fluotation test	1
Hallimond tube	1 set
Magnetic separator	1
Gauss meter	1
Magnetic flux coil	1
Electrostatic separator	1
Classifier	1
Elutriator	1
Filter press	1
Centrifugal separator	1
Jigger	1
Others	
<b>2.4 Firing test</b>	
Electric furnace, siliconit	1
Refractoriness measurment furnace	1
Heating microscope	1
Universal mixer	1
Universal testing machine	1
Hydrauric compressive strength tester	1
Photometer for measurment of paperclay whiteness	1
Dryer	1
Auger machine	1
Others	

### 3. Other technical work

#### 3.1 Photogeological and topographic work

Item	Number needed
Stereo plotter with accessory	1
Distance measurement and theodolite unit	1
Stereo mirror	4
Instrument for topographic survey	1 set
Caluculator, Canon SX110: 1; YHP: 2	3
Auto level	1
Dark room facilities	1 set
Others	

#### 3.2 Making thin section

Slab saw, cutter	1
Micro Clump, slicer	1
Automatic polishing machine	1
Polishing machine	1
Others	

#### 3.3 Printing

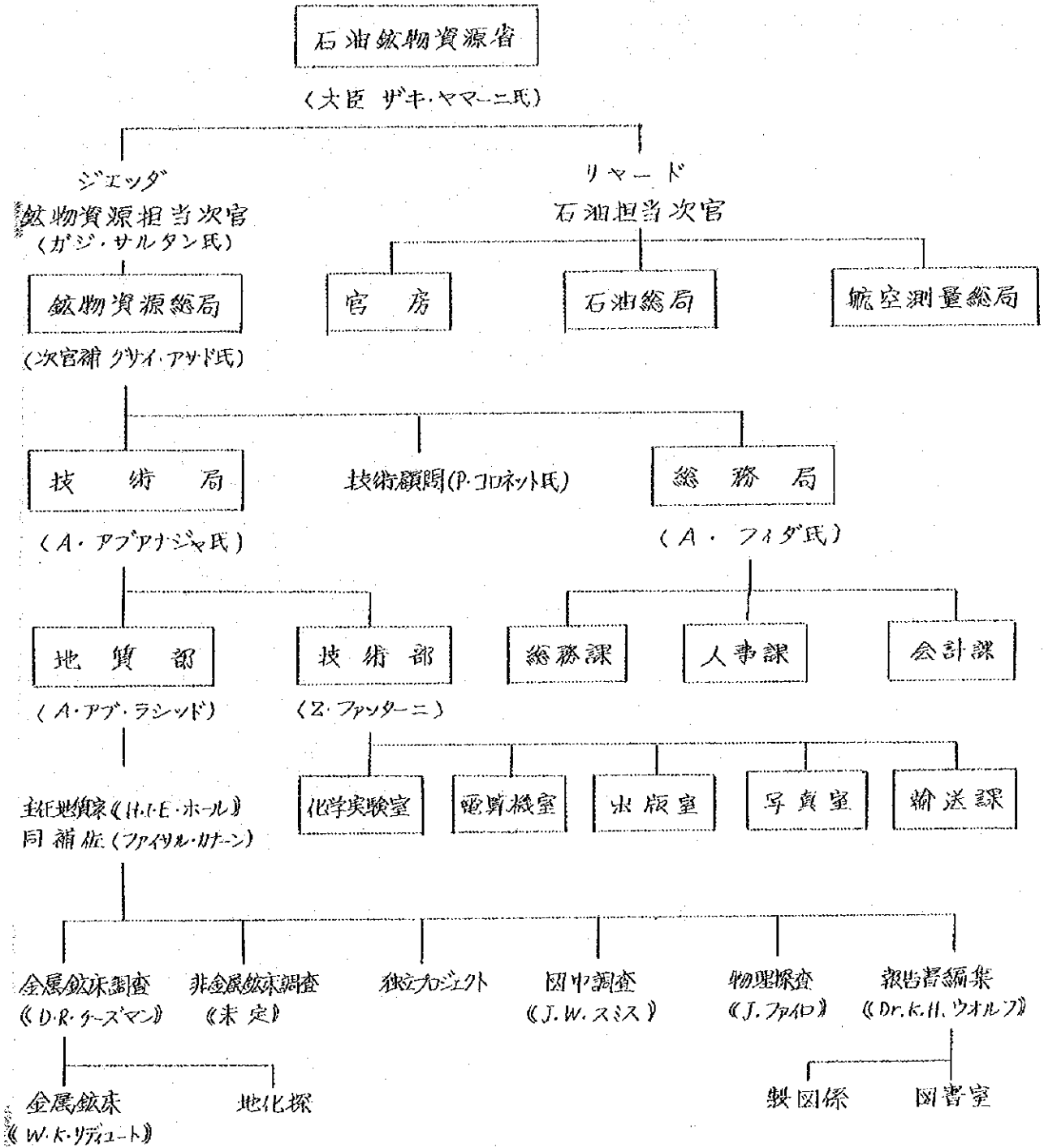
Printer with accessory, Lustetter	1
Blue printer	1
Zerox copy machine, rental	1
Others	



#### 4. Facilities for office and laboratory work

Item	Number needed
Desk, a	16
b	15
Chair, a	16
b	15
Steel cabinet	30
Filing cabinet	20
Locker, for personal	4
twin	12
Black board	4
Electric calculator	4
Typewriter, IMB	2
portable	8
Electric cleaner	5
Sofa set	3
Folding chair	30
Tables	10
Drafting table	4
Map case	2
Electric fan	10
Carpet	4
Books and publications	
Others	

鉱物資源総局 (DGMR) 組織図



(註) ( )内はグループコントラクトの外人地質家

USGS / DGMR 化学実験室調査報告

調査日 '76年3月28日  
 調査者 安藤、蓮田、藤井、  
 面会人 Mr. J. カレー  
 Mr. アリ・ハーン

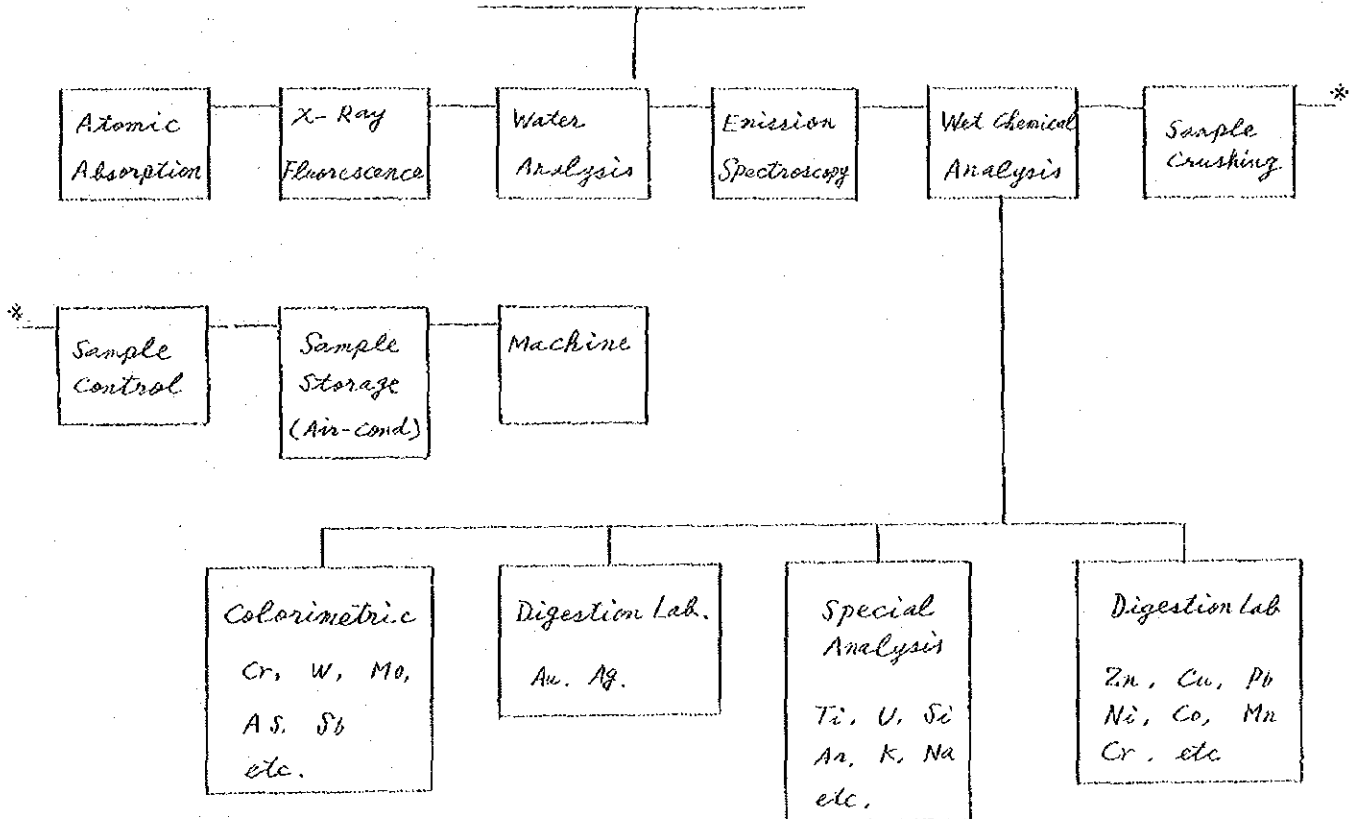
1. 機構

Technical Director

Joe Curry (USGS)

Admin. Director

Alli Z. Kahn



2. 人員

Number of chemist

7 { 2 Directors  
 5 Graduate  
 17 Assistant, high school

計) 24名

### 3. 内 容

USGSの Mt Curry の他は、アラビア、パレスチナ、レバノン人で構成されている。

この Anal. Lab は、Geochemical Prospecting (地化学探鉱) の目的で設備され、現在部屋と施設を拡張中である (6月完成予定)。

分析数は月によって変動があるが、max. 25,000 ~ 20,000, min. 7,000 ~ 5,000 成分である。分析成分は主として金属微量成分。

既設の実験室のフロア図 } 付 第 1 図  
拡張中の実験室のフロア図 }

#### 研究室と主な装置

##### 1) 原子吸光分析室

現在 Perkin Elmer 2台があり、trace metal を分析中。

拡張計画では、新しくつくられる部屋に通常の原子吸光装置4台とフレイムレス装置2台が設置予定である。

アセチレンガスと亜硝酸 ( $\text{NO}_2$ ) ガスは、ジェットで容易に入手可能。

##### 2) X線ケイ光分析室

現在 GE の装置があるが古くなり作動不良のため、拡張計画室に新装置を設置予定。

##### 3) 分光分析室

Jaco 3.4 m Grating Spectrograph, フィルム撮影,

6 Step D.C. Arc法, 約30元素を半定量する。

##### 4) 湿式分析室

比色分析室 (Cr, W, Mo, As, Sb, etc) の他に特殊分析室 (Ti, U, Si, Al, Na, K etc) がある。

その他、分析試料の酸分解抽出室が2つある。この分解抽出室は比色分析および原子吸光分析用である。

#### 5) 粉 碎 室

拡張計画室がほぼ完成し、Denver製ジョークラッシャー(各種)による粗砕と、ロールミルによる二次破碎およびWC製振動ディスクミルによる分析試料の粉碎システムが出来あがっている。参照第1図。

6) 化学薬品の保存室は、かなり広く、空調がなされている。

7) Office-wt. roomの一部に質量分析計があるが、古く作動していない。新拡張計画において、質量分析計を設置する考えはない。

#### 4. 所 見

USGSのCurryを中心とするLabのactivityはGeochemical prospectingの目的に対しては、かなり良く出来ており、現在進行中の拡張計画が完了すれば、世界的にみても一流の化学Labであることは間違いない。また運営もうまくいつている印象をうけた。

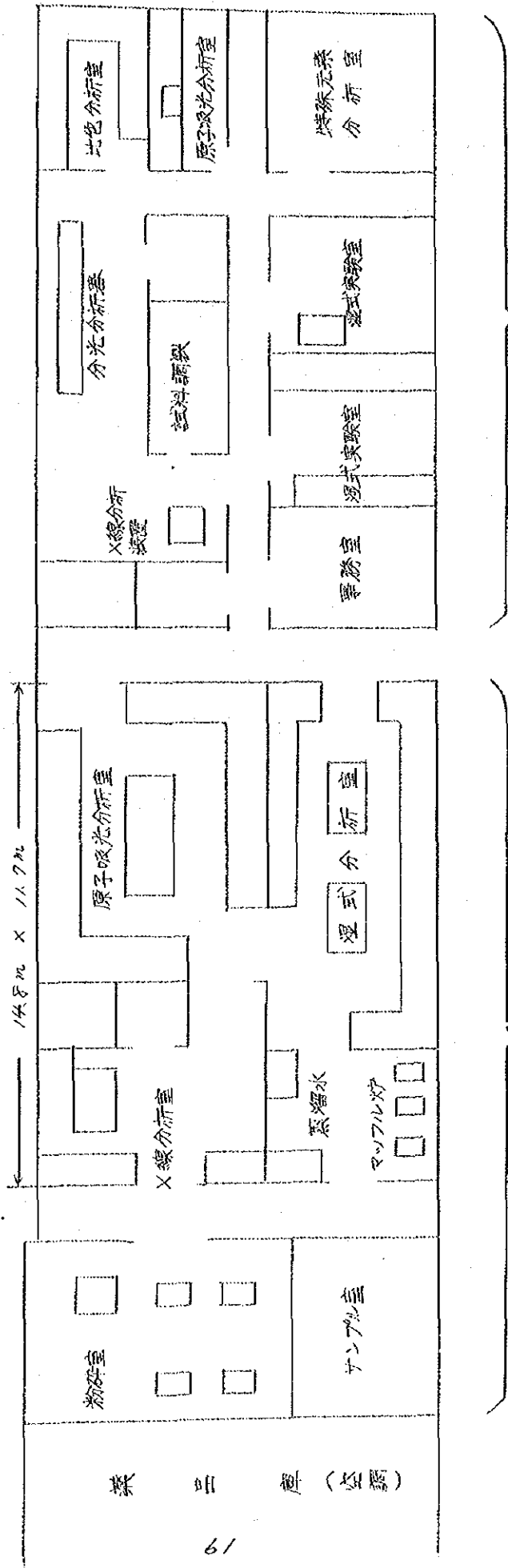
この設備によれば、メタル元素(主として微量成分、一部非金属元素をふくむ)の分析は、Activation(N.A.A.法、中性子放射化分析)法に頼る一部の元素(例えば希土類元素など)を除いては、総て可能であり、一応完成したシステムである。

ただし、このLabの分析目的があくまでもTrace metal analysisを中心としているため、Major(Silicates and other geological materials)の分析方法と分析体制の確立は行われていない。Curryによれば主成分分析を必要とする試料はドイツのコンサルタントに外注し、AZ, alkaliなどの一部の元素についてのみ、原子

吸光分析法により、分析を実施しているのが現状である。Carry によれば、当 Lab において、主成分分析を行なうことは、当面考えていない。

また、撰録および耐火物試験も当面の拡張計画に入っていない。

第 1 図 USGS / D&MR Chemical Laboratory



USGS/DGMR 出版室・写真実験室調査報告

調査日 76年3月28日

調査員 桑形久夫(地調) 橋本久義(ITIT)

面会人 Mr. Cremer Editor of Publication  
Mr. John Walthall Chief photo Lab

1. 場所および配置

USGS/DGMR ケミカルラボ, ガレージ等と同一の敷地内にある.

配置図 別添図1

フォトラボ見取図 別添図2

出版部見取図 別添図3

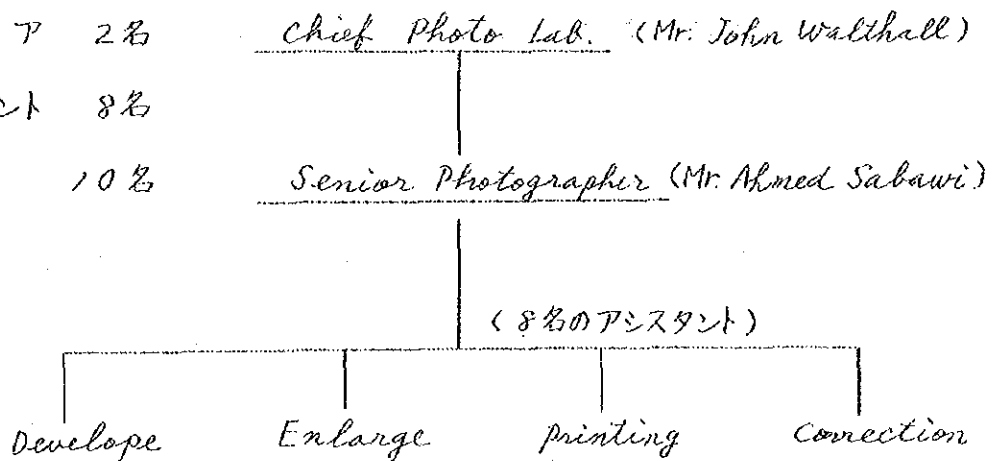
2. 機構、人員

① フォトラボ

シニア 2名

アシスタント 8名

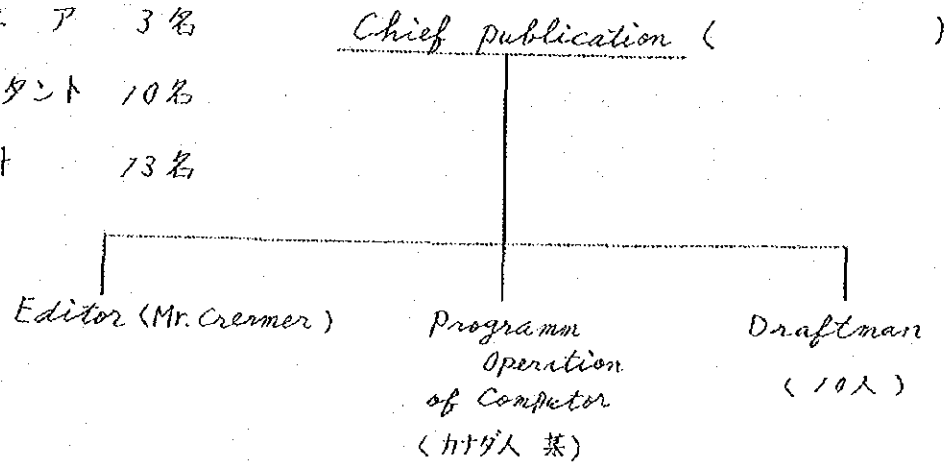
計 10名





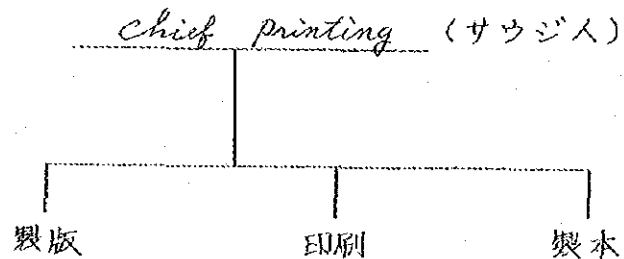
② 出版

シニア 3名  
 アシスタント 10名  
 計 13名



③ 印刷

シニア 1名  
 アシスタント 2名  
 計 3名



3. 内容

USGSの設計により作られたプレハブ建物で、約80m x 60mの2階建となっている。

フォトラボは、現在カラープリントも出来るようになっており、最新の設備をそなえている。

出版部は、コンピューターによるデータ解析、出版物管理をおこなおうとしている。又作図台も最高級のものをもっており、officeは快適である。

印刷部は、オフセット印刷設備および簡単な製本設備をもっており、一応自前ですべて可能である。他省の印刷も一部ひきうけているもよう。

## 主な装置

### ◇ フォトラボ

カラープロセス	manual 現像機
プリンターエンラジャー	Robertson 製 7倍~1/4
変歪修正機	Wild E4-4502 A1サイズ
カメラ	Wild RC-8
ドライヤー	少なくとも2台
青図用コンタクトプリンター	1台
現像液、フィルム	コダック

### ◇ 出版

コンピューター	Digital Computer Ltd. 製 容量不明
製図台	16台
その他	Blue print, XEROX, etc.

### ◇ 印刷

オフセットプロセス	1式
オフセット印刷機	最大 11×17inch A3版まで 200枚分の能力、単色刷、 6ヶ月以内には多色刷機を購入予定
裁断機	
製本機	(ホッチキスのでかいの)

## 所 見

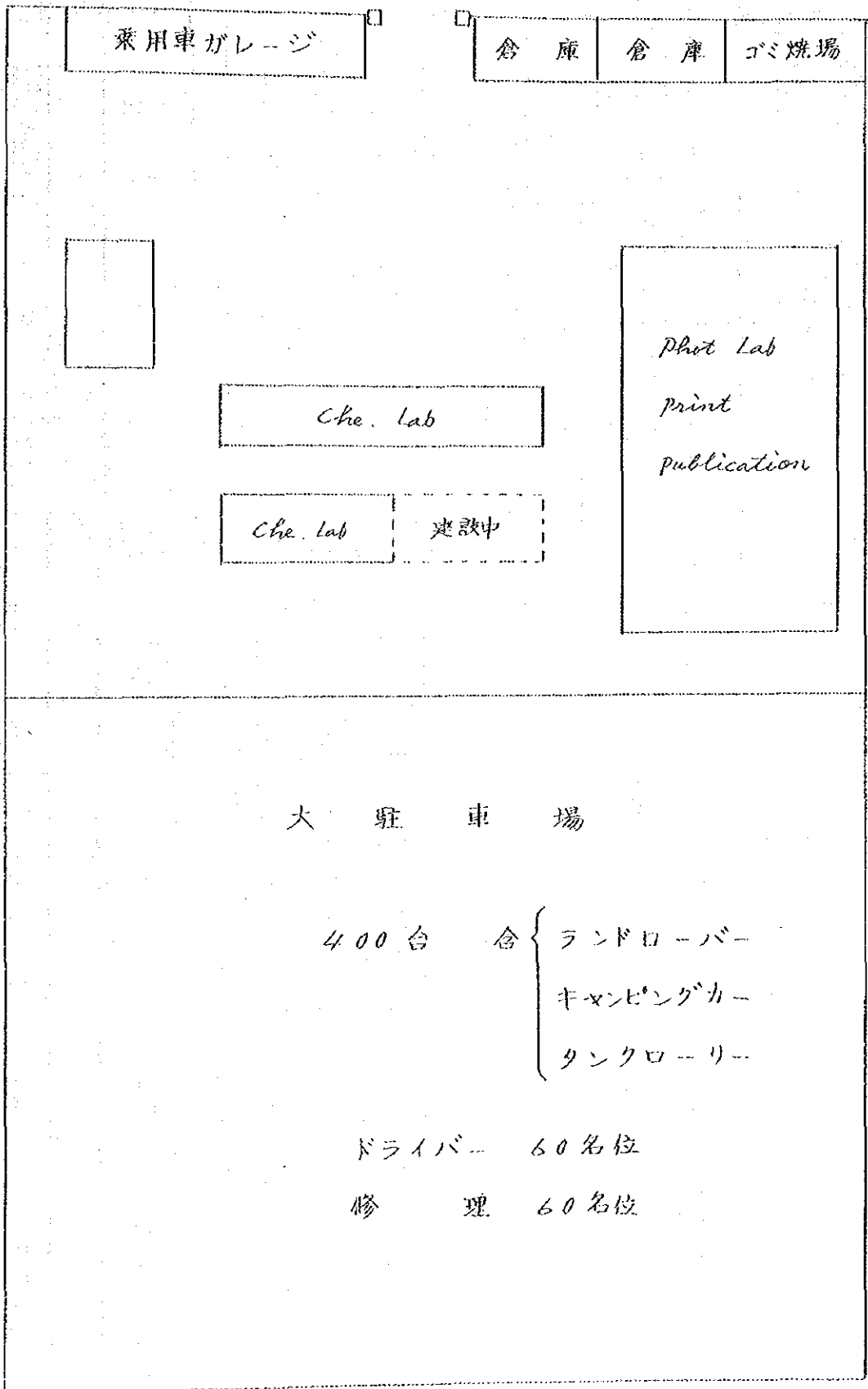
設備は最新式であり、作業もかなり能率的におこなわれているという印象であった。しかし、設備投資の割には、業務量は少なく余力は充分にありそうである。

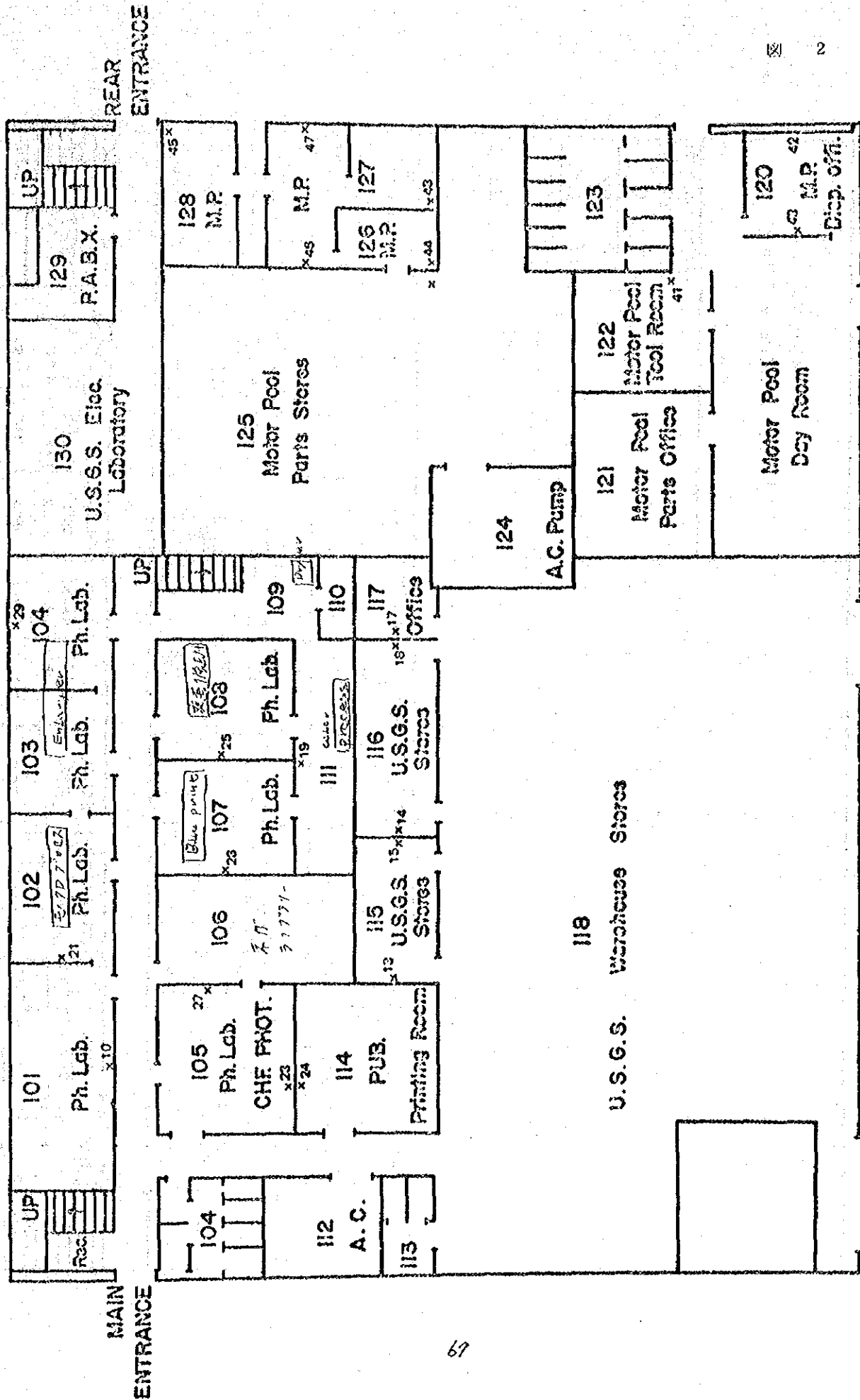
シニアのスタッフは非常に少ないが、アシスタントは十分な訓練を受けており、有能であるため、問題はないとのことである。

日本派遣の調査団が仮に独自の設備をもつとすれば、現地労働者の訓練の問題が、最大のポイントであろう。

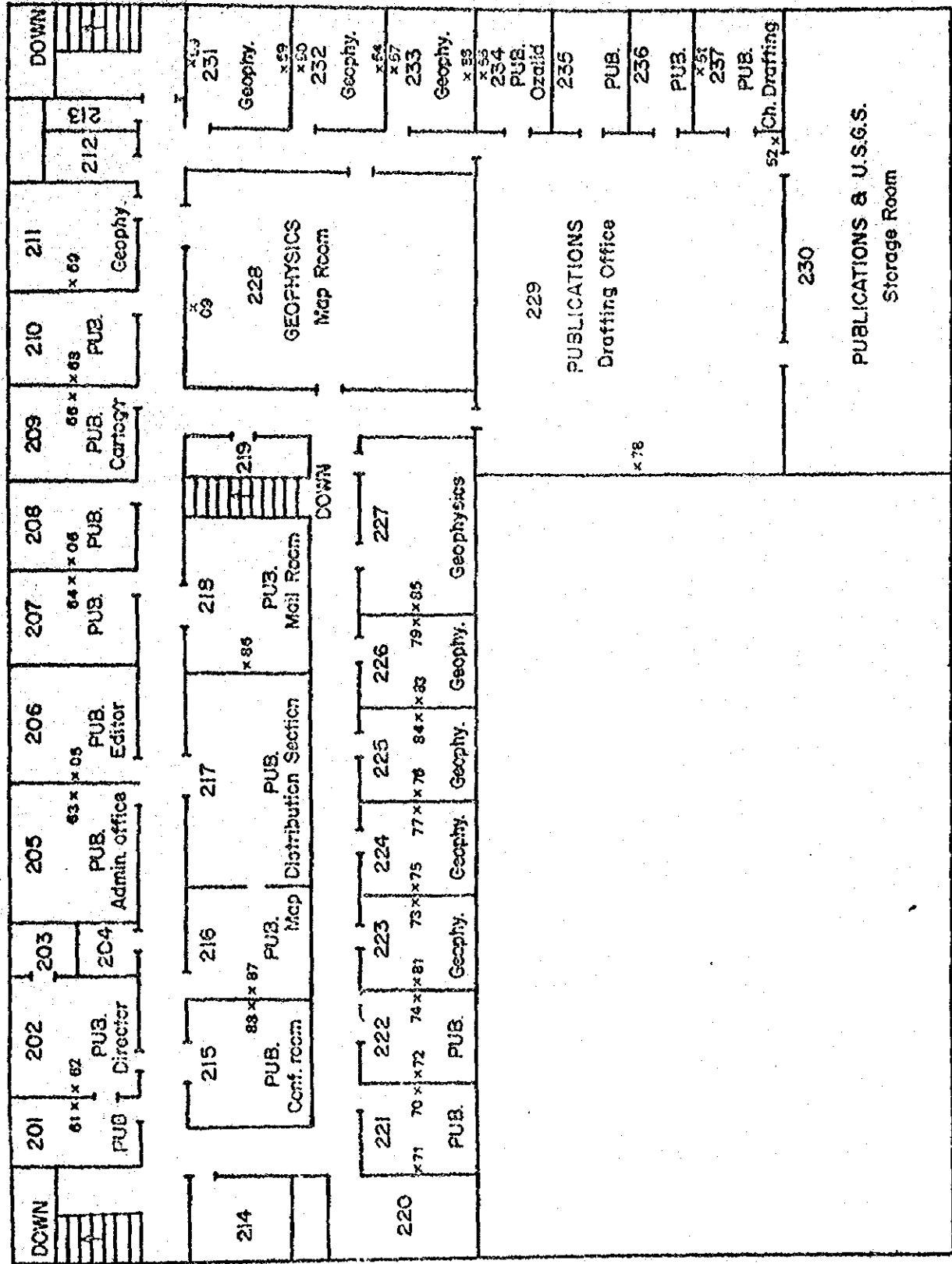
個人的には、この出版室、フォトラボを共用する形でも大きな障害はあり得ないとの所感であった。

出版物整理、データ整理については、やはり独立のものを有する必要があると思われるが、当面は、このオフィスのものを時々利用する形でも、差支えないと思われる。将来、データが管理しきれなくなった時点で、コンピューターの導入を考えたも遅くないと思われる。





**FIRST FLOOR**



SECOND FLOOR

## USGS ミッションの現状

調査日 76年3月30日  
 調査者 藤井、安藤、橋本  
 面会者 Dr. Kiilgaard  
 Head, USGS Mission

## 1. USGS ミッションの現在までの経緯

1950 ~ 58 : Dr. G. Brown 以下数名の地質家が来サシ、一部分  
 サウジ政府負担で一般地質調査を行なった。これに  
 より全土に亘る 1/50万地質図および 1/200万地質図  
 が完成された。58年以降USGSの協力は中断さ  
 れた。各地質図はUSGSにより1963年迄に出版  
 された。

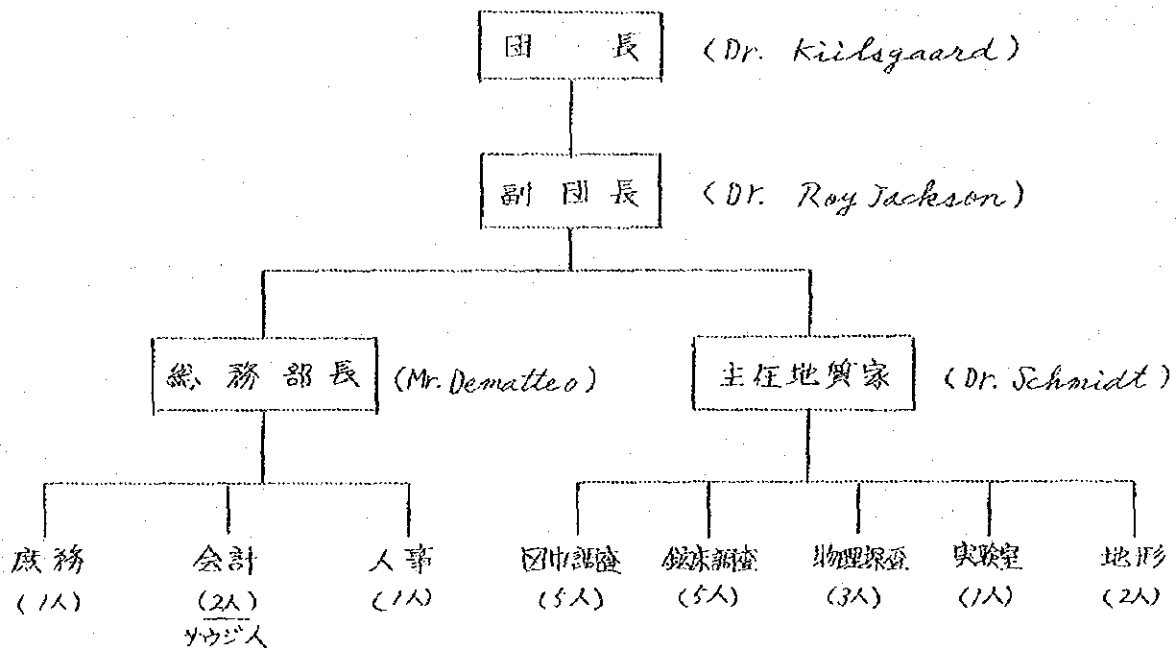
1963 ~ 66 : 1963年ヤマニ石油相がUSGSを訪れ、協力の  
 再開を要請した。これに基づいて25人のスタッフ  
 が入サシ、鉱床探査を主とする調査を行なっている。  
 この費用は大部分サ側が負担した。

1966以降 : 米側の要求で、1966年に至り初めて正式の国家間  
 契約が結ばれ、独立ミッションとして組織が確立さ  
 れた。以後協力の中心を図中調査に切換え、サウジ  
 の先カンブリア系層状地の 1/10万地質図の作製、一  
 部の鉱床調査(金属・燐鉱・ラテライト等)を行な  
 っている。

現在独立したオフィス・付属ラボラトリー（X線回析装置、簡易分析室、薄片室）を持ち、更にUSGS FundによりDGMの化学実験室、出版室などの設計、建設、運営指導まで行なうなど、現在ではDGM自体にとって計画遂行上欠くべからざる組織となっている。また米人スタッフは外交官と同様の特権を有しているとのことである。

## 2. 現 状

### (1) 組 織・人 員



その他、化学実験室、出版室、写真実験室などにもスタッフを派遣しており、総定員数は33人で現員は28人である。ほかに現地雇用のスタッフ（会計その他）8人がいる。

勿論、秘書、タイピスト、事務員、実験助手、運転手、入夫、コック等を保有しており、その総数は260人である。

### (2) 財 政

資金は全てサ側負担であるが、米本国へ送られるドル会計と現地で



の費用を賄うリアル会計とに分れている。75年度の予算は次の通りである。

ドル会計	1. 米人スタッフの給料、住宅費、教育費、往復旅費、保険料、その他	約1,700万リアル ≒ 480万ドル
	2. 器具(米国で購入するもの)	約80万リアル ≒ 21万ドル
	3. サウジ人のトレーニング費	不明

但し、トレーニング費のかなりの部分は米側負担という。

リアル会計	1. 現地雇傭人の給料	約770万リアル ≒ 216万ドル
	2. オフィスの借料	不明
	3. 器具その他	約1,500万リアル ≒ 430万ドル

従って判明分だけで約1,150万ドルとなる。

### 3. 契約の内容

Dr. Kullsgaard は、契約書の内容について詳しく説明してくれたが写しをとることは出来なかった。説明によると契約は3年契約で次のような内容である。

- (1) 業務内容
- (2) 派遣人員
- (3) 予算
- (4) その他

特に注目されたのは、次の諸点であった。

- ① 問題が起った時は D G M R との話し合いで解決し、ペナルティはない。
- ② 予算が余った時は次年度へ繰越しまたは *refund* される。
- ③ リアル会計は 50 万リアル宛払い込まれるが、口座の金がなくなつて 6 日間払い込まれない時は、U S G S が契約を打切る権利を持つ。
- ④ インフレヘッジとして予算は 1 年毎に 1.5% 増にしている。

*[The page contains extremely faint and illegible text, likely bleed-through from the reverse side of the document. The text is too light to transcribe accurately.]*